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Socio-economic factors affecting adoption of early maturing maize varieties by small scale farmers in Safana Local Government Area of Katsina State, Nigeria

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This paper examined the socio-economic factors affecting early maturing maize varieties adoption in Safana Local Government Area of Katsina State, Nigeria. Using random sampling techniques, 300 maize farmers were selected across 10 communities in the Local Government area. Out of the 300 respondents sampled 163 were non-adopters and 137 were adopters. Data obtained were analyzed using descriptive statistics, adoption index and Probit regression models. The major findings showed that 88% of respondents were male headed, average age of household head was 44 years, average household size was 11 persons, dependency ratio was 1.49, level of education was Islamic education, average years of schooling was 5 years and average years of farming was 25 years. About 65% of farmers had access to extension agent, only about 10% had access to credit and labor force was mostly family labor. Results of probit model showed that farmers' size of land for maize cultivation (1%), farmers' participation in an association (1%), number of extension contacts (10%), age of farmer (5%) and income from sales of maize (1%) influenced the adoption of early maturing maize varieties. The adoption of early maturing maize varieties has contributed in increasing the income of maize farming households as well as enhancing the status of maize farming households.

Key words: Socio-economic factor, adoption, early maturing maize varieties.

INTRODUCTION

Maize is a major cereal and one of the most important food crops in Nigeria. It is one of the major crops grown in Katsina State. Its genetic plasticity has made it the most widely cultivated crop in the country, from the wet evergreen climate of the forest zone, to the dry ecology of the Sudan savanna. Being photoperiod sensitive, it can be grown anytime of the year giving greater flexibility to fit into different cropping patterns. It is one of the most

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dominant cereal crops in the southern and northern Guinea and Sudan savannas (Onyibe et al., 2006). Trends in maize production indicate a steady growth, mostly due to the expansion of cultivated area, but also the result of early maturing maize yields. In 1989 to 1991, the average maize yield in Africa of 1.2 tons per hectare was twice that estimated for the 1950s, before improved varieties were generally available (Byerlee and Heisey, 1997). In the last 20 years widespread adoption of early maturing maize varieties in the savannas means that maize is no longer a backyard crop but a major cereal grown for both cash and food (Eckebil, 1994; Fajemish, 1994; Smith et al., 1997). The development and promotion of quality protein maize (QPM), a high lysine type of maize that can improve the nutrition, particularly for women and children in places where maize comprises the major source of protein in human diets. QPM also boosts the productivity of monogastric farm animals (poultry and swine) when used in feeds, and is valuable where farmers cannot afford or obtain lysine supplements for feed (Reynolds et al., 2008). Maize therefore has a considerable potential to enhance food security and the productivity and sustainability of the crop-livestock system (Arege et al., 2006).

However, despite the potential for further yield increases, maize production faces numerous problems including poor soil fertility, *Striga*, disease, drought, low and erratic rainfall, and long dry season (Tambo and Abdoulaye, 2011). Over years the International Institute of Tropical Agriculture (IITA) has in collaboration with national partners developed and disseminated a number of early maturing maize technologies that meet the requirement of their major clients and small-scale farmers in northern Nigeria and West Africa savanna at large.

IITA has made significant advances in improving the productivity of maize, by developing a number of improved varieties with generally high grain and yields, resistance to major insects, pests and diseases (Alene and Manyong, 2007). Several of these varieties have been released in Nigeria but are not widely disseminated in northern Nigeria including Katsina State. Baseline studies carried out by Ayanwale et al. (2013) shows limited adoption of improved technologies in Katsina State, and about 26% of the sampled farmers in Safana local government area were aware of early maturing maize varieties but zero percent has adopted citing unavailability of the seeds. Despite the development of a large number of early maturing maize varieties, farmers in northern Nigeria including Katsina State have continued to grow predominantly local varieties (Tarawali and Kureh, 2004). The limited use of improved varieties in a predominantly maize growing region may be due to several factors; lack of information on early maturing maize varieties, unavailability of seed, or the unacceptability of new varieties due to low market values or unsuitability for the farming system (Ellis-Jones, 2009).

