Socio-Economic Factors Determining the Adoption of Post-harvest Technologies among Maize Farmers in Kwara State, Nigeria

*Damilola Toluse Ajibesin[1], Oluwemimo Oluwasola[2]and Damilola Ajayi[3]

[1,2,3]*Department of Agricultural Economics, Faculty of Agriculture, ObafemiAwolowo University, P.M.B 013, Ile-Ife, Osun State, Nigeria*

Abstract - *The study examined the socio-economic factors influencing the adoption of post-harvest technologies among maize farmers in Kwara State, Nigeria. A multistage sampling technique was used to select a total of 180 respondents in the study area. Primary data were collected with the aid of a well-structured questionnaire on farmer's socio-economic characteristics, postharvest technologies adopted as well as the cost and returns in adopting the technology. Data were analyzed using descriptive statistics, budgeting analysis, and multinomial logit regression model. The results of the study revealed that majority of the maize farmers were married men in their late middle ages, with large household sizes. The study also showed that the storage of maize enhanced the profitability of maize production. Factors such as the quantity of maize harvested, farming experience, marital status, household size, membership of farmers/cooperative associations and amount of credit borrowed determined the use of storage technologies. The study recommended that efforts should be made to access farmers to output enhancing technologies that will encourage them to use post-harvest technologies and also enhance their income earning capacity.*

Keywords: *Adoption, Post-harvest Technologies, Maize, Farmers, Socio-economic factors*

I. INTRODUCTION

Maize is the most important cereal globally after wheat and rice with regards to area cultivated and total output (Eleweanya*et al.*, 2005). The importance of maize in the food economy of Nigeria cannot be overemphasized. Its cultivation provides employment opportunities for farming and non-farming households along the maize value chain, which in turn serves as a source of income for operators (Osundare, 2013). Maize has industrial end uses for human consumption. For example, it is used as flour, beer, malt drinks, cornflakes, starch, syrup and animal consumption, or mainly prepared as feed for poultry.The economic and agricultural policies in Nigeria have further put maize in a prominent position in the country's food economy as the ban placed on the importation of rice and wheat flour makes maize a very important raw material sought after by feed mills, flour mills and breweries (Osundare, 2013). In Nigeria, the total output of maize has continued to increase over the past years from 1.1 million tonnes in 1961 to 10.0 million tonnes in 2014 (FAOSTAT, 2015)yet, it has not been able to meet the domestic demand of the nation, (Babatunde*et al.*, 2008). For example, the domestic demand of 10.2 million tonnes far outstripped the national supply of 10.4 million tonnes in 2014 (FAOSAT, 2015). To make up for the shortfall in supply, the country had to import 150,000 tonnes of maize (USDA, 2015).

In an attempt to increase maize production to bridge the gap between the demand and supply of maize, extensive research works on maize have been carried out by National Agricultural Research Institute (NARI) and International Institute for Tropical Agriculture (IITA) on developing and introducing improved maize varieties that are disease resistant and high yielding.In spite of these efforts, maize production and output level have faced a number of constraints such as low productivity, farmers not adopting/using improved technologies, low capitalization of farms, price fluctuations, incidences of disease and pest attacks, inefficiency of resources utilization and poor storage facilities (Ojo, 2003; Onuk*et al.*, 2010). By far the major challenge facing self -sufficiency in maize production is the loss incurred between the farm and the market through postharvest losses. In Nigeria postharvest loss of maize is estimated to be between 20% and 40% and occurs from harvesting or field drying, platform drying, threshing and shelling, winnowing, farm storage, transport to market and market storage (Aphlis, 2013). The use of post-harvest technologies as drying, threshing, winnowing, processing, bagging, storage, transportation (World bank *et al*., 2011) selection, preservation, packaging, and processing contributes to the promotion of agricultural production through the improvement of farmer's income by raising the value of agricultural produce (Bourne, 2004). Thus, effective and adequate storage of maize grains is a major research thrust for enhanced maize production in order to reduce the huge economic loss (Olakojo and Akinlosotu, 2004).

