ESTIMATION OF MAIZE SEED REPLACEMENT RATE AMONG SMALLHOLDER FARMERS IN NORTH WEST, NIGERIA

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Abstract

The study estimated the seed replacement rate among smallholder maize producers in North-Western Nigeria. A survey of smallholder maize production for 3 seasons was conducted in Kaduna, Kano and Katsina. Multi-stage sampling was used to select 374 smallholder maize farmers who replaced seed and those not. Cross-sectional data were collected using structured questionnaires and the data collected was analysed using SPSS version 20 and excel worksheets for the following: descriptive statistics; logit regression model and seed replacement rate. The mean age of the farmers was 46 years; 48.7% had 10 – 19 years of experience and 74.1% had formal education with a mean household size of 12 people. From the findings, mathe jority of the farmers 55.1belong to farmers' associations with a minimum household income from maize production of 60,000 naira per annum. The result revealed farming experience and cooperative membership as the positive and significant socio-economic variables that influence smallholder producer seed replacement.From the findings also 98.9% of the respondents were aware of seed replacement and 85.3% practice it during the study period. Majority of the respondents 57.1% had 49 – 92% seed replacement rate. Inadequate seed management information was ranked 1st constraints to the seed replaced farmers while non-seed replace farmers ranked low fodder yield as their 1st constraints to seed replacement. The study concluded that significant number of smallholder maize farmers are aware and practice seed replacement but not at 100% replacement rate. The study recommended encouraging other farmers to join cooperatives societies; seed system monitoring by the NASC be strengthen; and seminars/campaign to build capacity of the downstream seed marketers and farmers by the government, researchers and NGOs.

Keywords: Farmers, Maize, Replacement, Seed, Smallholder.

Introduction

Maize (Zea mays L.) is a cereal crop that is grown widely throughout the world in a range of agro-ecological environments. Specifically, maize is a hot season crop and is grown principally in areas with temperatures ranging from 21 - 30°C (70 - 86 F), though seeds germinate best at a lower temperature range of 18 - 21°C (Sowunmi and Akintola, 2010).

Maize is cultivated by approximately 55 million smallholder farmers in sub-Saharan Africa (IITA, 2016). Farmers' current maize yields are 50 to 75% lower than attainable yields and the persisting yield gaps have been attributed to many biophysical and socioeconomic factors, and are exacerbated by the extant weak support systems for wide technology adoption among farmers (IITA, 2016).

Seed is the critical determinant of agricultural production on which the performance and efficacy of other inputs depend. The use of quality seed alone can increase productivity by 15-20 % and the use of traditional varieties coupled with farm-saved seed whose quality is not guaranteed resulted in a drastic reduction in productivity (Ambika et al., 2014). The seed Replacement Rate is the percentage of area sown out of the total area of the crop planted in the season by using certified/quality seeds other than the farm-saved seed (Parmar, 2016).

Overall, smallholder farmers are characterized by marginalization, in terms of accessibility, resources, information, technology, capital and assets, but there is great variation in the degree to which each of these applies (Murphy, 2010). The Food and Agriculture Organization of the United Nations (2008) adopted a 2-hectare (ha) threshold as a broad measure of a small farm (which is not inclusive of fishers and other small-scale food producers). Akinsuyi (2011) reported that more than 80% of the total farmers in Nigeria are smallholder farmers and they are the backbone of the Nigerian agricultural sector and deserve every support to produce more food.

The broad objective was estimate seed replacement rate among smallholder maize producers in North-Western Nigeria. The specific objectives were to:

i. determine the socio-economic characteristics of smallholder maize producers influencing seeds replacement in the study area;
ii. estimate the seed replacement rate among smallholder maize producers; and
iii. describe the constraints of smallholder maize producerson seed replacement in the study area.

Methodology

Study Area

North-West is made up of seven (7) states which include

Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara. The zone embraces the old Hausa states of Daura, Gobir, Kano, Katsina, Kebbi, Zamfara and Zazzau (Ibrahim, 2012). The zone has a landmass of 216,065 sq km and it covers about 25.75% of the Nigerian population which is 35,786,944 (NPC, 2006) and the projected population in 2016 was 48,942,307 (2016). The Great savannah belt of the Great Plains of Hausa land dominates the region, this region experiences rainfall between 508 and 1,524 mm per year (Ibrahim, 2012). The savannah in the region is zoned into two categories of Guinea and Sudan savannas, and these savannas are the most suitable ecological zones for maize production in Nigeria.

