NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 51 Number 1, April 2020 Pg. 189-194
Available online at: http://www.ajol.info/index.php/naj

DETERMINANTS OF ADOPTION OF IMPROVED SORGHUM VARIETIES (*Sorghum bicolor*) AMONG HOUSEHOLDS IN NIGER STATE, NIGERIA

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Abstract
This study analysed the adoption of improved sorghum varieties among farming households in Niger State, Nigeria. A Multistage sampling procedure was adopted to collect data from 100 farming households in Gbako and Katcha Local Government Areas (LGA) with the aid of a well structured questionnaire. Both descriptive and inferential methods were used to analyse the data. Logit model was used to estimate the factors affecting adoption of improved sorghum varieties in the study area Results show that the coefficients for education and access to credit were directly related to probability of adoption of improved sorghum varieties at 1% and 10% level of significance. The coefficients of farm size and gestation period were negative and significant at 5% level each. The study recommends targeted breeding and release of improved sorghum seeds with early maturing varieties to farmers to enhance productivity and maximum use of land. Policies targeted at free and affordable education will enable farmers' access and process innovations for enhanced sorghum production as well as provision of credit at little or no interest rates.

Keywords: Adoption, Improved Sorghum varieties, Education, Farm Size, Access to Credit and Gestation period

Introduction

Sorghum (*Sorghum bicolor*) commonly referred to as Guinea Corn in West Africa is the fourth most important cereal in the world after rice, wheat and maize (Dogget, 2013). It is used in peasant and subsistent farming communities for making beer and malt. Its stem is used in fencing and construction of temporary buildings. In more advanced agriculture, the grain is used as a livestock feed, while the whole crop is used as silage or forage (Cobley, 2015). Egharevba (2015) reported the use of Sorghum in local recipes like *Tuwo*, *Akamu* and *Kunu* in Nigeria. Sorghum is a C_4 upright, short day, annual or short term perennial vigorous grass of the *Poaceae* family that varies between 0.6 –5.0m in height, depending on variety or growing conditions, each stem produces panicle which comes in a great variety of architecture (Rao *et al*., 2013). Sorghum has broad and coarse leaves, similar in shape to those of Maize but shorter and wider. The leaf blades are waxy, and the sheaths encircle the culm with overlapping margin. Sorghum has erect panicle but may drop as seeds mature. The panicle is usually compact as seen in most grain sorghum. The grain is predominantly white, yellow, red or reddish known (Barkeworth, 2015).

Roger (2005) defined adoption as a decision to make full use of an innovation or new technology as the best opportunity available to the farmer. In view of the uncertainty about the outcome or otherwise profitability of such innovation, greater effort is required by the farmer to decide whether to use the innovation or not. According to Rogers (1995), for a technology to be acceptable by a farmer, two conditions must be fulfilled; he/she must go through an adoption process such as awareness interest, evaluation and trial, and also the innovation must be economically profitable, socially acceptable and technologically visible. Generally, most farmers show different attitude towards the adoption of agricultural technologies with attendant effect on farm output and famer livelihoods (Ayinde *et al.,* 2013). Seed is the key input in Agriculture and to a great extent, yield and quality of crop depend on the quality of the seed used (Adenuga *et al.,* 2014). Improved crop varieties make farmers to cultivate several times within the

planting season because of a relatively short growing period. The genetic potential of these seeds also ensure increase in quantity harvested, disease and pest resistance and drought tolerance, and can compete favourably with weeds. There can be drastic improvement in Nigeria's agriculture if the available improved technologies are accepted and adopted by the farmers. This could be as a result of increase in numbers of adopters, expansion of area under cultivation or reliance on irrigation (Datt and Ravallion, 1996). Modern agricultural technologies and improved practices have keys in the realization of increased agricultural productivity and in raising the standard of living of the farming population. However, low rates of adoption of improved agricultural production technologies have been reported to be a major reason for the inadequacy in Nigeria agricultural production. Efforts put in by agricultural research may not yield the desired result if they are not put to use by the end users. Therefore, identification of the factors influencing adoption of improved technologies is very vital. This will help in raising the productivity of the farmers and thereby improve their livelihoods. Currently, there are few studies conducted on adoption of improved agricultural technologies for sorghum in Nigeria (Donstop *et al.,* 2011). The knowledge of this study is necessary to assist the current and prospective sorghum farmers and agricultural policy makers in taking decisions and making recommendations that will enhance adoption of improved sorghum varieties among farming households in the study area.

