



DETERMINANTS OF ADOPTION OF IMPROVED POTATO PRODUCTION TECHNOLOGIES BY FARMERS IN NORTHERN ZONE OF PLATEAU STATE, NIGERIA

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ABSTRACT

The study examined the determinants of adoption of improved potato production technologies by farmers in Northern Zone of Plateau State. A multi-stage random sampling technique was used to select 210 respondents. Data were collected using structured questionnaire and analyzed using both descriptive and inferential statistics. The result reveals that majority (76.5%) of the respondents had access to extension agent and 84.5% of the respondents received extension visit annually. Majority (72.5%) of the respondents indicated extension agents as their sources of information. Above half (58.0%) of the respondents were aware of recommended potato production technologies. The major technologies adopted by the respondents were improved planting materials (96.5%), optimum fertilizer application (92.0%) and improved use of herbicides (87.0%) which were ranked 1st, 2nd and 3rd respectively. The result also revealed that years of experience ($P < 0.01$), membership of association ($P < 0.05$), yield output ($P < 0.01$), and access to extension agent ($P < 0.05$) significantly influenced the adoption of recommended potato production technologies in the study area. The major constraints faced by the respondents were inadequate improved planting materials (1st), improved use of herbicides (2nd) and insufficient information (3rd). The study concluded that most of the respondents had no access to extension services but had adopted and used most of the recommended potato production technologies in the study area. Hence the need for potato farmers should form and joint cooperatives and associations to increase their awareness and access to recommended production practices. Also, authorities and NGOs should help to recruit and train more personnel in extension teaching and potato farmers should pull down resources and purchase equipment and tools to assist in adoption and uses of recommended potato production technologies to enhance productivity.

Keywords: Adoption, Technology and Potato.

INTRODUCTION

Food is a basic need of man and requires a steady production to meet consumers' need for consumption (Obi-Egbedi and Gulak, 2020). FAO (2021) opined that the nation's agricultural production is still largely in the hands of the small-scale farmers who are said to account for over seventy percent (70%) of the total agricultural production but in spite of the tremendous human, diverse climatic and land resources in Nigeria, the food supply has continued to fall below demand level. Nigeria has been finding it difficult to feed its population without recourse to massive importation of food (FAO *et al*, 2020). Meeting the ever-growing



demand for food remains a major challenge for world agriculture (Fabiya & Idowu, 2016; FAO *et al.*, 2020).

Potato (*Solanum tuberosum* L.) is the world's fourth largest food crop in terms of production after maize, rice and wheat (FAOSTAT, 2016; Ahmadu *et al.*, 2021; Tkachenko *et al.*, 2021). It is thus, the largest non-cereal food crop cultivated in the world. It was first cultivated in South America and easily substitutes for cereals in many developing countries; making potato very crucial for food security. Global output of potato is about 388 million metric tonnes with a yield per hectare of 20.11 kg/ha. Over half of the global output is produced in developing countries and 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).

In addition, potato production in Africa is estimated at 25 million metric tonnes with yield per hectare of 13.21 kg/ha, and per capita consumption (fresh and processed) of 18.76 kg/capita/year. Algeria is the leading producer of potato in Africa with a production of 4.60 metric tonnes, followed by Egypt (4.32 metric tonnes) and South Africa (2.45 metric tonnes). Nigeria's production of 1.28 metric tonnes ranks seventh in Africa after Morocco (1.92 metric tonnes), Tanzania (1.74 metric tonnes) and Kenya, the fourth to sixth largest African producers (FAOSTAT, 2019). Nigeria's production level has been on the increase with yield per hectare of 3.72 kg/ha. Domestic consumption of both fresh and processed potato stands at 4.63 kg/capita (FAOSTAT, 2019).

The production and marketing of potatoes in Plateau State has become an integral part of the rural economy, both the rainy and dry season as it is cultivated as rain-fed and dry season crop (Okunade & Ibrahim, 2011). Plateau state has conducive climatic requirements for potato production. 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 90% of potato produced in the country comes from Plateau State. 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; Obi-Egbedi and Gulak, 2020).

