PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 29 (1) 293-302 Jan. 2025

Factors Influencing Adoption of Improved Production Technologies among Irish Potato (*Solanum Tuberosum*) Farmers in Bokkos Local Government Area of Plateau State, Nigeria

UDOH, ED*; SAMSON, EO; EMA, IE; OGAR, BI

High Forest Research Station Awi, Forestry Research Institute of Nigeria, Cross River State, Niggeria

*Corresponding Author Email: Enodonald196@gmail.com
***ORCID:** https://orcid.org/0009-0004-3746-6776
*Tel: +234(0)8036161601

***Co-Authors Email**: enochosen@yahoo.com; idonema@yahoo.com; basseyimohogar73@gmail.com*

ABSTRACT: This study examined factors influencing the adoption of improved production technologies among Irish potato farmers in Bokkos Local Government Area, Plateau State, Nigeria. A total of 160 farmers were surveyed using a structured questionnaire. The data were analyzed using descriptive statistics, Likert scales, and logit regression. The findings show that most farmers are relatively young, with 47% aged 31–40 years, 67% male, and 90% married. Additionally, 44% have completed secondary education, and 61% have 6–10 years of farming experience. Farmers demonstrated strong awareness of technologies for appropriate harvesting (mean = 3.44), timely weeding (mean = 3.41), and optimal planting dates (mean = 3.25). However, awareness was lower for seed treatment (mean = 1.99) and recommended plant spacing (mean = 2.08). Adoption rates reflected these trends, with high adoption for harvesting and weeding technologies but low utilization of seed treatment and proper spacing. Logit regression analysis identified age, educational status, annual income, farming experience, and extension contact as significant predictors of adoption. Major constraints included the high cost of technology (69%), inadequate extension contact (61%), and limited credit access (48%). The study recommends affordable credit options, enhanced extension services, simplified technologies, and improved access to address these constraints. These measures are expected to increase productivity and improve farmers' livelihoods.

DOI: https://dx.doi.org/10.4314/jasem.v29i1.36

Cite this Article as: UDOH, E. D; SAMSON, E. O; EMA, I. E; OGAR, B. I (2025) Factors Influencing Adoption of Improved Production Technologies among Irish Potato (*Solanum Tuberosum*) Farmers in Bokkos Local Government Area of Plateau State, Nigeria *J. Appl. Sci. Environ. Manage.* 29 (1) 293-302

Dates**:** Received: 22 October 2024; Revised: 20 November 2024; Accepted: 08 December 2024; Published: 18December 2024

Keywords: Factors; influencing; adoption; improved; production; technologies; Irish Potato

Irish potato (*Solanum tuberosum L.*) is the world's fourth largest food crop in terms of production after maize, rice and wheat (FAOSTAT, 2016). It is thus, the largest non-cereal food crop cultivated in the world. It was first cultivated in South America (Zhang *et al*., 2016) and easily substitutes for cereals in many developing countries; making Irish potato very crucial for food security. Global output of Irish potato is about 388 million metric tonnes with a yield per hectare of 20,110.8 kg/ha. 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). Irish potato production in Africa is estimated at 25 million metric tonnes with yield per hectare of

*Corresponding Author Email: Enodonald196@gmail.com;
***ORCID:** https://orcid.org/0009-0004-3746-6776
Tel: +234(0)8036161601

13,215.4 kg/ha, and per capita consumption (fresh and processed) of 18.76 kg/capita/year (FAOSTAT, 2019). 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) and South Africa (2,450,540 metric tonnes). Nigeria's production of 1,284,370 metric tonnes ranks seventh in Africa after Morocco (1,924,870 metric tonnes), Tanzania (1,749,201 metric tonnes) and Kenya, the fourth to sixth largest African producers (FAOSTAT, 2019). Irish potato is a major root crop in Nigeria and is by far the most efficient tuber crop in terms of tuber yield and days to maturity. It matures in about 80- 90 days as compared to 9-12 months for yam and cassava (Sanusi and Babatunde, 2017). Nigeria's production level has been on the increase with yield per hectare of 3,720.1 kg/ha (FAOSTAT, 2019). Domestic consumption of both fresh and processed Irish potato stands at 4.63 kg/capita (FAOSTAT, 2015). Irish potato was introduced to Nigeria in the early 19th Century when it was first planted in the Jos Plateau (Taiy *et al.*, 2017; Tadesse *et al*., 2018).

