



ADOPTION OF IMPROVED MAIZE (*Zea mays* L.) PRODUCTION TECHNOLOGIES AMONG FARMERS IN WESTERN ZONE OF BAUCHI STATE, NIGERIA

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ABSTRACT

The study examined adoption of improved maize production technologies among farmers in Western zone of Bauchi State, Nigeria. Multi-stage sampling procedure was employed in selecting 120 farmers for the study. Data were collected using structured questionnaire and analysed using both descriptive and inferential statistics. The result shows that majority (80.84%) of the farmers fell within the ages of 20-39 years with the mean age of 38 years. Most (94.20%) of the respondents were males and 56.67% were married with a mean household size of 8 persons. Furthermore, the result revealed that majority (89.17%) of the respondents had one form of education or another with secondary education (42.50%) had the highest percentage, the mean years of farming experience was 10 years. The results from linear regression analysis showed that age, household size, farm size, marital status and educational level were significant at $P < 0.1$ and $P < 0.05$, respectively. The major constraints militating against the adoption of improved technologies used in maize production were high cost of inputs (79.17%), poor market price (72.50%) and inadequate inputs (70.83%) among others. The study concluded that age, farm size and household size were the major determinants of adoption of improved maize production technologies in the study area. It was recommended that a good and stable market price, subsidize and adequate inputs and extension personnel should be provided in the study area.

Keywords: Adoption, Maize, Production, Respondents, Technologies.

INTRODUCTION

In Nigeria agriculture is one of the major sectors of the economy and a major contributor to GDP (Turaki, 2018). During the 60's the growth of the Nigerian economy was derived mainly from the agricultural sector, as a nation adopting different agricultural programmes and policies aimed at raising the production and efficiency of the sector (Federal Ministry of Agriculture and Rural Development [FMARD], 2013). However, in more recent years there has been a marked deterioration value in the performance of Nigeria in agriculture; this was due the facts that the nation agriculture has always been dominated by small-scale farmers. An estimated 76% of Nigeria's population lives in the rural areas who represent a substantial proportion of farming population and produces over 90% total agricultural output in the country (Lawal *et al.*, 2013). For any crops to be cultivated and attained the desired yield, farmers need to be sensitized on such crops and the innovations that comes along with (Bashir *et al.*, 2014). Improvement in agricultural productivity is essential in the pursuit of global food scarcity given the challenges of population growth and climate uncertainties (Xu *et al.*, 2013). Extension workers play a very significant role in providing information to farmers concerning new and improved ways of cultivating the crop.



The role of agriculture remains significant in the Nigerian economy despite the strategic importance of petroleum sector as a major contributor to Gross Domestic Product (GDP), agriculture provides employment for Nigerians and account for more than one-third of total GDP and labour force (FAOSTAT and World Bank, 2013). Agricultural sector contributes about 41% of the GDP and employs about 65% of the total population and 80% are rural population (Central Bank of Nigeria [CBN], 2013). From this study it can be deduced that, if the productivity of farmers will improve, efforts would need to be made by concerned authorities and stakeholders in agriculture to find means through which farmers' efficiency in the use of modern/improve farm implement would be enhanced so as to make farmers more productive. Increasing population's pressure and consequent increase in food demand have necessitated the introduction of improved technologies to increase agricultural productivity. Improved technologies are various "technical know-how" for the promotion and development of agriculture, unfortunately, in developing countries some of these improved technologies have been rejected by rural people.

In Nigeria, rural farmers produce the bulk of food (maize) needs of the nation despite their unique and pivotal position; they belong to the poorest segment of population and therefore cannot invest much on their farms. The needs to constantly increase food production level have informed government at different times in Nigeria to embark upon the establishment of different agro-based ministries and agencies. These governmental organisations are saddled with the responsibilities of providing essential services aimed at improving farmers' efficiency and increase production through adoption of innovations.

