 J Hum Ecol, 27(2): 155-160 (2009)

Factors Affecting the Adoption of Yam Storage Technologies in the Northern Ecological Zone of Edo State, Nigeria

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KEYWORDS Adoption. Yam. Storage. Technologies. Nigeria

ABSTRACT The study examined the factors affecting the adoption of modern yam storage technologies by farmers in the northern ecological zone of Edo State, Nigeria. Data were collected from 127 respondents and analysed with frequency tables and logistic regression. Data analysis reveals yam barn to be the major traditional storage method used by farmers (100%). Their adoption of improved yam storage technologies was low with shelving being the most widely adopted (28.3%). Logistic regression analysis indicates that age (odd ratio = 0.67), farm size (3.68), farming experience (1.25) and contact with extension agents (1.79) had significant ($p<0.05$) influence on farmers' adoption of improved yam storage technology. Major constraints limiting the farmers' adoption of these technologies were ignorance of technology existence (100%), non-availability (46.5%) and high cost (34.6%)of the some of the storage technologies. Farmers should be provided with information regarding improved storage methods as well as exposed to training on their use.

INTRODUCTION

Post-harvest storage losses have been of concern even to the United Nations which brought it to international focus when it declared in 1975 that "further reduction of post-harvest food losses in developing countries should be undertaken as a matter of priority" (FAO and UNEP 1981). This led many national governments to take more seriously the problems of storage of agricultural produce. Although attempts have been made to increase agricultural production by bringing more land into cultivation and use of improved seeds and chemicals, these have been less effective because any apparent gain in production has been lost from the moment the food crop is harvested to the time it reaches the consumers' table (Oracca-Tetteh 1978).

Post-harvest food losses are one of the important sources of food insecurity in Africa. According to AMCOST (2006), pre- and post-harvest food crop loss among African countries is estimated at about 10%, which is higher than the global average. Although it has been difficult to quantify post-harvest storage losses, some claim that as much as 20% of yam tubers may be lost to pest attack in storage (Sauphanor and Ratnadass 1985 cited by FAO 1998). Tropical root and tuber crops such as cassava, yam, and cocoyam are important household food security and income generating crops in many African countries (AMCOST 2006; FAO 1998), and over 5 million people are said to depend on these crops for food, feeds and income. Thus, losses associated with these crops limit the potential income of the farmers, threatens food security and exacerbates conditions of poverty among rural households, whose income stream depends on the ability to store excess farm produce for a later date (Ntiokwana 1999 cited by Thamaga-Chitja et al. 2004).

Although farmers have been known to practice indigenous storage of farm produce, these have been known to be less effective compared to modern storage methods. According to Mughogho (1989), Omoruyi and Orhue (1991) and Tyler (1982), produce stored under the traditional system usually do not keep long and farmers usually suffer great losses. Thus, there is need for the extension service to actively pursue and communicate knowledge of improved storage methods to farmers since effective storage plays an important role in stabilising food supply at the household level by smoothing the seasonal food production.

For storage to be effective, crop losses must be minimised (Takavarasha and Rukovo 1989). Improved methods of storage have therefore been

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developed which attempt to minimize crop losses and reduce the causes of post-harvest deterioration of yam tubers (Ezeike 1995; Fiagan 1995). The agricultural extension service in Nigeria and in Edo State particularly has disseminated and encouraged farmers' adoption of improved yam storage methods (Osagie 1992). It was hoped that farmers' adoption of these technologies would lead to food losses, improved income and enhanced food security (Florkowski and Xi-Ling 1990).

However, the widespread and continued use of traditional storage practices by small scale and subsistence farmers in Edo State despite considerable losses usually associated with these methods (Mughogho 1989) and the availability of improved storage methods (Osagie1992) warrant investigation.

Objectives of the Study

The study examined the factors affecting the adoption of yam storage technologies by farmers in the northern ecological zone of Edo State, Nigeria. Specifically, this study looked at the following objectives, which are to:

1. Identify the personal characteristics of yam producers in the study area.
2. Ascertain the yam storage methods the farmers are presently using.
3. Assess the farmers' awareness and adoption of improved yam storage methods recommended by the state extension service.
4. Determine the factors affecting the adoption of these improved storage methods by the farmers.
5. Ascertain the seriousness of post-harvest losses and identify the yam storage problems faced by farmers in the study area.