Plateau State has an average maximum temperature of 31.7oC and a minimum temperature of 15oC. The highest temperatures are recorded in the months of March to May while the lowest temperatures are between December and January (Harmattan months). Thus, a rainfall season running from April to October and a dry season with a cold dry harmattan wind that prevails over the state from November to February. This gives the state a near temperate climatic condition that favours the cultivation of crops like Irish potato which require an optimum temperature of 150C for tuber formation (Okonkwo *et al*., 2009). The Jos-Plateau meets this condition in both rainy and dry season, thus making the crop one of the most important root crops grown on the Jos- Plateau. It is currently widely cultivated in commercial quantities in Plateau state. The State is notably the most important area for potato production in Nigeria as over 80% of Irish potato produced in the country comes from Plateau State (Muhammed *et al*., 2016). Other Irish potato producing states in Nigeria include Kaduna and Taraba States. The crop has become a marketable crop used for different purposes. It is consumed majorly fresh as a vegetable, processed into other potato food products (snacks, fries, crisp) and used as food ingredients. Non-food uses include: starch for industry, animal feed, glue and re-used as seed tubers (Ojo, 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). According to Loevinsohn *et al*. (2013), the most common areas of technology development and promotion for crops include improved planting materials and management 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). 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. With increasing population and low output from agricultural land, adoption of improved agricultural technologies and modern method of farming is importance for increased output. Despite the economic significance of the Irish potato, its productivity has remained at low levels in Plateau State. Although the State records the highest production indices in Nigeria, per capita productivity is still low. Its productivity stands at an average of 6.5 tons per hectare falling below an optimal standard of 20 tons per hectare (FAOSTAT, 2011). Although investments have been made in research and development in an effort to improve Irish potato productivity of smallholder farmers, these efforts have not yielded expected results. The National Root Crop Research Institute (NRCRI), Vom and other agricultural research institutions in Nigeria and abroad have made notable achievements in increasing the yield of Irish potato by developing varieties of Irish potato which are capable of responding to improved cultural practices. The Research institute has also been working very closely with agricultural extension system and other stakeholders in the area in trying to disseminate these technologies to farmers (Girei *et al.*, 2020). Yet low productivity remains a major challenge. This implies that technological advances generated through research have not widely translated to increased productivity. Preliminary investigation reveals that many farmers still rely on traditional methods of production and this has lowered their level of productivity. There is dearth of information on the factors hindering or promoting the adoption of improved potato production practices by the farmers. 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). It is therefore pertinent to understand the

mechanisms underlying technology adoption. Several studies have been carried out on Irish potato in Plateau State which focused on the productivity, resources use, marketing, nutrition, output, climatic conditions and price dynamics (Lenka *et al*., 2006; Nweze *et al*., 2006; Kudi *et al*., 2008; Dimlong, 2012; Wuyep *et al*., 2013; Zemba *et al*., 2013; Panwal 2018). Little attention has been given to the adoption of improved production practices. It is therefore against this backdrop that this study seeks to analyses the factors influencing the adoption of improved production practices among potato farmers in Bokkos Local Government Area of Plateau State. Hence, the objective of this study is to evaluate the factors influencing adoption of improved production technologies among Irish potato (*Solanum Tuberosum*) marmers in Bokkos Local Government Area of Plateau State, Nigeria

MATERIALS AND METHODS

Study Area: The study was conducted in Bokkos Local Government Area of Plateau state, Nigeria. The Local Government area is located on latitude of $9^0$00'00'E and longitude of $9^0$18'00'N. It has an estimated 2020 population of 272,795 (NPC, 2006) and a land area of about1.682km2 (649sq.m). Bokkos Local Government Area is in the central zone of plateau state, Nigeria and it is one of the 17 LGAs in the state. It was created in 1991 out of the Mangu Local Government Area of Plateau State. Its headquarters is Bokkos which is 77 kilometers from Jos the state capital. The L.G.A shares boundaries with Qua'an Pan L.G.A to the south, Barkin-Ladi to the North. Sanga L.G.A of Kaduna state and Wamba L.G.A of Nasarawa state to the West and Mangu LGA to the East. Bokkos local government has eight districts namely; Sha, Manguna, Richa, Daffo, Kamwai, Mushere, Bokkos and Toff. Though situated in the tropical zone, a higher altitude means that the local Government Area has a temperate climate with an average temperate of between 180C and 220C. Harmattan winds cause the coldest weather between December and February. The warmest temperature usually occurs in the dry season months of March and April. The mean annual rainfall is 146cm (57inches). The highest rainfall is recorded during the months of July and August. The crops cultivated in the area are yam, maize, potato, sugarcane, cocoa yam while the livestock reared in the area are goats, sheep, pigs and cattle. Languages spoken are mostly, Ron, Mushere and kulere. Their occupation is mostly farming and local tin mining.