Aware of the huge economic and food supply loss to the nation consequent on the large post-harvest losses, the Federal Government of Nigeria established a number of research institutes including: the Nigerian Stored Products Research Institute (NSPRI), the National Center for Agricultural Mechanization (NCAM) and the National Root Crops Research Institute (NRCRI) to proffer solutions to the challenges of post-harvest losses among other functions. In spite of the efforts of these institutes as well as the existence of several opportunities to reduce postharvest losses, farmers still incur substantial losses. Several reasons have been given for this including storing grains with high moisture content, poor hygiene and use of inappropriate storage facilities, and in several cases, failure to use modern storage facilities (Bett and Nguyo, 2007).Consequently, post-harvest losses have continued unabated as farmers do not make use of the technologies available. According to (Adetunji, 2007 and Sekumade*et al.*, 2009) factors such as rise in capital invested, transportation cost, labor cost, and farmer's age have been attributed to farmers not making use of storage facilities. In addition, the quantity of maize to be stored, years of farming experience, as well as educational level influences farmer's use of storage facilities be it semi-modern or modern storage. While literature is rich on efforts to increase the production of maize to meet national food needs, very little information is available on farmer's access to storage facilities to reduce postharvest losses. The availability of information on socio-economic factors governing the adoption of appropriate storage facilities to farmers will reduce post-harvest losses, hence this study. Specifically, this study seeks to describe the socio-economic characteristics of maize farmers; analyze costs and returns to farmers resulting from their use of post-harvest technologies and determine the factors influencing the adoption of post-harvest technologies among maize farmers.

II. METHODOLOGY

A. Sampling Technique and Data collection

The study was carried out in Kwara State, Nigeria. The State was purposively selected for the study because it is one of the major maize producing states in the middle belt area of the country (Adetunji, 2007). In addition, the Nigeria Stored Product Research Institute (NSPRI) and the Nigeria Center for Agricultural Mechanization (NCAM) are both located in the State which helps to increase the access of maize farmers to different varieties of storage facilities and equipment. The State is located in the North central geopolitical zone and has a landmass of 32,500 square kilometers (km^2). It is situated between latitudes 6.5^0 and 11.5^0 N and longitude 2.8^0 and 7.5^0 E. The State is bounded to the North by Niger State, to the South by Osun and Ondo States, to the East by Kogi State and to the West by Oyo State. The state is constituted into sixteen Local Government Areas and has four agricultural zones with its headquarters in Kaiama, Patigi, Shao, and Igbaja.

A multistage sampling technique was employed in selecting respondents for the study. Using the Agricultural Development Project (ADP) classification of agricultural zones in the State as a stratification basis, two agricultural zones were randomly selected out of the four zones in the State at the first stage. The second stage of sampling involved the random selection of three Local government Areas (LGAs) from each of the two agricultural zones. At the third stage, three villages were further selected from each LGA, giving a total of eighteen villages. The last stage involved a random selection of ten maize farmers from each village. In summary, a total of one hundred and eighty farmers were sampled for the study. The data collected were analyzed using descriptive statistics, budgeting analysis, and multinomial logistic regression model.

B. Data Analysis

Descriptive statistics were used to describe the socio-economic characteristics of maize farmers while budgeting technique was used to determine the costs and returns to the use of postharvest technologies among maize farmers. The budgeting model was estimated as:

$$\Pi_i = P_iQ_i - TC_i \qquad (1)$$

Where

Π_i = Net income

P_i = Price per unit of maize stored (₦)

Q_i – Quantity of maize stored

TC_i = Total costs of storing maize (fixed costs {FC} plus the variable costs {vc}) (₦)

Variable costs (VC) included in the analysis were expenditures on maize seedlings, fertilizer, pesticides, labor, transportation. Items that could be used for more than a production season were classified as fixed costs (FC). These include hoes, cutlasses, buckets, storage technologies, file, and rent.

The multinomial logistic model was used to determine the factors influencing the adoption of post-harvest technologies among maize farmers and was used to express a farmer's likelihood of adopting a particular post-harvest storage technology. Suppose an individual farmer's utility after adopting a particular storage technology (e .g. Purdue bag e.t.c) for a given vector of economic, social, and physical factors (*X*) is denoted by Uij (*X*). Then, the preference for adopting or not adopting can be defined as a linear relationship given by:

$$Uij\ (X) = \gamma\ j\ Xij + eij \qquad (2)$$

$$Yij\ (X) = \gamma\ j\ Xij + eij \qquad (3)$$

Where Uij denote the utility that the farmers derive by choosing one of possible three outcomes (i.e no storage, Purdue bag storage, and ordinary bag storage) γ j varies and Xij remains constant across alternatives and eij is a random error term. The qualitative variable Y indexes the likelihood of adoption, then it will take a value of one if the farmer adopts a particular technology(Y=1) and zero otherwise (Y=0).