Hypothesis of the Study

The following null hypothesis was tested:

Ho: There is no significant association between farmers' socio-economic characteristics and adoption of improved yam storage techniques.

METHODOLOGY

The northern ecological zone of Edo State is characterized by savannah vegetation, and lies within the northern agricultural zone of the state agricultural extension service. Farming is the predominant economic activity of the people yam, maize and cassava are major crops grown.

The zone comprises of 5 Local Government (LGAs) councils namely Owan West, Owan East, Etsako Central, Etsako West and Akoko – Edo. Owan West and Etsako West LGs were randomly sampled. Owan West consists of 9 communities (Sabo, Ukhomora, Emen, Okhia, Ovbiokhuan, Oke, Abiosi, Uzeba and Okpuje) of which 3 communities (Abiosi, Oke and Uzeba) were randomly sampled. In Etsako West LG, 3 communities were also randomly sampled (Ayoywiri, Usogun and Agbede) from a total of 10 (Fuga, Agbede, Ekperi, Udaba, Ayoywiri, Azukara, Ogomeri, Usogun, Ugbekpe, Anegbete). From each selected community (6 in all) 25 yam farmers were randomly sampled, making the total respondents 150.

Data were gathered from the respondents by means of a structured interview schedule. Only 127 of the expected 150 responses were found useful for data analysis. Analysis of data was done using frequency table, percentage, mean and logistic regresson.

Measurement of Variables

Adoption of Improved Storage Technologies: For the purpose of hypothesis test, a farmer is taken to be an adopter if he/she is using any of the recommended storage method.

Yam Storage Constraints: The seriousness of specific post-harvest storage problems of the farmers was measured on a 5 point Likert scale: very serious (scored 5), serious (4), moderately serious (3), not serious (2) and undecided (1). To decide which constraints were serious, a mean score of 3.00 was used as in Tologbonse *et al* (2006). This mid-point was obtained by summing the assigned scores (1+2+3+4+5) to get 15 and dividing by 5 to get 3.00. The weighted mean score for each problem was obtained by multiplying the frequency scores with the point scale for each rating and dividing by the sample size (number of respondents). Any variable/storage problem having a mean score $\geq$3.00 is considered serious while any with a weighted mean score <3.00 is considered not serious.

RESULTS AND DISCUSSION

Personal Characteristics of Respondents

Results of Table 1 show that yam production in the study area is male dominated (94.5%), which

may be attributed to the intensive labour requirement of yam cultivation (e.g. heap construction, pegging and digging). Most respondents were married (83.5%) while more than half (60.6%) had a low educational experience not exceeding primary education, which may impede their acceptance of improved storage technologies since education facilitates farmers' adoption of innovations (Onemolease 2005).

Most respondents were above 40 years (81.16%) indicating an ageing farming population, which is consistent with the assertions of Ekong (2003) that farming in the rural areas of Nigeria is dominated by older farmers because of the out-migration of youths to urban centres in search of white-collar jobs. The farmers are quite experienced in yam cultivation since the majority of them (45.6%) have been cultivation the crop for over 20 years. About 52% of them have 5-9 members in their household, implying that they have access to costless labour thereby reducing labour cost.

The small operational scale of the farmers (67.7% had 1ha and below) may limit output and constrain adoption of modern storage facilities (Bhattacharyya 1997). The economic return to yam production in the study area is very low: only 43.3% realized an annual income of 20,001-40,000 naira (147.05 – 294.11 US dollars). The finding suggests that the farmers produced other crops, as confirmed by the researchers' observation of the farming system in the study area, which is characterized by mixed cropping.

