International Journal of Innovative Food, Nutrition & Sustainable Agriculture 13(1):17-30, Jan-Mar, 2025

© SEAHI PUBLICATIONS, 2025 www.seahipublications.org ISSN: 2467-8481

doi:10.5281/zenodo.14934011

Assessment Of The Adoption Of Improved Maize Production Technologies Among Small-Scale Farmers In Awka Agricultural Zone Of Anambra State, Nigeria

[1]Ejeagwu G. I. & [2]M. G. Nenna

[1&2]Department of Agricultural Economics & Extension,
Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Nigeria

ABSTRACT
The study assessed adoption of improved maize production technologies (IMPT) among small scale farmers in Awka Agricultural Zone of Anambra State, Nigeria. The specific objectives of the study were to describe the socio-economic characteristics of the maize farmers, identify the maize farmers' sources of information, assess the farmers adoption level, determine the socio-economic variables of the farmers that influenced IMPT adoption level and identify constraints. Multistage sampling techniques which include purposive and random sampling procedures were employed in the selection of 125 respondents from 5 town communities of the study area. Questionnaire was used for the primary data collection. Data were analyzed using descriptive statistics and multiple regression analysis. The study found that the majority of the respondents were: females (57.6%), married (54.4%), between the age range of 41-50 years (31.0%), managing household size of 4.54 and an average farm size of 1.46 hectares obtaing information mainly from fellow farmers ($\bar{x}$=2.73), friends ($\bar{x}$=2.64) and non-governmental organizations ($\bar{x}$=2.63). The study further found that the major IMPT adopted highly by the respondents include: site selection ($\bar{x}$=4.06), inorganic fertilizer application ($\bar{x}$=3.77) and herbicide use ($\bar{x}$=3.59). The socio-economic characteristics of respondents found to significantly influenced adoption include marital status (p=0.69) and farm size (p=0.08) while their major constraints include: high cost of maize ($\bar{x}$=3.09) and inadequate suitable land ($\bar{x}$=3.08). The study concludes that the farmers adopted some improved maize production technologies and *inter alia* recommended that government and philanthropist should subsidize high cost of fertilizer to encourage increased IMPT.
Keywords: Improved maize, Production Technologies, Adoption, Awka, Nigeria.

INTRODUCTION

Agriculture is defined as the science and art of farming (Enibe, 2020). The different areas of specialization in agriculture include; animal science, agronomy, agricultural economics, agricultural extension, horticulture and forestry, fishery and aquaculture (Enibe, 2020). Agriculture is revealed to be the mainstay of the Nigerian economy which employed over 70% of the country's population. Agriculture is revealed to be endowed with the potential to drive economic growth of the countries that have farmers' increasing productivities and market linkages (Enibe *et al.*, 2023). Maize is an important food and feed

crop in Nigeria and in different parts of the world (Njoku, 2018). Maize or Corn (*Zea mays L.*) is a member of the grass family (*gramineae*) (Oladejo and Adetunji, 2017). Maize is a stable cereal and popular due to its high nutritional significance enriched with abundant amount of macronutrients like starch, fibre, protein and fat along with micronutrients such as vitamin B complex, ß-carotene and essential minerals that include magnesium, zinc, phosphorus and copper (Ayeni, 2018). It is an important source of carbohydrate, protein, iron, vitamin B, and minerals (Ayichi, 2017).

Maize can be eaten in boiled, roasted or fried forms and it can be used for the development of variety of food products, such as, oil, eternal, flour, flakes, ***popcorn, tortillas, dough ball, fish bait, golden morn, quaker oat and custard (Ozor, 2017;*** Babatunde, 2018; Onu, et, al 2018 ***).*** In some countries such as Mexico and Indian; maize is consumed as second-cycle produce in the form of meat, eggs and dairy products (Usoro, 2017). Onu, et, al (2018) revealed that maize is one of the most abundant food crops in Nigeria. He added that about 80% of its output is consumed by man and animals while only 20% is utilized in industries. Maize is also used to supplement different food items to feed malnourished children (Koocheki, 2015). Maize has recently risen to be a commercial crop provides food, livestock feed and raw materials to agro-based industries (Iken and Amusa, 2016; Faruq, 2017). Ozor (2017) noted that maize is a major source of cooking oil (corn oil), glutens and maize starch which can be hydrolyzed and enzymatically treated to produce syrups, particularly high fructose corn-syrup and sweetener. He added that it can also be fermented and distilled to produce grain alcohol for whiskey and beer production (Ozor, 2017). Due to various uses of maize, it offers an almost unlimited scope for employment and thus a source income and livelihood for many people in different countries (Oladipo, 2018).

Despite the development and introduction of maize production technologies such as improved seed varieties, fertilizers, pesticides, herbicides, planters and irrigational systems by the existing research institutes, these technologies in maize production seem to have not been disseminated and adopted by farmers to increase the maize productivity level in many areas of Nigeria. Maize average yield is still found to be very low (1/3 tons/ha) compared to its potential yield (Babatunde et al., 2018). These indicate that there no significant increase in the productivity, output, income and standard of living of the farmers (Ogunniyi and Olagunju, 2015). Maize production in Awka Agricultural Zone, Anambra State has not been sufficient enough to meet the needs of people and livestock. For a reason that only 20% of the crop produced gets to the industries in Nigeria as noted by Onu, *et, al* (2018) indicates that the crop is still under produced and underutilized. This suggests the need to find ways to increase output of the crop. Gupta (2018) is of the view that the adoptionof improved maize technologies holds the key to ensure its increased output. It therefore, becomes necessary to understand the level of adoption of the crop's improved production technologies in different areas