In Nigeria, maize is the most important cereal crop after sorghum and millet, and the demand for maize as a result of various domestics and industrial uses has increase. Maize is one of the most completely domesticated of all cereal crop. The crop is an annual crop, botanically maize is a coarse annual grass classified in the tribe *maydeae*, from grass family known as *graminae*, class *monocot*, genus *zea*, specie *mays*. Its perpetuation for century has depend wholly upon the care of mankind. Maize is most productive in the middle and Northern belts of Nigeria, where sunshine is adequate and rainfall is moderate (Umar, 2016).

Adoption of improved technologies in agriculture can be in different aspects such as application of herbicide, pesticide, fertilizer and improved seeds. Technologies may include all the materials, techniques, practices and innovation which is used to maximize agricultural production. Technology packages associated with maize production are site selection, land preparation, seed selection, seed treatment, planting date, planting depth, fertilizer application, weeding, pest and disease control, harvesting time and storage (International Institute for Tropical Agriculture [IITA], 2013). When a new technology or practice is introduced in a community not all farmers may adopt at the same time, some farmers no matter what will continue farming entirely upon traditional agriculture (Idrissa, 2019).

MATERIAL AND METHODS

The Study Area

The study was conducted in Bauchi and Toro L.G.A of Bauchi State, North-Eastern zone of Nigeria, which falls within the Northern Guinea Savannah. The study area lies within the western agricultural zone of Bauchi State ADP. The western zone stretches from 90 30' to 100 48' N and 80 45' to 100 15' E and is one of the leading maize growing regions of Bauchi State. There are no separate population figures for each village in the study area. The annual rainfall in western agricultural zone varies between 1,000mm-1,200mm per annum. The major crops grown include sorghum, rice, maize, cowpea, groundnut, cotton, soy-bean and millet.



Sampling Procedure

The study used multi-stage sampling technique in selecting the respondents from the study area. Firstly, western agricultural zone of Bauchi state ADP was purposively selected due to high concentration of maize production in the zone. Secondly, three villages were selected from each of the two local government area Bauchi and Toro in the zone using simple random sampling technique. The selected villages were Kangere, Tudun-gambo and Durum from Bauchi LGA, while Nabordo, Rimin zayam and Gumau from Toro LGA given a total of six (6) villages. Finally, proportionate sample size of twenty percent (20%) of maize farmers were randomly selected from each village selected, given a total of 120 respondents in order to be able to capture maize producers.

Method of Data Collection

Data for this study were derived through the use of a well-structured questionnaire administered to the respondents with the aids of trained enumerators who supported the data collection that serves as a primary source of data for the study. Also, relevant information concerning socio-economic, various types of technologies used in maize production and theoretical framework on adoption of improved technologies etc. from other sources such as internets, journals, library materials, official documents was used as a source of secondary data for this research study to compliments the primary data.

Method of Data Analysis

The data collected were analysed using descriptive and inferential statistics. The descriptive statistics such as frequency tables and percentage were used to analyse the socio-economic characteristics, while the inferential statistics (multiple linear regression) were described. The regression equation estimated is stated as equation 1 is:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \mu_i \quad \dots(1)$$

The independent variables specified as determinants of adoption are defined as follows; where;

Y = Level of adoption (Number of technologies adopted)

X₁ = Age (years)

X₂ = Sex (Male=1 and Female=0)

X₃ = Marital status (1=married, 2= single, 3= widower and 4= divorced)

X₄ = Educational status (years in school)

X₅ = Household size (Number of persons)

X₆ = Farming experience (years)

X₇ = Farm size (ha)

X₈ = Annual farm income (₦)

X₉ = Main occupation

μ_i = error tem

RESULTS AND DISCUSSION

The results from Table 1 shows that, 25% of the respondents fell within the age brackets of 20-29 years, 39.17% were between 30-39 years, 16.67% were within the age of 40-49 years, while 13.33% of the respondents were between 50-59 years and only 5.83% were above 60 years old with the mean age of 38 years. This means that majority (64.17%) of the respondents were between the age brackets of 20-39 years old. This result closely agrees with the finding of Adewuyi *et al.* (2010) who reported that the mean age of agricultural producers was 41 years. The result is also similar to the findings Abubakar *et al.* (2013) who reported that most of the farmers (83%) were in their very active age bracket of 21-40 years. This implies that most of the respondents in the study area are in their active years of production and the



implication is that, they are energetic and innovative to adopt and accept more agricultural innovations or technologies introduced to them at a given point of time.

