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ANALYSIS OF DETERMINANTS OF ADOPTION OF QUALITY PROTEIN MAIZE AMONG RURAL FARMERS IN KADUNA STATE, NIGERIA

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Abstract
The study analyzed determinants of adoption of quality protein maize (QPM) among rural farmers in Kaduna State, Nigeria. The respondents were registered quality protein maize farmers in Kaduna State. Multistage sampling procedure was used for the study. Data were collected with the aid of a structured questionnaire. Data collected were analyzed using descriptive and inferential statistics. Findings revealed that maize production in the study area was dominated (67.63%) by male farmers, with a mean age of 41 years. Majority (81.84%) of the maize farmers were married, with an average household size of 8 persons per household, about 79% of the maize farmers had are form of formal education or the others, with more than half (52.63%) of the maize farmers cultivatings farm size of 1-2 hectares. The maize farmers had an average of 19 years of maize farming experience, with majority (66.84%) cultivating the QPM for an average of 8 years. More than half (55.67%) of the maize farmers sources of QPM information was through extension services and farmers field days. Finding further indicated that access to credit (0.046), output (0.046) and relative advantage (0.046) were positive and significant ($P<0.01$), while farm size (0.024) and membership of cooperative societies (0.049) were positive and significant ($P<0.05$). Based on these findings, the study recommended that extension agents need to embark on more extension program and campaigns that will encourage farmers irrespective of gender to go into large scale QPM production. This will enable farmers to enjoy full benefits of the QPM production in terms of cheap protein sources and output (return to investment).

Keywords: Analysis, determinants, adoption, quality protein maize, rural farmers.

1.0 Introduction

Maize is an important staple grain crop in the savanna zone of Nigeria. It is grown in different ecological zones of Nigeria by smallholder farmers on over 6.5 million hectares of land (Pricewaterhouse Coopers, 2021). The bulk of maize in Nigeria is produced in the States of Borno, Niger, Plateau, Katsina, Gombe, Bauchi, Kogi, Kaduna, Oyo and Taraba (Makama et al., 2022). These States produced about 64% of maize in Nigeria (Pwc, 2021). The crop is an important food for human beings and livestock. It is increasingly been used in food processing and pharmaceutical industries in Nigeria.

Technological advances such as hybrid maize and associated technological packages had been developed for maize production in Nigeria. The Technological 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 of Tropical Agriculture (IITA), 2013]. These improved technologies were disseminated to farmers in order to increase yield per land area. In spite of this, yield is still low at 1.7 tons/hectare compared to South Africa's 4.9 tons and Ethiopia's 4.2 (Pwc, 2021). According to IITA, 2013, less than 10% of Nigeria farmers used hybrid maize variety, which gives higher yields than the open pollinated variety (OPV).

To bridge this gap, various efforts and initiatives have been put in place by Kaduna State Government, but with unsatisfactory outcomes [Kaduna State Agricultural Development Programme (KADP, 2009)]. One of such efforts and advances is the promotion of quality protein maize (QPM) such as Sammaz 14 and 17 varieties for improved protein intake and food security enhancement through Sasakawa Global 2000 in collaboration with Institute for Agricultural Research (IAR) Zaria. Various QPM promotional activities like field demonstrations, field days, leaflets/brochures distribution and QPM seeds production have been conducted by IAR Zaria since the release of the QPM project in 2002 within the KADP Zones of Kaduna State (IAR, 2015).

Despite the promotional efforts, critical gaps exist between adoption and production differential of QPM across Kaduna State. Furthermore, the extent of QPM adoption has not been fully ascertained in the study area. On the basis of this, a study on the determinant of the adoption of QPM among maize farmers in Kaduna State becomes necessary.

2.0 Objectives of the Study

The broad objective of the study was to analyze determinants of adoption of quality protein maize among rural farmers and the specific objectives of the study were to:

i. describe the socio-economic characteristics of the maize farmers;

ii. identify maize farmers' sources of information; and

iii. determine adoption of QPM among the maize farmers in the study area.