According to Leif (2023) Diffusion of Innovation (DOI) theory developed by Roger in 1962 is one of the oldest social science theories. He added that the theory originated in communication to explain how over time, an idea or product gains momentum and spreads through a specific social system. He concluded that the end result of diffusion is that people as part of a community adopt a new idea, behaviour or product. The word adoption refers to the process that an individual possess through since the person first hears about an innovation until it starts to be used on a continuous basis (Atala & Issa, 2022). Leif (2023) reported that the five established adopter categories are: innovators, early adopter, early majority, later majority and laggards. According to Atala and Isa (2022), diffusion is a social concept concerned with the ways a new idea spreads through a social system; they added that the process of diffusion is indeed a precursor to adoption which begins with the actual entry of an innovation into the system. They further defined diffusion as the process by which an innovation is communicated via specific channels over a period of time among members of a social system. Sundstrom (2016) stated that diffusion of innovation theory deals with innovation development stage. Full definition of diffusion brought out four of its major elements which are: (i) innovation (2) communication channels (3) time and social system (Atala and Isa, 2022). According to Sennuga *et. al.,* (2003) the five characteristics of innovation theory are: relative advantage, compatibility, complexity, trialability and observability.

Several studies on maize have in the past been conducted. For example Babatunde et al., (2018), in their study revealed that maize supply is yet to meet its demand. Ojo et al (2017) worked on effect of miledew resistance maize technologies on farmer's yield and income and found that the crop's improvement technologies such as seed priming and fertilizer micro-dosing have only been applied to improve crop production without assessing their implications in the diseases of crops. They added that more than half of the farmers adopted the Downy mildew resistant maize in the study area. They revealed that the determinants of adoption of this variety by the maize farmers are farm size and extension contact. Umeh and Chukwu (2019), availability of a sustainable agricultural technology for Nigeria resource poor maize farmers is important due to the country's efforts at achieving food security. Ojo (2019) in his study noted that the determinant of adoption could help measure the changing weight of human capital; and that village, institutions, ethnicity and market influence the decision to adopt new production technologies. These therefore, contribute to the debate about economic and non-economic determinants of improved crop technologies adoption. Yusuf et al (2019) in their study noted that Nigeria's greatest resource as far as productivity increase is concerned is its small holder farmers; increasing their capacity, knowledge, skill and performance is the requisite for production enhancement. Studies as exampled above have shown that there is the need to increase maize production, understand production situation of the crop in the study area as little or no recent study has been conducted in the area and on the adoption of the crop's improved technologies. These raise important research questions: Who are the improved maize farmers in the study are? Where do the improved maize farmers in the study area source their improved maize production technologies? At what level of adoption of improved maize production technologies are the farmers in the study area? Which of the socio-economic characteristics of the maize farmers influence their adoption of improved maize production technologies? What are the problems of the improved maize farmers in the study area?

1.2 Objectives of the Study

The main objective of this study is to analyse the adoption of improved maize production technologies among small-scale farmers in Awka Agricultural Zone of Anambra State, Nigeria. The specific objectives are to:

i. describe the socio-economic characteristics of the maize farmers in the study area;
ii. identify the maize farmers' sources of information on improved maize production technologies in the study area;
iii. estimate the level of adoption of improved maize production technologies in the study area;
iv. determine the farmers' socio-economic variables that influenced adoption of improved maize production technologies;
v. identify the problems of the maize farmers in the study area.

2.3 Conceptual Framework

Conceptual framework is a representation of the relationship you expect to see between your variables or the characteristics or properties that you want to study (Sserunkuuma, 2015). The schema for the adoption of improved maize production technology by small scale framers in Awka Agricultural Zone is presented in Figure 1. The scheme suggests that small scale maize farmers' adoption of improved maize production technologies will help to improve their living standard, increase their income levels, reduce their poverty levels, increase their food security status e.t.c.

Block A represents the socio-economic characteristics of small scale farmers which may or may not influence the farmers to adopt or not adopt improved maize production technologies which are shown in Block C. Adoption will positively influence increased maize production.

Block B consist of the various sources of information by which the small scale farmers may or may not receive information on improved maize production technologies as presented in Block C. The problems or constraints of the small scale maize farmers which are outlined in Block D may be caused by any of those factors presented. The block B, C and D and all are linked to each other to affect the socio-

economic characteristics of small scale farmers which may or may not influence the farmers and other of such issues mentioned in Block A.