In order to reduce these constraints to crop production in Katsina State, the Sudan Savanna Task Force of the KKM PLS project was funded by the Forum for Agricultural Research in Africa (FARA) and led by IITA in collaboration with IAR and other collaborative bodies to disseminate improved agricultural technologies in the State. The objective of this paper was to collect information on socio-economic factors influencing adoption of early maturing maize varieties.

METHODOLOGY

Study area

This study was conducted in Safana LGA Katsina State, Nigeria. Safana Local Government Area(LGA) has a projected population of about 183,779 based on 3.2% growth rate (NPC, 2006) and an area of 282 km^2 (KTARDA, 2012). The Local Government is located at 12° N and 7°E of the equator. April is warmest with an average temperature of 37.9°C at noon. December is coldest with an average temperature of 13°C at night. Safana has no distinct temperature seasons; the temperature is relatively constant during the year.

Sampling procedure

The target populations for this study were male and female maize farmers from all the 10 communities of the Sorghum/Legume/Livestock platform in Safana LGA. These communities are Mai Jaura, Kunamawa A, Kunamawa B, Dogon Ruwa, Kanbiri, Sabon Garin Baure, Sabon Garin Gamji, Doga, Takatsaba, Kwayawa. There was no complete list of farmers in these communities but a list of maize farmers was generated with the help of both the village heads and extension agents in these communities. From each of the ten communities, 30 respondents were randomly selected giving a total of 300 respondents. Out of the 300 respondents sampled 163 were non-adopters and 137 were adopters.

Data collection

Primary data were used for this study. Data were collected using structured questionnaire administered by trained enumerators. The information collected was on sex, age, marital status farm size and family size based on 2012 farming season. The survey was conducted in March 2013.

Data analysis

The analytical tool that was employed for this study was probit regression model. The specification of the probit model follows that in the process of planting early maturing maize varieties, farmers have to decide between two choices, and if *Y* is the outcome from the choice, then:

Y_i = 1, if the farmer plants the early maturing maize varieties introduced.
Y_i = 0, if the farmer does not plant the early maturing maize varieties introduced

Either choice yields a utility index, U_i, that the individual farmer, *I*, acts to maximize. If U_i* is the critical or threshold level, at which decision to plant occurs, then:

$Y_i = 1$ if $U_i > U_i^*$
$Y_i = 0$ if $U_i \leq U_i^*$ (1)

The non-observable underlying utility function which ranks the preference of the *ith* farmer can be expressed thus:

$$\sum_{n=1}^{N} Bn\ Xni\ ei \quad (2)$$

Where, Xni = the nth variable of the *ith* observation and Bn = the nth parameter to be estimated.
The probability Pi for the farmer i to adopt the varieties is then:

$P_i = P[Y=1] = P[U_i >= U_i^*] = P[U_i^* < = U_i]$

Since U_i^* is a discrete random variables, if F [*] is its cumulative distribution function, then:

$P[Y = 1] = P[U_i^* < = U_i]\ F[U_i]$
$P[Y\text{-}1] = 1 - F[U_i]$ (3)

The form of F [*] is determined by the probability density function of the random variable U_i. Equation [ii] is a form of generalized linear models which can be rewritten as follows:

The Linear form of the model is specified as:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \mu \quad (4)$$

X_1 = Age of the farmer (in years)(-); $X_{2\,=}$ Years of formal education (+); X_3 = Number of years of farming experience (+); X_4 = Previous season farm income for maize (Naira) (+); X_5 = Farm size (hectares cultivated for maize per season) (+); X_6 = Access to credit (Amount of credit accessed during production season) (+); X_7 = Extension contact (Number of extension contacts during the production period) (+); X_8 = Household size (number of person in the household) (+);X_9 = membership of association (Years spent in association) (+); α = constant term; μ = disturbance term or error term, and $\beta_{1,}\beta_9$ are the regression coefficients of the independent variables.

