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SORGHUM STORAGE AND PEST CONTROL AMONG FARMING HOUSEHOLDS IN KWARA STATE, NIGERIA

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ABSTRACT

This study was carried out to analyse the sorghum storage and pest control in Kwara State. A multi–stage sampling technique was used to select sample for the study. Descriptive statistics and logit regression analysis were the analytical tools employed to achieve the research objectives. The results showed that the respondents have an average age of 46 years with an average family size of 9 persons. They have an average storage experience of 14 years with the majority (42.5%) were uneducated. The agro-chemicals mostly used by the respondents are Actellic liquid, Actellic dust and Phostoxin Tablet to prevent pest infestation and spoilage. The analysis showed that educational level, household size and access to credit having the t-values of 2.197, -3.075 and 2.539 respectively were the significant factors explaining the usage of improved storage facilities in the study area. For effective pests and disease control through adequate access to pesticide and appropriate storage facilities, policies like loan schemes that would substantially improve households' access to use and acquisition of credits will facilitate the usage of improved storage techniques and consequently will enhance households' income.

***Key words*:** Agrochemicals, sorghum, storage and improved techniques

INTRODUCTION

Nigeria is mainly an agrarian nation. The country is a major producer of some agricultural products (cocao, groundnuts, maize) and the leading producer and consumer of sorghum, cowpea and millet in the world (Werder and Manzo, 2002). Sorghum (*Sorghum bicolor L. Moench*) is one of the major cereal crops widely grown in Nigeria, and a very important staple food for the populace particularly in the Northern part of the country. According to Okpele, (2006) this crop is still one of the major sources of energy in the nutrition of both humans and livestock. It is the first most important cereal crops in Nigeria and is mainly used for food, animal feeds and making drinks (Ojo, 2000)

The increase in food demand-supply gap in Nigeria is attributable to the country's high population growth and high demand for her low price food items. This problem has become acute because the average crop yields for most of these agricultural products have been generally low from farmers' fields. Crops yields range between 500-800kg/ha for sorghum, maize, rice and millet (Sharma and Nwanze, 1997) and between 250-500kg/ha for cowpea and cotton (Singh *et al*., 1997). There is therefore an urgent need to raise the productivity levels of these crops and so give remedy to food insecurity and poverty in Nigeria. Over the years, successive governments in Nigeria have initiated efforts aimed at raising the nation's agricultural production. However, several constraints have posed as challenges to these efforts. These constraints include crop losses due to storage pests, diseases, weeds, drought, weather and inadequate funding constraints.

The storage of agricultural products may be done for consumption at a future date or for economic reasons. Government may also store

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surplus agricultural products for price stabilization by releasing such crop reserves to the market in times of food scarcity. Despite the numerous advantages of crop storage, damage by storage pests especially the insect pests is the most important limiting factors to the efficient storage of agricultural products. In some instances, losses up to 30 to 70 percent have been recorded on stored food in the absence of efficient storage pests control measures (Dike, 1994). Postharvest loss is the degradation in both quantity and quality of a food production from harvest to consumption. Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product. These losses are generally more common in developed countries (Kader, 2002). Quantity losses refer to those that result in the loss of the amount of a product. Loss of quantity is more common in developing countries (Kitinoja and Gorny, 2010). For stored product pests cause damage to crops as they eat up portions of the produce leading to losses usually manifested by reduction in weight (Kumar and Okoronkwo, (1991). These pests also contaminate produce with fresh foreign materials.