Tale 1: Personal characteristics of respondents (n = 127)

Variables	*Frequency*	*Percentages*
Gender		
Female	7	5.5
Male	120	94.5
Marital Status		
Married	106	83.5
Single	21	16.5
Educational Level		
Did not go to school	24	18.9
Primary school	53	41.7
Secondary school	41	32.3
Post – secondary education	9	7.1
Age (years)		
30 and below	3	2.4
31 – 40	47	36.5
41 – 50	63	49.6
51 & above	40	31.5
Farming Experience (years)		
10 & below	30	23.7
11 – 20	39	30.7
21 & above	58	45.6
Household Size		
4 & below	17	13.4
5 – 9	66	52.0
10 – 14	32	25.2
Above 14	12	9.4
Farm Size (hectare)		
1.0 & below	86	67.7
1.1 – 2.0	24	18.9
2.1 & above	17	13.4
*Income (₦)**		
20, 000 & below	24	18.9
20,001 – 40,000	55	43.3
40,001 – 60,000	26	20.5
> 60,000	22	17.3

*Exchange rate: 1US Dollar to 136 Naira
Source: Field survey, 2006

Traditional Storage Methods Used by Respondents

Table 2 reveals the major traditional storage method used by the respondents and the frequency or regularity of use. The result indicates that storage of yam tubers in barns was the major storage method used by the respondents in the study area (100%). However, in terms of frequency of use, yam barns (mean = 4.87) and heaping of yam tubers and covering them on the floor with grass/soil (mean = 3.69) were regularly used as storage methods by the respondents. These methods have been criticized of been an ineffective and inefficient method of storage (Mughogho 1989).

Table 2: Traditional storage methods of respondents

Methods	*Major method used*		*Regularity (Mean)*
	Freq	*%*	
Yam barns	127	100.00	4.87*
Heaping and covering of yam tubers	-	-	3.69*
Bare floor/ground	-	-	1.91
Raised platform	-	-	1.54
Pits/holes dug in ground	-	-	1.51

* Regular (mean > 3.50)
Source: Field survey, 2006

Respondents' Perception of Storage Losses

The result of Table 3 shows that 44.1% of the respondents experienced serious post-harvest storage losses, 21.3% suffered very serious losses while 34.6% considered the losses not serious. The finding shows that majority of the yam

Table 3: Respondents' perception of storage losses

Perception	*Frequency*	*%*
Not serious	44	34.6
Serious	56	44.1
Very serious	27	21.3
Total	127	100.0

Source: Field survey, 2006

producers encountered severe post-harvest storage losses, and this calls for serious concern.

Storage Problems Faced by Respondents

From Table 4, it is seen that tuber rottening, with a mean of 3.56, was the only serous storage problem faced by the respondents. Others such as rodent attack (3.17), infection of tubers (2.39) and insect/termite attack (2.25) were not considered serous (mean<3.50).

Table 4: Storage problems faced by respondents

Problems	*Mean*
Rottening of tubers	3.56*
Rodent attack	3.17
Infection of tubers	2.39
Insect/termite attack	2.25
Theft of tubers	2.10

*Serious (mean > 3.50)
Source: Field survey, 2006

Respondent Awareness and Adoption of Improved Storage Methods

Results of Table 5 indicate that none of the respondents were aware of or adopted refrigeration and gamma irradiation as a yam storage method. About 26.8% were aware of the use of chemicals in yam storage but only 11% have adopted it, and while 30.7% were aware of shelving (i.e. storing in barns having shelves on which yams can be placed), only 28.3% have adopted it. The result shows that the awareness and adoption of improved yam storage methods by farmers in the study area are low, with shelving being the most widely adopted method.

Respondent Classification Based on Use of Improved Storage Methods

Table 6 reveals that the majority of the respondents (66.9%) did not adopt any of the improved yam storage methods while 33.1% have adopted at least one of the methods. The result indicates that the level of adoption was very poor in the study area, and probably explains the seriousness of post-harvest storage losses experienced by the farmers (see Table 3)

Table 6: Respondent classification based on use of improved storage methods.

Category	*Frequency*	*Percentage*
Non – adopter	85	66.9
Adopter	42	33.1
Total	127	100.0

Source: Field survey, 2006

Factors Responsible for Respondents' Non – Use of Improved Storage Methods

The result of Table 7 reveals that ignorance of existence of storage methods (100%), non – availability (46.5%) and high cost (34.6%) of storage technologies accounted for farmers non-use of modern storage technologies, while about 20% claimed not to understand their use. The percentage of non – response was high because respondents felt they could not explain their non – adoption for technologies whose existence they are not aware of such as refrigeration and irradiation. Thus, all (100%) claimed ignorance of existence.