RESULTS AND DISCUSSION

Socio-economic characteristics of maize farmers

A summary of demographic data is provided in Table 1. It examined the distribution of respondents by gender, age, household size, education, farming experience, extension contacts, sources of information, membership of association, credit facilities and labor force.

Gender

The result of the analysis showed 88% of households were headed by males and 12% were female headed in the study area. The result is in agreement with findings of Yanguba (2004) who reported that 96% of farm households surveyed in Katsina State were male headed. Mbavai (2013) reported similar trend in a study of cowpea farmers in Musawa LGA of Katisna States. This result shows that men are more involved in maize farming. Because of the influence of tradition and religion women are generally restricted to their compounds.

Age

Results from the study show that majority of the farmers were between the ages of 35-54. Thirty-six percent of the respondents were aged 35-44 years while 32.7% were aged 45-54%. The average age of respondent was 44 years. Idrisa (2009) reported 40 years as active age of farmers for farm households in Southern Borno, Nigeria. This result agree with those of Mbavai (2013), Idrisa (2009), Kamara (2009), Akudugu et al. (2012), Mignouna et al. (2013) which showed the farming population in the study area and that of northern Nigeria generally is relatively young. This means that there is an active labor force available for farming.

Household size

Result from the study shows that about 80% of responding households had not less than nine members. The average household size in the study area was 11 persons per household. Household size determines the available human labor force that can be employed in carrying out crop production activities. Agwu (2004) in his work discovered an average of seven people per household, Amos (2007) found average household size to be nine persons; Idrisa (2009) in his findings recorded an average of seven persons while Mignouna et al. (2013) in his result documented an average of nine persons per family. According to them, household size determines the availability of household labor supply.

Dependency ratio

The result from this work showed the dependency ratio of 1.49. This implies that there are more dependents (children below 15 years old and adults above 64 years old) compared to adults (>15 years and <64 years old) in the study area. This finding is in-line with Mignouna et al. (2013) whose result showed a dependency ratio of 1.29 and they concluded that the sampled population in their study area was more dependents.

Education

The result shows that 14% of the respondents had no formal education, 12.3% had primary school education, 10.3% had secondary school education, 3.7% had tertiary education and Islamic education had 59.7% which is the highest. Education increases the ability to assess, interpret, and process information about a new technology, enhancing farmers' managerial skills including efficient use of agricultural inputs. From the result majority of

Table 1. Socio-economic characteristics of respondent farming households.

Variables	Adopters	Non-adopters	Pooled
Male-headed households (%)	92.7	84.0	88.0
Age			
<24	0.6	-	0.3
25-34	8.6	14.6	11.3
35-44	37.4	34.3	36
45-54	31.1	34.3	32.7
55-64	14.1	13.1	13.7
>65	8.0	3.6	6
Age of household heads (Average)	42	43	44
Average Household size	9	13	11
Dependency ratio	1.36	1.61	1.49
Level of education (%)			
No formal	11.7	16	14
Primary	12.4	12.3	12.3
Secondary	13.9	7.4	10.3
Tertiary	5.1	2.5	3.7
Islamic	56.9	62	59.7
Average years of schooling	6	5	5
Years of farming experience (%)			
1-10	16.1	17.8	17
11-20	35	29.4	32
21-30	24.1	25.4	24.7
31-40	19	21.8	20.6
41-50	5.8	5.8	5.7
Average years of farming	25	24	25
Contact with extension agent (%)			
Contact	86.9	68.1	76.67
No Contact	13.1	31.9	23.33

respondents had Islamic education. This is due to the fact that the study area is a predominantly Muslim community where Islamic knowledge is given a high priority. The low level formal education in Safana LGA might limit adoption of the technology. This result contradict the results of Bonabana-Wabbi (2002) in Uganda, Jones (2005) in Togo-Benin, Muyange (2009) in Kenya, Kudi et al. (2011) in Kwara (Nigeria) who reported high level of formal education among households in their study areas. High level of formal education in a study area would mean that majority of farmers are expected to accept new technology within a relative shorter period of time.