Let Pij (j=0, 1, 2) denote the probability associated with the three choices, with

j=0 if none use of storage technology,

j=1 if Purdue bag is used,

j=2 if ordinary bag is used.

The probability of the farmer adopting any of the storage technology is expressed as

$$Pij = \frac{\exp(\gamma j\ Xi)}{1+\sum_{j-1}^{2}\exp(\gamma j\ Xi)} \quad (4)$$

For j=1, 2

Where Pij is the probability of being in each of the groups 1, 2

$$P_{i0} = \frac{1}{1+\sum_{j-1}^{2}\exp(\gamma j\ Xi)} \quad (5)$$

For j=0

Where P_{i0} is the probability of being in the reference group or group 0

The explicit form of the function is specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \text{- - - - -} \ \beta n\ Xn \quad (6)$$

Where

Y = Likelihood of Adoption

β_0 = Intercept

$\beta 1$ - - - - βn = estimated parameters

X_1 - - - - Xn = set of independent variables

The model used was implicitly specified as;

$$Y = (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, + e) \quad (7)$$

Where

Y= Likelihood of Adoption (Y=1 if the respondent adopts post-harvest technologies and Y=0 if otherwise)

X_1= sex of the respondent (Male=1, otherwise=0)

X_2= marital status (Married=1, otherwise=0)

X_3= level of education (years)

X_4= household size

X_5= farming experience (years)

X_6= Major occupation (expressed as a dummy; Farming = 1, otherwise = 0)

X_7= quantity harvested (Kg)

X_8= amount borrowed (₦)

X_9= membership of Association (expressed as a dummy; if yes1, if otherwise 0)

X_{10}= farm size (hectares)

e=Random error

III. RESULTS AND DISCUSSIONS

A. Socioeconomic characteristics of Maize Farmers

Table 1 shows that majority of the farmers (92.8%) were males while 7.2% were females. The dominance of male respondents could be attributed to the prevailing land tenure arrangement which enhanced male farmers to land more than their female counterparts. It could also be attributed to the age-long gender division of labour practiced in the area where women are engaged more in trading and processing while men are involved in farming (Oluwasola, 1998) The age distribution of the respondents revealed that majority of the farmers (47.8%) were aged between 51-60 years with a mean age 51±9.36 years. This implies that majority of the maize farmers were in their late middle age but still productive. The result further revealed that majority (87.8%) of the farmers were married; 44.4% of the farmers had a household size that ranged from 7 – 9 members, with an average family size of 8.41±3.16. Clearly, farmers in the study area had large household sizes suggesting the availability of family labor(4)for farm use. This confirms the view that large family size is typical of most rural farming communities in Nigeria where household labor is the most dependable source of farm labor (Oluwasola, 2010). However, large household sizes could affect farm capitalization and adoption of improved storage technologies as large household sizes could result in high family expenditure especially where the family members are not engaged in productive activities.

The level of education among the farmers was fairly low as nearly 50% of the respondent had less than secondary education while only 6.7% completed tertiary education. The low level of education among maize farmers could have serious implications on their ability to access information about various post-harvest storage facilities that they can use. While Majority of the respondents (50.6%) were engaged in farming as their primary occupation, the remaining 49.6% were into farming as secondary occupation as they were engaged in other vocations like artisans, trading, and hunting. The study also revealed that the farmers have been engaged in maize production for an average of 15.58±7.67 years implying that farmers in the study area had enough farming experience to enhance maize production as well inform farmer's decision on whether or not to adopt post-harvest storage technologies.The land used for farming were acquired by the farmers through inheritance (74.4%) rent (17.2%) gifts (5.0 %) and lease (3.3%). The mean farmland available for cultivation to respondents was 3.81±2.04 hectares while the mean farmland cultivated by the farmers to both maize and food crops was 2.77±1.67 hectares. Using a t-test analysis, the mean of the total farmland available to the farmers and the mean of farm size under cultivation were significantly different at 1%. This confirmed that notable portions of farmland available to the farmers were not cultivated. The mean farm size for maize cultivation in the study area was 2.19±1.82 hectares. This implies that although maize is the most important economic crop planted by the farmers most of the respondents had limited access to land hence the area of land for maize cultivation which could affect the use of postharvest storage technologies. This result is corroborated by the findings of Adebisi*et al*., (2015)