Sampling Technique and Sampling Size: sampling technique was used for the study. The first stage involved a purposive selection of four (4) districts out of the eight (8) districts in the Local Government Area. The second stage involved a random selection of two villages from each of the 4 districts selected. A reconnaissance survey of the eight (8) selected villages gave a total of 1,070 registered potato farmers. Finally, 15% of the sample frame was randomly selected from each of the selected villages in the study area. Therefore, one hundred and sixty (160) potato farmers constituted the sample size for the study. The sampling size is presented in the table 1 below.

Method of Data Collection: Primary data were collected for the study using structured questionnaire and interview schedule designed in line with the objectives of the study. The information generated includes socio-economic characteristics of potato farmers, the level of awareness of improved Irish potato production practices, the level of adoption of improved Irish potato production practices and the constraints associated with the adoption of improved Irish potato production practices in the study area.

Method of Data analysis: Simple descriptive statistics such as frequencies, percentages and mean were used to describe the socio-economic characteristic of the farmers (objective i) and the constraints to adoption of improved potato production technologies (objective v). Four point Likert scale was used to assess the level of awareness of improved Irish potato production technologies (objective ii). Adoption index was used to estimate the level of adoption of improved potato production technologies (objective iii) while Logit regression model was used to determine the factors that influence the adoption of improved Irish potato production technologies in the study area (objective iv)

Model Specification

Four Point Likert Scale: Respondents' level of awareness of improved Irish potato production technologies was determined using four point Likert scale. The Likert scale is a measure of attitudes, preferences and subjective reactions by eliciting a response along the lines of strength of agreement with the scale items (Likert, 1932). To determine the level of awareness, responses were rated on a 4-point Likert'stype scale thus: fully aware (4), aware (3), seldom aware (2) and not aware (1) for each improved Irish potato production technology. The responses were counted with respect to the weights. The score for each variable was multiplied by the corresponding weight to obtain a weighted score. Further, the weighted scores were summed to obtain a weighted sum. The weighted sum was further

divided by the number of respondents to obtain a weighted mean for each variable. Finally, the weighted means were sorted in descending order against the decision rule. The mid-point values of the scale were summed up and further divided by 4 to obtain a mean of 2.5. Any variable with weighted mean value equal to or above the cut-off mean of 2.5 was considered to have high awareness, while any variable with weighted mean of less than 2.5 is considered to have low awareness. The improved Irish potato production technologies considered are: land preparation by machines (tractors), improved seed varieties, seed treatment, appropriate planting dates, recommended plant spacing, use of organic manure, application of inorganic fertilizer, recommended time of weeding, use of herbicides for weed control, use of pesticides for pest and disease control, seed treatment, crop rotation and appropriate time of harvesting. Similarly, four point Likert scale was used to analyze the level of adoption of improved Irish Potato production technologies among the farmers. Nine improved Irish potato production technologies were considered for this study:

i. Improved seed varieties
ii. Seed treatment
iii. Appropriate planting date
iv. Use of recommended spacing
v. Application of recommended fertilizer
vi. Recommended time of weeding
vii. Use of herbicides for weed control
viii. Use of pesticides for pest control
ix. Appropriate time of harvesting

Responses were rated on a 4-point Likert'stype scale thus: fully adopted (4), adopted (3), seldom adopted (2), not adopted (1) for each improved technology. The responses were counted with respect to the weights. The score for each variable was multiplied by the corresponding weight to obtain a weighted score. Further, the weighted scores were summed to obtain a weighted sum. The weighted sum was further divided by the number of respondents to obtain a weighted mean for each variable. Finally, the weighted means were sorted in descending order against the decision rule. The mid-point values of the scale were summed up and further divided by 4 to obtain a mean of 2.5. Any technology with weighted mean value equal to or above the cut-off mean of 2.5 was considered adopted, while those with weighted mean of less than 2.5 are considered not adopted. These weighted means were used to determine the relationship between the dependent variable (level of adoption) and the independent variables. The weighted score was used as the dependent (Y) variable in the regression.

Decision rule: Any improved production technology with mean score of 2.5 and above is classified as high adoption while those with mean score less than 2.5 are classified under low adoption. For this study; adoption status is denoted thus;

High adoption (1=Adopted).
Low adoption (0 = not adopted)

Logit Regression Model: The logit regression model was used to determine the factors that influence the adoption of improved Irish potato production technologies in the study area.
Theoretically, the logit model is expressed as

$$Y= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \text{---------} \beta_n X_n$$

Where Y = Level of adoption (1=high, 0=low); β_0 = Intercept ; β_1 - - - - n = estimated parameters; X_1 - - - - n = set of independent variables; X_1 = Age (years) X_2 = Gender (male 1, female 0); X_3 = Educational status (years spent in school); X_4 = Marital status (married 1, single 0); X_5 = Farming experience (years); X_6 = Household size (number of persons in the household); X_7 = Farm size (ha); X_8 = Annual income (N); X_9 = Extension contact (number of visit)