Farming experience

The distribution of respondents based on years of farming experience shows that 17% of maize farmers in the study area had experience in maize production from 1 and 10 years, 32% had been producing maize for eleven and twenty years, 24.7% had experience for twenty-one to thirty years, 20.6% had experience for thirty-one to forty years and 5.7% had experience for more than forty-one years. The mean years of experience for the farmers were 25 years. This implies that majority of maize farmers had long period of farming experience and therefore would be conversant with constraints to increased maize production. Yanguba (2004) found similar result in his work that farmers in Katsina had 24 years farming experience. Bello et al. (2012) found out that most (83.70%) of the respondents in Jenkwe Development Area of Nasarawa State, Nigeria had above 10 years of farming experience. Years of experience in farming were important because management skills of farmers improved with experience.

Contact with extension agents

The result in Table 1 showed that both adopters and non-

Table 2. Classification of responses based on sources of information on early maturing maize varieties.

Sources of information	Adopters	Non-adopters	Pooled
0	4(2.9)	32(19.6)	36(12.0)
1	0	1(0.6)	1(0.3)
1, 2	11(8.0)	19(11.6)	30(9.9)
1, 2, 5	2(1.5)	3(1.8)	10(3.3)
1, 3	5(3.6)	4(2.4)	5(1.6)
1, 3, 5	5(3.6)	2(1.2)	9(3.0)
1, 5	9(6.5)	10(6.1)	7(2.3)
1, 2, 3	5(3.6)	5(3.1)	19(6.3)
2	3(2.2)	7(4.3)	11(3.6)
3	24(17.5)	5(3.1)	29(9.7)
3, 5	0	2(1.2)	3(1.0)
4	3(2.2)	1(0.6)	4(1.3)
5	5(4.4)	7(4.3)	13(4.3)
6	58(42.3)	65(39.9)	123(41.0)
Total	137(100)	163(100)	300(100)

0=no response, 1=market visit, 2=TV/Radio, 3=other farmers, 4=middlemen, 5=friend/relative, 6=extension agents. Figures in parenthesis are percentages.

adopters had contact with extension agents to a percentage greater than 60%. About 86.9% of the adopters had contact with an extension agent while 13.1% had no contact with extension agents. About 68.1% of non-adopters had contact with extension agents while 31.9% did not. Farmers must have information about the intrinsic characteristics of improved varieties before they can consider planting them or not. Ayayi and Solomon (2010), Ede (2011), Gama (2013) found that about Fifty-Three percent and above of the respondents in their study area had contact with extension agents.

Sources of information on early maturing maize varieties

The result on Table 2 reveals that majority (41%) of farmers got the information on early maturing maize varieties from extension agents. The impact of this information on farmers' decisions varies according to its channel, sources, content, motivation and especially, frequency of visit. Also, it could be due to the various interventions received by Safana LGA through different Governmental and Non-Governmental Organizations. Adesope et al. (2012), Ango et al. (2013) found in their study that respondents (farming households) had good source of information on agricultural technologies.

Membership of association of early maturing maize varieties farmers

Analysis on Table 3 shows the distribution of respondents based on membership of associations. Obviously, the percentage of membership was higher among the adopters (72.1%). About 46.6% of the non-adopters had nothing to do with an association. The average years spent in an association was five years for adopters and three years for non-adopters. The overall mean number of years respondents were registered as members of an association was 4 years. Membership of an association enables farmers to interact with other farmers, share their experiences and assist themselves. Interaction of farmers with other farmers is an avenue through which innovation diffusion can occur. According to Oboh et al. (2006) membership of an association or any farming group is a strong determinant of adoption of cassava varieties in Benue State.

Table 3. Membership of association of early maturing maize varieties farmers.

Variable	Adopters	Non-adopters
Member	99(72.3)	87(53.4)
Non Member	38(27.7)	76(46.6)
Total	**137(100)**	**163(100)**

Figures in parenthesis are percentages.