Table 5: Respondent awareness and adoption of improved storage methods (n = 127)

Modern methods	*Awareness*		*Adoption*	
	*Freq **	*%*	*Freq **	*%*
Refrigeration (i.e. use of fridge/deep freezer)	-	-	-	-
Gamma irradiation	-	-	-	-
Shelving (i.e. string in barns having shelves on which yams can be placed).	39	30.7	36	28.3
Use of chemicals (inhibit sprouting/prevent root rot)	34	26.8	14	11.0

* Multiple response
Source: Field survey, 2006

Table 7: Factors responsible for farmers non – use of improved storage methods

Factors	*Serious*		*Not serious*		*Non response*	
	*Freq **	*%*	*Freq**	*%*	*Freq **	*%*
Ignorance of existence	127	100.0	-	-	-	-
Non – available of technology	59	46.5	12	9.4	56	44.1
High cost of methods	44	34.6	29	22.8	54	42.5
Do not understand how to use it	25	19.7	36	28.3	66	52.0

* Multiple response hence total exceed sample size (127)
Source: Field survey, 2006

Relationship Between Farmers' Characteristics and Adoption of Improved Storage Methods by Farmers (Logistic Regression)

Table 8 shows that a significant ($p<0.05$) association exist between farmers age (Odd ratio = 0.67), farming experience (1.25), farm size (3.68), contact with extension agents (1.79) and adoption of improved yam storage technology. The R square (0.683) shows that about 68% of the odd/ likelihood of farmers adopting improved storage technology is explained by the independent variables with a percent prediction of 92%. The significance of the model is given by the model chi-square (85.56; $p<0.05$).

Older farmers were 0.67 times less likely to adopt improved storage methods compared with younger farmers, corroborating the finding of Lemchi et al. (2003) that younger farmers are more likely to adopt farm innovations than the older farmers being more willing to take risk. Farmers with longer farming experience are 1.3 times more likely to adopt improved storage technology compared with the less experienced farmers. Onemolease (2005) obtained a significant negative relationship between farming experience and adoption of technologies. Farmers with large farms are almost 4 times as likely as their farmers with smaller farms to adopt improved storage technology. Farmers with larger farms have been reported to be positively disposed to use of farm innovations (Agbamu 1993), largely because having larger farms strengthens farmers capacity to produce more, which he/she would be interested in preserving from loss. Farmers' in contact with extension agents are almost 2 times (odd ratio = 1.78) as likely as those with no contact to adopt improved storage technology. The result agrees with the findings of Atala et al. (1992). Extension agents, by interacting with farmers, are able to convince them to implement recommended farm innovations.

Table 8: Relationship between farmers' characteristics and adoption of improved storage method (Logistic regression)

Variables	*Odds ratio (OR)*	*Prob. level*
Sex	0.001	0.683
Education	1.18	0.683
Age	0.67*	0.000
Farming experience	1.25*	0.000
Household size	1.133	0.243
Farm size	3.68*	0.005
Income	0.82	0.503
Contact with extension agents	1.79*	0.044
Model Estimates		
% correct prediction	92.1	
Nagelkerke R Square	0.682	
Model Chi-square	85.56	

Source: Computed from field Survey data, 2006.

CONCLUSION AND RECOMMENDATIONS

The results of the study indicated that yam farmers in the study area experienced serious post-harvest yam storage losses particularly due to tuber rot. Despite the dissemination of improved storage methods most farmers claimed not to be aware and are yet to adopt the technologies. Reasons for the low adoption was, apart from lack of awareness of the storage methods, include non – availability and high cost of the storage technologies in addition to a poor understanding of technology utilization (19.7%).

To facilitate the adoption of modern post-harvest yam storage technologies among farmers in the study area, the following recommendations are proposed:

Extension agents should actively disseminate information on improved storage techniques to yam farmers in the study area through use of mass media (e.g. radio/tv) and farmers groups.

To solve the problem of inadequate capital, farmers should pool their funds through joint contribution. Such funds can be used to purchase the costly storage facilities.

Available sources of storage technologies should be communicated to farmers by the zonal extension service.

Use of some modern storage technologies require specialised skills and technical know-how which farmers lack. Farmers should be trained on the use of these improved storage methods such as chemicals and refrigeration.

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