SOCIOECONOMIC FACTORS INFLUENCING ADOPTION OF POTATO VALUE CHAIN SUPPORT PROJECT (PS-PVCSP) TECHNOLOGIES IN PLATEAU STATE, NIGERIA

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ABSTRACT

The study examined the factors influencing adoption of potato value chain support project technologies in Plateau State, Nigeria. A multi-stage sampling technique was used in selecting 390 respondents. Data were collected using structured questionnaire and analysed using descriptive statistics and regression analysis. The result revealed a mean age, household size, farming experience and farm size of 38.0 years, 7.0 persons, 12.0 years and 0.7ha, respectively. majority (58.5%) of the respondents were female and 73.8% were married. Key technologies promoted by the project includes fertiliser application (52.7%), planting time (50.5%) and planting material (49.5%). This is followed by weeding (44.9%), harvesting (44.1%), planting depth (43.6%), method of planting (42.1%), and planting space (39.7%). The results of regression analysis of socio-economic factors influencing adoption of the PS-PVCSP recommended technologies reveal the adjusted R^2 value of 0.621, implying that the independent variables explained 62.1% of the variations in the dependent variable. The result revealed that age (r = 0.0820), education (r = 0.0950), household size (r = 0.470), farm size (r = 0.0920), farming experience (r = 0.320), capital (r = 0.580), sources of information (r = 0.380), and extension contact (r = 0.1570) were the factors significantly influenced the adoption of recommended production technologies promoted by the project. The study recommended that extension programmes should focus on training and educating farmers about the benefits and application of the recommended technologies, incentives such as subsidies for planting materials and fertilisers can encourage adoption among the age group while ensuring long-term sustainability. There should be accessible credit schemes specifically tailored for potato farmers to ease the procurement of fertilisers, improved planting materials, and other necessary and farmers should be encouraged to form and join cooperatives in other to enjoy economy of scale.

Keywords: Adoption, Technology, Potato Value Chain.

INTRODUCTION

Agriculture plays a fundamental role in economic growth, enhancing food security, poverty reduction and rural development. It is the main source of income for about 2.5 billion people in the developing world (Wandji, *et al*., 2021). Consequently, additional sustainable agricultural technologies such as improved agricultural technologies remain an important part of the efforts to boost food availability, crop production and improve soil quality in a bid to reduce food and nutrition insecurity which is currently threatening humans' right to food accessibility in developing countries (Sennuga and Fadiji, 2020).

Irish potato (*Solanum tuberosum L*.) is the world's fourth largest food crop in terms of production after maize, rice and wheat (Food and Agriculture Organisation Statistics) [FAOSTAT], 2016). It is thus, the largest non-cereal food crop cultivated in the world after it was first cultivated in South America and its global output is estimated at 388 million metric tonnes and the yield per hectare stands at 20,110.8kg/ha (FAOSTAT, 2019). In Africa, potato output stands at 25 million metric tonnes with yield per hectare of 13,215.4 kg/ha (Zhang *et al*., 2016). Algeria is the leading producer of Irish potato in Africa with a production 4,606,400 metric tonnes, followed by Egypt (4,325,480 metric tonnes) (FAOSTAT, 2019) and South Africa (2,450,540 metric tonnes). Over half of the global output is produced in developing countries, almost one-third of the output is harvested in China and India alone while China is the leading producer in the world with 99 million metric tonnes (FAOSTAT, 2019).

Farmers generally obtain very low crop yields because the local varieties used by farmers have low potential yield, most of the Irish potato is grown under rain-fed conditions and irrigation is used only in limited areas, little or no fertilisers are used and pest control is not adequate (Sennuga, *et al*., 2020). Nigeria's production level has been on the increase with the harvested area of Irish potato is 345.2 thousand hectares and production is as high as 1,284,368 tons while yield is 3,720.1 kg/ha (FAOSTAT, 2019). Technology is one of the resources for agricultural production.