Credit facilities on early maturing maize varieties

The result presented on Table 4 shows that only 11.7% adapters had access to credit and 10.4% for non-adopters. The importance of agricultural credit in

Table 4. Access to credit on early maturing maize varieties.

Variable	Adopters	Non-adopters
Yes	16(11.7)	17(10.4)
No	121(88.3)	146(89.6)
Total	**137(100)**	**163(100)**

Figures in parenthesis are percentage.

Table 5. Labor force on early maturing maize varieties.

Variables	Adopters	Non-adopters
Family labor	68(49.6)	63(38.7)
Hired labor	16(11.7)	60(36.8)
Family and hired labor	53(38.7)	40(24.5)
Total	**137(100)**	**163(100)**

Figures in parenthesis are percentages.

production cannot be over emphasized. It increases the purchasing power of farmers and adoption of improved technology. The study observed that the crop farmers in the study area used different amounts of credit to finance their production activities. Results from this study showed that very few farmers have access to credit which may limit their ability to expand production of maize. This finding agrees with Idrisa (2009), Ayayi and Solomon (2010), Adesope et al. (2012) found out that credit availability was very essential for agricultural productivity.

Labor force on early maturing maize varieties

The result on the Table 5 indicated that about 49.6% of adopters and 38.7% of non-adopters used only family labor, while about 11.7 and 36.8% employed solely hired labor for adopters and non-adopters respectively, and 38.7 and 24.5% combination of family and hired labor respectively. The crop farmers were distributed based on the source of human labor employed in their crop production process. This further explains why household size is large.

Factors influencing the adoption of early maturing maize varieties

Nine variables were hypothesized to influence the probability of farmers' adoption of early maturing maize varieties as showed on Table 6. These factors are age of household head, education level of household head, household size, farm size, years of farming experience, membership of an association, number of extension contacts, amount of credit, and previous farm income for maize.

Out of the variables hypothesized to influence the probability of farmers' adoption to early maturing maize varieties, five were found to be significant at 1, 5 and 10% probability levels. These variables include farmers' size of land for maize cultivation, farmers' participation in an association, number of extension contacts, age of farmer and income from sales of maize.

The role of a farmer's age in explaining technology adoption has been controversial. In this study, age of farmer was negative and significant at 5% level of probability, suggesting that the older the farmer, the lesser his adoption level. Younger farmers are likely to take up new technology than older farmers being that they are risk bearers in decision making, less responsibility and more adventurous than older farmers. On the other hand, it may be that older farmers may have extra resource that makes it more likely for them to try new technologies. This result is similar to the findings of Muyanga (2009) and Yanguba (2004), which suggest that older people are sometimes thought to be less amenable to change and hence reluctant to change their old ways of doing things. In this case, age is expected to have a negative impact on adoption. On the other hand, older people may have higher accumulated capital, more contacts with extension and preferred by credit institutions predisposing them more to technology adoption than younger ones. This is in-line with Kamara (2010) who found in her study that the adoption of soybean in Borno State was positively influenced by female farmers suggesting that younger women are less involved in farming thereby limiting their participation in project activities.

The estimated parameter for income was significant at 1% probability level and it was positive. This implies that the higher the income of respondent, the higher their level of adoption. The more famers adopt early maize varieties, the more the sales and income they will get and invariably, the better their standard of living. This finding is in line with Bello et al. (2012) who confirmed that the positive relationship between income and adoption of Crop-Based Technologies. This implied that availability of income enhanced farmers' ability to purchase the inputs embodied in the new technology and paid for hired labor needed for the use of these inputs and improved management practices for greater productivity.

The parameter estimate for farmers' contact with extension agents was found to be positive and significant at 10% level of probability. This implies that farmers who had more interactions with extension workers adopted more of the early maturing maize seeds as production technology compared to farmers who had less interaction with extension agents. Increased frequency of interaction between extension agents and farmers results in better technical support received by farmers. This greatly increases farmers' knowledge of the benefits of technologies. Hence, it can motivate farmers into using more of the technology. This is in-line with the findings of

Table 6. Factors influencing the adoption of early maturing maize varieties.

