Economic Analysis of Maize Storage Techniques Utilized by Farmers in Osun State

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ABSTRACT: This study was carried out to analyze the economics of maize storage techniques employed by farmers in Olorunda local government area of Osun state. The specific objectives were to describe the socio-economic characteristics of maize farmers, investigate maize production practices and experience, examine types and characteristics of maize storage system used, as well as identify storage-related challenges encountered by respondents. Random sampling technique was employed to select 119 respondents in the study area. Data were collected with the aid of structured interview schedule and analyzed using both descriptive and inferential statistical tools.

Result of the analysis revealed that the mean age of respondents was 47.08years, 74.8% were male, while 84.9% were married with the mean household size of 6 members. The most common type of storage technique adopted in the study area was the crib, and the technique was also found to be the most profitable with a profit of #83,813 per ton of maize stored. Pest infestation and disease outbreak were recognized as the most serious challenges to the stored grains. The logit regression analysis revealed that there was significant relationship between socio-economic characteristics of respondents and storage decision of respondents. Further analysis established that significant relationship exists between the cost of storage and revenue generated by the farmers. Farmers are encouraged to form cooperative societies through which joint efforts could be made to put in place adequate and effective storage facilities for corporate use of members. This will reduce per head storage cost.

Keywords: Maize, Storage, Cost, Revenue

INTRODUCTION

All agricultural produce, either of plant or animal origin starts deteriorating almost as soon as they are harvested and it leads to losses. This deteriorating may start within few minutes of harvest resulting in partial or total loss within days. Maize, an important food for man and an ingredient of poultry and livestock feeds, is often with high moisture content during harvest and it is liable to microbial deteriorating even during storage (Asiedu et al, 2002). This sort of loss is unfortunate because it both lowers the income and standard of living of the farmers and also leads to waste of a large fraction of what is supposed to be a contribution to the nation's food supply.

Spoilage and total wastage of grains can be minimized through the use of storage technologies (Strahan et al., 2003). Storage is a way or a process by which agricultural produce or products are kept for future use (Thamaga-Chitja et al, 2004). Maize need to be stored from

one harvest to the next in order to maintain its constant supply all year round and to preserve its quality until required for use. Studies have shown that most Nigerian farmers stored maize in various indigenous storage structures for the purpose of self sustenance and household food security (Adekunle and Nabinta, 2006; Meikle et al, 2004). Meretiwon (1981) conducted a survey in the Oyo Local Government Area, which lies in the Southern Guinea Savanna zone of Nigeria. He identified four types of maize storage systems and these were: the traditional crib, modern ventilated crib, storage in bags and room storage in which the grains are piled on the floor in a room.

Storage structures either traditional or modern have been described as physical environment, medium or containers within which agricultural produce can be preserved against theft pest and diseases for a desirable period of time. Other functions of storage are crop/seeds preservation, quality improvement, quantity equalization and market price stabilization of agricultural produce. The various forms of storage techniques available for maize ranged from open field storage, polythene, jute bags, platforms tree storage to built structures (Sekumade and Akinleye, 2009). Storage techniques had been categorized to traditional and modern. Traditional techniques include Calabashes, gourd, earthen ware pots, underground storage, jute bags, baskets and sacks, aerial storage (tree trunks), storage on the ground or on drying floors, open platforms; while modern techniques consist of reinforced concrete silos, steel bins, rhombus, improved traditional bins, solid wall bins cribs and silos (Agboola, 2001; Udoh et al, 2002; Komolafe, 2006; Swiss Agency for Development and Cooperation (SADC), 2008). Successful farm storage enables farmer to sell maize when price are attractive (off season) but with the existing indigenous storage techniques, the market is subject to considerable short term and inter-seasonal price fluctuations, which affect the interests of both producers and consumers. The traditional storage techniques are very local and crude; some have been found to be functional, needing just little improvements while others are outdated and hazardous (Thamaga-Chitja et al, 2004). A major problem in agricultural development in the nation has been lack of modern and appropriate storage technologies for grains. Most new improved technologies innovation packages are improperly set up and also very expensive for small rural farmers in Nigeria (Agboola, 2001).There have been shortages in the supply of grains during off seasons despite government efforts at increase food production. The reason for this is the use of indigenous storage techniques which makes supply to the market short term and price fluctuations during seasons

which affects the interest of the farmer and consumers. The lack of adequate modern and appropriate storage facilities and its inefficiency where available, has led to high storage losses.