RESULTS AND DISCUSSIONS

Socio-economic Characteristics of Irish Potato Farmers: Socio-economic Characteristics of Irish Potato Farmers as presented in Table 1 shows that the majority of farmers (47%) are aged 31-40 years, followed by 26% aged 41-50 years, with a mean age of 40 years. Younger farmers (21-30 years) account for only 11%, raising concerns about the sustainability of farming practices. This finding aligns with Adamu *et al*. (2022), who observed that middle-aged farmers adopt new technologies faster due to higher risk tolerance and productivity goals. Males dominate Irish potato farming (67%), while women represent 33%. This reflects traditional roles where men engage in labor-intensive activities, but the substantial involvement of women underscores their contribution despite societal constraints. These findings corroborate Bawa *et al*. (2018), who noted limited access for women to agricultural resources. Most farmers (90%) are married, indicating a family-oriented farming system where households contribute labor, reducing costs in labor-intensive operations. This agrees with Nmadu *et al*. (2015), who highlighted that larger families provide additional labor for farming activities. Farmers are relatively

well-educated, with 44% holding secondary education, 18% tertiary education, 27% primary education, and 11% non-formal education. Education enhances the capacity to adopt modern practices (Girei *et al*., 2020; Njuguna *et al*., 2015). Tailored training programs are needed for those with lower educational levels.

Farmers have a mean household size of 9, with 48% having 6-10 members. Larger households contribute significantly to farming labor, minimizing operational costs. Garba (2013) noted that large households serve as labor insurance, aiding production efficiency.

Most farmers (61%) have 6-10 years of experience, with an average of 8 years. Experience fosters better decision-making and adoption of innovative practices. Selahkwe *et al*. (2021) emphasized that experienced farmers are more adept at assessing risks and benefits of technologies.

Farm sizes average 1.6 hectares, with 41% operating on 1.6-2.0 hectares. Small farm sizes necessitate intensive farming practices, but these farmers often face challenges in competing without adequate support. Selahkwe *et al*. (2021) stressed the need for targeted support for smallholders to boost productivity.

Farmers earn a mean annual income of 202,356 Naira, with 38% in the 101,000-150,000 Naira range. Many operate at subsistence levels, limiting their ability to invest in modern practices. Selahkwe *et al*. (2021) linked higher incomes to increased adoption of agricultural innovations.

Only 39% of farmers have access to credit, limiting investments in inputs like seeds and fertilizers. Ali et al. (2023) highlighted the importance of credit access in boosting productivity and technology adoption.
Over half (56%) of farmers reported no visits from extension agents, impeding knowledge transfer on improved practices. Vihi *et al*. (2024) found that regular extension contact significantly enhances technology adoption.Land inheritance is the predominant tenure system (71%), offering stability but limiting new entrants into farming. Girei *et al*. (2020) observed that secure land tenure promotes investments in productivity-enhancing practices. Only 43% of farmers belong to associations, limiting access to collective benefits like resource pooling and bargaining power. Odebiyi (2010) emphasized that cooperative groups enhance members' access to resources and opportunities. Farmers' Level of Awareness of Improved Irish Potato Production Technologies: The Table 2 provides insight into the level of awareness of various improved Irish potato production technologies among farmers in Bokkos Local Government Area. The responses were evaluated using a 4-point Likert scale**,** where a score of 4 indicates full awareness, 3 indicates awareness, 2 indicates seldom aware, and 1 indicates no awareness. A weighted mean of 2.5 was used as the cut-off point to determine high or low awareness of the technologies.

Table 1: Socio-economic Characteristics of Irish Potato Farmers

Variable	Frequency	%	Mean
Age			
21-30	17	11.0	
31-40	76	47.0	
41-50	41	26.0	
>50	26	16.0	**40**
Sex			
Male	107	67.0	
Female	53	33.0	
Marital status			
Single	16	10.0	
Married	144	90.0	
Educational status			
Primary	44	27.0	
Secondary	70	44.0	
Tertiary	29	18.0	
Non formal	17	11.0	
Household size			
1-5	39	24.0	
6-10	77	48.0	
11-15	32	20.0	
>15	12	8.0	**9**
Years of farming			
1-5	35	22.0	
6-10	97	61.0	
11-15	28	17.0	**8**
Farm size			
0.5-1.0	27	17.0	
1.1- 1.5	36	23.0	
1.6 – 2.0	66	41.0	
2.1- 2.50	23	14.0	
>2.50	8	5.0	**1.6**
Annual Income			
50,000 – 100,000	6	4.0	
101,000 -150,000	61	38.0	
151,000 -200,000	38	24.0	
201,000 -250,000	32	20.0	
>250,000	23	14.0	**202, 356**
Access to credit			
Yes	63	39.0	
No	97	61.0	
Number of visits			
No visit	89	56.0	
Once in last one year	56	35.0	
Twice in last one year	15	9.0	
Land tenure			
Inheritance	113	71.0	
Hired	37	23.0	
Purchased	10	6.0	
Membership			
Yes	69	43.0	
No	91	57.0	