Members of household are perceived to have similar utility function such that the result obtained when utility function of household is maximised is the same as the situation when the function of individual is maximised (Ositanwosu, 2012). In traditional agricultural production, family labour plays a very significant role in farm labour supply. The results from Table 1 revealed that, about 51.67% of the respondents belongs to household size of 1-5 persons, 18.33% had 6-10 persons, while 20 respondents representing 16.67% had 11-15 persons, and 16 respondents representing 13.33% had 16 and above persons in their household size. The mean household size of the respondents in the study area was found to be 8 persons, but however, larger household size may not necessarily translate into higher use of family labour. This finding indicates that cumulatively (86.67%) of the respondents in the study area had a fairly moderate amount of family.

Farming experience increases with age and the level of production reduces when a sizes. It is also indicated that married respondents need to sustain their family life by engaging the family in sharing of labour which help to reduce cost in the farm. The implication is that household members could probably provide labour supply, and hence the reduction in labour cost and part of the money would be spent on other family needs. Farmer is getting older due to the hardship and drudgery associated with farming activities. The distribution of the respondents based on farming experience from Table 1 also shows that about 42% of the respondents had the farming experience between 1-10 years, 31.67% had between 11-20 years farming experience, 20% of the respondents had between 21-30 years, while 5% had 31-40 years farming experience and only 1.66% had above 40 years of farming experience with the mean of 15 years in farming. Therefore, it can be deduced from the results that farming experience in the study area, generally correlates with the acquisition of improved technologies in the adoption of maize production. The result further shows that the model years of farming experience in maize production ranges between 1-10 years. This implies that the respondents are well experienced in maize production.

The result from Table 1 also indicated that majority (62.50%) of the respondents had between 1-3 hectares, 29.17% had between 4-6 hectares, 6.67% had 7-9 hectares, and only 1.66% had above 10 hectares of land. The mean farm size was 3 hectares, it can be deduced from the result that majority (62.50%) of the respondents were small-scale farmers who cultivate between 1-3 hectares of land for maize production. The findings of Sadiq and Yakasai (2013) correspond with the results, who reported that most of the maize farmers in Nigeria were small -scale who cultivated less than 3 hectares of land.

Analysis of the respondent's annual income in Table 1 further revealed that, about 33% obtained between one thousand to one hundred thousand naira (< ₦100, 000), 25.83% obtained between one hundred and one thousand to two hundred thousand naira (₦101,000 - ₦200,000), 18.33% obtained between two hundred and one to three hundred thousand naira (₦201,000 - ₦300,000), 11.67% obtained three hundred and one thousand to four hundred thousand naira and above. It is evident from Table 1 below that the mean annual income of the respondents who adopted the technologies used in maize production in the study area was (₦167, 394.17). The income of most farmers in Nigeria is low, this is due to their poor-resource base, small-scale farms holding and inability to secure the required capital to expand their farming businesses.



Table 1: Respondents Age, Household Size, Farming Experience, Farm Size and Annual Income

Variables	Frequency	Percentage	Mean
Age (years)			
20 - 29	30	25.00	38
30- 39	47	39.17	
40- 49	20	16.67	
50 - 59	16	13.33	
60 -69	7	5.83	
Total	120	100	
Household Size			
1- 5	62	51.67	8
6-10	22	18.33	
11-15	20	16.67	
16 and above	16	13.33	
Total	120	100	
Farming Experience (years)			
1- 10	50	41.67	10
11-20	38	31.67	
21-30	24	20.00	
31-40	8	6.66	
Total	120	100	
Farm Size			
1 – 3	75	62.50	3
4 – 7	35	29.17	
7 – 9	8	6.17	
10 and above	2	1.66	
Total	120	100	
Annual Income (N'’000)			
10 - 100	49	40.17	₦167, 394.17
101 - 200	35	29.83	
201 - 300	22	18.33	
300 and above	14	11.67	
Total	120	100	