Another problem that must be investigated is the cost implication of the improved technological innovation e.g. sophisticated storage facilities, silos, ware houses, expensive fungicide and insecticide treatment. Structures that will effectively preserve the quality and quantity of crops may be too expensive and complicated for the level of operation of the target farmers (Agboola, 2001). Problems caused by insects and rodents are more prominent than those caused by fungi. Storage losses stand as a major problem if food security is to be attained in the nation. There is therefore need to carryout studies on the situation of Nigeria maize storage systems. In the light of these, this study focused on analyzing the economics of maize storage techniques employed by farmers in Olorunda Local Government Area of Osun State. The specific objectives are to describe the socioeconomic characteristics of maize farmers, investigate maize production activities and types of various storage techniques used in the study area. Others include computing the profitability of various storage techniques as well as identify challenges associated with the existing storage techniques used in the study area. There were two hypotheses of the study. The first one stated that there is no significant relationship between socio-economic characteristics of respondents and storage decision. The second one stated that there is no significant relationship between cost of storage and revenue generated by the farmers.

METHODOLOGY

The study was carried out in Olorunda Local Government Area (LGA) of Osun State, Nigeria. Its headquarters is in Igbonna. According to the 2006 population census the LGA has a total population of 131,761. It has about 41 communities partially involved in farming because some areas are urban. Olorunda LGA shares boundary to the North with Ifelodun LGA, to the East with Boripe LGA, to the South with Osogbo LGA and to the West with Surulere LGA of Oyo state. There are two main climate seasons, the dry and wet seasons. The dry harmarttan period is usually experienced from November to March while the wet season usually starts around early April and ends towards the month of October. The annual rainfall ranges from 120 - 170cm while maximum average temperature ranges from 33-38^{0}C. Heterogeneous religions include Christianity, Islam and traditional worshippers.

The population for this study includes all crop farmers that are involved in maize cultivation in Olorunda local government area. Random sampling technique was employed. The list of registered crop farmers was collected at the LGA secretariat and respondents were reandomly selected from the avaialble list. A total number of 120 maize farmers formed the sample size. Primary data were obtained with the help of structured interview schedule. Information obtained covers the areas of socio-economic characteristics, production practices, storage techniques, challenges faced by respondents in the study area. Analytical tools used in the study include both descriptive and inferential.

-Descriptive analytical tools (tables, means, percentages, frequency counts) were used to analyze the socio-economic characteristics of respondents, types of storage techniques and challenges to the storage activities of the farmers.

-Budgetary analysis was carried out to investigate the profitability of different storage techniques.

Gross Margin (GM) = Total Revenue (TR) – Total Variable Cost (TVC)

Where: TR = Quantity retrieved from storage × Selling price

TVC = transport cost+ cost of packaging materials + labour cost + cost of chemicals

Total cost = TVC + Depreciated Fixed Cost (DFC)

Fixed cost items include containers used for storage + Constructions made for storage

Profit (π) = TR–TC

-Logit regression analysis was employed to identify determinants of maize storage decision of respondents.

-The ordinary least squares (OLS) regression analysis was employed to establish the relationship between storage cost and revenue generated by respondents.

The logit model takes the functional form $y_i = x_i\beta + \varepsilon_i$

Where y = 1for decision to store maize or y = 0 for decision not to store maize (i.e. to sell fresh immediately after harvest). The variable y_i is the observed contingent valuation bid by individual $_i$, y_i is a latent measure, and xi denotes the independent variables. β is a vector of parameters and ε_i the error term distributed as independent normal with zero mean and constant variance (0^2). The explanatory variables in the regression model are a set of variables dealing with socio-economic characteristics.

The logistic regression model was specified as: $Y = f(X_1, X_2, X_3, X_4, X_5, X_6)$

Where

Y= Storage decision (Yes = 1, otherwise = 0)

X_1= Sex of respondent (Male = 1, otherwise = 0)

X_2= Age of respondent (Years)

X_3= Years spent in school (Actual)

X_4= Household size (Actual)

X_5 = Farming experience (Years)

X_6 = Farm size (Hectares)

The OLS regression model employed to establish the relationship between storage cost and revenue generated by respondents was specified as: $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$

Where

Y = Total revenue (₦)

X_1 = Storage cost (₦)

X_2 = Transportation cost (₦)

X_3 = Storage Technique (Crib=1, Otherwise=0)

X_4 = Farming experience (years)

X_5 = Farm size (hectares)

X_6 = Period of storage (months)

RESULT AND DISCUSSION

Socio economic Characteristics of Respondents

Table 1 shows the age distribution of maize farmers in the study area. The result shows that 49.5% are between 41-50 years while 7.3% are less than 30 years. The mean age is 47.08 years. This implies that many of the farmers are still within economically active age. The study revealed that 74.8% of farmers are male while 25.2% are female. The study revealed that 84.9% are married while the mean household size was found to be 6. The average number of years spent in school by the respondents was 10years.This implies that many of the respondents had up to secondary school education.

