Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria
Number: Twenty-Fifth Annual Conference
Theme: Enhancing the Role of Public and Private Extension in Soil Conservation and Agricultural Productivity
Date: 28-29, July 2020
Venue: Usmanu Danfodiyo University, Sokoto, Nigeria
ISSN: 1595 – 1421.http://aesonnigeria.org/ConfProc . **Email**: editorinchief@aesonnigeria.org

Usage of Maize Storage Technologies for Postharvest Loss Prevention in Oke-Ogun/Saki Area of Oyo State, Nigeria

https://dx.doi.org/10.4314/jae.v25i1.2S

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Abstract

This study assessed the usage of traditional and improved maize storage technologies by farmers in Saki/Oke-Ogun area of Oyo State. The study was conducted from April-July, 2019; using a validated structured questionnaire for data collection. A multi-stage sampling technique was adopted to draw a sample of 191 maize farmers. Grain storage technologies usage frequency was measured on a four-point Likert-type numerical scale 4-1 as regularly, occasionally, seldom, and never respectively. Descriptive analysis of collected data revealed regular usage of both raffia woven basket (98.9%) and traditional crib (96.1%) by respondents. Sampled maize farmers overwhelmingly indicated non-usage of rhombus (98.0%) to store their produce; with a substantial number (88.2%) rarely using containers. Further analysis shows maize farmers used improved crib regularly (76.5%). Inert atmosphere silo (80.4%), conventional silo (76.5%), purdue improved crop storage (90.2%) and zerofly™ (65.4%) bags were never used to store maize by farmers. Chi-square(χ^2) *analysis revealed significant (p≤0.05) associations between technology* *usage and socioeconomic characteristics of maize farmers. The cost and bulk storage nature of improved storage technology could be traced to its never used; while awareness is also very low on the use of those cost effective bagged technologies.*

Keywords: Storage usage, traditional grain technology.

Introduction

Grain storage technologies in some literatures were also regarded as techniques, methods or structures. Nigerian Stored Products Research Institute (NSPRI, 1988) and Food and Agricultural Organisation, (FAO, 1994) classified storage technologies into three categories namely: traditional grain storage technologies (TGST); improved grain storage technologies (IGST) and modern centralized grain storage technologies (MCGST).

On-farm and off-farm TGST are so regarded because of its age long practice by farmers and are mostly made of unrefined local materials. They are usually small sized and often used for short term storage, which includes raffia baskets, cribs, rhombus, platforms/shelf, open field, roof, fireplace, storage bags, earthen pots and gourds (Adesida, 2008; Picard and Proctor, 1994; NSPRI, 1988). Improved grain storage technologies are products of innovations, storage ingenuity and/or efforts made by certain individuals, local and international non-governmental organizations or research institutions at improving the traditional structures which were subsequently patented as technologies. They are often used for medium term storage, classified into on-farm, domestic and commercial storage technologies. Examples are ventilated metal crib, polyethylene/jute bags, metal/brick bins, and hermetic storage technology which include zerofly™ bag, purdue improved crop storage (PICS) bag and plastic or metal drum with screw caps. Modern centralized grain storage technologies which includes silos and warehouses were developed to store grains for long time purpose; usually gigantic structures with sophisticated operations used for commercial storage of grains or strategic grains reserve (Udoh *et al*., 2000). Farmers use these technologies to store excess grains produced during production season which are released into markets during lean/low production season, this is done to balance demand–supply chain to even-out price fluctuation of the commodities in markets places. Some are also used to store seeds for the next planting season. It's relevant therefore to assess the frequency of usage of these technologies by maize farmers in the study area for storage of maize and other grains.