Source: Field survey (2019)

Source of Information, Extension Contact and Frequency of Visits

Table 2 shows the distribution of respondents according to sources of information from the study area. The result revealed that 44.17% obtained their information through listening to radio, 17.50% got information through watching television programme, 30.83% source information through contact with extension agents, and only 7.50% depended on prints media. The results indicate that majority (66.67%) depended on mass media (Radio/Television) available at hand as the major sources of information of improved technologies used in maize production. This is in line with the findings of Umar (2016) that extension information is in adoption of improved maize production in Bauchi State of Nigeria.

Agricultural extension agents serve as a driving force for adoption of any improved technologies used in agricultural production. The result from Table 2 further explained that about 37% of the respondents had contact with extension agents, while majority (63.33%) had no form of contact with extension agents, this implies that there is inadequate supply and number of extension workers in the study area which might affect the level of adoption of the



improved technologies used in maize production leading to low yield in the study area. This result shows that more is needed to be done in providing sufficient number of extension agents in the study area.

The result from Table 2 also indicates that 9.16% of the respondents had extension visit on weekly basis, 17.50% had extension visits on fortnight basis, and 21.67% had extension visits on monthly basis, while about 51.67% had extension visits on quarterly basis. This study shows that the rate of visit of extension workers was low indicating unavailability of the extension agents in the study area. This implies that farmers in the study area might lack most vital information with regard to improved technologies used in maize production. This result is in contrast to the findings of Okeke and Ademiluyi (2013) who found that there's a significant difference in the number of contacts with extension agents among maize farmers adopting improved technology and those using tradition

Table 2: Source of Information, Extension Contact and Frequency of Visits

Variables	Frequency	Percentage
Source of Information		
Radio	53	44.17
Extension agents	37	30.83
Television	21	17.50
Prints Media/Posters	9	7.50
Total	120	100
Contact with Extension Agents		
Yes	44	36.67
No	76	63.33
Total	120	100
Frequency of Extension Visits		
Weekly	9	9.16
Fortnightly	21	17.50
Monthly	26	21.67
Quarterly	62	51.67
Total	120	100

Source: Field Survey (2019)

Multiple Linear Regression Estimate Showing the Determinants of Adoption

The result from Table 3 revealed that age of the respondents was positive at 10% and had effect on the intensity of adopting the improved technologies used in maize production in the study area. This implies that for any increase in age by one year, the adoption intensity will increase by 0.182. The results conform with the finding of Muhammad and Katikpo (2010) who reported that age of the farmer can have a profound effect on participation in agricultural programme and technology adoption. This means that as the age of the respondents increase with experience, the more they adopt the available improved technologies introduced to them.

The result from Table 3 further indicate that household size was negative but significant at 5% level of probability, meaning that household size was important in adoption analysis of improved technologies used in maize production. This implies that any increase of household by one unit, the intensity of adoption may likely reduce by 0.314. This result also indicated that household was important in the adoption of improved technologies used in maize production showing that the larger the respondent's household is, the greater the probability of adoption. 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.

Table 3: Multiple Linear Regression Estimate of Factors Affecting Adoption

Variables	Coefficient	Standard error	t	Sig. Level
Constant	1.020	0.166	6.128***	0.000
Age	0.182	0.049	3.688***	0.000
Sex	-0.095	0.100	-0.957 ^{NS}	0.341
Marital status	-0.032	0.071	-0.448 [*]	0.655
Household size	0.314	0.055	-4.912***	0.000
Educational level	-0.270	0.067	4.659***	0.000
Farming experience	0.295	0.081	3.631***	0.000
Farm size	0.233	0.120	1.933 [*]	0.056
Annual income	-0.183	0.089	-2.055 ^{NS}	0.42
Occupation	-0.367	0.140	-2.614 ^{NS}	0.010
Pseudo likelihood	4.2628			
Probability > F	44.47			
R ²	0.0784			
R ² Adjusted	0.767			

*Significant at 10% (P< 0.1); **Significant at 5% (P< 0.05); ***Significant at 1% (P< 0.01); NS = Not Significant.