Table1: Socio-Economic Characteristics Distribution of Respondents, n = 119

Variables	Frequency	Percentage
Age		
<30	9	7.3
31-40	21	17.6
41-50	59	49.5
51-60	17	14.2
> 60	13	10.7
Sex		
Male	30	25.2
Female	89	74.8
Marital status		
Single	8	6.7
Married	101	84.9
Widowed	7	5.9
Divorced	2	1.7
Separated	1	0.8
Household size		
1-3	6	5.1
4-6	65	54.7
7-9	38	31.9
10-13	10	8.3
Educational status		
No formal schooling	14	11.8
Primary school	23	19.3
Secondary school	39	32.8
Tertiary school	43	36.1
Years of Schooling		
<5	16	13.5
6-10	35	29.5
11-15	42	35.4
16-20	26	21.8

Source: Field Survey, 2014

Maize Production Practices and Experience

Result of the analysis as contained in table 2 shows that 41.1% of the farmers has 11-20 years of farming experience while 3.2% has above 40 years farming experience. The mean farming experience was found to be 17.57 years. Analysis established the fact that almost half (49.6%) of the respondents inherited the farmlands they use. It was found that 57.8% has 0.1-1.0 hectares while 5.8% has above 2 hectares. The average farm size was 1.4 ha. Result showed that more than half (59.7%) of the respondents claimed to practice mixed farming system. It was found that large numbers of the respondents depend on cooperative society loans (41.2%) and personal savings (38.7%) to finance farm activities.

Table2: Maize Production Practices and Experience of Respondents, n = 119

Variables	Frequency	Percentage
Farming Experience (years)		
1-10	36	32.8
11-20	49	41.1
21-30	17	14.1
31-40	10	8.3
> 40	4	3.2
Land acquisition		
Inheritance	59	49.6
Rentage	24	20.2
Leasing	23	19.3
Purchase	11	9.2
Gift	2	1.7
Farm size (ha)		
≤ 1.0	69	57.8
1.1-2.0	32	27.9
Above 2	18	15.9
Major Source of finance		
Bank	6	5.0
Cooperative	49	41.2
Family	12	10.0
Friends	2	1.7
Personal Savings	45	38.7
Others (daily contribution)	5	3.4

Source: Field Survey, 2014

Types and Characteristics of Storage Techniques Used

Data contained in Table 3 shows the method of storage technique used by the respondents. Result revealed that 26.9% do not store at all, 20.2% make use of Jute bags, 2.5% makes use of elevated barn, 43.7% makes use of cribs, 2.5% makes use of metal drums, 0.8% makes use of silo and 3.4% makes use of open platform. Going by Agboola (2001), Udoh et al, (2002), Komolafe (2006) and SADC (2008)'s classifications, it could be inferred that many of the respondents are graduating from the use of traditional storage techniques to modern ones. The most common maize storage technique employed by the farmers in the study area is the crib, which refers to a small building specially made for storing corn. This result is in line with finding of Meretiwon (1981) when he identified four types of maize storage systems among farmers in the Oyo Local Government Area which include the traditional crib, modern ventilated crib, storage in bags and room storage in which the grains are piled on the floor in a room.

Finding as presented in table 3 implies that majority (73.1%) of maize producers store for future sale. Investigation revealed that 67.2% of respondents have the storage facility located off

farm while 5.9% claimed that the storage facility employed is located on farm. Result showed that 47% of respondents claimed that the damage done to stored grains was due to pest infestation, 48.7% of the respondents made use of phostoxin chemical during storage. Average length of storage was five months.

Table3: Types and Characteristics of Storage Techniques Used, n=119

Variables	Frequency	Percentage
Method of Storage		
No storage	32	26.9
Jute Bags	24	20.2
Elevated barn	3	2.5
Metal drum	3	2.5
Cribs	52	43.7
Silo	1	0.8
Open platform	4	3.4
Storage Location		
No storage	32	26.9
On farm	7	5.8
Off farm	80	67.2
Length of storage (months)		
No storage	32	26.9
1-6	28	23.5
7-12	59	49.5
*__Type of damage__		
No storage	32	26.9
Rot	1	0.8
Shrinkage	3	2.5
Sprouting	7	5.9
Pest infestation	57	47.9
Birds	2	1.7
Thieves	7	5.9
Moulding	17	14.3
*__Name of chemical__		
No storage	32	26.9
Cypermetrine	3	2.5
Phostoxin	58	48.7
DD force	6	5.0
Actellic	9	7.6

***Multiple responses**
Source: Field Survey, 2014.

Profitability of Various Storage Techniques Used

Result of data analysis shows the profitability of various storage techniques employed by the respondents. The cost, revenue and profit of the various storage techniques were examined. The most profitable storage system was the crib with profit of #83,813 per tonne of maize stored.