Source: Field survey, 2024

Farmers exhibited the highest awareness of the appropriate time of harvesting with a mean score of 3.44, indicating a strong understanding of the importance of timely harvesting to prevent losses and maintain crop quality. This was followed closely by awareness of the recommended time of weeding (3.41), which reflects the farmers' recognition of the role timely weed control plays in ensuring healthy crop growth. Awareness of appropriate planting dates was also high, with a mean score of 3.25, showing that farmers understand the significance of planting at optimal times to benefit from favorable climatic conditions. Knowledge of the use of herbicides for weed control was similarly strong, with a mean score of 3.24, highlighting that farmers are well aware of chemical weed management practices. In addition, there was a good level of awareness of improved seed varieties (3.11), showing that farmers recognize the benefits of using seeds that enhance yield and disease resistance. Awareness of the application of recommended fertilizer was also high (3.05), suggesting farmers understand the role of fertilizers in replenishing soil nutrients and boosting crop productivity. However, the awareness of other technologies was lower. Seed treatment had a mean score of 1.99, indicating a knowledge gap that could affect seed health and germination. Awareness of recommended plant spacing was also relatively low (2.08), which could impact plant growth due to competition for resources. Lastly, the use of pesticides for pest control had a mean score of 2.01, showing limited awareness, potentially leaving crops vulnerable to pest infestations and reducing yield quality.

In summary, while farmers are highly aware of key practices like harvesting, weeding, planting dates, and input use (fertilizers and herbicides), there are gaps in awareness regarding seed treatment, plant spacing, and pesticide use. Addressing these gaps through targeted training and extension services is crucial to improving productivity and adopting comprehensive agricultural practices. As Girei *et al*. (2020) noted, awareness is crucial for the adoption of improved technologies, underscoring the importance of increasing knowledge in these key areas. Level of adoption of Improved Irish Potato Production Technologies: The level of adoption of various improved Irish potato production technologies was analyzed using a 4-point Likert scale**.** The results show that the appropriate time of harvesting (Mean = 3.36) was the most highly adopted technology, followed by the recommended time of weeding (Mean = 3.21) and appropriate planting dates (Mean = 3.02). The high adoption of technologies reflects farmers' understanding of basic agronomic practices that have a direct impact on crop quality and yield. The adoption of herbicides and fertilizers further indicates that farmers are gradually embracing input-based technologies to improve productivity.

Table 2: Farmers' Level of Awareness of Improved Irish Potato Production Technologies

Level of Awareness	FA(4)	A(3)	SA(2)	NA(1)	Sum	Mean
Improved seed varieties	244	213	26	15	498	3.11*
Seed treatment	56	108	90	65	319	1.99
Appropriate planting dates	244	234	42	0	520	3.25*
Recommended plant spacing	44	81	172	36	333	2.08
Application of recommended fertilizer	224	201	64	0	489	3.05*
Recommended time of weeding	292	243	12	0	547	3.41*
Use of herbicides for weed control	256	213	50	0	519	3.24*
Use of pesticides for pest and control	48	69	162	44	324	2.01
Appropriate time of harvesting	284	267	0	0	551	3.44*

Source: Field survey, 2024

Note: FA=fully aware, A=aware, SA=seldom aware, NA=not aware

Table 3: Farmers' Level of Adoption of Improved Irish Potato Production Technologies

Level of Awareness	FA(4)	A(3)	SA(2)	NA(1)	Sum	Mean
Improved seed varieties	84	129	122	35	370	2.31
Seed treatment	44	51	162	51	309	1.92
Appropriate planting dates	164	246	74	0	484	3.02*
Recommended plant spacing	40	93	152	43	328	2.05
Application of recommended fertilizer	124	138	15	6	422	2.63*
Recommended time of weeding	220	252	42	0	514	3.21*
Use of herbicides for weed control	168	153	126	4	451	2.81*
Use of pesticides for pest and control	56	69	170	38	333	2.08
Appropriate time of harvesting	284	246	8	0	246	3.36*