3.0 Methodology

The study was conducted in Kaduna State, Nigeria. The State is located between latitudes 9°00' and 11°32'N and longitudes 6°05' and 8° 38'E (Fig 3). Kaduna State has a tropical continental climate with two distinct seasonal climates of dry and wet seasons. The wet season begins in April/May and ends in October, which is very much heavier in the Southern part. The average annual rainfall and humidity are 1,272.5mm and 56.64% respectively, while minimum and maximum temperatures are 15.1^0 and 35.18^0 Celsius, respectively (Makarau et al., 2013). The projected population in 2017 was 8,446,417, with a land mass of 48,473.2 Km^2 (NPC, 2016). The study area shares borders with

Zamfara, Katsina, Niger, Kano, Bauchi, Nasarawa, Plateau States, and the Federal Capital Territory. The vegetation consists of Guinea Savannah. About 80% of the State's population engaged in peasant farming for food crops. Crops produced include maize, sorghum, millet and rice. Other crops grown in commercial quantities include ginger, groundnut, cowpeas and soybeans. Cattle, sheep, goats, pigs and poultry are livestock reared in the study area.

Multistage sampling procedure was used to select 380 respondents primary data for the study. The first stage involved purposive selection of 4 extension blocks from 40 blocks based on the concentration of maize farming activities in the KADP blocks. This was followed by random selection of 43 cells from 218 cells which represent 20% of the cells in the selected extension blocks of the KADP zones. Lastly, three hundred and eighty maize farmers, which represent 40% of 2712 of the registered maize farmers who were randomly selected, Data were collected using structured questionnaire. Data collected were analyzed using descriptive statistics and logit regression. Logit model specified thus:

Y=Adoption of Quality Protein Maize (adopted =1, Otherwise =0)

X_1= Sex (dummy: Male=1, Otherwise = 0)

X_2=Age (years)

X_3= Marital status (dummy: Married=1, Otherwise = 0)

X_4=Household size (Number of persons)

X_5=Educational level (years spent in school)

X_6=Farm size of QPM (Hectares)

X_7=Farming experience in QPM (years)

X_8= Membership of association (dummy: Yes=1, Otherwise = 0)

X_9= Credit access (dummy: Access=1, Otherwise = 0)

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

X_{11}=Output QPM (Kg)

X_{12}=Relative advantage of innovation (dummy: Yes=1, Otherwise = 0)

X_{13}=Complexity of innovation (dummy: Yes =1, Otherwise = 0)

X_{14}= Compatibility of innovation (dummy: Yes =1, Otherwise = 0)
X_{15}= Affordability of innovation (dummy: Yes =1, Otherwise = 0)

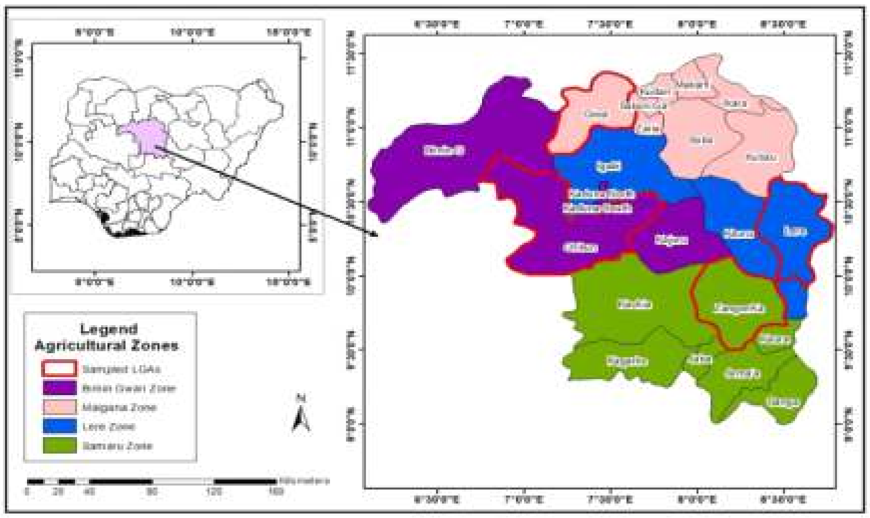

Fig.3. Map of the study area showing the studied Agricultural Zones, Kaduna State.
Source: Kaduna State Ministry of Land and Survey, (2024)