Sampling Procedure

Multistage sampling technique was used to draw the sample for the research. Stage I involved the selection of three states in North-Western Nigeria purposively; Kaduna, Kano and Katsina States were selected because they are among the major maize producers in Nigeria. Stage II involved purposive selection of four (4) Local Government Areas (LGAs) from each of the selected State based on the intensity of maize production and agro-ecological variation. Stage III involved purposive selection of four communities in each selected LGA based on the smallholder maize farmers' cluster. Stage IV involved a random selection of smallholder maize farmers in each of the selected communities, respectively. Tables 1 and 2 presents the sampling frame which was used to drawn samples from the three selected states and also by the selected LGAs.

Data Collection

Primary data were collected and analysed. The primary data were gathered using 374 structured questionnaires which were administered to the selected smallholder maize farmers in the selected communities using trained enumerators to ensure effectiveness. Three production seasons of 2016, 2017 and 2018 maize production data was collected and analysed. Mainly arithmetic mean, frequency and percentages were used to achieve objectives one and three.

Logit Regression Model

In addition to descriptive statistics used, logit regression model was also used to establish the effect of socio-economic factors for smallholder maize producers influencing seed replacement practice to achieve objective

Table 1: Registered Maize Farmers in the three (3) selected states and Sample Drawn per State

S/no	State	Registered maize farmers	Prevalence (%)	Sample drawn
1	Kano	245,170	44	164
2	Kaduna	220,806	40	150
3	Katsina	91,988	16	60
	Total	**557,964**	**100**	**374**

Table 2: LGAs Selected from the three States (3) and samples drawn

State	LGAs Selected	Number of selected communities	Ecological Zone	Estimated Maize Farmers	Sample Size
Kano	Doguwa	4	NGS	27,860	54
	Tudun Wada	4	NGS	22,288	44
	Bunkure	4	SDS	22,288	44
	Garin-Malam	4	SDS	11,144	22
	Total	16		83,580	164
Kaduna	Lere	4	NGS	28,000	53
	Soba	4	NGS	19,000	37
	Giwa	4	NGS	17,800	33
	Ikara	4	NGS	14,400	27
	Total	16		80,000	150
Katsina	Dandume	4	NGS	13,525	19
	Bakori	4	NGS	10,820	15
	Faskari	4	NGS	10,820	15
	Funtua	4	NGS	8,115	11
	Total	16		43,280	60
	Grand total	**48**		**206,860**	**374**

***NGS= Northern Guinea Savannah ***SDS= Sudan Savannah*

I.

Seed Replacement Rate (SRR)

The seed replacement rate model was used to achieve objective II of the researchwas computed below as:

$$SRR = \frac{C * 100}{A * K} \quad \ldots\ldots (20)$$

Where:

SRR = Seed replacement rate for maize

C = Quantity of Certifiedseeds used by maize producers (kg)

A = Area under maize production (ha)

K = Seed rate per unit of area (kg)

reported in Table 3.

Table 3 presents the maximum likelihood estimates of the logistic model for the factors determining the seed replacement status of the smallholder maize producers in the study area. Age, Farming experience, Household size, Annual income, Cooperative membership, Level of education and Extension contact were the variables included in the model. The result indicated an R2 value of 0.53 which implies that 53 % of the variation in the seed replacement status was accounted for by the explanatory variables included in the model. The remaining portion made, attributed to random disturbance. The estimated -2loglikehood of 292.040 proved the validity and reliability of the model.

Table 3: Socio-economic Determinants of Seed Replacement of Smallholder Maize Producers

Variables	B	SE	Wald	df	Sig.	Exp(B)
Age	-.004	.017	.042	1	.838	.996
Exp	.047	.021	4.998	1	.025**	1.048
HHsize	.035	.025	1.903	1	.168	1.035
Income	.000	.000	2.252	1	.133	1.000
Membership	.726	.340	4.565	1	.033**	2.068
Edu	-.012	.119	.010	1	.920	.988
Ex_Contact	18.872	13941.801	.000	1	.999	1570028 25.998
Constant	-18.749	13941.801	.000	1	.999	.000
Model Statistics						
-2 Log-likelihood	292.040					
Adjusted R^2	0.93					
Model R^2	0.53					
Sample size	374					
Dependent variable	Replacem ent Status					

*Source: Field survey, 2018; Independent variables: Age, Exp, HHsize, Income, Membership, Edu, Ex_Contact. ** Significant at 5% (P<0.05)*