Methodology

The study area was Niger State, Nigeria. Niger State is located in North Central zone of Nigeria. The state is one of the six states that make up the North Central Geo-political zone in the Northern part of Nigeria. It has interstate boundaries with Kwara State to the South-West, Kaduna State to the North-West and Federal Capital Territory (FCT) to the North-East. The state covers an area of 15,371 square kilometres (km) and lies between 700 and 900m above sea level, with a largely gentle and undulating landscape. It has a population of 4,759,393 (NPC, 2006). The predominant farming system in the area is shifting cultivation with mixed cropping. Mixed farming and crop rotation involve using mostly traditional farm tools such as hoe, cutlass, and sickle etc. Crops cultivated include: Sorghum, Yam, Ground-nut, Cowpea, Cassava and Vegetables.

Sampling Techniques and Data Collection

A multistage sampling procedure was adopted to select the respondents. In the first stage the Nupe Zone of the state was purposively selected because of the intensity of sorghum production in the area. Second stage involved selection of Gbako and Katcha LGAs. In the third stage, five villages were selected from each LGA and at the fourth stage, ten households were selected from each village using simple sampling technique at each sampling stage, making a total sample of 100 farmers for the study. Primary data were collected using a pre-tested questionnaire on socio-economic characteristics and other variables of interest.

Analytical Techniques

Statistical, analyses were performed on the data collected. The statistical techniques that were employed include descriptive statistics and the Logit model.

Logit Model

Logit model was used in this study to determine the factors influencing the adoption of improved sorghum variety in the study area. It is a type of probabilistic statistical classification model. It measures the relationship between a categorical dependent variable and one or more independent variables, which are usually (but not necessarily) continuous, by using probability scores as the predicted values of the dependent variable. The model is implicitly expressed according to Gujarati (1988) and Faleye (2013) as:

$$l = \log\beta \frac{p}{1\ p} = \beta_0 + \underline{\beta_1 X_1} + \beta_2 X_2 + - \\ - - - - \beta_n X_n + e \ldots\ldots\ldots\ldots\ldots (1)$$

Suppose the numerical values of 0 and 1 are assigned to the two outcomes of a binary variable. Often, the 0 represents a negative response and the 1 represents a positive response. The mean of this variable will be the proportion of positive responses. If p is the proportion of observations with an outcome of 1, then 1-p is the probability of a outcome of 0. The ratio p/(1-p) is called the odds and the logit is the logarithm of the odds, or just log odds. Mathematically, the logit transformation is written:

$$\frac{p}{1-p} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - \beta_7 X_{7+e} \quad \ldots\ldots\ldots (2)$$

Where,

β_0 =Intercept

$\beta_1 \ldots \beta_n$ =Estimated parameters

$X_1 \ldots\ldots X_n$ =Set of independent variables

X_1 =Farm size (ha)

X_2 = Education (years)

X_3 = Extension contact (1= if yes, 0=otherwise)

X_4 =Farming experience (years)

X_5 = Family size (number of adults in the farming household)

X_6 =Access to credit (1= if yes, 0= otherwise)

X_7 =Gestation period (years)

e = Error term

Results and Discussion

Socio-economic characteristics of the respondents

The results in Table 2 show that majority of the farmers in the study area were males (74.0%) with age range of 41-50 years, while about 40% were above 50 years. Majority of the farmers (75.0%) were married with formal education (77%). About 78.0% had 6-20 years experience in sorghum farming and 65.0% had large household size which ranged from 6-10 members. Majority (63%) of the farmers had less than 1 hectare of land for sorghum cultivation. This denotes the

importance of dissemination of improved sorghum varieties with only 38% who adopted improved sorghum varieties, denoting a problem of visibility, ignorance or perception of those improved varieties.

The dominance of males (74%) among the farming households indicates that there is large gender disparity in sorghum farming in the study area. This agrees with Adenuga *et al.,* (2014), that sorghum farming in the tropics is dominated by males due to the peculiarity of farming system mostly used. Similarly, the low participation of women may be due to the traditional roles of gender as males are known to involve in energy sapping tasks compared to females in the study area. The age group of the farming households is an indication that sorghum farmers in the study area are getting aged and this may pose serious threat to food security in the study area in the future. The low level of formal education of the farmers might contribute to the low level of adoption of improved technologies. This result confirms with Diagne *et al.,* (2009) who stated that adoption of improved agricultural production technologies is faster among educated farmers compared to the uneducated. The farmers are well experienced (78.0%) in sorghum farming with 6-20 years sorghum farming experience. This can be an advantage for them to make up for their low educational status. The large household size of the farming household may be due to the practice of polygamy in the study area, while the low hectareage in land used for sorghum cultivation may be due to the problem of land fragmentation commonly encountered by farmers in the study area. These findings therefore are in line with Adenuga *et al.,* (2014) who declared that the practice of polygamy among farming households is one of the reasons for large household size, while the existence of land tenure system in Nigeria has drastically reduced the available land in Nigeria for mechanized agriculture.