About 69.4% of the respondents were members of cooperative societies or farmers associations, while 30.6% were not. Those who were members had access to improved seedlings, fertilizers, and credits, information on new innovations/agricultural inputs like the Purdue improved cowpea bag (PIC bags) and at reduced price. About 88.3% of the respondents depended mainly on their personal savings for funding farm investments, 15.6% enjoyed financial assistance offered by cooperatives societies, while 3.44% sourced funds from banks, family, friends, and government (through Agricultural Development Programme). As pointed out by Adebisi*et al.*, (2015), depending on personal savings for farm investment could affect farmer's decision to use maize storage equipment's most especially improved storage ones since most of them are expensive and unaffordable to poor farmers. Majority (86.1%) of the farmers stored their maize after harvest, while only 13.9% did not. This therefore necessitates the need to adopt post-harvest storage technologies. About 66.5% of the respondents stored maize in rooms in their houses using ordinary bags made of polypropylene while 33.5% stored the maize with hermetic Purdue bags in rooms. This indicates that house storage technology was adopted by farmers in the study area but mostly with the use of ordinary bags made of polypropylene. The use of this storage method by the respondents was due to the fact that it was easily accessible to the farmers to acquire as they were cheap and affordable. Storing the maize in rooms in private houses also provided security against theft. The length of time the farmers stored the maize on the aggregate the extension of maize supply to the local market for a longer period of time (Adetunji*et al.*, 2007). It also enable the farmers to take advantage of high market prices instead of selling the product when there is glut in the market with its attendant negative impact on commodity prices In the study area about 55.0% of the farmers stored maize between four and six months, 26.7% stored theirs between one and three months while 4.4% of the respondents stored their maize for more than seven months after harvesting.

Table 1: Socio-economic characteristics of respondents

Characteristics	Frequency	Percentage
Gender		
Male	167	92.8
Female	13	7.2
Age (Years)		
≤30.0	6	3.3
31-40.0	20	11.1
41-50.0	41	22.8
51-60.0	86	47.8
61.70.0	26	14.4
>70.0	1	0.6
Marital status		
Single	12	6.7
Married	156	87.8
Divorced	2	1.1
Widowed	5	2.8
Separated	3	1.7
Level of education		
(years)	27	15.0
No formal education	8	4.4
Adult education	39	21.7
Primary school	89	49.5
Secondary school	12	8.7
Tertiary school	5	2.8
Quranic school		
Household size		
≤ 3	10	5.6
4-6	30	16.7
7-9	80	44.4
10-12	44	24.4
13-15	13	7.2
≥16	3	1.7

Main occupation		
Farming	91	50.6
Trading	44	24.4
Hunting	1	0.6
Artisan	35	19.4
Others	9	5.0
Farming experience		
(years)	14	7.8
≤ 5	49	27.2
6-10	35	19.4
11-15	47	26.1
16-20	17	9.4
21-25	12	6.7
26-30	6	3.3
≥ 31		
Mode of land		
acquisition	134	74.4
Inheritance	6	3.3
Lease	31	17.2
Rent	9	5.0
Gift		
Land area available for		
cultivation(Hectares)	57	31.7
≤2.00	14	7.8
2.01-3.00	47	26.1
3.01-4.00	12	6.7
4.01-5.00	33	18.3
5.01-6.00	17	9.4
≥6.01		
Total farm		
size(Hectares)	88	48.9
≤2.00	27	15.0
2.01-3.00	38	21.1
3.01-4.00	10	5.6
4.01-5.00	13	7.2
5.01-6.00	4	2.2
≥6.01		
Maize farm size		
≤2.00	132	73.3
2.01-3.00	7	3.9
3.01-4.00	32	17.8
4.01-5.00	5	2.8
≥5.01	4	2.2
Membership of cooperative/		
association	125	69.4
Yes	55	30.6
No		
Source of credit		
Personal savings	159	88.3
Cooperative society	28	15.6
Farmers association	3	1.67
Banks	2	1.1
Family	1	0.56
Friends	1	0.56
Government(ADP)	1	0.56
Maize storage		
Yes	155	86.1
No	25	13.9