Results and Discussion

Socio-economic determinants of seed replacement

Several parameters have been identified influencing the adoption behaviour of farmers from qualitative and quantitative models. Ogunsumi and Ewula (2005) reported that the socio-economic status of farmers is positively and strongly related to adoption and this implied that the higher the socio-economic status, the higher the tendency to adopt innovations. The study determined the effect of the socio-economic characteristics of the respondents in influencing seed replacement practice as

The result further revealed that farming experience and cooperative membership were positive and significant at a 5% level (P<0.05). The result indicated that farming experience and cooperative membership significantly influence the seed replacement status of smallholder maize producers. An increase in years of experience and cooperative membership by 5% will increase the seed replacement status by 47% from farming experience and 72.6% from cooperative membership. This implies that the more farmer years of experience the greater chances of the farmer practising seed replacement which may be because of staying longer in the system and gaining more experience and the ability to take risks to derive the potential benefits of seed replacement practice. Also as well as more farmers involved in cooperative activities the higher the tendency to practice seed replacement which may be because cooperative societies facilitate the supply of improved agricultural inputs seed inclusive and also support members in case of adverse consequences on certain risks.

Seed replacement among smallholder maize producers

Table 4 presented the result of seed replacement awareness; seed replacement status and channels of awareness of seed replacement among smallholder maize farmers in the study area.

Table 4: Awareness, Status and Channels of Awareness of Seed Replacement

Variables	Frequency	Percentage	Rank
Awareness on Seed Replacement			
Aware	370	98.9	
Not Aware	04	1.1	
Total	**374**	**100**	
Seed Replacement Status			
Seed replaced	319	85.3	
Seed not replaced	55	14.7	
Total	**374**	**100**	
Channel of Awareness			
*Extension agents	361	96.5	1st
*Mass media	221	59.1	2nd
*Cooperative/economic group	84	22.5	4th
*Individual farmer	102	27.3	3rd

*Source: Field survey, 2018 *Multiple responses*

From the findings, a majority (98.9%) of the respondents were aware of seed replacement practices while only (1.1%) were not aware, which shows that seed replacement is a common practice among farmers in the area. This implies that the majority of the respondents were aware of seed replacement practice and maybe because is a common practice in the area and coupled with respondents' educational status; participating in farmer cooperative societies and also having good extension contact. From the findings, a majority (85.3%) practised seed replacement during the study period while the least (14.7%) did not. This may be attributed to the fact that the majority were enlightened about seed replacement and also having access to certified/quality seeds in the area. Also from the results, the majority (96.5%) of the respondents found information through extension agents and ranked it 1st then followed by mass media (59.1%), then (27.3%) and (22.5%) for individual farmers and cooperative groups respectively which were ranked 2nd, 3rd and 4th. This may be due to their proximity to various agricultural research institutions in the study area and also indicated the ability of the extension agents to deliver services in the area. This is in agreement with Komolafe et al. (2014) in the determinant of adoption of improved crop practices among women farmers in Ekiti East LGA of Ekiti State, Nigeria where a majority of the farmers obtained information from extension agents and followed by fellow farmers and also in line with the findings of Issa et al. (2016) in Analysis of socio-economic factors influencing farmers' adoption of improved maize production practices in Ikara LGA of Kaduna State, Nigeria where 92.5% of the farmers reported obtaining information from radio.

Seed replacement rate

Seed Replacement Rate (SRR) is the percentage of area sown out of total area of crop planted in the season by using certified/quality seeds other than the farm saved seed (Parmar, 2016). Table 5 presented estimated seed replacement rate of the smallholder maize farmers in the study area.

Table 5: Seed Replacement Rate

Maize Seed Replacement rate (%)	**Farmers Replaced Seed**		**Average Certified Seed used (kg)/farmer**
	Frequency	**Percentage**	
- - -	96	30.1	14.73
49 – 92	182	57.1	42.27
93 – 136	33	10.3	31.71
137 – 180	02	1.0	200.0
181 – 224	06	1.9	129.67
Total	**319**	**100**	
Statistics			
Minimum	4%		
Maximum	224%		
Mean	83.13%		

Field survey, 2018

From the result in Table 5 majority (57.1 %) of the respondents had a 49 – 92 % seed replacement rate and the actual quantity of seed used for the season was 42.27 kg per farmer. Also from the result, the minimum replacement rate was 4%, 224% maximum and the mean replacement rate was 83.13%. This implies that over 50% of the respondents had a seed rate above 40% and that means majority of the respondents who replaced seeds covered 40% of their total land holdings with quality/certified seed during the study period while some among the respondents who reported replacement above 100% indicated low knowledge of seed management and resource over-utilization among smallholder farmers in the study area. According to Abubakar et al. (2016), improved varieties have become popular among farmers who are impressed by the performance of the improved seedlings hence, they accepted them and also agree with the findings of Hoda et al. (2017) in Unleashing Bihar's Agriculture Potential: Sources and Drivers of Agriculture were seed replacement rate (SRR) of maize grown from 21.2% in 2001-2002 to 100% in 2011-2012 and seed replacement rate for maize is far higher than all the Indian averages of 56.76%.