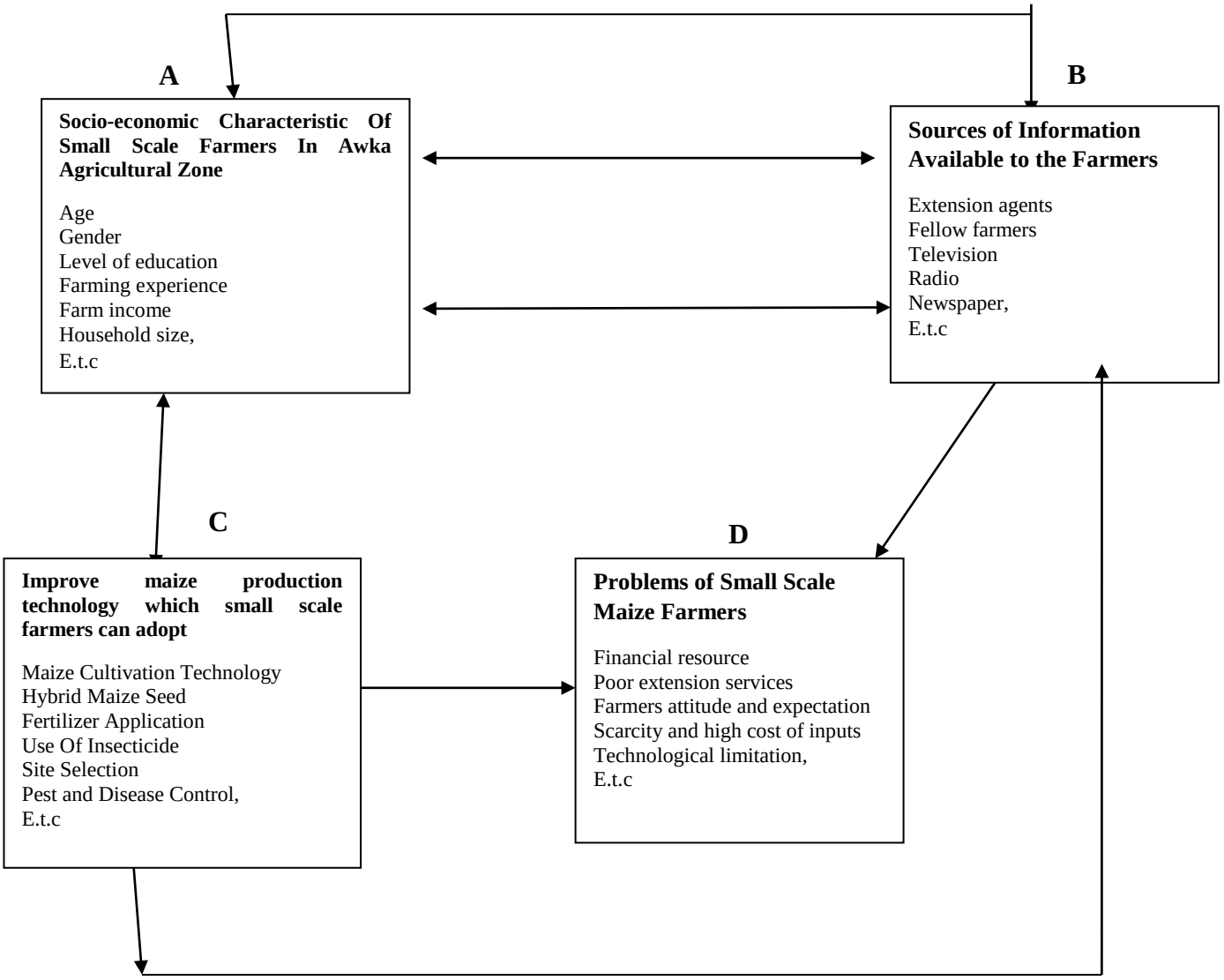

Figure 2: Schema for adoption of improved maize production technologies in Awka Agricultural Zone

RESEARCH METHODOLOGY

3.1 Population and Sampling Procedure

The study population comprises all small holder maize farmers in the study area. Purposive and random sampling methods were used to select 125 respondents from the study area. Awka Agricultural Zone was purposively selected at stage 1. This is because the area is familiar to the researcher and is highly known for its maize production activities. At stage II, one town community was randomly selected from each of the five L.G.As of the zone. At stage III, 25 farmers were randomly selected from each of the five communities to arrive at 125 respondents. Primary data were collected through the use of questionnaire administered with the help of trained enumerators.

3.2 Methods of Data Collection

Data for the study were collected through primary and secondary sources. Primary data were collected from the respondents using a well structured questionnaire and trained enumerators. Primary data were collected on the Maize farmers': socio-economic characteristics, sources of information on improved maize production technologies, levels of adoption of the improved maize production technologies and on their problems to adoption of improved maize production technologies. Secondary data were collected from relevant Journal articles, research documents and books.

3.3 Methods of Data Analysis

Objectives i, ii, iii and v were analyzed using descriptive statistics such as frequency distributions, percentages and means score. Multiple regression analysis was used to analyze objective iv and test the hypothesis which states that there is no significant relationship between socio-economic variables of the respondents that influence adoption of improved maize production technologies. The implicit form of the multiple regression model used to examine the effect of socio-economic factors of the respondents on level of adoption was given as follows:

$Y= \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_{5+} \beta_6X_6 + \beta_7X_7 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9$ ……...+u

Where,

Y= Adoption score

α= constant term

β_1- β_{12}= regression coefficient

X_1 = Age (years)

X_2 = Educational levels (no formal education = 1, primary education = 2), secondary education=3, tertiary education=4)

X_3 = Farming experience (years)

X_4 = Household size (actual number)

X_5 = Gender (male = 1, female = 0)

X_6 = Farm income

X_7 = Membership of social organization

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Maize Farmers

Table 1 reveals that 42.4% of the respondents were male while 57.6% were female, implying that the predominant maize farmers in the study area were female. The finding contradicts that of Danladi et al., (2021) who found that 55.12% of maize farmers in Zing Local Government Area (LGA) in Taraba State of Nigeria were male while 44.88% were female. The result of the finding could probably be due to the fact that majority of males in that study prefer to engage in non-agricultural activities such as trading, artisan, civil service, driving etc. The order reason could be due to the cultural differences existing in the two study areas. Specifically, the study of Danladi *et al* (2021) was conducted in the Northern part of Nigeria while this study was conducted in Awka Agricultural zone of Southeast Nigeria. Also, the result of this study is understood because females are more likely to be more engaged in small scale farming activities than the males.