Damage and losses to stored grains especially sorghum by insect pests is very severe, it has been estimated that about 75 percent of problem of storage losses is due to insect pests. The total estimated annual loss of grains to insect pests in Nigeria is about 20 percent of total production (Ajibola and Daramola, 1998). Storage pests cause direct and indirect damage to stored agricultural products. Direct damage are in form of weight loss, loss grade of grains, lowering of harvests market value, contamination and damage to storage structures and containers. Indirect damage on crops include: heating and moisture migration in silos and other storage structure like rhombus and cribs. Other indirect damages are spreading of moulds and spares throughout the grains mass and monetary expenses in terms of the purchasing pest control chemical. Recent report on assessment of stored products losses are few in literature and some of the ones available provide outdated data on a few products. For instance, it was reported a few decades ago that about 4 percent of the total annual production of sorghum or about 30,000 tonnes valued at over 30million US dollars is lost annually to the sorghum brunched in Nigeria alone (Singh, 2000). Losses from weevil infestation were put at 50 percent for cereals on storage. Pest like rodent directly consumes food commodities stored by man. A single average sized rat may alone consume at least 500g of grain per month (Appert, 1997). Partially consumed food may become inedible and in the use of seed, the germination capacity may be impaired. Rodent may be more economically important in bulk grain storage because they contaminate the commodity with their carcasses hair, feaces and urine (Evans, 2007). Appert (1997) also reported that birds damage stored products especially cereals by directly consuming them. Their economic importance is perhaps largely related to contamination of the grain with their droppings, feather or various materials.

Despite the adoption of the traditional and the improved ways of controlling storage pest losses for agricultural produces, the persistent post harvest losses for Sorghum is still on the increase. Efforts aimed at achieving viable crop storage are timely as such efforts would go a long way in alleviating the key problem facing agriculture in Nigeria. This study helps the policy makers in the area of agricultural storage pest control to come up with appropriate policy for agricultural food loss prevention. This study therefore describes the storage activities and highlights the determinants of the usage of improved storage techniques in the study area.

MATERIALS AND METHOD

The research work was carried out in Kwara state, Nigeria because the state is noted for sorghum production. The state lies between latitude 7^{o} 45N and 9^{o}30N and longitudes 2^{o}30E and 6^{o}25E (Figure 1). According to the 2006 National Population Census report, the popula-

tion of Kwara state stood at 2.73 million. Popular ethnic groups found in the state include; Yoruba, Fulani, Batunu, Nupe, Bokobanu and Gambari. Over 90 percent of the rural populace is involved in farming (Kwara ministry of Information, 2004). The favourable climate and the large expanse of land makes the state well suited for the cultivation of a wide variety of crops including cereals, tubers, legumes and vegetables like spinach, okra etc(kwara State Dairy, 2002). The state is classified into four agro ecological zones: A, B, C and D by the Kwara State Agricultural Development Project (KWADP). The classification is based on the ecology and administrative convenience.

Sorghum producing households and traders constitute the target population for the study. A three stage sampling procedure was employed to select a representative sample for the study. The sampling is the KWADP Village listing. The first stage involved a random of 2 Local Government Areas (LGAs) from each of the four ADP zones resulting in 8 LGAs. This was followed by random selection of 2 villages from each of the selected LGAs making a total of 16 villages. In each of the selected villages 12 farming households were selected to make up a sample size of 192. However, only 160 questionnaires were returned and analyzed.

Variables and measurements used to achieve the research objectives

The dependent variable (Y) usage of improved storage techniques takes the value of 1 if the household head was a user and 0 if otherwise. The common agro-chemicals used by