4.0 Results and Discussion

4.1 Socioeconomic characteristics of the maize farmers

Table 1 revealed that maize production in the study area was dominated (67.63%) by male farmers. The domination of males in maize production in the study area could be attributed to the fact that males have access to land and other production resources more than female folks. The findings agrees with that of Mgnouna *et al.* (2011)

who reported that gender affects technology adoption with men having more access to and control over key production resources than the women as a result of socio-cultural values and norms.

Table 1 revealed that 58.16% of the maize farmers were older than 40 years and the mean age was 41 years. It can therefore be inferred that more of the maize farmers in this study were in their active and productive age, having the energy to cope with the rigors of QPM production and may be willing to experiment with newly introduced maize production practices. Majority (81.84%) of the maize farmers were married, with an average household size of 8 persons per household, hence the availability of family labour that could enhance adoption of QPM, especially where the farm size is large (Table 1). This finding is in tandem with Mignouna *et al. (*2011) who posited that larger households have the capacity to relax labour constraints required for the introduction of new technology that is labour intensive.

Educationally, 29.74% of the maize farmers attended secondary education while 28.42% and 21.08% attended tertiary and primary education, respectively. Only 20.79% had non formal education. Cumulatively, about 79% of the maize farmers had some form of formal education. This shows that these maize farmers possessed basic education to read, write and interpret extension messages. This can help to narrow information gap on QPM adoption and production practices hence increased production efficiency and output. This finding is similar with that of Makarau et al. (2013); Manza *et al.* (2015) and Ajah and Nmadu (2012) who reported that maize farmers in Kaduna State and Abuja were fairly educated and had at least primary education.

Table 1 on farm size revealed that more than half (52.63%) of the maize farmers cultivated a farm size of 1-2 hectares, while 22.12% cultivated less than1 hectare of land maize. The findings further revealed that 20% and 5.26% of the maize farmers had farm size, ranging from 3-4ha and above 4ha, respectively. Their mean farm size was 2ha. This indicates that QPM producers in the study area were small-scale farmers. This finding corroborates that of Jamilu *et al.* (2014) and Issa *et al.* (2016) who found that maize farmers operate on small scale and small which stimulate the farmers to adopt the innovations since it can be tried on small scale to avert risk. This implies that the maize farmers have the ability to adopt QPM variety with their small farm sizes.

Table 1 further revealed that 64.7% had 1-20 years an average of 19 years of maize farming experience implying that the maize farmers were well experienced in maize farming. Experience brings about specialization and perfection that could help the maize farmers to adopt recommended QPM production practices. This Finding is in tandem with that of Issa *et al.* (2016) who found that, there was high farming experience among farmers. The result also revealed that majority (66.84%) of the respondents have been cultivating the QPM for 6-10 years, while 26.32% cultivated the maize for 1-5 years with the mean of 5.5 years. The implication of the finding is that maize farmers are experienced in QPM cultivation and therefore can be an effective channel of disseminating QPM information to other farmers.