Table 1 shows that the majority of the respondents (31.0%) were between 41 and 50 years, with mean age of 45.73 years. The result indicates that majority of respondents were relatively young and in their active age. The result further suggest that older people might have left farming due to various reasons that may include death, lack of strength required to cope with the drudgeries associated with framing. The result agrees with Haruna *et al.* (2023) who found that the mean age of maize farmers in Kuje Area Council of FCT Abuja was 43.81 with mean age of 45.723,

Table 1 shows that majority (54.4%) of maize farmers were married while 36.0% of them were single. This implies that majority of the respondents were married and supports their households and livelihoods with proceeds of their maize farming. This is in congruent with Adeola *et al.* (2023) who found that 73% of maize farmers in Kastina State were married. The result of married people in Kastina State seems to be far greater than that of the study area. This could be because northern people of Nigeria appear to get married earlier than those in Southeast Nigeria especially the Igbo people.

Table 1 shows that majority (52.0%) of the respondents had household size of between 4 and 6, 20.0% with an average household size of 4.54. This implies that half of respondents were farmers with average household size who could provide average family maize production labour while a significant population of the respondents had small households who could not provide adequate family labour. The result agrees with Suleiman and Balaraba (2019), who observed that household size is used as a proxy of family labour given that each individual in the household is a potential source of labour for increased adoption of maize production technologies.

Table 1 shows that 34.4% of the respondents had obtained primary education, 16.8% had secondary education while 16.0% had tertiary education while 32.8% had no formal education. The result reveals that majority of maize the farmers were educated and could read and understand information related to improved maize production technologies for increasing maize output. The result is in agreement with Yakubu *et al.* (2019) posited that western education facilitates the adoption of modern technologies and improved farm practices. The result further reveals that a significant population (32.8%) of the respondents had no formal education and who may not understand improved maize production technologies. This aspect of the result shows that one of the ways to increase adoption of maize production technologies in the study area is to use more efficient agricultural extension system and or isolate the uneducated farmers and offer them formal education. Atueyi, Nkechukwu, & Jacobs (2019) also found in their study that small and medium scale enterprises hold the highest consumption of the agricultural produce.

Table 1 reveals that majority (50.4%) of respondents had 6 to 10 years in maize farming experience with a mean maize farming experience of 9.10 years. The result implies that majority of the respondents had enough maize farming experience and positioned to adopt improved maize production technologies that may be offered to them. The finding agrees with that of Danladi et al., (2021) who reported that 38.55% of the maize farmers in Zing LGA of Taraba State, Nigeria had farming experience of 7 to 10 years.

Table 1 further reveals that majority (51.2%) of the respondents were members of different cooperative societies which include processing (51.2%), production (32.8%) and marketing (9.6%) cooperative societies. This implies that majority of the farmers were members of cooperative societies and positioned to access low interest loans from their cooperatives for increase maize production. In evidence, Samson and Obademi (2018), observed that membership of cooperative societies have advantages of accessibility to micro-credit facilities unlike non-cooperative members. The results suggest the need for extension agents and agencies to encourage farmers and particularly maize farmers to enroll in cooperative societies or groups and position themselves for such benefits and increased farm output.

Table 1 shows that the majority of the respondents (92.0%) had between 1-2 hectares of farm land with an average farm size of 1.46 hectares. This implies that majority of the respondents were small holder maize farmers and under produce maize in the study area. The result reveals that the demand for maize in the study area seems to be greater than its supply suggesting the need of the farmers in the study area to upgrade their farm scale to become commercial maize farmers for closing the maize demand and supply gap of the area. The result is in agreement with Adeola *et al.* (2023) who found that 59% of the maize farmers in Funtua Local Government Area of Katsina state had land size of between 1 and 2 hectares with average farm size is 1.26 hectare. The result also reveals the need to encourage farmers to adopt maize production technologies and increase their maize output even in their small farm sizes. The result suggests the need for further studies to understand why maize farm size in different parts of Nigeria especially in Northern Nigeria where there are large expanse of land for maize production.

Table 1 shows that majority (60.0%) of the maize farmers made less than ₦100,000 as their average annual farm income, with an average annual farm income of ₦184,637.60. This implies that the respondents were small scale farmers whose maize production income was inadequate for their livelihoods and who were most likely supporting their households with income from other sources. The result suggests that the abilities of the farmers to adopt improved maize production technologies for increased production of the crop may be limited by their low income. The result agrees with Odoh *et al.* (2020) who found that farmers in Benue state earned an average sum of 100,564 naira.

Table 1 indicates that majority of the respondents 42.4% had extension contacts once in a year, while 2.4% had no extension contact. This implies inadequacy of extension activities and services in the study area and this could hinder their ability to adopt improved maize production technologies in the study area. This result agrees

with the findings of Suleiman and Balaraba (2019), who also found that 65.8% of maize farmers in the Rijau Local Government Area of Niger State had no extension contact.

Table 4.1: Socio-economic characteristics of maize farmers

Characteristics	Frequency	Percentage	Mean
Gender			
Male	53	42.4	
Female	72	57.6	
Age			
20-30	22	17.6	
31-40	26	20.8	
41-50	39	31.0	45.723
51-60	25	20.0	
61 and above	13	10.4	
Marital status			
Married	68	54.4	
Single	45	36.0	
Widowed/widower	4	3.2	
Divorced	8	6.4	
Household size			
1-3	15	12.0	
4-6	54	52.0	4.543
7-9	25	20.0	
10 and above	20	16.0	
Education level			
No formal education	41	32.8	
Primary education	43	34.4	
Secondary school	21	16.8	
Tertiary education	20	16.0	
Farming experience			
1-5	26	20.8	
6-10	63	50.4	9.10
11 and above	36	28.8	
Membership of farmers' group/cooperative			
Processing cooperative society	64	51.2	
Production cooperative society	41	32.8	
Marketing cooperative society	12	9.6	
Isisu group (Thrift group)	8	6.4	
Farm size			
1-2	115	92.0	1.4560
3-4	10	8.0	
Annual farm income			
Does less then 1000,0000	75	60.0	
100001- 200000	18	14.4	184,637.6000
200001-400000	13	10.4	
400001-600000	14	11.2	
6000001 and above	5	4.0	
Number of extension contacts			
Once a year	53	42.4	
Once in two weeks	30	24.0	
Weekly	20	10.0	
Once in six months	12	9.6	
Once in a month	7	5.6	
None	3	2.4	

Source: Field survey, 2023.