Source**:** Field survey, 2024

Note: FA=fully adopted, A=adopted, SA=seldom adopted, NA=not adopted

The use of herbicides for weed control (Mean = 2.81) and the application of recommended fertilizer (Mean = 2.63) were moderately adopted, reflecting farmers' increasing use of inputs to improve productivity. However, the adoption of improved seed varieties (Mean = 2.31) and recommended plant spacing (Mean = 2.05) was low, indicating that many farmers

are yet to fully integrate these practices. The use of pesticides for pest control (Mean = 2.08) and seed treatment (Mean = 1.92) had the lowest adoption rates, highlighting significant gaps in pest management and seed treatment practices that require targeted interventions. Factors Influencing Adoption of Improved Irish Potato Production Technologies: The logit regression analysis in Table 4 examines several variables that influence the adoption of improved Irish potato production technologies among farmers in Bokkos Local Government Area. The model includes nine independent variables and assesses their significance in determining the likelihood of adoption. The analysis includes 160 observations and has a Likelihood Ratio (LR) $chi^2(9)$ = 46.69 with a p-value of 0.0000**,** indicating that the model is statistically significant. The Pseudo R^2 value of 0.6533 suggests that approximately 65.33% of the variance in technology adoption can be explained by the independent variables included in the model. Five significant variables; age, educational status, annual income, extension contact, and cooperative membership influenced the adoption of improved Irish potato production technologies.

Age (X_1): The coefficient of age is negative (-1.210) and significant at the 5% level (p = 0.012). The negative coefficient for age indicates that as farmers grow older, their likelihood of adopting improved technologies decreases. This finding suggests that older farmers may be more resistant to change and may rely on traditional farming practices. Factors contributing to this resistance could include a lack of exposure to new ideas, established farming habits, or limited access to training and information on improved practices. This trend highlights the importance of targeting younger farmers and developing programs that can engage older farmers in learning about new technologies. This is in consonance with findings by Mamudu *et al.* (2012) on adoption of modern agricultural production technologies by farm household in Ghana that old farmers tend to be less productive, and usually conservative and abhorring innovation information.

Educational Status (X_4)**:** The coefficient is positive (0.0958) and marginally significant at the 10% level (p = 0.088). The positive coefficient indicates that higher educational attainment is associated with a greater likelihood of adopting improved technologies. Educated farmers are generally more receptive to new ideas and practices because they have a better understanding of the benefits associated with innovations. This underscores the need for educational programs that can increase farmers' knowledge and skills, thus enhancing their ability to adopt modern agricultural techniques. This result is consistent with Vihi *et al.* (2024) who also reported a positive and significant effect of education on adoption of improved rice production practices in Wase LGA, Plateau State.

Farming Experience (X_6)**:** The coefficient is positive (3.693) and marginally significant at the 10% level (p = 0.080). This suggests that farmers with more experience are more likely to adopt improved technologies. Experience can enhance farmers' confidence and willingness to try new practices, suggesting that initiatives to leverage the expertise of experienced farmers could promote wider adoption. The finding aligns with Abubakar *et al*. (2023) who reported positive and significant relationship between years of experience and adoption of agricultural technologies. Annual Income (X_8): The coefficient is positive (1.397) and significant at the 5% level (p = 0.030). The positive relationship between annual income and technology adoption suggests that farmers with higher incomes are more likely to invest in improved agricultural practices. Financial stability allows farmers to purchase quality inputs, access new technologies, and invest in training. This finding emphasizes the importance of economic support programs that can provide farmers with the resources they need to adopt modern practices. Extension Contact (X_9):

Table 4: Logit Regression of Factors Influencing Adoption of Improved Irish Potato Production Technologies

Variable	Coef	Std Error	Z	P>|z|
Constant	16.8951	6.6256	2.55	0.011
Age (X_1)	-1.210	0.479	-2.53	0.012**
Gender (X_2)	-.3138	.2302	-1.36	0.173
Marital status(X_3)	3.6509	2.3657	1.54	0.123
Educational status (X_4)	.0958	.0562	1.70	0.088*
Household size (X_5)	3.650	2.365	1.54	0.123
Farming experience (X_6)	3.693	2.108	1.75	0.080*
Farm size (X_7)	-0.001	0.286	-0.00	0.998
Annual income (X_8)	1.397	0.642	2.17	0.030**
Extension contact (X_9)	3.7360	1.6280	2.30	0.022**
Number of observations	160			
LR chi2(9)	46.69			
Prob > chi2	0.0000			
Pseudo R2	0.6533			
Log likelihood	-12.389096			

*Note: ** and * Significant at 5% and 10%*

The coefficient is positive (3.736) and significant at the 5% level (p = 0.022). This implies that farmers who have contact with extension services are more likely to adopt improved technologies. Regular contact with extension agents is positively associated with the likelihood of adopting new technologies. This highlights the crucial role that extension services

play in providing farmers with information, resources, and support, which are essential for successful technology adoption. This result is consistent with salahkwe *et al.* (2021) who reported a positive significant effect of extension contact on adoption of technology. This result is also very consistent with studies by Kudi *et al.* (2010) and Namwata *et al*. (2010).