Constraints of maize seed replacement in the study area

The results on Table 6 revealed that the constraints were ranked by both groups of replaced seeds and non-replace seeds farmers on a scale of 1 – 11 as degree of challenge severity.

From Table 6, the results revealed that the constraints smallholder maize farmers had in seed replacement were inadequate seed information management ranked 1st by the seed-replaced farmers while non-seed replaced farmers ranked low fodder yield as the first constraint. This implies that the seed replacers accepted the replacement practice which was attributed to their higher socio-economic status and social interactions while the non-seed replacers were constrained due to their socio-economic status and demand of the crop residue for feeding their livestock to augment their means of livelihood.

From the result also seed replaced farmers ranked seeds as not available and too expensive as the second constraint while non-replace seed farmers ranked low-yielding varieties as their 2nd constraint. This may be because of their difference in experience and beliefs where the seed replacers considered the maize grains measure as yield obtained and access to the quality seed was constrained while non-seed replacers considered both grain and other crop residues which were important to them in feeding their livestock. Other rankings were 3rd seed not good for intercropping and the least ranking 14th was the unacceptable colour of seed by both the seed replaced and non-seed replace farmers, seed required much fertilizer for seed replacers and ranked 4th while non-seed replacers ranked inadequate seed information management as 4th. The 5th constraints were seed sensitive pest and diseases for seed replacers while seed were not available/expensive for non-seed replacers then 6th were variety sensitive to drought for seed replacers and small grain size for non-seed replacers and 7th low market value for seed replacers and require much fertilizer for non-replacers respectively.

Table 6: Constraints Associated with Seed Replacement on Maize Production

Constraints	Replaced Seed F (%)	Ranking	Seed not Replace F (%)	Ranking
*Inadequate seed information management	299(93.7)	1st	46(83.6)	4th
*Seed not available/too expensive	253(79.3)	2nd	41(74.5)	5th
*Not good in intercropping	200(51.1)	3rd	48(87.3)	3rd
*Requires much fertilizers	159(49.8)	4th	38(69.1)	7th
*Variety sensitive to pests & diseases	151(47.3)	5th	37(67.3)	8th
*Variety sensitive to drought	121(37.9)	6th	34(61.8)	9th
*Low market value	118(37.0)	7th	32(58.2)	10th
*Produce small grain size	99(31.0)	8th	39(70.9)	6th
*Low yielding variety	86(27.0)	9th	50(90.1)	2nd
*Low fodder yield	45(14.1)	10th	52(94.5)	1st
*Unacceptable seed color	11(3.4)	11th	07(12.7)	11th

*Source: Field Survey, 2018*Multiple responses; figures inside parenthesis are percentages*

Conclusion

From the findings of the study, the majority of the selected smallholder farmers were aware of seed replacement and practice it, the average seed replacement rate among the farmers who practice it was good. Farming experience and cooperative membership were the socio-economic variables that influence smallholder maize producers to practice seed replacement. Both groups were constrained by the seed replacement practice majorly inadequate seed management information for the seed-replaced farmers and low crop residues for the non-se

management information for the seed-replaced farmers and low crop residues for the non-seed-replaced farmers.

Recommendation

Based on the findings of the study, the following recommendations were made:

(i) It is recommended for the need of cooperative department of the state's Ministry of Agriculture to encourage more farmers to register with farmer cooperatives organization for membership.

(ii) Knowledge sharing between experienced maize producers in the study area to the upcoming maize farmers should be encouraged to speed up the adoption of new knowledge and ease the learning process among the farmers;

(iii) Seminars and enlightenment campaigns should be conducted to build the capacity of downstream seed marketers and farmers on seed handling, storage and seed information management by government, NGOs and major seed marketers; and

(iv) Making certified seeds that are more suitable to the farmers' environment more accessible by governments, researchers, seed marketers and NGOs in the study area.

Declaration of interest

The authors have no relevant financial or non-financial interests to disclose.

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