4.2 Sources of Information on Improved Maize Production Technologies by the Farmers

Table 2 shows that the first, second, third, fourth and fift sources of the respondent's information on improved maize production technologies were respectively as follows: fellow farmers ($\bar{x}$=2.73), friends ($\bar{x}$=2.64), NGOs ($\bar{x}$=2.63), farmers' cooperative ($\bar{x}$=2.54) and mobile phone ($\bar{x}$=2.5200). The result reveals that fellow farmers, NGOs and Cooperative societies were the three major sources of improved maize production technologies' information. The result further reveals that the impact of the other sources of information on improved maize production technologies is not felt in the study area including those of the extension service, and mass media. The result suggests the need for the extension service of the study area to step up their service delivery for increased maize production in the study area. The result is in line with this study which reveals that extension service delivery in the study area is inadequate. The findings corroborate with that of Bawa *et al.* (2014) who reported that friends, neighbours, and cooperative societies were the major sources of information on maize production technologies in Southern Borno State of Nigeria.

Table 4.2: Sources of famers' information on improved maize production technologies

Sources	Mean	Ranking
Fellow farmers	2.73	1st
Friends	2.64	2nd
NGOS	2.63	3rd
Farmer cooperative	2.53	4th
Mobile phone	2.52	5th
Television	1.92	6th
Extension agents	1.90	7th
Billboards	1.82	8th
ADP	1.77	9th
Radio	1.71	10th
Hand bills	1.64	15th

Source: Field survey, 2023.

4.3 Level of Adoption of Improved Maize Production Technologies by Maize Farmers

Table 3 reveals that the six most highly adopted improved maize production technologies in the study area were respectively: Site selection ($\bar{x}$ =4.06), inorganic fertilizer application ($\bar{x} = 3.77$), herbicide for weed control ($\bar{x} = 3.59$), planting space and depth ($\bar{x} = 3.54$), land preparation ($\bar{x} = 3.37$), seed selection and treatment ($\bar{x}$ =3.02).

The high adoption of Site selection and inorganic fertilizer application indicate that maize farmers knew them as very important things and the important soil requirements of the crop which include nitrogen and sunlight. The result agrees with Everest et al., (2022) who reveals that planting maize in nitrogen rich soil will positively impact its growth and yield (Everest *et al*., 2022). Similarly inorganic fertilizer application had high adoption on improved maize production technologies. The result further collaborates with Chairuman et al., (2023) who reported that application of fertilizer reduce the effects of degraded soil on maize production by improving nutrients for the crop's uptake.

Also, the high adoption of herbicide for weed control by the respondents suggests that they knew that it saves them the weeding time and adds economic values in the maize production process. In addition, the high adoption of planting space and depth by the respondents indicates that they knew its value in maize production. The later is in agreement with Hussen, *et al*., (2013) who reported that depth of sowing and spacing is an important factor in maximizing the maize plant yield. Similarly, the high adoption of land preparation by the respondents implies that the respondents were aware that it creates friendly

environment for plant growth and good yield. The result agrees with Mano and Awoyemi *(*2020) who reported that land preparation increases productivity and yield.

In contrast, Table 4.3 shows that the respondents had low adoption of pesticide use and improved maize varieties. The reason could be due to high costs of pesticides and improved maize varieties. The results agree with the findings of Salihu et al. (2016) who reported that high cost of farm inputs was one of the constraints faced by farmers. The result however, contradicts the report of Haruna *et al*. (2023) who found that maize farmers in Kuje Area Council of FCT-Abuja adopted improved maize varieties. Similarly, Table 4.3 shows that mechanical harvesting had low adoption by the maize farmers of the study area. The result is understandable because section 4.1 reveals that the respondents were small scale maize farmers with an average farm size of 1.46 hectares which might be in segmented plots of land where tractor and other large mechanical farm machinery may not be easily employed.

Table 4.3:Level of adoption of improved maize production technologies by maize farmers

Technology	**Mean**	Std. Deviation
Site selection	4.06	1.25559
fertilizer application	3.77	1.30838
Herbicide for weed control	3.59	1.51389
Planting space and depth	3.54	1.24112
Land preparation	3.37	1.38270
Seed selection and treatment	3.02	1.42254
Pesticide use	2.91	1.31380
Use of improved varieties	2.86	1.26583
Planting date	2.84	1.35837
Mechanical harvesting	2.72	1.33562

Source: Field survey, 2023

4.4 Influence of Socioeconomic Characteristics on the Adoption of Improved Maize Production Technologies

Table 4.4 shows F-value of 7.296 and R^2-value of 0.415. The F value of 7.296 indicates that the model was fit and that the null hypothesis is false. This is because the figure (7.3) is by far greater than one, meaning that there is a significant relationship between the respondents' socioeconomic characteristics and adoption of improved maize technologies. The R^2 is explained as the number that tells you how well the independent variable (s) in a statistical model explains the variation in the dependent variable. It ranges from 0 to 1, where 1 indicates a perfect fit of the model to the data. The R^2 value (0.415) result therefore, indicates that 42% of the total variation in adoption of improved maize technologies (dependent variable) is explained by the socio-economic characteristics (independent variables) in the regression model while the 58% is due to error. This suggests that there are other significant variables that are influencing adoption of improved maize technologies which were not contained in the model.