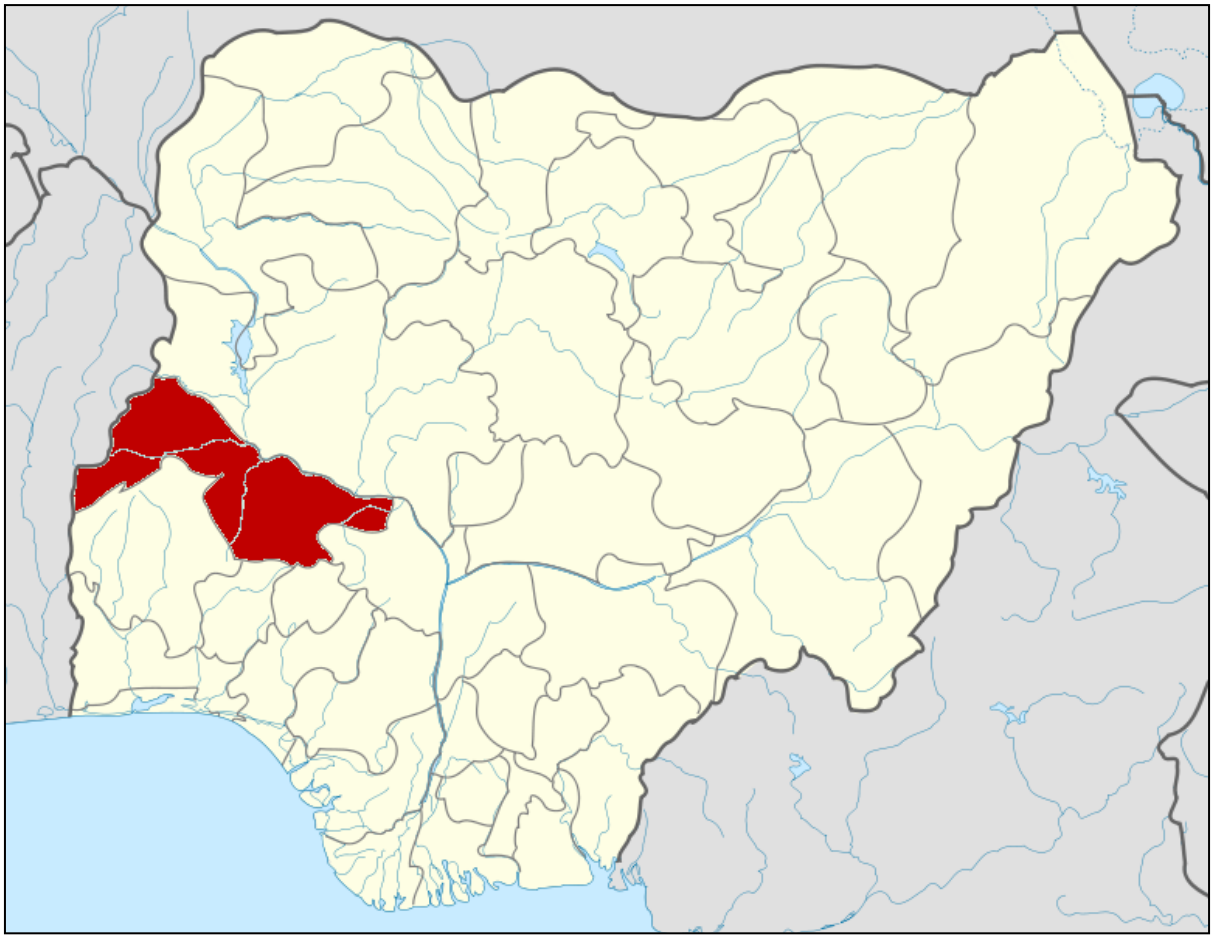

Figure 1: Map of Nigeria showing the location of Kwara State.

the respondents are actellic liquid, actellic dust and phostoxin

Education of household head (X_1) was measured as the number of years of scholling of the household head. According to Babatunde *et. al.,* (2007) education is a social capital, which could impact positively on a household's ability to take good and well–informed production and nutritional decision.

Dummy variable was used to capture whether or not the household head accept that pests are threat to the stored sorghum (X_2). It takes the value of 1 if yes and 0 if otherwise.

The size of the household (X_3) generally reflects the level of family labour available. This was based on the number of direct and dependants of the household.

In order to enhance the flow of credit services (X_4) to Nigerian rural areas, Government has, in the past, initiated a series of publicly-financed micro/rural credit programmes and policies targetted at the poor. It takes the value of 1 if the household head has access to credit and 0 if otherwise

Descriptive statistics such as frequency, percentages, mean and mode were used to analyze data gathered for different post harvest storage techniques available, the tool was also used to examine the socio economic characteristics of the households that store sorghum in the study areas and constraints faced in the usage of improved storage facilities.