Storage technologies		
Room storage in an ordinary bag	103	66.5
Room storage in hermetic Purdue bag	52	33.5
Length of storage		
Do not store	25	13.9
1.00-3.00	48	26.7
4.00-6.00	99	55.0
≥7.00	8	4.4

Source: Field Survey, 2015

B. Cost and returnto Farming Enterprise with the use of Post-harvest technologies

Table 2: shows the result of the profitability analysis of maize cultivation based on the post-harvest storage technology adopted by farmers as well as their production performance. Table 1 had shown that majority of the farmer's stored maize in their house with the use of ordinary bags made of polypropylene and hermetic Purdue Improved Cowpea bags. The result shows a significant difference between the total revenue earned by farmers that adopted Purdue bags (₦88,904.15) and those who adopted ordinary bags (₦114,123.61) at 1% level of significance. The difference between the total cost of production incurred by farmers who adopted Purdue bags (₦46,625.96) and those who adopted ordinary bags (₦60,287.98) was significant at 1%. Also, the difference between the total variable cost of production by farmers that adopted Purdue bags (₦41,410.58) and those who adopted ordinary bags (₦53,261.42) was significant at 1%, suggesting that there is a difference in the cost of production incurred by farmers who adopted post-harvest storage Purdue bags and ordinary bags made of polypropylene. The gross margin of adopters of Purdue bags was ₦47,493.57 while that of ordinary bag adopters was ₦60,862.19 The net farm income for adopters of Purdue bags was ₦42,278.22 while that of ordinary bag adopters was ₦53,835.63 which were both significantly different at 1%. The rate of return was respectively 0.91and 0.89 for Purdue and ordinary bag adopters, implying that for every ₦1.00 invested in the enterprise, a net income of ₦0.91 and ₦0.89 was realized by adopters of Purdue bags and ordinary bags respectively. The operating cash expense ratio calculated for Purdue and ordinary bag adopters was 0.47, indicating that from every ₦1.00 generated from the business with the use of post-harvest storage technologies, ₦0.47 was invested as the running cost into the business while the benefit-cost ratio was 1.91 and 1.89 for Purdue and ordinary bags adopters respectively implying that for every ₦1.00 invested in maize production with the use of post-harvest storage technologies, ₦1.91 and ₦1.89 was realized as income respectively. All these ratios affirm that maize production in the study area with the use of post-harvest storage technologies, be it Purdue improved cowpea (PIC) bag and ordinary bag is a profitable venture.

A. Table 2: Cost and return to Farming Enterprise with the use of Post-harvest technologies

	Item	Pooled	Purdue bag users	Ordinary bag users	T-test
1	**REVENUE**				
	Quantity	1359.95	1189.99	1475.80	6.11***
	Price per kg	76.94	74.71	77.33	3.19***
A	**Total revenue (TR)**	**104,634.55**	**88,904.15**	**114,123.61**	**4.37*** **
2	**VARIABLE COSTS**				
I	Cost of seed	1730.23	1619.82	1796.22	0.07
II	Cost of fertilizer	9699.61	9591.60	9948.63	0.03
III	Cost of pesticides	2094.50	2039.28	2107.43	0.78