The coefficient of marital status was negative and significant at 10% level in affecting adoption of improved maize production technologies. It further implies that for every farmer that gets married, the level of adoption of improved technologies reduces by 0.144. This contradicts the prior expectation that married farming households should have high level of adoption of improved technologies so as to expand their production and provide food as well as other needs for their families. This finding runs contrary to the finding of Umar *et al*. (2022) who found that marital status was significant in influencing the adoption of improved maize technologies in Western Zone of Bauchi State, Nigeria. This may be because the respondents of this study as seen in section 4.1 were small scale farmers who had average household size had and invested on small land areas. In evidence, Table 4.4 shows that farm size was found to be positive and significant at 10% level in influencing adoption of improved maize technologies. The Table further reveals that a unit increase in farm size, increases adoption level by

0.131. The result indicates that the larger the farm size, the higher the probability of improved maize technologies adoption. Similarly, Table 4.4 shows that household size was positive and significant at 1% level in affecting adoption of improved maize production technologies. This implies that as household size increases, the adoption level of improved technologies increases by 0.356 which might be because farmers adopt new technology to improve their maize production and provide basic needs for their families. This result is in line with the findings of Sani *et al.* (2018) who stated that household size of the respondents was a significant factor in adoption analysis of improved maize production in Bauchi State, Nigeria.

Membership of cooperative was positive and significant at 1% level in influencing adoption of improved maize production technologies, implying that as farmers join cooperatives, their level of adoption of improved maize technologies by farmer increases by 0.237. The result suggests that Maize farmers need to be encouraged to enroll with farmers' organizations as one of the ways of increasing their adoption of the crop's technologies. This result is in line with that of Haruna et al. (2023) who found that cooperative membership influenced adoption of improved maize production technologies in FCT-Abuja. This might be because, cooperatives provides access to information about improved maize production technologies which can boost the maize output of their members. It might also be because cooperative societies, most often grant their member free or low interest loans which position their members to purchase improved seed and adopt maize production technologies. This is because section Table 4.5 revealed that high cost of improved maize is one of the major problems of the respondents ($\bar{x}$=3.089).

Table 4.4: Multiple regression estimate of factors affecting adoption of improved maize technologies

Independent variables	Un-standardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.584	1.557		1.018	.311
Age	.001	.020	.003	.035	.972
Marital status	-.602	.328	-.144	-1.837	.069*
Farming experience	.091	.069	.111	1.331	.186
Education level	.296	.205	.115	1.445	.151
Farm size	.487	.279	.131	1.746	.084*
Household size	.544	.122	.356	4.463	.000***
Membership of social organization	1.631	.558	.237	2.921	.004***
different social organizations	-.030	.268	-.009	-.112	.911
Annual income	1.148E-006	.000	.071	.942	.348
Extension visit	.076	.472	.012	.162	.872
Number of extension visit	-.216	.139	-.115	-1.556	.122

Key: Dependent variable: adoption score, *,**,***Significant (**Sig.**) at 10%,5% and 1% respectively R= 0.644, R^2=0.415, Adjusted R^2= 0.358, P-value = 0.000, F-value = 7.296, Std. error of the estimate= 2.46579

4.5 Problems of the maize producers in the adoption of technologies in the study area

Table 4.5 shows that the encountered problems of the respondents include: high cost of improved maize ($\bar{x}$=3.089), inadequate suitable land ($\bar{x}$=3.08), low output of improved maize ($\bar{x}$=2.81), theft of mature maize in the fields ($\bar{x}$=2.82), inadequate transportation ($\bar{x}$=2.80), inadequate government support/subsidies ($\bar{x}$=2.71). The result reveals that the two major problems of the respondents were high cost of improved maize and inadequate suitable land and two of them which relates with all other identified problems can be attributed to lack of fund. This is in the sense that the farmers' complaint of high cost of improved maize may be because they lack government support as shown in Table 4.5, and could

not access credit facilities to: solve their transport problems, obtain pesticides and herbicides for solving their maize pests and diseases problems or purchase their needed infrastructural facilities. Similarly, their second major problem of inadequate suitable land could be because they lack fund to purchase their needed farm inputs such as fertilizers and labour costs which will help them to all things being equal increase their farm output and income. Inadequate access to credit as identified by the respondents was another constraint facing the respondent. This might be because some credit institutions require collateral which cannot be met by the farmers leading to low investment and income from agriculture.

The result reveals that subsidizing the cost of improved maize varieties by the government is one of the considerable ways of increasing farmers' adoption of improved maize technologies in the study area. The result further showed that the land problems of the farmers need to be studied for better understanding of how to make the farmers' available land suitable for maize production and adoption of the crop's improved technologies. The low output of improved maize production may be due to other factors such as poor nutrients or other poor production treatment issues such as inadequate and untimely fertilizer application and inadequate suitable land. The result suggests the need for further investigation on the farmer's improved maize production treatment conditions. In evidence, inadequate suitable land and inadequate access to credit facilities were in Table 4.5 found to be some of the constraints of maize producers. The findings also implies that farmers with small farm size and low income from the farm might not be able to adopt improved maize technologies, purchase fertilizer, keep watch over their farm produce and ability to access storage and processing facilities as observed by (Meyo and Egoh, 2020).

The result supports Kadafur *et al*. (2020) who found that high cost of improved maize varieties constrained maize farmers in the adoption of maize varieties in Northern Guinea Savannah of Borno State, Nigeria. The result also agrees with Okonji and Awolu (2020) who reported that inadequate credit hindered adoption of improved maize production technology by farmers in Ekiti State. The result is further in agreement with Haruna et al. (2023) who found that high cost of labour, inadequate modern infrastructures were among the constraints of the maize farmers in Kuje Area Council FCT-Abuja.