Methodology

Oyo State is one of the states in the South-west geopolitical zone of Nigeria which lies between longitude $2^{0}4^{1}$ and $4^{0}3^{1}$ East and $7^{0}2^{1}$ and $9^{0}2^{1}$ North (fig. 1). According to National Population Commission (2006), Oyo State has a population of 5,591,589 people with 33 local government areas (LGAs) divided into four agricultural zones

ISSN: 1595 – 1421.http://aesonnigeria.org/ConfProc . **Email**: editorinchief@aesonnigeria.org

(Ogbomoso zone, Ibadan/Ibarapa zone, Oyo zone and Oke-Ogun/Saki zone). The indigenes are the Yoruba's with appreciable proportions of other Nigerians and Nationals of neighbouring West Africa countries like Benin Republic, Ghana and Republic of Togo. Majority of the people engage in farming and trading with appreciable proportion in the civil service. The climatic conditions of the State encourage the cultivation of cash crops such as cashew, citrus, cocoa, and kolanut, arable crops like maize, cassava, and yam performs well on the fertile soil.

The list of blocks, cells, and all the registered names (totaled 1873) and contact addresses of maize farmers in Oke-Ogun/Saki Agricultural zone were obtained from Oyo State Agricultural Development Programmes (OYSADEP). A multistage sampling technique which involves proportionate selection of 50% of the component blocks that made up each zone was done at random; followed by proportionate selection of 20% of component cells that made up each selected block, done also at random, and finally, proportionate selection of 20% of maize farmers in each selected cell (Table 1). Thus, a total of 191 maize farmers were selected for this study.

Table 1: Sampling of maize farmers in Oke-Ogun/Saki Agricultural Zone of Oyo State

Zone	Blocks	No of maize farmers	50% of Blocks	20% of cells in each Block	20% of maize farmers	Total no of farmers for sampling
Oke-Ogun/Saki	Saki-West	260	Saki-East	Aba-Isehin	52	52
				Aba-Ogbomoso		
	Irepo	250				
	Olorunsogo	224				
	Saki-East	202	Iwajowa	Igbo-Eleeru	40	40
				Aba-Okeho		
	Iwajowa	200				
	Kajola	244				
	Orelope	245	Kajola	Ilero, Ilua	49	49
	Atisbo	248				
			Atisbo	Tede, Ago-Are	50	50
Total		**1873**			**191**	**191**

Adapted from Sangotegbe *et.al*, (2012)

To test the research model, a questionnaire survey was used to gather research data. The data collection instrument contained self-generated lists of traditional and improved grain storage technologies; which required respondents to indicate the ones in-use, where multiple responses were allowed. Frequency of usage of listed technologies was measured using a four-point Likert-type numerical scale 4-1 as

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regularly, occasionally, rarely and never respectively. Content validity of the data collection instrument was adapted from previous literature (Del Siege, 2010) and facial validity was carried out by experts, items found ambiguous were removed.

IBM-SPSS statistics 20.0 was used for data analysis. Data collected were subjected to descriptive statistical analysis. Inferential statistical tool such as Chi-square was used to test the association between storage technologies usage and socioeconomic characteristics of the farmers.

Results and Discussion

Frequency of Use of Grain Storage Technologies

Table 2 reveals *regular* usage of both "raffia woven basket" (98.9%) and "traditional crib" (96.1%); this is in line with Adebisi *et. al.,* (2015) who reported regular usage of both technologies in certain parts of Oyo state different from the present area of this study. Rhombus was *never* used by 98.0% of the sampled respondents just as eighty-five percent of sampled respondents indicate they *never* used "underground pit" to store their grain; Adesina *et al*., (2019); Adejumon and Raji, (2007); and Jelle, (2003) all affirmed the use of these technologies mainly in the dry tropics of Northern Nigeria. Eighty-eight percent of the sampled respondents *rarely* use "containers" in the traditional storage technology category; this is a priori expectation in the sense that storage in containers is a form of domestic and off-farm techniques often used mainly for storage of shelled grains at homes (Nigerian Stored Products Research Institute, 1982). Gourds are the hard, dried outside cases of certain fruits or vegetable, nearly 83% of sampled respondents indicated they *never* used these small capacity containers for storage of their produce, this is line with Picard and Proctor (1994) and NSPRI (1988) which asserts the predominant use of gouts in some villages in very few states of Northern Nigeria.