This is followed by metal drums (#81,667), jute bags (#42,064), open platform (#39,300) and elevated barn (#37,200).

Table 4: Profitability of Various Storage Technique Used

Storage Technique	Cost (₦)	Revenue (₦)	Profit (₦)
Cribs	22,122	105,935	83,813
Jute bag	6,627	48,691	42,064
Open platform	8,300	47,600	39,300
Metal bin	7,228	88,895	81,667
Elevated barn	10,500	47,700	37,200

Source: Field survey, 2014

Storage-related Challenges faced by Respondents

Data analysis showed that 71.9% of the farmers endorsed pests and diseases as source of challenge to effective maize storage, 42.9% identified with financial challenge while 18.5% claimed to be faced with transportation challenge.

Table 5: Constraints faced with the existing storage techniques

Constraint	*Frequency	Percentage
Finance	51	42.9
Transport	22	18.5
Labour	7	5.9
Pest and disease	85	71.4
Theft	3	2.5
Security	5	4.2

***Multiple Responses**

Source: Field survey, 2014

Relationship between socio-economic characteristics of respondents and storage decision

Age (X_1) of the maize farmers is significant at 1% and the coefficient bears a positive sign. This is an indicator that age of the maize farmers has a positive effect on storage decision of respondents. It implies that as respondents advance in age, there is higher probability of deciding to store some or all of the produced grains for future use or sale. Farming experience

(X_5) is significant at 10% and the coefficient bears a positive sign. This indicated that farming experience of the respondents have a positive effect on the storage decision. It implies that as respondents acquire more farming experience in years, there is higher probability that the farmer will decide to store for future use (sale) instead of selling immediately after harvest. The remaining four variables (sex, years spent in school, household size and farm size) were not statistically significant. However, as significant relationship was found between some socio-economic characteristics of respondents and storage decision, the null hypothesis was rejected.

Table6: Relationship between socio-economic characteristics of respondents and storage decision

Variable	Coefficient(β)	P-value	Significance remark
Sex	-0.263	0.621	Not significant
Age	0.122	0.001	Significant at 1%
Yrs in school	0.080	0.153	Not significant
HH size	0.066	0.582	Not significant
Farming exp	-0.075	0.068	Significant at 10%
Farm size	0.044	0.126	Not significant

Source: Data Analysis, 2014

Relationship between total revenue earned by the respondents and storage cost

Result of the OLS regression analysis showed the relationship between total revenue which is the dependent variable and the explanatory variable the adjusted R^2 is 0.688 which implies that 69% of the variation in revenue generated was explained by the explanatory variables included in the model.

Storage cost (X_1) of maize carried a positive sign and was significant at 1% which shows that the cost of storage has a positive effect on the revenue generated by respondents. This established the fact that proper storage is associated with a cost but there is a benefit attached to it at the long run. This is attached to the fact that total revenue increases as a result of respondents selling the stored maize during off season when the price is higher. Storage technique (X_3) is positively and significantly related with revenue. Respondents using the crib technique generate more revenue in the study area. Period or length of storage (X_6) also carried a positive sign and was significant at 1%, which implies that the longer the length of storage the higher revenue generated by respondents. The remaining three variables (depreciation cost,

farming experience and farm size) were found not to be significantly related with revenue generated by respondents. The result therefore shows that there is a significant relationship between total revenue and the cost of storage. Hence the null hypothesis is rejected.

Table7: Relationship between total revenue earned by the farmers and the cost of storage.

Variable	Coefficient	t-value	Significance remark
Storage cost	0.628	7.931	Significant at1%
Transport cost	- 0.046	-0.585	Not significant
Storage technique	0.044	2.487	Significant
Farming exp.	0.180	1.409	Not significant
Farm size	-0.067	-0.892	Not significant
Storage duration	0.276	3.202	Significant at 1%

Source: Data analysis, 2014

Adjusted $R^2 = 0.688$

F = 58.18 (Significant at 1%)

CONCLUSION AND RECOMMENDATIONS

Based on findings, this study concluded that the most common storage technique employed by the respondents was the crib and it was found to be the most profitable. Factors influencing storage decision among respondents include age and farming experience. Storage-related challenges to the farmers include pests/ disease, finance, and transportation. Cost of storage, storage technique employed and length of storage were found to have effects on the revenue generated by the respondents.

The following were recommended based on findings in this study: Crop farmers are advised to form cooperative groups through which joint efforts could be made to put in place adequate and effective storage facilities (e.g. the crib and metal drums) for corporate use of members. Joint efforts will also be focused on solving the financial challenges by releasing timely loans to members at very low interest rates. This study also recommends that the government should repair damaged major roads so as to ease the problem of transportation experienced by crop farmers.

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