Theft of mature maize in the fields was another problem faced by maize farmers in the study area as regards adoption of improved maize technology. This implies that theft is a discouraging factor in maize production and adoption of the crop's technologies. The result suggests the need for the farmers and community leaders to find ways of reducing theft problems in the study area as one of the ways of increasing maize production.

Table 4.5: Mean distribution of constraints of the maize producers in the adoption of technologies in the study area.

Constraints	Mean	Std. Deviation
High cost of improved maize	3.098	1.10728
Inadequate suitable land	3.08	1.06710
Low output of improved maize	2.82	1.0244
Inadequate transportation	2.80	1.12880
Theft of mature maize in form fields	2.81	1.05262
Inadequate government support/subsidies	2.71	1.03031
Inadequate access to credit facilities	2.69	2.91663
Low income from agriculture	2.69	1.16685
Incidence of pest and diseases	2.66	1.22543
High cost of fertilizers	2.64	1.05800
High cost of labour	2.61	0.95795
Insecurity Problems at the farm fields	2.58	1.14430
Poor infrastructural facilities	2.34	1.13553
High cost of transportation	2.36	1.19407
Inadequate contact with extension agents	2.39	1.04647
Destruction of plant by storm,	2.53	1.11135
Drought and flood	2.45	1.03531
Destruction of plant by cattle	2.00	1.07763

Source: Field survey, 2023

5.1 CONCLUSION

The study concludes that some improved maize production technologies had high adoption such as site selection, inorganic fertilizer application, herbicides for weed control, planting space and depth, land preparation and planting of both early and late maize while the respondents encountered some major constraints such as high cost of improved maize varieties, lack of suitable land and theft of mature maize in farm fields all linked to lack of fund.

5.2 RECOMMENDATIONS

1. The government, extension agents and Non-governmental organization (NGO) should encourage farmers to enroll in farmers' organization and cooperative societies. This is because this study found that membership of cooperative societies was positive and significant at 1% level which indicates that encouraging farmers to enroll with cooperative societies is one of the ways to increase adoption of the crop's innovation and output.
2. The government, non-governmental organization (NGOs) and philanthropist should subsidize the high cost of improved maize varieties and fertilizer as some of the ways to encourage adoption of the crop's technologies and increased production of the crop.
3. Federal, state and local government should provide infrastructural facilities such as rural roads for farmers to enable them bring out their farm produce to the markets located far from their respective farming communities.
4. Government should encourage institutions to offer low interest loans to maize farmers. This will enable them obtain fund to purchase farm inputs to increase their productive potentials.
5. Further studies should be carried out by students and researchers on the farmer's maize production treatment condition/issues and on gender issue. This will help to discover the reasons for the low output of improved maize which is one of the discovered constraints. The study/studies will also help to discover what are lacking in the soils which made the land unsuitable for improved maize production.

REFERENCES

Adeola, S. S., Yusuf, H. D., Zazifi, B., & Ibrahim, H. Y. (2023). Maize production scale efficiency and it socioeconomic determinants among smallholder farmers in Funtua Local Government Area, Kasitna State, *Nigeria. Nigerian Agricultural Journal*, 54(1), 459-466. http://www.ajol.info/index.php/naj.

Atueyi C. L.Nkechukwu, G.C. & Jacobs C.J (2019) Effect of financial inclusion on small and medium scale enterprise in Nigeria. *International Journal of Management and Marketing Systems 13 (5) 1-17*

Ayichi, D. (2017). Agricultural technology transfers for sustainable rural development. In Ebo, E.C.U. Okoye & D. Anyichi (Eds).*Rural Development in Nigeria: Concept processes and prospects.* Enugu: Auto-Century publishing company, pp.126-134.

Babatunde RO, Fayode S. &Bardo A. A (2018).Fadama maize Production in Nigeria: Case study from Kwara State. *Research Journal of Agriculture*. 4(5): 340-345.

Bawa, D. B., Ani, A. O. & Bzugu, P. M. (2014). Influence of agricultural information on maize farmers in Southern Borno State, Nigeria. New Media and Mass Communication, 31.ISSN 2224-3267 (Paper) ISSN 2224-3275 (Online).

Chairuman, N., Batubara, S., Aryati, V. &Siagian, D. R. (2023). Enhancing the maize growth and production by applying the phosphorus and potassium nutrients in inceptisol of Langkat Regency , 5th International Conference on Sustainable Agriculture, 1172(2023), 012042, doi:10.1088/1755-1315/1172/1/012042. Available at http://www.academicjournals.org/AJAR. Accessed at January 24, 2024.

Danladi, T. E., Orunyo, E. D., Wilson, M. U., &Bala, K. (2021). Effects of socio-economic characteristics of maize farmers in Zing Local Government Area, Taraba State, Nigeria. *International Journal of Environment and Agriculture Research*, 7(8): 40 –54.

Enibe, D.O (2020). How students choose careers: understanding the career choices, motivations and problems of agricultural students in Anambra State, Nigeria. *American International Journal of Social Science Research,* 5(3): 1-5.

Enibe, D.O, Ezeonwurie I.B & Okeke, M.N (2023). Gender Issues In Crop Technology Development, Transfer And Utilization In Anambra State Of Nigeria. *International Journal of Advanced Multidisciplinary Research And Studies,* 3 (2): 324-330.

