

Full Length Research Paper

Adoption and impact of early maturing maize varieties on farmers income in Safana Local Government Area of Katsina, Nigeria

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This paper examined the adoption and impact of early maturing maize varieties on farmers' income 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. Data obtained were analyzed using descriptive statistics, adoption index, double difference method and Z-statistics to estimate impact of early maturing maize varieties on income of farmers. The study divided the respondents into 137 adopters and 163 non adopters. 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. Result from the study showed that out of 300 maize farmers sampled, 137 farming household adopted the varieties with a general adoption rate of 45.67%. The mean difference analysis of the impact on adoption of early maturing maize varieties on income status between adopters and non-adopters of early maturing maize varieties shows that there is a positive mean income of ₦ 42,689. The result of the T-test showed that there was significant difference at 1% level of significance between adopters and non-adopters in relation to income level. Policy which provides adequately trained and equipped extension workers to disseminate improved agricultural technology has the potential to raise farmers' income.

Key words: Adoption, impact, farmers, income.

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 content 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 insensitive, 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). In West and Central Africa 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).

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 such as: 2000 SYN EE (white), ACR 95 TZE COMP 5 W (white), EV 99 DT W STR (SAMMAZ 27) (white) and 99 TZEE Y STR (yellow), with generally high grain and yields, resistance to major insects, pests and diseases (Alene and Manyong, 2007). 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 et al., 2009).

In order to reduce these constraints to crop production in Katsina State, the Sudan Savanna Task Force of the KKM PLS project funded by the Forum for Agricultural Research in Africa (FARA) and led by IITA in collaboration with IAR and other collaborative bodies to disseminate agricultural technologies to enhance farmers' incomes (Ellis-Jones et al., 2009). The objective of this paper was to calculate the adoption of early maturing maize varieties and its impact on farmers' income.

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 km² (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 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 10 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 descriptive statistics, adoption index and double difference method.

Adoption index

Adoption rate was computed for farmers based on expressing the total number of farmers adopting varieties as a percentage of the total number of farmers under study. It is expressed as:

$$\beta_v = \frac{\beta_{vi}}{\beta} \times 100 \tag{1}$$

Where: β_v = Adoption rate for early maturing maize variety v , β_{vi} = Adopter of early maturing maize variety v and β = Number of maize farmers (300).

Double difference method

$$DD = \left[\left(\frac{1}{N_A} \sum_{i=1}^{N_A} (\bar{Y}_1^A - \bar{Y}_0^A) \right) - \left(\frac{1}{N_{NA}} \sum_{j=1}^{N_{NA}} (\bar{Y}_1^{NA} - \bar{Y}_0^{NA}) \right) \right] \tag{2}$$

Where, \bar{Y}_0^A =Average income (N) of the adopters 2008; \bar{Y}_1^A =Average income (N) of the adopters 2012, \bar{Y}_0^{NA} =Average income (N) of the non-adopters 2008, \bar{Y}_1^{NA} =Average income (N) of the non-adopters 2012, N_A = number of adopters, N_{NA} = number of non-adopters and DD = the difference between the average changes in the income for the adopters and non-adopters.

It is common to find difference in difference estimators presented in a Table 1.

RESULTS AND DISCUSSION

Socio-economic characteristics of maize farmers

A summary of demographic data is provided in Table 1. It

Table 1. Double difference estimate of the impact of adoption of early maturing maize varieties on farmers' income.

	2008	2012	Difference between periods
Adopters	\bar{Y}_0^A	\bar{Y}_1^A	$\bar{Y}_1^A - \bar{Y}_0^A$
Non-adopters	\bar{Y}_0^{NA}	\bar{Y}_1^{NA}	$\bar{Y}_1^{NA} - \bar{Y}_0^{NA}$
Difference between groups	$\bar{Y}_0^A - \bar{Y}_0^{NA}$	$\bar{Y}_1^A - \bar{Y}_1^{NA}$	$\bar{Y}_1^A - \bar{Y}_1^{NA} - (\bar{Y}_0^A - \bar{Y}_0^{NA})$

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 Katsina 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, Guo and Dadzie (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 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, Muyanga (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

Table 2. 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

Sources of information on early maturing maize varieties.