Mhoja *et al*. (2021) define adoption as the integration of new technology into existing practice and is usually proceeded by a period of 'trying' and some degree of adaptation. For Rogers (2003), adoption is a decision of "full use of an innovation as the best course of action available". The process of adopting an idea or new innovation does not happen as a single unit act, but rather a mental process that consists of at least five stages namely; the awareness stage, the interest stage, the evaluation stage, trial stage and finally, the adoption stage (Rogers, 2013, Cheteni *et al*. 2014; Sennuga and Oyewole, 2020).

Adoption of 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 labourers (Sennuga *et al*. 2020). Adoption of improved technologies is believed to be a major factor in the success of the green revolution experienced by developed countries (Ravallion and Chen, 2014). Conversely, non-adopters can hardly maintain their marginal livelihood with socio-economic stagnation leading to deprivation (Jain *et al*., 2019).

Several efforts have been devoted to the development and transfer of new technologies to improve Irish potato production in Nigeria, one of which is the Plateau State Potato Value Chain Support Project (PS-PVCP). The project is an off-shoot of Fadama II Project Implemented from 2004 to June, 2013 and supported by the African Development Bank (AfDB). The project was conceived based on the impressive performance of Plateau State Project Office that came first among other States of Borno, Katsina, Jigawa and Kogi that participated in Fadama II Project. This necessitated the Federal Ministry of Finance (FMoF), the Federal Ministry of Agriculture and Rural Development (FMARD) and the African Development Bank (AfDB) to consider channelling the unutilised funds into a single State Project called Potato Value Chain Project because Plateau State produces over 90% of the Potato in the Country. The project become disbursement effective in November, 2017 and was closed in December, 2022 **(**Plateau State, (2023).

Socio-economic factors refers to the position of individual or group relative to others in the society (Idowu, 2017). The choice for appropriate technology according to Erhabhor and Nwagbo (2016), should be based on the socio-cultural considerations of the farmers with particular reference to simplicity of the technology, such that vast majority of the farmers can put it into practice at reasonable cost and returns. Also, World Bank (2018) recommended that for a project to be appropriate and viable, it should be formulated and designed so that it is sustainable under prevailing socio-economic conditions and be seen as an advantage to those intended to benefit from it. Socio-economic characteristics significantly influence the adoption of PS-PVCSP technologies, as they shape farmers' decision-making, resource allocation, and ability to manage risks.

Plateau State is potentially conducive for potato production due to its favourable weather conditions and good strategic location. One important way to increase agricultural productivity is through the introduction of improved agricultural technologies and management systems. This study therefore attempts to examine the factors influencing the adoption of the Plateau State Potato Value Chain Support Project (PS-VCSP) that previous studies did not address. Improved technologies are core to agricultural development and the improved technologies selected are compatible to local environment of the farmers in Plateau State. Specific to the Plateau State region, studies have not been conducted on the determinants factors influencing adoption of the PS-PVCSP. This research intends to address the gap in the literature by providing information on the factors influencing the projects recommended technologies among beneficiaries in Plateau State, Nigeria. The study attempted to**;**

i. describe the socio-economic characteristics of potato farmers in the study area;
ii. assess level of adoption of the technologies promoted by the project;
iii. determine the contributions of socio-economic characteristics to the adoption of technologies promoted by the project among potato farmers and

METHODOLOGY

Plateau State, located in north-central Nigeria, has a projected population of 4,864,480 million people in 2023 and covers 30,913 km^2. Its temperate climate (13°C–22°C), high-altitude terrain (up to 1,600m), and mean annual rainfall of 1,450mm favour Irish potato production. The State grows cereals like maize, yam, and rice alongside horticultural crops and supports livestock farming (NBS, 2022).

A multi-stage sampling procedure was used for the selection of the respondents for the study. In the first stage, all the 11 beneficiary Local Government Areas were purposively selected because they were the areas of project intervention, the selected LGAs were Bassa, Barkin Ladi, Bokkos, Jos East, Jos South, Jos North, Langtang North, Mangu, Pankshin, Riyom, and Shendam. In the second stage, 0.5% were proportionately selected across the list of beneficiaries in the 11 participating LGAs giving a total of 390 respondents as the sample size for the study. The sampling frame is the list of beneficiaries of PS-PVCSP obtained from the project office.