IV	Cost of labour	32236.57	22936.32	35214.99	6.19***
V	Cost of transportation	2482.65	2526.47	2995.16	2.87***
VI	Cost of storage	1465.25	2697.09	1198.99	7.52***
B	**Total variable cost(TVC)**	**49,708.81**	**41,410.58**	**53,261.42**	**3.98*** **
C	**Gross margin**=(TR-TVC)	**54,925.74**	**47,493.57**	**60,862.19**	4.50***
3	**FIXED COSTS**				
I	Cost of hoe	1607.47	1025.27	1699.01	5.31***
II	Cost of cutlass	1526.83	941.45	1738.99	4.82***
III	Cost of bucket	252.43	229.37	299.86	0.93
IV	Cost of Knapsack sprayer	712.90	710.80	764.11	0.27
V	Cost of file	484.74	308.49	505.17	4.82***
VI	Land rent	2013.89	2000.00	2024.27	1.00
D	**Total fixed costs (TFC)**	**6598.26**	**5215.38**	**7031.41**	4.84***
E	Total cost (TC=TVC+TFC)	56,307.07	46,625.96	60,292.83	4.72***
F	Net Farm Income(NI)= (GM-TFC)	48,327.48	42,278.22	53,830.78	3.68***
G	Profit margin (F/A*100)	46.18	47.55	47.16	
H	Rate of Return (F/E)	0.86	0.91	0.89	
	Operating Cost Expense Ratio (B/A)	0.48	0.47	0.47	
	Benefit Cost Ratio (A/E)	1.86	1.91	1.89	
	Net Farm Income Ratio (F/C)	0.88	0.89	0.87	

Source: Field survey, 2015*** Significant 1%

C. Factors influencing adoption of post-harvest technology

The factors that influenced the adoption of post-harvest technology among maize farmers were examined using multinomial logistic regression model. None use of storage technology was taken as the base for comparison. The results from the logistic regression model were obtained using the maximum likelihood estimation technique and are presented in Table 3. An additional insight was also provided by analyzing the marginal effects. The likelihood estimates of the logit model indicated that the Chi-square statistic value of 136.685 was statistically significant at 1% level. This indicates that variation in the adoption of Purdue and ordinary bag post-harvest storage technologies is explained by the estimates of the specified explanatory variables.

The result of the multinomial logit analysis revealed that the probability of adopting Purdue improved cowpea (PIC) bag relative to none use of storage technology is positive and significantly determined by years of farming experience, quantity of maize harvested for storage, marital status, and membership of an association. As shown,, increase in years of farming experience, a unit increase in the quantity of maize harvested, being a member of farmers association, and being married increased the chance of adopting Purdue bag post-harvest storage technology by 0.04%, 5.33e-05%, 0.027% and 0.48% respectively, while a unit increase in household member and an increase in the amount of credit borrowed from any source reduced the probability of adopting post-harvest storage technology by 0.0054% and 5.0e-06% respectively.

Also, the probability of adopting ordinary bag relative to none use of storage technology was significant and positively determined by years of farming experience, the quantity of maize harvested and marital status. Thus,, increase in years of farming experience, a unit increase in the quantity of maize harvested, and being married increased the chance of adopting post-harvest storage technology by 0.17%, 0.002%, and 10.40% respectively, while an additional increase in the amount of credit borrowed from farmers association/cooperative societies reduced the probability of adopting post-harvest storage technology by 1.95e-05 %. This implies that farmers who have long years of farming experience, harvest maize produce in large quantities, who are members of a group, who are married, who have minimal household size and borrowed less credit are more likely to adopt post-harvest storage technologies.

Farming experience of the farmers is significantly associated with the probability of adopting Purdue bag and ordinary bag storage technologies. The probability of adopting Purdue bag and ordinary bag relative to none use of storage technology increases by 0.04% and 0.17% respectively, for every additional increase in farmer's years of farming experience, implying that farmers with longer farming experience are more likely to adopt the use of storage technologies than those with lesser farming experience. Adetunji*et al.* (2007), Okoede-Okojie and Onemolease (2009) found that as farming experience increases, the probability of adopting post-harvest storage technology also increases.

Similarly, the marital status of the farmers significantly influenced the likelihood of adopting Purdue and ordinary bag storage technologies. Being married increases the probability of adopting Purdue bag and ordinary bag by 0.48% and 10.4% respectively. This is in line with Ajijola*et al.*, (2015) who reported that the probability of adoption of storage technologies increases as farmers get married because the need to ensure household food security becomes critical.

Quantity of maize harvested had a significant effect on the choice of Purdue bag and ordinary bag storage technologies. The likelihood of adopting Purdue bag and ordinary bag storage technology relative to none use of storage technology increased by 5.3e-05% and 0.0022% for every additional increase in the quantity of maize harvested. This is further corroborated by the findings of Adetunji*et al.* (2007) and Okoruwa*et al.* (2009) who found that increase in the quantity of maize harvested, increases farmer's chance of adopting storage technologies.Membershipof farmer's association/cooperatives had a positive influence on adopting Purdue bag storage technology relative to other storage technologies. Farmers who belong to an agricultural-related group had a higher chance of adopting Purdue storage technology by 0.0078%. Being a member of an association enables farmers to interact with other farmers, share experience and knowledge about improved technology as well as provides access to credit and other farm inputs. This finding is supported by the findings of Ademiluyi (2014).