Constraints to Adoption of Improved Irish Potato Production Technologies: The results from Table 5 highlight the significant constraints that farmers face in adopting improved Irish potato production technologies. The survey reveals high cost of technology (69%), inadequate extension contact (61%), and inadequate credit access (48%). Additional barriers include non-accessibility of technologies (28%) and complexity of some technologies (7%). To overcome these challenges, farmers require affordable credit options, enhanced extension services, simplified technologies, and improved access to these technologies. Addressing these constraints can increase productivity and improve farmers' livelihoods.

Table 5: Constraints to Adoption of Improved Irish Potato Production Technologies (n=160)

Constraints	*Frequency	Percentage	Rank
High cost of technology	111	69.0	1st
Inadequate extension contact	97	61.0	2nd
Inadequate credit access	77	48.0	3rd
Non accessibility of the technologies	44	28.0	4th
Complexity of some technologies	11	7.0	5th

***Multiple responses

Conclusion The study concludes that socio-economic characteristics, particularly age, education, farming experience, income, and extension contact, significantly influence the adoption of improved Irish potato production technologies. Younger and more educated farmers, along with those with higher incomes and regular contact with extension services, were more likely to adopt modern agricultural practices. While farmers showed high awareness and adoption of some technologies (such as proper harvesting, weeding, and planting dates), other critical practices like seed treatment and plant spacing were less adopted. This suggests that while progress is being made, there are still gaps in the adoption of key technologies necessary to enhance productivity.

Declaration of Conflict of Interest: The authors declare no conflict of interest.

Data Availability: Data are available upon request from the first author.

REFERENCES

Abubakar, HN; Umar, BF; Gbanguba, AU; Dauda, NS; Hamisu, G.Y.S and Abubakar, MB (2023). Adoption of Improved Rice Processing Technologies: a Case of Small-Scale Rice Processor Groups under IFAD- Value Chain Development Program in Niger State. Badeggi *J. Agric. Res. Env.* 2023, 05(01), 60 – 71

Ali, S; Khan, MA; Shahbaz, P (2023). The Credit Accessibility and Adoption of New Agricultural Inputs Nexus: Evidence from Pakistan. *Sustainability*, Volume 15, Issue 2, January 2023

Bawa, AG; Sani, MH; Iliyasu, Y. (2018). Analysis of the Effects of Insurgency on Cowpea Production in Potiskum Local Government Area of Yobe State, Nigeria. *J. of Agrip. and Sust. Dev.* **1**(1): 82-89.

Bawa, DB; Ani, AO (2014). Analysis of Adoption of Improved Maize Production Technology among Farmers in Southern Borno, Nigeria. *Res. on Hum.. and Soc. Sc. Retrieved online at* www.iiste.org.

Challa, M (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

.

de Janvry, A; Macours, K; 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.

Dimlong, SY (2012). Best Practices on potato (Solanum tubersum L) Production and storage", pp18. German Agency for International Co-operation GIZ. Abuja Nigeria.

FAOSTAT (2016). Food and Agricultural Organization of the United Nations. FAO Statistical Database 2015. Retrieved 7/1/2016 from World Wide Web http://faostat3.fao.org/download/ FB/CC/E

FAOSTAT (2019). Food andAgricultural Organization of the United Nations. FAO Statistical Database. Retrieval date January 5, 2019, from World Wide Web http://www.potatopro.com/world/ potato-statistics . http://www.fao.org/faostat/en/data

Food and Agricultural Organisation (2008). Crop prospects and food situation, http://www.potato2008.org/en/potato/utilization.html.

Food and Agricultural Organization Statistic FAOSTAT (2019). World Food and Agricultural Organization Data of Statistics, FAO, Rome, Italy.

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, AA; Salau, ES; Audu, SI; Darason, YM (2020). Determinants of Adoption of Recommended Irish Potato (*Solanum tuberosum*) Production Technologies by Smallholder Farmers in Plateau State, Nigeria. *J. of Agric. and Research*, **6**(6): 1-14.

Kudi, TM; Bolaji, M; Akinola, MO; Nasa, IDH (2011). Analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria. *Int. J. of Peace and Development Studies*, 1(3): 8–12.

Lenka, DM; Asumugha, GN; Dung, EA; Nwauzor, EC (2006). Socio-economic Analysis of Farming Risk in Potato Production in Plateau State", In: Adepoju, S.O and Okuneye, P.D(ed), "Technology and agricultural development in Nigeria", Farm Management Association of Nigeria (FAMAN): Proceedings of 20th Annual National Conference. Sept. 18- 21st: pp. 337-340, held at Federal College of Forestry Jos, Nigeria.

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.

Margaret, M; Samuel, K (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *J. of Econ. and Sust. Dev.* **6**(5): 21-35.