The study used primary data which were collected using a structured questionnaire. Information on beneficiaries' socioeconomic characteristics, type of technologies promoted as well as constraints to the Irish potato production were collected. Descriptive statistics such as frequency, percentage and mean were used to achieve objective i, ii and iv. On the other hand, multiple regression analysis (OLS) was used to achieve objective iii.

Table 4: Sampling size determination plan

State	LGA	Sample Frame	Sample Size (0.5%)
	Bassa	6,987	35
	Barkin Ladi	9,882	49
	Bokkos	12,508	63
	Jos East	5,041	25
Plateau	Jos South	7,405	37
	Jos North	2,504	13
	Langtang North	4,160	20
	Mangu	11,984	60
	Pankshin	5,017	25
	Riyom	7,509	38
	Shendam	5,003	25
Total		**78,000**	**390**

Source: PS-PVCSP Office (2022)

A regression model that contains more than one regressor variable is called a multiple regression model (Montgomery and Runger, 2017). An MLR model is "typically employed to measure the effects of the explanatory variables on performance" (Farina *et al*., 2015). It can accurately reflect the correlations among factors, indicate the degree of fit and improve the effect of the regression equation (Holmes and Rinaman, 2015). Linear relationships among the various factors can be analysed intuitively and promptly by using multiple sets of data. In this study, considering that farmers' adoption of technology is associated with multiple factors, it is effective and realistic to estimate the dependent variable by using the optimal combination of multiple independent variables, which can be accurately realized by an MLR model.

Model specification

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots. B_{10}X_{10} + u$

where;

Y= Adoption of recommended technology promoted (total no. of recommended technologies adopted by the respondent).

X_1 = Age (in years)

X_2 = Marital status (Single = 1, Married =2)

X_3 = Level of education (Number of years in formal schooling)

X_4 = Household size (number of people in household)

X_5 = Farm size (ha)

X_6 = Farming experience (number of years in potato production)

X_7 = Capital (₦)

X_8 = Sources of information (in number)

X_9 = Membership of cooperatives (Number of cooperatives a farmer belongs)

X_{10} = Extension contact (Number of visits the respondents)

U = Error term a = Constant

b_1- b_{13} = Regression coefficients

RESULTS AND DISCUSSION

Socioeconomic characteristics

Age is critical in agricultural production activities, essentially due to the labour-intensive nature and the drudgery associated with agricultural production. The result presented in Table 2 revealed that half (50%) of the respondents were within the age bracket of 31-40 years with a mean age of 38.0 years and standard deviation of 10.85. This implies that most of the respondents in the study area were still in their active years which is expected to enhance their farming activities as well as their ability to adopt PS-PVCSP for household food security. Analogously, Ekwe, (2019) reported the mean age of 42 years among potato farmers in Plateau State, Nigeria. This result conformed also to the findings of Nze and Azubuike (2016) that most of the potato farmers in Abia State were in their productive ages and were thus able to cope with the challenges of agriculture.

The results of sex distribution of the respondents indicated that more than half (58.46%) of the respondents were female and 41.54% were male. The findings indicated that there is more

female involvement in Potato Value Chain Support Project than male. In contrast, Wassihun *et al.* (2019) who found that Irish potato farmers were mostly male in Ethiopia. The result also is in disagreement with the findings of Otitoju and Arene (2010) that Nigerian Agriculture is dominated by men.

The findings in Table 2 also revealed that majority (73.08%) of the respondents were married in the study area. The result agreed with Dominic *et al.* (2021) that over 30% of Irish potato farmers in Nigeria were married. This implies that majority of the potato farmers were more committed in farming because of the need to supplement the family's means of livelihood as such they could adopt Good Agronomic Practices (GAP).

The results in Table 2 further revealed that 30.77% and 24.87% of the respondents had primary and secondary education with 25.64% that have never been to school. Education is key to development of any economy as it enhanced behavioural changes of individual and thus, facilitate for awareness. Technologies developed and disseminated usually suffer setbacks in places where the level of literacy is low. The implication of this findings is that there is likelihood for higher adoption of PVCSP technologies in the study area. The result also is in tandem with Wassihun *et al.* (2019) that most of the farmers possessed some form of formal education, predominantly at the secondary level.