The logit model was used to analyse factors influencing the decision to use improved storage techniques. The dependent variable is the usage of improved storage techniques by the respondents, which is one if yes, and zero otherwise. Following Maddala (1990) and Babcock *et al* (1995), the model specification gives rise to a system of two probabilities as:

$$\boxed{\text{Prob}\left(Y_{i=j}\right) = \Sigma^2 \frac{e^{\beta j Xi}}{e^{\beta k Ni}}} \quad (1)$$

Where J = 0 or 1
Expanding equation 1:

$$\boxed{\text{Prob}(Y_i = j) = \frac{e^{n_j x_i}}{e^{n_0 x_i} + e^{n_i x_i}}} \quad (2)$$

The equations above have interdeterminancy problem and need to be removed. This calls that we assumed that n_0 in the denominator is zero i.e. n_o =0. Then, $e^{n\,Xi}$ = 1, hence

$$\boxed{\text{Prob}(Y_i = j) = \frac{e^{n_j x_i}}{1 + e^{n_i x_i}}} \quad (3)$$

$$\boxed{\text{Prob}(Y_i = j) = \frac{e^{n_j x_i}}{1 + n^2 e^{n_k x_i}}}$$

Then, the probability of being users (j = 0 or 1) is:

$$\text{Prob}\,(Y_i = 0) = \boxed{\frac{1}{1 + \sum_{k=1}^{2} e\beta_k X_i}} \quad (4)$$

$$\text{Prob}\,(Y_i = 1) = \boxed{\frac{e\beta_{1Xi}}{1 + \sum_{k=1}^{2} e\beta_k X_i}} \quad (5)$$

Where β_j is a vector of parameters that relates the explanatory variable X_i to the probability.

The variables for the logit analysis are:

Y = Usage of improved storage techniques which is 1 if users and 0 if non- users
X_1 = Number of years of formal education of household head
X_2 = Dummy variable for where the household head accept the challenge that pests are threat to the stored sorghum= 1 or 0 otherwise
X_3 = Household size in number
X_4 = Use of credit where Yes =1 and 0 otherwise.

RESULTS AND DISCUSSION

Socio-economic characteristics of the Household Heads

The age of the farming households' heads ranged between 30 and 75 years with an average of 46 years. About 6.0% of household heads were above 60 years. Over 93% of the households' heads in the study area were below 60 years of age. The implication is that these household heads are in their active ages and can therefore be more productive (Table 1).

Sex distribution varied appreciably as 6.9% and 93.1% of the household heads were females and males respectively. The average household size was 9 persons. Most (69.3%) households were polygamous in nature. Polygamous nature of the people probably explains the large family size recorded in the area. Their availability reduces labour constraints faced during the peak of the farming season. Majority (47.4%) of the household heads were predominantly involved in agricultural trading, while others were involved in farming, non-agricultural trading, and civil service as their secondary sources of livelihood. Most (57.5%) farming household heads were literate with most of them having primary education (29.4%) and this was followed by adult education (11.2%). Given this level of literacy it is expected that information can be disseminated with ease among these households' heads. The households head's years of storage experience ranged between 5 and 30 years with an average of the average of 13.9 years. Households' heads storage experience is expected to have a considerable effect on their productive efficiency. Majority of the household heads (74.4%) got their initial starting capital from personal savings.

Storage Activities

About 46.0% of the households employed both family and hired labour in the storage of their sorghum while 50% and 3.8% of the sampled household heads' depend on family and hired labour respectively (Table 2).

Store is very important in keeping agricultural

Table 1. Socio-economic characteristics of the household heads

Variables	Frequency	Percentage
i) Age		
21-40 years	42	26.3
41-60 years	108	67.5
61-80 years	10	06.2
Total	160	100.0
ii) Sex		
Male	149	93.1
Female	11	06.9
Total	160	100.0
iii) Marital Status		
Married	140	87.5
Single	05	03.1
Widower/ Separated	15	09.4
Total	160	100.
iv) Household Size		
1-5	14	08.8
6-10	100	62.5
11-15	44	27.5
16-20	02	01.2
Total	160	100.0
v) Education Status		
No Formal Education	68	42.5
Quranic Education	14	8.80
Primary Education	47	29.4
Secondary Education	12	07.5
Tertiary Education	01	0.60
Adult Education	18	11.2
Total	160	100.0
vi) Storage Experience		
1-10	42	26.2
11-20	102	63.8
21-30	16	10.0
Total	160	100.0
vii)Source of Credit		
Personal Income	119	74.4
Cooperatives	25	15.6
Banks	16	10.0
Total	160	100.0

produce especially sorghum. Result shows that sorghum stores are mostly (45.6%) inherited by the respondents. About 29% of the sampled households paid rents on their store and this made them to incur extra cost compared to those who owned or inherited their stores. Most (32.5%) respondents used Actellic liquid to prevent pest infestation, followed by phostoxin tablet (20.6%). Thirty percent of the respondents did not use agro-chemicals at all. The table revealed that the use of bags or sacks for sorghum storage is common in the area. Half of the respondents used sacks to store their sorghum. The use of silos was least (0.6%) used in the study area. On the whole, 23% of the sampled respondents have adopted improved storage techniques.