Muhammad, A; Gindi, AA; Gona, A; Kaka, Y (2016). Partial Economic Analysis of Irish Potato Production under Kebbi State Agroecological Conditions. *Int. J. of Life Sc. and Scientific Research*, 2 (2): 183-190.

Namwata, B; Lwelamira, J; Mzirai, O (2010). Adoption of Improved Agricultural Technologies for Irish Potatoes (Solanum tuberosum) among farmers in Mbeye district Tanzania. A case of Illungu word. *J. of Animal and Plant Sc.* 927 – 933.

Njuguna, IM; Ng'endo, CM; Makal, SK (2015). Influence of Demographic characteristics on Adoption of Improved Potato Varieties by Smallholder Farmers in Mumberes Division, Baringo county, Kenya. *J. of Agric. and Rural dev*. 7(4):114-121.

Nmadu JN; Sallawu, H; Omojeso, BV (2015). Socio-Economic Factors Affecting the Adoption of Innovation by Cocoa Farmers in Ondo State, Nigeria. *European J. of Business, Econ. and Account.* **3**(2): 58- 66.

Nweze, N. J. & Panwal E. F. (2006). Resource- use and productivity among rainfed and irrigated Irish Potato Producers in Plateau State, Nigeria. A paper presented at 20th Annual National Conference of Farm Management Association of Nigeria, held at Forestry Research Institute of Nigeria, Federal College of Forestry, Jos Plateau, 18th-21stSeptember, 2006

Odebiyi, OC (2010). Impact of Micro-finance Bank Loan on Aquaculture Development in Ogun State, Nigeria. *Global J. of Sci. Frontier Res, Agric and Biology*, 12 (4): 9 – 22.

Ojo, FT (2013). Potato Production in the Tropics. *Unpublished M.Sc project*. University of Ibadan, 40- 60pp

Okonkwo, JC; Amadi, CO; Nwosu, KI (2009). Potato Production, Storage, Processing and Utilization in Nigeria. (2nd ed.). Umudike: NRCRI.

Panwal, EF (2018). Resource Use and Productivity among Rain-Fed and Irrigated Irish

PotatoProducers in Plateau State, Nigeria. *J. of Agric. and Sust. 11(1), 1–10.*

Rasheed, GA; Kehinde, YO; Williams, AA. (2019). Adoption Intensity Determinants for Improved Sweet Potato Varieties among Farmers in Nigeria. *Int. J. for Agric. Mgt. and Dev.* **9**(3): 203-211 Sanusi MM & Babatunde DA, 2017. Analysis of Potato Consumption among Households in Odeda Local Government Area , Ogun State , Nigeria, 89–99. https://doi.org/10.1515/ats

Selahkwe, C; Manu, IN; Tohnain, NL; Eileen, BN; Chefor, F (2021). Factors That Determine the Adoption of Improved Irish Potato Technologies by Farmers in the Western Region of Cameroon. *Agric. Sci.* Volume 12, Issue 12, December 2021

Tadesse, B; Bakala, F; Mariam, LW (2018). Assessment of postharvest loss along potato value chain : the case of Sheka Zone , southwest Ethiopia. *Agric. & Food Sec*. 1– 14. https://doi.org/10.1186/s40066- 018-0158-4

Taiye, R J; Onyango, C; Nkurumwa, A; Ngetich, K (2017). Socioeconomic Characteristics of Smallholder Potato Farmers in Mauche Ward of Nakuru County, Kenya, 5(5), 257–266. https://doi.org/10.13189/ujar.2017.050502

Vihi, SK; Selzing, PM; Udoh, ED; Makwin, FM; Binuyo, G; Jesse, B; Dalla, AA; Sulaiman, JK (202). Adoption of Improved Production Technologies among Rice Farmers in Wase Local Government Area, Plateau State, Nigeria. *Nig. Agric. J*. 55 (1): 161-170

Wuyep, SZ; Zemba, AA; Jahknwa, CJ (2013). Effects of precipitation effectiveness on the yield of Irish potato (solanum tuberosum) in Jos-Plateau, Nigeria. *Int. J. of Res. in App, Nat. and Soc. Sci.* (IMPACT:, 1(5), 27–32.

Zemba, BA; Wuyep, SZ; Adebayo, A A; Jahknwa, CJ (2013). Growth and Yield Response of Irish Potato (Solanum Tuberosum) to Climate in Jos-South, Plateau State , Nigeria. *Global J. of Human Soc. Sci. Geo, Geo-Sc, Env. Disaster Mgt, 13(5), 13–18.*

Zhang, L; Su, W; Eriksson, T; Liu, C (2016). How Off-farm Employment Affects Technical Efficiency of China ' s Farms : The Case of Jiangsu. *China & World Economy*. 24(3), 37–51