Table 5: Distribution of respondents according age, sex and marital status and educational level (n= 390)

Variable (n=390)	Frequency	Percentage	Mean	Std. Dev.
Age (Years)				
20-30	75	19.23	38.0	10.85
31-40	197	50.51		
41-50	56	14.36		
51-60	40	10.26		
61-70	22	5.64		
Sex				
Male	162	41.54		
Female	228	58.46		
Marital status				
Single	80	20.51		
Married	285	73.08		
Divorced	10	2.56		
Widowed	15	3.85		
Educational Level				
Non-formal Education	23	5.90		
Never being to school	100	25.64		
Primary	120	30.77		
Secondary Education	97	24.87		
Tertiary Education	50	12.82		

Source: Field Survey, 2022

In a typical African community, the size of a household has great implication for labour availability and dissemination of information relevant to the household (Ekong, 2010). The result in Table 3 revealed that more than half (50.77%) of the respondents had household size of 6-7 persons with a mean household size of 7 persons and standard deviation of 4.8. This implies that there will be availability of family labour for potato production among the respondents since they have large household sizes. This agreed with the report of Ogheneruemu and Dominic (2020) that households size is a critical consideration for family labour in farming activities for African countries, due to the possibility of substituting or complementing hired labour with family labour for farm activities.

The findings in Table 3 also show that almost half (46.15%) had farm size that ranges from 0.6-1.0ha and 26.15% had 0.1-0.5ha with a mean farm size of 0.7 ha and standard deviation of 0.57. This implies that, the respondents in the study area were small scale farmers operating on a farm land that is less than 3 ha. The result agreed with the report of Aheisibwe *et al*. (2017) which put small scale farmers in Nigeria into the category 0.16 hectares. This may have negative implications for high level of PS-PCVSP adoption in potato production. However, Pailwar *et al.* (2010) opined that, large farmland ownership helps farmers to benefit from economies of scale, higher production and income and thus increase adoption of recommended technologies.

The result in Table 3 also revealed that, a reasonable proportion (41-79%) of the respondents had 11-15 years of experience in Irish potato value chain with an average years of farming experience

of 12 years and standard deviation of 5.58. The results imply that most of the respondents have acquired long years of farming experience in potato production and thus, are expected to adopt new practices that could enhance their productivity. In a related study Arimi (2014) opined that higher number of years of experience in farming helps farmers understand and tackle the complications of the enterprise. Similarly, Kabir and Ranais (2012) reported that farming experience increases the likelihood of adoption of best practices among farmers since they have both knowledge and adequate information.

Table 6: Distribution of respondents' according to household size, farm size and farming experience (n= 390)

Variable (n=390)	Frequency	Percentage	Mean	Std. Dev.
Household size				
1.00-5.00	94	24.10	7.0 persons	4.85
6.00-10.00	198	50.77		
11.00-15.00	68	17.44		
16.00-20.00	20	5.13		
21.00-25.00	10	2.56		
Farm size (ha)				
0.1- 0.5	102	26.15		
0.6-1.0	180	46.15	0.7 ha	0.57
1.1-1.5	55	14.10		
1.6-2.0	32	8.21		
2.1-2.5	21	5.38		
Farming experience (Year)				
1-5	55	14.10		
6-10	74	18.97		
11-15	163	41.79	12.0 years	5.58
16-20	65	16.67		
21-25	33	8.46		

Source: Field Survey, 2022

Respondents' access to extension and sources of information on project

Extension contact has been described as essential in driving adoption of improved agricultural innovations (Ekwe and Nwachukwu, 2011). The results in Table 4 showed that majority (67.69%) of the respondents had access to extension. The results were in disagreement to the findings by Osahon (2018) which indicated that most of the farmers in potato production had no contact with extension in South East, Nigeria.