Variables	Coef.	Std. Err.	Z	P>|z|
Educational level of farmer	0.20009	0.05722	0.35	0.727
Age of farmer	-0.29155**	0.14038	-2.08	0.038
Income	0.02342***	7.59	2.79	0.005
Household size	0.004197	0.01457	0.29	0.773
Farming experience	0.016099	0.01292	1.25	0.213
Number of extension contacts	0.078975*	0.044	1.79	0.073
Years of Participation in an association	0.074580***	0.02271	3.28	0.001
Amount of credit	-2.04	0.000012	-0.02	0.986
Size of farm	3.04290***	0.36916	8.24	0.000
Constant	0.03640	0.80978	0.04	0.964
Log likelihood	-142.88251			
Pseudo R^2	0.3091			

***P<0.01; **P<0.05, *P<0.10.

Ebojei et al. (2012) which also suggested that participation in hybrid maize could be motivated by frequent contacts with extension agents. Extension agents popularize innovation by making farms exchange idea, experiences, and make it cheaper to source information, knowledge and skills in order to enable farmers to improve their livelihood. Farmers who have frequent contacts with extension agents had a higher probability of participation in the innovation. This was presumed; as farmers were privileged with materials and managerial support, followed by cheap and timely availability of knowledge and skills, which apparently helped them, apply new technology.

Membership in an association was found to be positive at 1% significant level of probability. This implies that membership in an association will lead to an increase in adoption of early maturing maize varieties. The membership of social organizations and cooperatives enhances the interaction, exchange and cross-fertilization of ideas among farmers. Hence, it offers an effective channel for extension contact with large number of farmers as well as opportunities for participatory interaction with extension organization. This result is similar to that obtained by Zavale et al. (2005) which says that membership of organization or cooperative indicates the intensity of contacts with other farmers. Kamara (2010) also found out that membership of an association was significant in influencing the adoption of improved soybean production among male and female farmers in Borno State. Farmers who do not have contacts with extension agents may still be informed about new technologies by their peers.

Farm size was also found significant at probabilistic level of 1%. This variable is expected to have positive relationship with farmers' adoption decisions. Farmers with larger farms will be more willing to devote portion of the land to an untried variety compared to those of smaller farms. This is because the lager the farm size cultivated the higher the tendency to adopt. Therefore farm is expected to have a positive impact on adoption. The farm size influences households' decision to adopt or to reject new technologies. Hence, land holding was hypothesized to have positive and significant relationship with adoption and intensity of adoption. The finding corresponds with that of Kamara (2010) and Bamire et al (2010). Feeder et al. (1985) in Ebojei et al. (2012), assert that, the positive and significant coefficient of farm size indicates its positive influence on participation in technology adoption. They said it may be because the farm size is a surrogate for a large number of factors such as size of wealth, access to credit, capacity to bear risk, access to information and other factors.

Farming experience, household size and educational level of farmer, amount of credit had no significant influence on the adoption of early maturing maize varieties in the study area.

In this study, it was hypothesized that there is no significant relationship between adoption of early maturing maize varieties and socio-economic characteristics of farmers. This hypothesis was examined by testing the variables using the probit regression model. The result of the probit model shows that five (5) were found to influence the probability of farmers' adoption to early maturing maize varieties. This implies that the null hypothesis which states that there is no significant relationship between the adoption of early maturing maize varieties and socioeconomic characteristics of farmers will be rejected.

Conclusion

The main factors are age of household head, farm size, membership of an association, number of extension

contacts, and previous farm income for maize. The adoption of early maturing maize varieties has contributed in increasing the income of maize farming households as well as enhancing the status of maize farming households and this suggests that the adoption of early maturing maize varieties by maize farming households was very instrumental in enhancing the income and well-being of the maize farming households.

Conflict of Interest

The authors have not declared any conflict of interest.

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