Table 2 further shows that 76.5% of maize farmers in the study area use "improved maize crib" *regularly* to store their maize. Inert atmosphere silo and conventional silo were *never* used to store maize by 80.4% and 76.5% of sampled respondents respectively; this may not be too surprising as these technologies were developed for bulk and commercial storage of grains. Also, PICS and zerofly™ bags were *never* used to store maize by 90.2% and 65.4% of sampled farmers respectively; despite that bags technologies are very cost effective, the poor usage is a clear indication of little or no awareness created on these technologies for storage of maize and other grains by farmers across the study locations. Nwaubani, *et.al*; (2020) reported the use of PICS and zerofly™ bags in markets storehouses within Ibadan metropolis by traders and grain merchants for insect-pest management. In a similar vein, the *rare* (62.7%) usage of "warehouse bagged storage" could be attributed to low level of awareness and adoption of electronic warehouse receipt system (e-WRS) as a way of reducing storage loss (Benson *et.al*, 2019) in certain parts of the study area.

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Table 2: Usage of traditional and improved grain storage technologies

Storage Technology	Reg %	Occa %	Rarely %	Never %	Wtd Score	Wtd Mean	Ranking
Traditional							
Raffia woven basket	98. 9	1.1	Nil	Nil	762	3.99	1st
Traditional maize crib	96.1	2.0	2.0	Nil	744	3.89	2nd
Roof Storage	23.6	17.6	35.3	23.5	461	2.41	3rd
Hang-Over fire	21.6	19.6	33.3	25.5	452	2.37	4th
Earthen Pots	2.0	27.5	64.7	5.9	431	2.26	5th
Containers	Nil	5.9	88.2	5.9	382	2.00	6th
Gout	2.0	2.0	13.7	82.4	241	1.26	7th
Underground pit	Nil	Nil	15.7	84.3	221	1.16	8th
Rhombus	Nil	2.0	Nil	98.0	189	0.99	9th
Improved							
Improved maize crib	77.4	22.6	Nil	Nil	721	3.77	1st
Hermetic drum	Nil	21.6	58.8	19.6	385	2.01	2nd
Warehouse bagged storage	Nil	6.8	64.4	28.8	340	1.78	3rd
Conventional silo	Nil	Nil	23.5	76.4	236	1.24	4th
Inert atmosphere silo	Nil	Nil	19.6	80.4	228	1.19	5th
ZeroFly Bags™	3.1	11.0	20.4	65.4	290	1.51	6th
Purdue Pmproved Crop Storage (PICS) Bag	Nil	2.0	7.8	90.2	214	1.12	7th

Source: Field Survey, 2019. Reg = Regularly, Occa= Occasionally, Wtd Mean= Weighted Mean

Associations between Storage Technology Usage and Socio-Economic Characteristics of Maize Farmers

Tables 3-6 show that storage technologies in both traditional and improved categories which includes hang-over fire, pots, roof storage, inert atmosphere silo, hermetic plastic/metal drum, conventional silo, improved crib, warehouse bagged storage, shows significant associations with the years of storage experience of maize farmers (Table 3). This is a strong indication that the experienced gained over the years using these technologies could have exposed them to proper usage thereby harnessing the storage benefits therein; Ainembabazi and Mugisha (2014) found a relationship between adoption-usage and years of experience with agricultural technologies in maize and other crops. Analysis of storage technologies usage in relation to the educational status of maize farmer (Table 4) reveals to a large extent that, educational status of farmers played a vital role in usage of these technologies with relationships showing high level of significance (p = 0.000), most especially in the improved technologies category. This implies that the educational status of the respondents enabled them to utilize the benefits these technologies presents; Adebisi *et al.*, (2015) recorded similar observation in their study.

Socio-economic characteristic of respondents such as household size (Table 5) and annual income (Table 6) were significantly associated with storage technology usage ($p \leq 0.05$). Household size of farm family shows availability of manual labour;

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consequently, large household size could increase production output leading to availability of more farm produce for consumption, sales as well as for storage purposes, this supports Urgessa (2015) that household size and others are the most significant variables that affects agricultural productivity which could in- turn affect storage.