The production and marketing of potato in the highland zones of Plateau State has become an integral part of the rural economy, both at the rainy and dry season as it is cultivated as a rain-fed and dry season crop (Okunade & Ibrahim, 2011). Due to the increasing number of uses to which potato can be put, production activities have been increasing. Apart from this, profitability is the main objective of production and is important to every farmer, as it will not only improve farmers' income and livelihood but would also influence the farmers' adoption of new technologies (Ashley-Dejo *et al.*, 2021; and Adamu *et al.*, 2022).

The attitude of farmers towards adoption of any crop or technologies is influenced by their expectation of economic benefits (Ejembi *et al.*, 2018). In addition, farmers who adopted a particular production method of crop do so in anticipation of economic benefits. Thus, the establishment of the Potato Research Centre, Kuru-Plateau State by the National Root Crops Research Institute (NRCRI) in 1976 marked the beginning of rapid expansion of potato production in Nigeria. Despite notable efforts devoted to the development and transfer of new technologies to improve potato production in Plateau State; including potato seeds multiplication, training of farmers, potato research, breeding and selection of new improved varieties (Zemba *et al.*, 2013); annual potato production in the state stands at 900,000 metric tonnes (Jwanya *et al.*, 2014). This output level has not been increasing at farm level while yields have continued to decline substantially and remain lower than potential yields (FAOSTAT,



2016). This is an indication that technological advances generated through research and investments have not widely translated into improved efficiency.

Despite the recorded increase in research and development of new technologies on potato production, which is being viewed as an important route out of poverty in most of the developing countries (Girei *et al.*, 2020), many farmers still rely on traditional methods of production and as such attaining optimal yield, eradicating poverty and food security is nearly unrealistic. It is therefore against this backdrop, the study aims at investigating the determinants of adoption of improved potato production technologies by farmers in Northern Zone of Plateau State, Nigeria. The study attempted to identify the sources of information on improved potato production technologies, determine the level of adoption of the recommended improved Potato production technologies by farmers, examine the determinants of adoption of improved potato production technologies and describe the constraints to adoption of potato production technologies in the study area.

MATERIALS AND METHODS

The Study Area

The study area is Plateau State. It is one of the thirty - six states that make up the Federal Republic of Nigeria, including the Federal Capital Territory, Abuja. The State is located in the north-central zone of Nigeria and lies between latitude 8°30' and 10°30'N, longitude 7°30' and 13°37'E, It has an estimated population of 3,178,712 (NPC 2006 Projection), 3.78 million people and based on the annual population growth rate of 3.2%, the projected population of the State is about 4,469,232 million people in 2019. The State is bounded by Kaduna and Bauchi states to the north, Taraba on the east and Nasarawa to the south and west with a landmass covering 30, 913 square kilometres, the state was created on 3rd February 1976, from Benue-Plateau, with its administrative headquarters in Jos. It is structured into 17 local government areas (LGAs) Nnaji *et al.*, (2019).

The state falls within the Northern Guinea Savanna zone, the climate is characterized by two distinct wet and dry seasons. The wet season starts in late April and ends in October, while the dry season starts in November and ends mid-April. The mean annual rainfall is about 1450mm, and relative humidity of 60%. The mean monthly maximum and minimum temperatures are 20°C and 15°C, respectively. (FAO, 2010).

Plateau State is primarily an agrarian community. The State has a land mass of 30,913 square km or 6,678,162 acres Adeoye *et al.* (2022). About two thirds of the land area is arable. The major food crops include potatoes, sweet potatoes, chili pepper tomatoes and strawberry. Others include leafy vegetables, cereals, legumes and root and tuber crops and tree crops. Vegetables include carrots, lettuce, radish, cucumber, sweet pepper, hot pepper, green beans, parsley and fruits include strawberries. However, cereal production on the Plateau represents about 34% of all agricultural produce; root and tubers production represent about 32 % while horticultural crops stand out at about 21%. The least is forest products which represent 13% (Adeoye *et al.* (2022).