Table 1: Socioeconomic Characteristics of Quality Protein Maize Farmers (n=380)

Variables	Frequency	Percentage	Mean
Sex			
Male	257	67.63	
Female	123	32.37	
Total	380	100	
Age (years)			
1 – 20	3	0.79	41
21 – 40	156	41.05	
Above40	221	58.16	
Total	380	100	
Marital status			
Single	33	8.63	
Married	311	81.84	
Divorce	15	3.95	
Seperated	5	1.32	
Widow/ Widower	16	4.21	
Total	380	100	
Household Size			
1 – 10	275	72.4	
11 – 20	96	25.3	8
Above20	9	2.4	
Total	380	100	
Educational Level			
No School	79	20.79	
Primary School	80	21.05	
Secondary School	113	29.74	
Tertiary Institution	108	28.42	
Total	380	100	
Farm size (ha)			
<1	84	22.12	
1-2	200	52.63	2
3- 4	76	20	
> 4	20	5.26	
Total	380	100	
Farming experience (Years)			
1 – 20	246	64.7	19
21-40	74	19.5	
Above40	60	15.8	
Total	380	100	
Years of QPM farming (years)			
1 – 5	100	26.32	
6 – 10	254	66.84	8
Above10	26	6.84	
Total	380	100	

Source: Field Survey, (2019)

4.2 Institutional variables

Table 2 indicated that, 53.16% of the maize farmers accessed credit for their farming activities. Majority (53.16%) of the respondents acquired credit facilities, which facilitated their QPM production. Agricultural credit is an empowerment tool for greater productivity, particularly to resource poor farmers, who are operating small scale farming. It is believed that farmers' access to credit assist them in reducing their risks, raise productivity, obtain high returns on investments, increase income and improve quality of their lives and that of their dependents. Obisesan (2013) reported that access to credit is a vital pathway to agricultural transformation. It contributes to the farmers' social welfare, enhances production, and helps in capital formation.

Table 2 also shows that 78.70% of the maize farmers were members of cooperative societies. The findings agrees while Audu *et al*. (2009) who that most of the farmers in their study area belonged to cooperative society. The impact of cooperative societies is hinged on the direct influence on other factors of adoption, such as awareness, access to credit and opportunities for technical or more in-depth training via extension workers. Overwhelming majority (92.63%) of the maize farmers had access to extension services (Table 2). Extension agents have a great role in influencing diffusion and adoption of innovations such as QPM. This implies that extension services on QPM are available in the study area, which can enhance QPM adoption and its recommended production practices.

Table 2: Distribution of the maize farmers according to institutional variables

Institutional variables	Frequency	Percentage
Membership of Cooperative		
Cooperator	299	78.7
Non-cooperator	81	21.3
Total	380	100
Credit access		
Has access	202	53.16
Has no access	178	46.84
Total	380	100
Access to Extension Service		
Access	352	92.63
No Access	28	7.37
Total	380	100

Source: Field Survey, (2019).

4.3 Sources of Information on Quality Protein Maize

Information sources on QPM in Table 3 revealed that 58.68% of the maize farmers obtained their information through extension agents. This was followed by maize farmers who got their information from field days (52.63%). Another 42.11% of them got information from fellow QPM farmers. Those who got their information from Research Institutes, NGOs, friends and the media (radio or television) accounted for 36.84%, 17.11%, 7.37% and 6.32% respectively. The use of extension agents as a source of information source by more of the maize farmers could be attributed to high extension coverage in the study area (Table 3)

Table 3: Farmers Sources of information on QPM (n=380)

Sources of information	Frequency	Percentage
Extension agents	223	58.68
NGO	65	17.11
Research institutes	140	36.84
Media (radio/TV)	24	6.32
Fellow QPM farmer	160	42.11
Field days	200	52.63
Friends	28	7.37
Total	380*	100.00

Source: Field Survey (2019). *Multiple Reponses

4.4 Determinants of Adoption of Quality Protein Maize

Investigation on factors influencing adoption of QPM recommended practices from Table 4 was analyzed using multiple regressions. The coefficient of determination (R^2) value of 0.6302 implies that 63.02 % variation in the adoption of QPM recommended practices was explained by the variable in the model. The f-statistic is significant at 1%, which shows that the explanatory variables in the model are jointly significant and fits the model. Seven (5) out of the 15 variables were significant.