The result in Table 4 also point out that almost half (46.21%) and a reasonable proportion (21.21%) of the respondents' sourced information from research institutes and co-farmers/friends, respectively. According to Namwata *et al.* (2010), the efficiency of co-farmers, friends/relations; extension agents and mobile phone providing information to farmers on improved Irish potato production technologies play a significant role in the level of farmers' adoption technologies.

Table 4: Distribution of respondents according to access to extension and source of information (n= 390)

Access to extension agent	Frequency	Percentage*
Yes	264	67.69
No	126	32.31
Sources of information		
Extension Worker	18	4.02
Village/Community Leaders	47	10.49

Co-Farmers/Friends	95	21.21
Research Institutions	207	46.21
Traders	66	14.73
Internet	15	3.35

Source: Field Survey, 2022 ***Multiple response**

Adoption of technologies promoted by the PS-PVCSP to farmers

The Plateau State Value Chain Support Project promoted some technologies and Good Agronomic Practices to the beneficiaries in the study area. As shown in Table 5 the major technologies promoted and adopted were fertiliser application (52.7%), planting time (50.5%) and planting material (49.5%). In contrast to this finding, Jacinta and Edward (2019) reported that Irish potato value addition technologies promoted to smallholder in Zomba, Malawi famers were on processing.

Table 5: Distribution of respondents according to adoption of technologies promoted by the PS-PVCSP (n= 390)

Recommended technologies	Frequency	Percentage*
Fertiliser application	205	52.7
Planting time	197	50.5
Planting material	193	49.5
Weeding	175	44.9
Harvesting	172	44.1
Planting depth	170	43.6
Method of planting	164	42.1
Planting space	155	39.7

Source: Field Survey, 2022 ***Multiple response**

Socioeconomic factors influencing adoption of the PS-PVCSP recommended technologies

The results of regression analysis of socio-economic factors influencing adoption of the project's recommended potato production technologies are presented in Table 6. According to the analysis, the adjusted R^2 value was found to be 0.621, implying that the independent variables explained 62.1% of the variations in the dependent variable. The fitness of the model was further confirmed by the low value of the standard error of the estimate (Standard Error = 0.001). Again, the overall significance of the model was depicted by the F-value which was significant at 1% level of significance. The significance of F-ratio shows that the regression result was statistically reliable. The result revealed that out of the ten (10) variables included in the regression model age ($p\leq 0.01$), education, household size ($p\leq 0.01$), farm size ($p\leq 0.01$), farming experience ($p\leq 0.05$), capital ($p\leq 0.05$), sources of information ($p\leq 0.05$), and extension contact ($p\leq 0.05$) were the factors that significantly influence the adoption of recommended potato production technologies promoted by the PS-VCSP at 1%, 5% and 10%, respectively, in the study area.

Coefficient for age (0.0820) was found to be positive and statistically ($p\leq 0.001$) significant at 1% level of significance. This might be attributed to the fact that majority of the farmers had more years of experience in potato value chain in the study area as buttressed in Table 3. This is in tandem with the report of Ajibefun (2016) that young farmers adopt less of technologies than older farmers. This could be due to their experience and knowledge accumulated over the years

The coefficient of household size (0.0470) was found to be positive and statistically ($p\leq 0.01$) significant at 10% level of significance. This means that as the household size increases, adoption of the project recommended technologies also increases. This could be due to the large household size under the care of the respondents which include the provision of food among others. Consequently, technologies promoted by the PS-PVCSP is expected to increased yield in the study area. This agrees with Adesope (2016), who opined that youth are less conservative in their nature and are more receptive to change.

Similarly, the coefficient of farm size (0.0920) was found to be positive and statistically ($p\leq 0.001$) significant in influencing adoption of the PS-PVCSP recommended technologies. This means that as the farm size increases, adoption of the project's recommended Irish potato production technologies also increases. Farm size has a bearing on the capacity of farmers to adopt improved technologies. Farmers with large farm size can afford to devote part of their farms for irish potato production without significantly affecting the total land left for the production of the staple food crops compared to small land holders. Ajibefun (2016) observed that land size is also one of the indicators of the level of economic resources available to farmers.