In the areas of solid minerals, the state is equally endowed tremendously, as it can boast commercial and large-scale availability of the following minerals; Tin, Zircon, Galena, Tantalite, Gemstones, Monazite, Columbite, Kaoline etc. Also, the state produces a lot of agricultural products, excess of which are sold and transported to other parts of the country and for exports.

Sampling Technique and Sample size

Multi-stage sampling technique was used for this study. The first stage is the purposive selection of two (2) LGAs. These are Barkin Ladi and Jos South. They were selected based on



the predominance of potato production activities among the farmers in the Northern Zone of the State. The second stage involved a random selection of 3 villages from each of the 2 LGAs selected, making six villages. In the Final stage, 35 potato farmers were randomly selected from each of the selected villages making a total of 210 respondents as the sample size for the study.

Methods of Data Collection and Analysis

Data were collected using a structured questionnaire. The data collected were analysed using descriptive and inferential statistics.

Descriptive Statistics

This was used to achieve objectives i, ii, and iv of the study. This involved the measures of central tendency such as mean, frequency distribution and percentages.

Multiple Regression Analysis

This was used to achieve objectives iii. The regression analysis is useful in estimating the contributions of each variable to the dependent variable to determine the best variable predictive of adoption by farmers and effects (Olayide and Heady, 2012). Agwu *et al.* (2008) applied the number of technologies adopted by a farmer as dependent variable (Y). This study will apply the number of recommended potato production practices adopted by a farmer as dependent variable (Y). The number of recommended potato production practices adopted by the farmer will be used as proxy for the adoption which is the dependent variable Y.

The model is specified below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \text{-----} + \beta_8 X_8 + e.$$

Where:

Y= dependent variable as defined above i.e. Adoption (number of recommended practice adopted by a farmer)

X₁ = Farmers' age (years)

X₂ = Marital status (single, married)

X₃ = Level of education (Number of years in formal schooling)

X₄ = Household size (number in household)

X₅ = Farm size (hectares)

X₆ = Farming experience (years in potato production)

X₇ = Access to credit (actual amount received ₦)

X₈ = Information source (number of sources used)

β₁ – β₈ = Regression coefficients

a = constant

e = error term

RESULTS AND DISCUSSION

Sources of Information on Improved Potato Production Technologies

The result in Table 1 reveal the respondents' access, awareness and extension contacts which are paramount factors for adoption of technologies especially among potato farmers in the study area. The result show that majority (76.5%) of the respondents had no access to extension, while 23.5% of the respondents had access to extension. This implies that extension service delivery is inadequate among potato farmers in the study area. On the other hand the result shows that only 8% and 7.5% of the respondents had annual and quarterly contact with extension agents in the study area. The result further shows that majority (72.5%) of the respondents had different sources of information, while 20% and 7.5% of the respondents indicated mass media and open market as their major sources of information. This implies that despite the inadequacy of extension services among potato farmers they had other sources of



information which could include from other farmers, personal experience and field researchers among others. Although membership to organization (i.e. Cooperative membership) is considered as important information source including farming among farmers (Odoemenem & Obinne, 2010) results from this study revealed that only 28% of the respondents were members of organizations (i.e. farmers groups). This information shows that the potential of social-network (social capital) through farmers group as source of agricultural related information has not been fully utilized in the area. The result further shows that majority (58%) of the respondents were not aware of recommended potato production technologies, while 42% of the respondents were aware of recommended potato production technologies in the study area. This implies that most of the respondents had no awareness of recommended production technologies and technologies in potato production which could be attributed to inadequate access to extension services and contacts.

Table 1: Distribution of Respondents According to their Sources of Information (n=200)

Variable	Frequency	Percentage
Access to extension		
Yes	47	23.5
No	153	76.5
Frequency of extension contact		
None	169	84.5
Quarterly	15	7.5
Annually	16	8.0
Sources of information		
Mass media	40	20.0
Open market	15	7.5
More than one source	145	72.5
Awareness of recommended potato production		
Yes	84	42.0
No	116	58.0

Source: Field Survey, (2023)

Improved Potato Production Technologies Adopted

The result from Table 2 shows the adopted potato production technologies among the respondents where use of improved planting materials, use of improved herbicides and optimum fertilizer application. These were respectively ranked as ranked 1st, 2nd and 3rd adopted technologies by the respondents, on the other hand planting time and techniques, harvesting and storage/preservation methods were adopted and ranked 4th, 5th and 6th respectively by the respondents in the study area. This implies that most of the respondents who had access to potato production technologies had adopted most of the technologies.