Everest, T., Gönül, S. S., · Aykut O. & Hasan Ö. (2022). Suitable site selection by using full consistency method (FUCOM): a case study for maize cultivation in Northwest Turkey. Environment, Development and Sustainability. Available at https://doi.org/10.100 7/s10668-022-02787-5. Accessed on 30 March, 2024.

Faruq, H.M., (2017) Economic efficiency and constraints of maize production in the Northern Region of Bangladesh. *Journal of Innovation and Development Strateg*y, 2(1):18-32.

Gupta O.A (2018) Information on maize production among rural youth: a solution for sustainable food security in Nigeria Ladoke Akintola University of Technology, *Library Philosophy and Practice (e-journal).* 7(9); 127 – 137.

Haruna, L. Z., Sennuga, S. O., Bamidele, J., Bankole, O., Alabuja, F. O., Preyor, T. J. & Barnabas, T. M. (2023). Factors influencing farmers' adoption of improved technologies in Maize Production in Kuje Area Council of FCT-Abuja, Nigeria. *Journal of Agriculture Research,* 6(4).Doi: 10.5281/zenodo.7924557.

Hussen, S. Alemu, B., and Ahmed, F. (2013).Effect of planting depth on growth performance of maize (Zea-Mays) at the experimental site of Wollo University, Dessie, Ethiopia. *International Journal of Science, Basic and Applied Research,* 8(1): 10-15.

Iken, J.E.,& Amusa, N.A.,(2016).Maize research and production in Nigeria. *African Journal of Biotechnology, 3*(6):302–307.

Kadafur, I, M., Idrisa, Y. Lawal, &Shehu, A. (2020).Adoption of improved maize varieties in Northern Guinea Savannah of Borno State, Nigeria. *Journal of Agricultural Extension,* 24(1).ISSN(e): 24086851; ISSN(Print); 1119944X.

Koocheki .A.(2015).Sustainable agriculture and the environment. Final report of the future of food, Islamic Republic of Iran Academy of Science, Tehran. Available @ https://www.fao.org.Accessed on 12 December, 2022.

Mano, A.O & Awoyemi, T.T (2020). Effect of desertification on maize production potentials in the North Eastern Nigeria. *Journal of Agricultural Research and Policies* 1(1), 37-41.

Njoku, J.E. (2018) Factors influencing adoption of maize production technologies by small holders in Imo state of Nigeria. In J.O. Olukosi, A.O. Ogungbile and B.A. Kalu (Eds), *Appropriate Agricultural Technologies Working Paper* No. 2015/07 Maastricht School of Management, Netherland. Available @http://johnuebersax.com/stat/likert.htm.AccessedMay 10th2023.

Odoh, N. E., Nwibo, S. U., Eze, A. V., & Igwe, E. O. (2020). Farmers income and savings pattern in Benue State, Nigeria. *Journal of Agricultural Extension*, 24(1): 123-130.

Ogunniyi , A. & Olagunju, K. (2015) .Impact of agricultural innovation on improved livelihood and productivity outcomes among smallholder farmers in Rural Nigeria. Agricultural *Science Research Journals Vol.2*(2) pp.77-83

Ojo, D.K., Saka, J.O., Ogunsumi, I.O., Afolami, C.A & Fakoya, E.O. (2017) Effect of down miledew resistance maize technologies on farmer's yield and income in downy miledew endermic area. *Journal of Nigerian Asset. Vol.2*(2) pp.62-70

Ojo, S.O.,(2019).Productivity and technical efficiency of poultry egg production in Nigeria, *International Journal ofPoultryScience2(6):*459-464.

Okonji, C. J. &Awolu, O. T. (2020).Factors influencing adoption of improved technology among maize farmers in Ekiti State, Nigeria. *Agrosearch*, 20(2), 102-112.

Oladejo, J. A., & Adetunji, M.O. (2017).Economic analysis of maize (zea mays L.) production in Oyo state of Nigeria. *Agricultural Science Research Journals*.2(2), 32.

Oladipo, (2018). Agro-industry as strategy for rural development: An impact Assessment of Nigeria oil palm industry, *European journal of social* science vol.7(1),75 -87.

Onu, E. G., Ogara I. M., Yahaya, H., and Nannim N. (2018) Economic Analysis of Maize Production in Mangu Local Government Area of Plateau State, Nigeria. *Journal of Production, Agriculture and Technology*, 6(1):1-11.

Ozor M.U, (2017). Economic analysis of dry maize in the South East States of Nigeria. Unpublished Ph. D Thesis Department of Agricultural Economics and Extention, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus. Anambra State, Nigeria.

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

Suleiman, A., & Balaraba A.S. (2019).Technical efficiency of maize production in Rijau Local Government Area of Niger State, Nigeria. *Journal of Agriculture and Veterinary Science*, 12(2): 63-71.

Umar,A. J.,Idi, S. & Bose,A. A. (2022). Adoption of improved maize (*zea mays* l.) production technologies among farmers in Western Zone of Bauchi State, Nigeria. *Journal of Agripreneurship and Sustainable Development(JASD)* Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University Bauchi.

Umeh .K. & Chukwu .A. (2019). Transforming African Agriculture by Promoting Improved Technology and Management Practices. Background Paper for African Transformation Report 2016: Transforming Africa's Agriculture. Joint research between African Center for Economic Transformation (ACET) and Japan International Cooperation Agency Research institute (JICARI).

Usoro E.J. (2017). The Nigerian maize industry (Government Policy and Export Production 1906-1965), Ibadan University Press. Pp.130-140.

Yakubu, A., Oladimeji, Y.U., & Hassan, A.A. (2019).Technical efficiency of maize farmers in Kano State of Nigeria using data envelopment analysis approach. *Ethiopian Journal of Environmental Studies & Management*, 12(2): 136–147.