Table 1: Socio-Economic and Demographic Characteristics of Sorghum Farmers

Characteristics	Frequency	Percentage (%)
Gender		
Male	74	74.0
Female	26	26.0
Total	100	100.0
Age (years)		
21-30	05	05.0
31-40	13	13.0
41-50	42	42.0
51-60	24	24.0
61-70	10	10.0
>70	06	06.0
Total	100	100.0
Marital Status		
Single	12	12.0
Married	75	75.0
Divorced	08	08.0
Widowed	05	05.0
Total	100	100.0
Level of Education		
No formal education	23	23.0
Qur'anic Education	26	26.0
Primary	36	36.0
Secondary Education	11	11.0
Tertiary Education	04	04.0
Total	100	100.0
Farming Experience (years)		
1-5	12	12.0
6-10	31	31.0
11-15	29	29.0
16-20	18	18.0
21-25	10	10.0
>25	100	100.0
Household Size		
1-5	29.0	29.0
6-10	65	65.0
11-15	04	04.0
>15	02	02.0
Total	100	100.0
Farm Size (ha)		
Less than 1	63	63.0
1-5	18	18.0
6-10	11	11.0
11-15	07	07.0
>15	01	01.0
Total	100	100.0
Adoption of Improved sorghum Varieties		
Yes	38	38.0
No	62	62.0

Source: Field Survey, 2017

Determinants of adoption of Improved Sorghum Varieties

Table 2 presents the maximum likelihood estimates of the Logit regression model for improved sorghum variety adoption decision. The significant Chi-square value of 27.77 ($p<0.01$) indicates a significant estimation that the hypothesized variables globally influence the adoption of improved sorghum varieties among farming households. Farm size ($p<0.05$), level of education of sorghum farmers ($p<0.01$), gestation period ($p<0.05$) and access to credit ($p<0.10$) significantly influenced the probability of adopting improved sorghum varieties. The level of education of the farmers and access to credit were positive while farm size and gestation period of the seed were negative. The result of Logit model for the determinants of the adoption of improved sorghum varieties implied that increase in the level of education of the farmers and their access to credit will lead to a corresponding increase in the likelihood of adopting improved sorghum varieties, while increase in the farm size and gestation period of the seed will decrease the likelihood of adoption of improved sorghum varieties. This confirms Awotide *et al.,* (2014). Other variables such as age, sex, family size, extension contact and technology were not significant factors in adoption of improved sorghum varieties in the study area.

Table 2: Determinants of Adoption of Improved Sorghum Varieties

Variables	Coefficients	Standard Error	t-value
Constant	-6.192	3.136	0.048
Age	0.0204	0.0515	0.396
Sex	0.4785	0.7902	0.6055
Household size	0.1077	0.2135	0.5044
Education Level	0.3027***	0.0945	3.203
Farming Experience	0.0780	0.0562	1.387
arm Size	-0.0274**	0.0134	-2.044
Gestation Period	-0.065**	0.0299	-2.173
Extension contact	-0.28511	0.6883	-0.196
Access to Credit	-0836*	0.6366	1.702
Technology	-0.42788	0.7349	-0.582

Source: Field Survey, 2017

Log Likelihood function = -34.114 Restricted log likelihood = =13.45**, Chi-square = 27.77*, P = 0.16x10-3; N = 100; DF = 90; *** Significant at 1%, ** Significant at 5%, * Significant at 10%**

Conclusion

This study has shown that farm size, level of education, access to credit and gestation period are the important factors influencing the adoption of improved sorghum varieties in the study area. The study therefore recommends that farmers should be encouraged to attain adult education. This is because it is easier for educated farmers to accept modern agricultural technologies, especially production technology such as improved sorghum varieties. It is also important to broaden their understanding about the benefits associated with improved sorghum varieties. Also, the results of the study suggests that farm size available to sorghum farmers should be optimally managed for better adoption of the improved sorghum seed. Early maturing sorghum varieties and credit should be made available to farmers for enhanced productivity.

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