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 from Table 2 showed that both adopters and

non-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.

The result on Table 3 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

Table 3. 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.

Table 4. 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.

Governmental and Non-Governmental Organizations. Adesope et al. (2012) and 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 4 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. (2008), membership of an association or any farming group is a strong determinant of adoption of cassava varieties in Benue State.

Credit facilities on early maturing maize varieties

The result presented on Table 5 shows that only 11.7% adopters had access to credit and 10.4% for non-adopters. The importance of agricultural credit in 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.

Table 5. 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 6. 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

Table 7. Double difference estimate of the impact of adoption of early maturing maize varieties on farmers' mean income.

	2008	2012	Difference (2012-2008)
Adopters	62,002	129,189	67,187***
Non-adopters	66,625	91,123	24,498***
Difference between groups	-4,622	38,066	42,689***

*** P<0.01

Labor force on early maturing maize varieties

The result on the Table 6 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.

Adoption rate

Result from the study showed that out of three hundred maize farmers sampled, 137 farming household adopted the varieties with a general adoption rate of 45.67% this indicated an increase in adoption. Ayanwale et al. (2013) in the baseline report reported that as at 2008 adoption rate of early maturing maize varieties in Safana LGA was 36%. This implies that there is an increase in adoption rate by 9.6%. This result coincide with that of Saka and Lawal (2009), whose result shows that farmers in their study area responded appreciably to intervention programme that promote the use of improved rice

varieties with an adoption rate of 68.7% which has resulted in an estimated proportional production increase of 19.4%.

Estimation of the impact of the project on farmers' income

The double difference estimate of the impact of adoption of early maturing maize varieties on farmers' mean income on Table 7 shows those adopters of early maturing maize varieties enjoyed an increase of 52% in their income (N 62,002- 129,189), resulting in a difference of income of N 67,187 which is significant at 1%. The non-adopters had an increment of 26.9% (N 66,625- 91,123) but not as high as that of non-adopters in their income within the same period of time. Double difference analysis result further proved the fact that the increase in income realized by the adopters was attributed to their usage of early maturing maize varieties based on the positive mean income value obtained which was significant at 1% level of probability. The finding is in-line with Simonyan and Omolehin (2012) who found a positive mean double income difference of about N 30,973 was realized between beneficiaries and non-beneficiaries before and after Fadama II project.

Table 8. Z-Test on income of adopters and non-adopters.

Category	Number	Mean Income	z-value
Adopters	137	95,596	3.53***
Non-adopters	163	87,874	

*** P<0.01.

The difference in income was significant at 10% level.

A Z-test was run to determine the impact of adopting early maturing maize varieties on farmers' income. The data on the income of farmers was disaggregated into groups – adopters and non-adopters for comparison. The incomes for before intervention and after intervention were combined to get the result shown on Table 8. From the Table, the mean income of adopters (N 95,596) is higher than the mean income of non-adopters (N 87,874) by N 7,721 and it is significant at 1% probability level. This implies that there was a significant difference in the adoption of early maturing maize varieties among adopters and non-adopters. Therefore, adopting these maize varieties had contributed in enhancing the income of the maize farming households in the study area. Morris, Tripp and Dankyi (1999), in their work *Adoption and Impacts of Early maturing maize Production Technology: A Case Study of the Ghana Grains Development Project* sited that Farmers who reported increased income from maize sales use the income to pay children's school fees. The next most common reported uses included purchasing building materials to expand or renovate the farmer's house, investing in merchandise for a family-owned retail trading business, and purchasing additional agricultural land. The additional income earned through maize farming (much of which presumably can be attributed to the adoption of GGDP-generated technologies) for the most part seems to have been invested productively, rather than spent on short term consumption.

Conclusion

Many socio-economic factors that affect adoption of early maturing maize varieties throughout Safana were discussed in this paper. 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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