Source: Field survey (2019)

The result also shows that coefficient of farm size (Table 3) was positive and significant at 5% level of probability, therefore a unit increase of farm size by one unit, adoption level may likely increase by 0.233. This result implies that farm size was important in the adoption of improved technologies used in maize production showing that the larger the farm size is, the higher the probability of adoption. The coefficients of age, marital status, and household size, educational level, farming experience and farm size of the respondents were found to be the determinants of adoption of improved technologies used in maize production in the study area. This implies that they don't have direct effect in the adoption of improved maize production technologies in the study area. The result contradicts the finding of Julius *et al.* (2015) who reported that adoption of most technologies increases with increase in household and farming experience as well as educational level.

Constraints Affecting Adoption of Maize Production Technologies

The result from Table 4 shows the constraints encountered by the respondents in adopting the technologies used in maize production in the study area. The results revealed that majority (79.17) high cost of inputs, followed by poor markets price with 72.50%, inadequate inputs 70.83%, inadequate capital 63.33% were considered as the major problems faced by the maize farmers in the study area. Other challenges include labour costs (55.83%), poor extension services (53.30%) and pests and diseases (45.83%). The result agrees with the findings of Salihu *et al.* (2016) who reported that inadequate capital, high cost of farm inputs, poor market and incidence of pest and diseases are the constraints faced by farmers.

High cost of inputs coupled with Poor market price was considered as the major challenge facing maize farmers in the study area. This is due to the lack of readily available and stable market prices to offer their produce from larger companies. As a result, farmers were usually left with no option than to sell their produce to maize hoarders sometimes on credit at the mercy of hoarders. Poor access to credit (capital availability) was also a problem facing



maize farmers in the study area. This may account for the reason that most of the respondents are small scale farmers as reported by Sani and Silas (2012) in their study of Socio-economic determinants and production constraints in adoption of new improved variety. Also, majority (63.33%) of the farmers were not having access to credit facilities to boost up their maize production. This implies that capital availability contributes significantly to technology adoption, because credit is necessary for the purchase and use of new technologies by low capital-based farmers. The results conform with the findings of Ghimire *et al.* (2015).

Pests and diseases were responsible for the pre-harvest and post-harvest losses suffered by crop producers. The damage cause by pest and diseases makes it difficult for farmers to preserve their produce, hence it forces them to sell their produce at the point of harvest. This problem contributes to the lack of good market because maize produce is mostly scarce during the planting time. Pests and diseases control are considered to be too expensive by farmers in Northern Region of Ghana; hence the low levels of adoption of such technologies Namwata *et al.* (2010).

Table 4: Distribution of Respondents According to Constraints Encountered

Variables	Frequency	Percentage	Ranking
High cost of inputs	95	79.17	1 st
Poor market price	87	72.50	2 nd
Inadequate inputs	85	70.83	3 rd
Inadequate capital	76	63.33	4 th
High Labour cost	67	55.83	5 th
Inadequate extension services	64	53.30	6 th
Pests and diseases	55	45.83	7 th

* Multiple responses were recorded

Source: Field survey (2019)

CONCLUSION AND RECOMMENDATIONS

The study showed that farmers' level of adoption of improved maize production technologies was moderate in the study area. The major determinants of adoption of improved technologies used in maize production were age, marital status, and household size educational level, farming experience and farm size. It is expected that the adoption of maize production technologies would continue to rise above moderate if the identified constraints/challenges are addressed by all stakeholders in agriculture, not for the benefit of farmers alone but for the society in general, considering its essential role. Based on the findings of this study, the following recommendations were made:

1. Farmers should form cooperative societies in order to have access to credit from financial institutions so as to increase the level of their capital position in order to increase production.
2. Government should create good and stable market price so as to avoid seasonal price fluctuations over a period of time.
3. Farmers should embark group marketing sourcing agricultural inputs and selling their outputs in the study area.

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