Household size negatively influenced the probability of adopting Purdue bag storage technology relative to other storage technologies. An increase in the household size by one member decreased the probability of adopting Purdue bag storage technology by 0.0054%. The amount of credit borrowed also significantly but negatively influenced the likelihood of adopting Purdue bag and ordinary bag storage technology relative to none use of storage technology. An increase in the amount of credit borrowed by the farmer decreased the probability of adopting Purdue bag and ordinary bag storage technologies by 5.0e-05% and 1.95e-05%. Debt obligation as well as increased in household expenditure with increase in household size tend to reduce the amount of funds farmers could have used in purchasing storage technologies.

Table 3: Factors influencing the adoption of post-harvest technologies among maize farmers

Variables	Coefficient	Standard error	P-value	Marginal effects
Purdue bag				
Sex of respondent	-1.1189	1.4222	0.4314	0.11
Marital status	4.1231	1.6834	0.0143**	0.48
Level of education	0.1655	0.1082	0.1262	0.0023
Household size	-0.3717	0.1818	0.0409**	0.0054
Farming experience	0.2418	0.0995	0.0151**	0.42
Main Occupation	-0.2134	1.0641	0.8411	0.0078
Quantity of maize	0.0032	0.0012	0.0085***	5.3e-05

harvested				
Amount of credit borrowed	-3.54463e-05	9.01606e-06	0.0001***	5.0e-05
Membership of association	3.4715	1.3399	0.0096***	0.027
Farm size	0.3229	1.0180	0.7511	0..0014
Constant	-11.287	2.4825	0.0000***	
Ordinary bag				
Sex of respondent	-0.8795	1.1191	0.4319	0.0439
Marital status	3.0829	1.3772	0.0252**	10.40
Level of education	0.1117	0.0993	0.2605	0.081
Household size	-0.2647	0.1622	0.1026	0.19
Farming experience	0.2519	0.0927	0.0066***	0.17
Main Occupation	-0.7778	0.9506	0.4132	0.48
Quantity of maize harvested	0.0031	0.0012	0.0076***	0.0022
Amount of credit borrowed	-2.74117e-05	7.991e-06	0.0006***	1.9e-05
Membership of association	0.2530	0.8256	0.7593	0.43
Farm size	-0.1907	0.9843	0.8463	0.084
Constant	-6.2412	1.9305	0.0012***	
Number of observation	180			
Percentage predicted correctly	71.1%			
Log-likelihood value	-103.076			

Source: Field Survey, 2015

IV. CONCLUSION

The study examined the socio-economic factors influencing the adoption of improved storage technologies among maize farmers in Kwara State, Nigeria. Results show that majority of the farmers were in their late middle age, married and had fairly large family sizes. Furthermore, most of the respondents were members of cooperative societies/farmers associations who could easily have access to new information. It was also revealed that farmers stored maize in rooms in their houses with the use of ordinary bags made of polypropylene and Hermetic Purdue Improved Cowpea (PIC) bags as a result of its affordability and accessibility. They are also popular because they can be used to prevent maize from insect and weevil infestation and from being stolen by thieves. The results also revealed that maize farming was a profitable enterprise with the use of different post-harvest storage technologies and that cost of labor accounts for larger percentage of the cost expended by users of Purdue bag and ordinary bag storage technologies in maize production. Factors significantly influencing farmer's decision to adopt post-harvest storage technologies were revealed and the significant factors include quantity of maize harvested, farming experience, marital status, amount of credit borrowed, household size, and membership of farmer's associate on / cooperative.

To enhance the adoption of post-harvest storage technologies with a view to improving maize output, preserve and supply good quality maize all year round, there is the need to encourage farmer's participation in cooperative society/ farmers associations, which will serve as an avenue for them to have more information about storage technologies. Provision of various technologies that can reduce the cost of labor in farm enterprise is important in the study area since the cost of labour employed by farmer's accounted for a larger percentage of the cost expended in farming operations. It was observed that maize production with the use of post-harvest storage is a profitable venture hence efforts should be made to access the storage technologies to smallholder farmers. This will go a long way to enhance their income earning capacity.