Table: 2 Storage activities of the respondents

Activity	Frequency	Percentage
i) Source of Labour		
Family Labour	80	50.0
Hired Labour	6	3.80
Family and Hired Labour	74	46.2
Total	160	100.0
ii) Store acquisition		
Inherited	73	45.6
Rented	47	29.4
Owned	40	25.0
Total	160	100.0
iii) Agrochemical Used		
Actellic Liquid	52	32.5
Actellic Dust	27	16.9
Phostoxin	33	20.6
Not Applicable	48	30.0
Total	160	100.0
iv) Storage Techniques		
Earthen Pot	3	1.9
Jute Bag	8	5.0
Gourd	1	0.6
Raised Platform	11	6.9
Drum	13	8.1
Crib	53	33.1
Rhumbus	15	9.4
Sacks/Bags	80	50.0
Silo	1	0.6
Total	160	100.0
v) Extent of adoption		
Improved Storage Techniques		
Warehouse	31	
Modified Mud Rhumbus	51	
Ventilated Crib		
Silo of varying sizes		
Modified Oil Drums		

Source: Field survey 2011/2012
Note: Also the extent adoption of improved storage techniques were not in percentages because there are multiple responses

Determinants of the usage of improved storage techniques

The drivers of the usage of improved storage technique among the sampled households are presented in Table 3.

The logistic model explains 48.32% of the total variation in adoption status of households. This implies that the variables in the regression analysis accounted for about 50% of the households' decision to adopt improved storage facilities. The coefficient of educational status, household size and credit access with the t-values of 2.197, -3.075 and 2.539 respectively were all found to be significant in explaining the variation in the usage of improved storage techniques. Educational status of household head is positive and significantly influenced usage of improved storage techniques at 10% level of probability. This implies that as the educational status of the household head increases, the adoption of improved storage facilities increases. This could be due to the fact that educated household head are generally able to follow the required guidelines and methods involved in the improved storage techniques. Household size is negative and significantly influenced adoption of improved storage techniques at 1% level of significance. This implies as the household size increases, the possibility that the household head would adopt improved storage tech-

niques decreases. This is because the larger the household size the less they are able to purchase and adopt improved storage technique in the area. Access to credit facilities was significant and positively related to the adoption of improved storage techniques at 5% level of probability. This implies that the more the household heads have access to credit facilities, the higher the adoption of improved storage techniques.

CONCLUSION AND RECOMMENDATIONS

The respondents have an average age of 46 years with an average storage experience of 14 years. The agro chemicals mostly used by the respondents are Actellic liquid, Actellic dust and Phostoxin Tablet to prevent pest infestation and spoilage. Also, the study showed that the level of adoption of improved storage techniques in Kwara State is generally low. The study indicated that educational status of the household head; household size and credit access were the major drivers explaining the adoption of improved storage techniques in the study area. Policy should target at strengthening farming households towards having improved access to both formal and informal sources of credits. Policy aimed at reducing household size should also be vigorously pursued. This has the potential to increase the intensity and the usage of improved storage techniques among farming households in the study area to attain sustainable sorghum production.

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Table: 3 Logit regression analysis of households heads' use of improved storage techniques

Variables	Coefficients	Std Error	t-value	P[|Z|>z]
Constant	2.377***	0.714	3.329	0.002
Educational Status (X_1)	0.134*	0.061	2.197	0.030
Pest Threat (X_2)	-0.304	0.479	-0.635	0.526
Household Size (X_3)	-0.206* **	0.067	-3.075	0.002
Credit Access (X_4)	1.191 **	0.469	2.539	0.011

Source: Data Analysis, 2012. ***parameter significant at 1%, ** parameter significant at 5%, * parameter significant at 10%

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