The coefficient of farming experience (0.0320) was found to be positive and statistically ($p \leq 0.05$) significant. This means that the more their farming experience, the higher the probability of adoption of the recommended Irish potato production technologies promoted by the PS-PVCS Project. Years of experience in farming is an important determinant of the respondents' level of farm income. Farming involve a lot of risks and uncertainties, therefore to be competent enough to handle all the vagaries of agriculture, farmers must have stayed in farming business for quite some time (Ogundele and Okoruwa, 2016).

The coefficient of capital (0.0580) was also found to be positive and statistically ($p \leq 0.05$) significant. This suggests that farmers who received credit adopted more of the project's recommended technologies than otherwise. Implying that availability of credit enhances adoption of recommended Irish potato production technologies. This is in accordance with a priori expectation that availability of credit enhances farmers' ability to purchase inputs embodied in a new technology. It also pays for hired labour needed for the use of these inputs and improved management practices. This corroborates with the earlier findings that the mean income of the respondents was ₦462,000 in Table 5.

The coefficient of information sources (0.0380) was found to be positive and statistically ($p \leq 0.05$) significant. This implies that information sources had a direct relationship with the adoption of the project's recommended production technologies. This result is confirmed by the earlier result which revealed that research institute constitute the major source of the respondents' sources of information (Table 3). Though information creates awareness and educate the farmers on application of technologies, consequences of wrong applications and the effect of timely applications. Such technical information is very useful during the trial stage of adoption process and are capable of leading to adoption of agricultural innovations. This could happen given the fact that cooperatives are among the strongest determinants that play important role in adoption of technologies. A similar finding was reported by Yigezu *et al*. (2015) on adoption of potato technology component.

The coefficient of extension contact (0.1570) was found to be positive and statistically ($p \leq 0.01$) significant. This implies that beneficiaries who have more access to extension services adopted more of the projects' recommended technologies than those with less access. Extension contacts enhances access to information on recommended practices, material inputs of the technologies such as fertilisers and credit for the purchase of inputs and payment of hired labour in addition to change in attitude. This finding is in consistent with the study of Deji *et al.* (2015), who found access to extension contact as a predictive factor of adoption behaviour of beneficiaries in developing countries.

Table 6: Factors influencing adoption of the project's recommended Irish potato production technologies

Variable (n=390)	Coefficients	Standard Error	T- value
Constant	18.301	2.559	7.1512***
Age	0.0012	0.0240	3.4167***
Marital status	0.1080	0.1700	0.6353NS
Education	0.0950	0.0530	1.7925*
Household size	0.0470	0.0220	2.1364**
Farm size	0.0920	0.0140	6.5714***
Year Farming experience	0.0320	0.0110	2.9091**
Capital (Naira)	0.0580	0.0270	2.1482**
Number of Information source	0.0380	0.0140	2.7143**
Membership of association	0.0260	0.0330	0.7878NS
Number of Extension contact	0.1570	0.0910	1.7253*
R square		0.817	
Adjusted R square		0.621	
F-value		12.3113***	
Standard error		0.001	

***** Significant at 1%, ** Significant at 5%, * Significant at 10%**

CONCLUSIONS AND RECOMMENDATIONS

The study concluded that socio-economic factors significantly influence the adoption of Potato Value Chain Support Project (PS-PVCSP) technologies in Plateau State, Nigeria. Key factors such as age, education, household size, farming experience, capital, access to information, and extension contact positively impacted the adoption of promoted technologies, including fertiliser application, planting time, and improved planting materials. It is therefore recommended that; extension programmes should focus on training and educating farmers about the benefits and application of the recommended technologies, incentives such as subsidies for planting materials and fertilisers can encourage adoption among the age group while

ensuring long-term sustainability. There should be accessible credit schemes specifically tailored for potato farmers to ease the procurement of fertilisers, improved planting materials, and other necessary. Since access to information significantly affects adoption, government and project implementers should expand the reach of extension services. Regular field visits, community radio programmes, and farmer-to-farmer knowledge-sharing platforms can improve the flow of information about the technologies and farmers should be encourage to form and join cooperatives in other to enjoy economy of scale.

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