REFERENCES

[1] Aphilis, (2013). African postharvest losses information system

[2] Adebisi, G. L., Owolade, E. O., and Jatto, B.O., (2015) Assessment of the Use of Maize Storage Structures among Maize Farmers in IdoLocal Government Area of Oyo State Open access library journal 2:1-10

[3] Ademiluyi, I. O. (2014). Adoption of Improved Maize Varieties among Farmers in Bassa Local Government Area of Plateau State, Nigeria.International Journal of Innovative Agriculture and Biology Research, 2(4):26-33.

[4] Adetunji, M. O. (2007). Economics of Maize Storage Techniques by Farmers in Kwara, State Nigeria, Pakistan Journal of Social Sciences, 4(3):442-450

[5] Ajijola S., Awoyemi D. O., Egbetokun O.A., Odetola S. K., (2015). Socio-economic effect on the use of information and communication technology among rural farming households in Afijio local government area, Oyo-State, Nigeria.Journal of Economic and Sustainable Development. 6(19):51-58.

[6] Bett, C., and Nguyo, R. (2007). Postharvest storage practices and techniques used by farmers in semi-arid eastern and central Kenya. Proceedings of African crop science conference proceedings, 8:1023- 1227.

[7] Bourne, M. C. (2004). Selection and use of postharvest technologies as a component of the food chain.Journal of Food Science, 69(2):43-46.

[8] Eleweanya, A. N., Uguru, M. I., Eneobong, E. E., and Okocha, P. I. (2005). Correlation and path coefficient analysis of grain yield-related characters in maize (Zea mays) under Umudike conditions of South Eastern Nigeria. Agro-science Journal. 4 (1): 24-28

[9] FAOSTAT, (2015). Statistical Database of the Food and Agriculture Organization of the United Nations. Available at http://www.fao.org/faostat/en/#data/QC

[10] Oluwasola, O. (2010) Stimulating rural employment and income for cassava (Manihot sp.) processing farming households in Oyo State, Nigeria through policy initiatives Journal of Development and Agricultural Economics 2(2):18-25.

[11] Oluwasola, O. (1998) Women in Agriculture in Nigeria. In A. Sesay and A.I. Odebiyi (eds.) Women in Society and Development (pp 59 – 720Dokun Publishing House, Ibadan, Nigeria.

[12] Osundare, F. O. (2013). Socio-economic study of maize farmers under different production technologies in southwest Nigeria Journal of Agricultural Technology, 9(5):1069-1080.

[13] Ojo, S. O. (2003). Productivity and technical efficiency of poultry egg production in Nigeria, International Journal of Poultry Science, 2(6):459-464.

[14] Onuk E. G., Ogara I. M., Yahaya, H., and Nannim, N., (2010). Economic Analysis of Maize Production in Mangu Local Government Area of Plateau State, Nigeria.PAT Journal, 6(1): 1-11.

[15] Olakojo S. A., and Akinlosotu T. A. (2004). Comparative study of storage methods of maize grains in southwestern Nigeria African Journal of Biotechnology, 3(7):362- 365.

[16] Okoede-okojie, D. U., and Onemolease, E. A. (2009). Factors affecting the adoption of yam storage technologies in the northern ecological zone of Edo State, Nigeria Journal of Human Ecology, 27:155-160.

[17] Okoruwa, V. O., Ojo, O. A., Akintola, C. M., Ologboho, A. D., and Ewete, F. K. (2009) Post-harvest grain management storage techniques and pesticides use by farmers in South-West Nigeria, Journal of Economics and Rural Development 18(1): 53-72

[18] Sekumade, A. B., Akinleye, S. O. (2009). Comparative Analysis of Maize Storage Technologies in North Central Nigeria, Research Journal of Social Sciences, 4: 7–14.

[19] USDA, (2015). Nigerian Corn Production by year.

[20] World Bank, FAO, NRI, (2011). Missing Food: the case of Post-harvest Grain Losses inSub-Saharan Africa. In: Economic Sector Work Report No. 60371-AFR. World Bank, Washington, DC.