Table 2: Distribution of Respondents According to Potato Production Technologies Adopted

Variable	Frequency	Rank
Improved planting materials	96.5	1 st
Planting time and technique	78.5	4 th
Optimum rate of fertilizer application	87.0	3 rd
Improved use of herbicides	92.0	2 nd
Harvesting	69.5	5 th
Storage and preservation method	62.0	6 th

Source: Field Survey, (2023)



Respondents' Level of Adoption of Potato Recommended Technologies

The result from Table 3 shows the levels of adoption and use of technologies by the respondents, improved planting materials, planting time and techniques and use of herbicides were the major technologies adopted and used by the respondents as indicated by a mean scores of 3.5, 3.1 and 3.0 respectively. On the other hand the respondents did not adopt and use cold rooms, fertilizer application rates, harvesting technologies, processing/value addition and storage/preservation technologies as indicated by the mean scores of 2.9, 2.8, 2.5 and 1.3 respectively. This implies that most of the respondents who had adopted potato production practice or technologies were using such technologies except for some few which could either be expensive or not-accessible by the respondents in the study area hence the inability to use such technologies in the study area.

Table 3: Distribution of Respondents According to their levels of Adoption

Variables	Mean Score	Decision
Improved planting materials	3.5	Adopted
Planting time and technique	3.1	Adopted
Cold room technologies	1.3	Not adopted
Fertilizer application technologies	2.9	Not adopted
Herbicides use for weeding technologies	3.0	Adopted
Harvesting technologies	2.8	Not adopted
Processing and value addition technologies	1.3	Not adopted
Storage and preservation method	2.5	Not adopted

Source: Field Survey, (2023)

Determinants Factors Influencing the Adoption of Recommended Potato Production Technologies

The result from Table 4 shows the factors influencing the adoption of recommended potato production technologies by the respondents, the findings shows that years of membership of associations, annual output of potato in bags and access to extension service were found to be positively significant at 1% ($P < 0.01$) and influencing the rate of adoption for recommended potato production technologies among the respondents. This implies that one unit increase in years of membership of associations, annual output of potato in bags and access to extension service will lead to one unit increase in adoption of recommended technologies by the respondents, while potato allocated land was found to be negatively significant at 1% ($P < 0.01$) toward influencing the adoption of recommended technologies by the respondents which implies that one unit increase in allocated land for potato will result to one unit decrease in adoption of recommended technologies, which could be attributed to the facts that adoption of technologies will result to higher output/yield than only increasing land size without adopting recommended technologies in the study area.

Table 4: Determinants of Adoption of Recommended Potato Technologies

Variables	B	Std. Error	t	Sig.
Sex	-.058	.084	-.691	.491
Age	-.001	.002	-.428	.669
Marital status	-.030	.027	-1.129	.261
Household size	.007	.004	1.605	.110
Educational level	.090	.048	1.869	.063
Farm size	-.010	.017	-.556	.579
Potato allocated land	-1.000	.266	-3.756	.000***
Farming experience	.006	.003	1.762	.080
Potato farming experience	-.001	.003	-.456	.649
Membership of association	.773	.305	2.536	.012**
Years of membership experience	.110	.031	3.534	.001***
Annual potato output in bags	.008	.003	2.683	.001***
Annual income in naira	-1.859E-8	.000	-.310	.757
Access to extension service	.133	.048	2.773	.005**
Frequency of contacts	.084	.048	1.741	.083
R	.902			
R square	.814			

Source: Field Survey, (2023) *** significant at 1% ($P < 0.01$) ** Significant at 5% ($P < 0.05$)