The coefficient of farm size has positive coefficient (0.024) and significant at 5% probability level. Implying that 1% increase in farm size would lead to adoption of QPM recommended practices by 0.02%. This finding is supported by Godfrey *et al.* (2021) and Aswanthy and Imelda (2021) that farm size positively and significantly influenced the adoption of an innovation. Membership of association has positive coefficient (0.049) and statistically significant at 5% probability level. This indicates that membership of association would increase the likelihood of adoption of QPM recommended practices by 0.05% in the study area.

The coefficient of access to farm credit was also significant at 1% with a positive coefficient. The coefficient (0.046) of credit shows that access of maize farmers to credit by 1%, would increase the chances of adopting improved QPM recommended practices by 0.05%. The finding agrees with Tata *et al*. (2018); Aswanthy and Imelda (2020) who reported that farmers' access to credit is precondition for adopting technologies. The coefficient of farm output (0.046) was positively and significantly related to adoption of QPM recommended practices. It shows that if farm output increases by 1%, it would increase adoption of QPM recommended practices by 0.05%. It can therefore be inferred that increased in yield would encourage the maize farmers to adopt more QPM recommended practices. This finding is supported by Mende *et al.*, (2015); Shiferaw *et al.* (2014) that farmers' decision to adopt new technology is influenced by high yield, increase in income and improved standard of living.

Relative advantage of the technology has positive effect (0.046) to adoption of QPM recommended practices and significant at 5%. The coefficient shows that increase in relative advantage would increase the likelihood of adoption of QPM recommended practices by 0.05%. This finding is in line with that of Tesfaye *et al.* (2016); Wossen *et al.* (2017) who posited that advantage derived by respondents towards a technology stimulate its adoption. Compatibility of QPM recommended practices has positive coefficient (0.384) and significant at 5%. The coefficient indicated that if the compatibility of QPM recommended practices increased by 5%, it would increase the likelihood of its adoption by 0.38% among the maize farmers.

Table 4: Determinants of Adoption of QPM Recommended Practices

Variables	Coefficient	Standard error	t-ratios
Sex(x_1)	0.013	0.014	0.98
Age(x_2)	0.066	0.080	0.83
Marital status(x_3)	0.037	0.054	0.69
Household size(x_4)	0.014	0.029	0.48
Education(x_5)	0.401	0.081	4.98
Farm size(x_6)	0.024**	0.0118	2.05
Farming experience(x_7)	0.018	0.027	0.66
Membership of association(x_8)	0.049**	0.018	2.74
Credit access(x_9)	0.046***	0.015	3.02
Extension contact(x_{10})	0.013	0.013	1.00
Output(x_{11})	0.046***	0.018	2.55
Relative advantage(x_{12})	0.046***	0.015	3.02
Complexity(x_{13})	0.003	0.113	0.003
Compatibility(x_{14})	0.384	0.082	4.67
Affordability(x_{15})	0.065	0.099	0.66
Constant	0.466**	0.171	2.72

Source: Data Analysis (2019). R^2 = 0.6302, Adj R-squared = 0.6137
***, ** indicate significance at 1 &5% probability level

5.0 Conclusion and Recommendations

5.1 Conclusion

The study investigated determinants of adoption of QPM in Kaduna State**.** The result of the study revealed that most of the maize farmers were males, cultivating 1-2hectares of land with an average QPM farming experience of above 5years. Their major sources of information on QPM were Extension Agents and Farmers. Field Days. The study further indicated that farm size, credit access, output and relative advantage, were significant variables that determined adoption of QPM recommended production practices in the study area.

5.2 Recommendations

Based on the findings of this study, it was recommended that:

i. Extension agents need to embark on more extension program and campaigns that will encourage farmers, irrespective of gender to go into QPM production. This will enable farmers to enjoy full benefits of QPM production in terms of cheap protein sources and output (return to investment).

ii. Extension program on full adoption of QPM production practices should be carried out using the maize farmers in the cooperative group, who will in turn serve as para extension in the dissemination of information on the full adoption of QPM recommended production practices to people in the study area.

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