Data in Tables 3, 4, and 6 show that there were no significant associations (p≥0.05) between variables such as years of storage experience; educational status; and annual income of the respondents, and usage of Raffia Palm Basket storage technology. This could be due to the fact that the technology is made from indigenous/native knowledge of weaving with hands, learned from family members, which has become a tradition in consonance with Benson, (2020) who found out that tradition and family members are the main sources of information and training on traditional technologies. Similarly, usage of bags storage technologies (PICS and ZeroFly) and years of storage experience of the respondents are not significantly associated (p≥0.05), the implication of this is that farmers gained little experience due to poor usage; a consequence of low awareness about the technologies.

Table 3: Association between the storage technologies used and years of storage experience

Variables	Years of Storage Experience		
	χ^2-value	**Df**	**Contingency Coefficient**
Inert atmosphere silo	33.213*	15	0.384
Hermetic drum	112.567*	30	0.608
Conventional silo	36.757*	15	0.401
Improved maize crib	49.580*	15	0.453
Warehouse bagged	137.661*	30	0.646
PICS bags	25.803	30	0.755
ZeroFly bags	18.002	21	0.674
Raffia palm basket	17.244	16	0.620
Hang-over Fire	190.292*	45	0.706
Pots	133.466*	34	0.640
Roof storage	198.726*	60	0.713
Traditional Crib	16.377	30	0.280

***P≤0.05. Source: Field Survey, 2019**

Table 4: Association between the storage technologies used and educational status

Variables	Educational status		
	χ^2-value	**Df**	**Contingency Coefficient**
Inert atmosphere silo	77.119	3	0.535
Hermetic drum	27.009	6	0.351
Conventional silo	57.534	3	0.480
Improved maize crib	12.554	3	0.248
Warehouse bagged	45.169	6	0.436
PICS bags	29.938	6	0.367
ZeroFly bags	23.342	4	0.246
Raffia palm basket	42.621	6	0.241
Hang-over Fire	206.272	9	0.720
Pots	85.378	9	0.555
Roof storage	26.616	5	0.728
Traditional Crib	26.948	6	0.351

***P≤0.05. Source: Field Survey, 2019**

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Table 5: Association between the storage technologies used and household size

Variables	Household Size		
	χ^2-value	Df	Contingency Coefficient
Inert atmosphere silo	37.353	7	0.404
Hermetic drum	96.527	14	0.578
Conventional silo	44.684	7	0.435
Improved maize crib	75.501	7	0.531
Warehouse bagged	78.956	14	0.540
PICS bags	31.797	14	0.377
ZeroFly bags	31.342	14	0.374
Raffia palm basket	38.632	12	0.381
Hang-over Fire	167.079	21	0.682
Pots	113.021	21	0.608
Roof storage	184.598	28	0.700
Traditional Crib	76.205	14	0.533

***P≤0.05. Source: Field Survey, 2019**

Table 6: Association between the Storage Technologies used and annual income

Variables	Annual Income		
	χ^2-value	Df	Contingency Coefficient
Inert atmosphere silo	48.822	9	0.450
Hermetic drum	69.556	18	0.516
Conventional silo	41.173	9	0.420
Improved maize crib	16.942	9	0.285
Warehouse bagged	77.314	18	0.536
PICS bag	214.927	18	0.727
ZeroFly bags	121.342	12	0.540
Raffia palm basket	101.774	22	0.365
Hang-over Fire	120.181	27	0.620
Pots	49.966	27	0.454
Roof storage	139.927	36	0.649
Traditional Crib	54.966	18	0.472

***P≤0.05. Source: Field Survey, 2019**

Conclusion and Recommendations

Maize storage technologies in the traditional category recorded good usage amongst the sampled respondents; this could be traced to the fact that usage knowledge was learned over time from family members. Maize farmers in the study area indicated poor usage of improved storage technologies consequence of cost of the technology, bulk storage nature and low level of awareness created for the cost effective ones. The socio-economic characteristics of maize farmers such as years of storage experience, their educational status, the size of their family household as well as the annual income accrued from their farming enterprise played vital roles in usage or otherwise of these technologies.

Bagged storage technologies (ZeroFly and PICS) are affordable and simple to use, there is the need for raising the level of awareness on the use of these cost effective bag technologies by extension agents, NSPRI and other relevant stakeholders.

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