On the other hand, the result reveals that membership of association was found to be positively significant at 5% ($P < 0.05$) toward influencing the adoption of recommended technologies which implies that one unit increase in membership of association will lead to one unit increase in adoption of recommended technologies in the study area. Sex, age, marital status, household size, status in the family, type of family, secondary occupation, educational level, farm size, farming experience, potato farming experience, season of potato production, annual income and frequency of extension contacts were not significant and had no influence on respondents levels of adoption for recommended production technologies in potato production in the study area. This implies that there are factors influencing the adoption of improved potato production technologies and increase in these will result to increase in the level of adoption of improved production technologies among the respondents in the study area. Kudi *et al.* (2010) in their work on analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria stated that seventy six percent of the farmers had contact with extension agent, while twenty four percent had no contact with extension agent. This implies that the more the contact with the extension agents the more the adoption rate. Their result also indicates that eighty percent of the respondents had access to credit, while twenty percent had no access to credit. Kudi *et al.* (2010) argued that there is that tendency that farmers will adopt new innovations because majority of them had access to credit which would enable them to purchase inputs and pay for labour required in the adoption of new varieties. Ayinde *et al.* (2010) found that education level of farmers; farming experience; farm size; access to extension agents and access to credit have significant and positive influence on adoption. Akanya *et al.* (2019), found extension contact and credit facilities to be positively and significantly related to awareness, adoption and gross farm output of farmers. On the other hand, Njuguna *et al.* (2015) reported that family size was a significant factor influencing



adoption of improved potato varieties. Large families provide readily available and cheap labour which is important in adoption decisions.

Constraints to Adoption of Potato Production Technologies

The result from Table 5 shows the constraints faced by the respondents in the adoption of recommended technologies where inadequate improved planting materials, inadequate technical know-how and insufficient information were the major constraints faced by the respondents toward adoption of recommended technologies and were ranked 1st, 2nd and 3rd respectively. On the other hand high cost of technology, non-accessibility of technology, inadequate credit facilities, complexity of technology and inadequate awareness were ranked 4th, 5th, 6th, 7th and 8th by the respondents respectively. This implies that like any other technology the technologies associated to potato production comes with its constraints especially in the study area where accessibility, complexity and poor access to credit were faced by the respondents which could be attributed to the fact that most of the respondents were small scale farmers in the study area. insecurity of land tenure particularly leasing arrangements, absentee ownership, small operating units and higher property taxes have been hypothesized to be institutionalized obstacles to adoption of recommended environmental management technologies (Akpoko, 2014). Abdullahi, *et al.* (2019) reported that, the various constraints face by farmers in the adoption of improved rice farming technologies. Scarcity of inputs (37.5%) and paucity of fund (35.8%) respectively were the major constraints of the farmers, while (25.0%) of the farmers identified death of information as another type of constraint. Garba *et al.* (2018) indicated that, high labour requirement to be the major constraints to SOSAT technology in millet production. This might be linked to the fact that millet processing is labour intensive due to the unavailability of modern processing facilities in the study area.

Table 6: Distribution of Respondents According to Constraints Faced in Adoption of Recommended Technologies

Variables	Percentage	Rank
High cost of technology	79.0	4 th
Complexity of technology	70.5	7 th
Non-accessibility of technology	73.5	5 th
Inadequate credit facilities	72.5	6 th
Inadequate awareness	69.5	8 th
Insufficient information	81.0	3 rd
Inadequate technical know-how	83.5	2 nd
Inadequate improved planting materials	92.0	1 st

Source: Field Survey, (2023)

CONCLUSION AND RECOMMENDATIONS

The study concluded that though most of the respondents had no access to extension services but had adopted and used most of the recommended potato production technologies as indicated by the mean scores of 3.0 and above in the study area. Membership of association, years of experience, potato output and access to extension services were the determinants factors influencing the adoption of potato recommended technologies. Based on the result of this study, the following recommendations were made:

- Potato farmers should form and joint cooperatives and associations to increase their awareness and access to recommended production practices
- Authorities and NGOs should help to recruit and train more personnel in extension teaching



- iii. Potato farmers should pool their resources and purchase equipment's and tools to assist in adoption and uses of recommended potato technology
- iv. Potato farmers should be trained and educated on the use of recommended technologies in potato production
- v. Government should assist in dissemination of recommended technologies among potato farmers.

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