Determinants of use of recommended food grains storage technologies or sustainable food security programme in urban southwest Nigeria

[1]Abiodun, A. A. [2] Apantaku, S. O. and [2] Awotunde, J. M.
Nigerian Stored Products Research Institute, Km. 3, Asa Dam Road, Ilorin, Nigeria,
Department of Agricultural Extension and Rural Development, University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria
E-mail: aaabiodun@yahoo.com

Abstract
The study was conducted to analyse determinants of use of modern food grains storage technologies, and identify grain storage related problems in urban Southwest Nigeria so as to sustain food security programme. A pre-data survey was carried out to enumerate recommended grain storage technologies in the study area. Descriptive units of data were normalized to standard Z-scores, and data analysed with descriptive and inferential statistics. Modern and improved grain storage technologies in use were: improved cribs (7.22%), stores and warehouses (16.66%) drum and hermetic containers (15.55%) polythene-lined bags (10.55%) silos (1.11%). Indigenous technologies were local crib (6.66), ceiling top under roof (0.55%), sacks (37.77%) bowls (3.88%). Progressive Z-scores from 0-3 for favourable statements showed that technology attributes and communication factors were favourable determinants of use of modern grain storage technologies. While situational factors and perceived disincentives had few favourable determinants, perceived incentives had none. At $p<0.05$, gender ($X^2=7.04$) was significantly related to use of modern food grains storage technologies while educational status ($X^2=5.5$) was not. Correlation analyses showed significant relationships between age ($r = 0.91$), quantity of grains stored ($r = 0.98$) and use of modern grain storage technologies. There is significant difference among farmers', traders' and housewives' levels of use of recommended technologies ($W = 2213.4$, $X^2 = 19920.6$). Use of various communication channels in parallel, linking research and recipients and commercial warehousing are recommended.
Keywords: Determinants, Use, Grain technology, Storage.

INTRODUCTION

Nigerian Food Security Programme is centred on three-tier grain storage programme; Strategic Grain Reserve, Buffer Stock and On-Farm Storage Programme (Talabi 1998). The On-Farm storage programme is for small scale farmers to adopt technologically improved small scale storage structures and store 85% of the total grains required for food security. The deficit is to be complemented by activities of grain merchants and households (Olumeko 1998). Some factors are accountable for households not meeting its food security needs. National Agricultural Marketing Council (2002) discovered that income is the most single important determinant of a household ability to meet its food security needs. Some authors have pointed out more food insecurity in rural areas than in urban areas. Rose and Charlton (2002) opined that food insecure households were more likely to live in rural areas.

The Southwest zone of Nigeria lies between latitudes 6^0 and 9^0 north of Equator and longitudes 2^0 and 6^0 east of the Greenwich Meridian. Some grains are produced two times in a year in the zone and as such food security is supposed to be guaranteed in urban households. However, some authors have pointed out ineffective post-harvest handling systems in the zone (Salunkhe,Kadam and Chavan 1985; FAO 1989; FAO 1990). All these do not guarantee good storage of grains, hence a threat to sustainability of food security programme. Hindmarsh and Trotter (1990) pointed out that cost reduction in grain storage has been achieved mainly by tackling specific physical and biological problems causing losses of quality and quantity, whereas more fundamental problems arise. The objective of this study is to analyse the use of recommended food grains storage technologies and assess its determinants for sustainability of urban food security programme in Southwest Nigeria. In doing this, the following specific objectives were addressed.

a. Enumerate recommended food grains storage technologies.
b. Determine the levels of use of recommended and indigenous food grains storage technologies.
c. Assess the determinants of use of recommended food grains storage technologies.
d. Investigate grain storage related problems.

METHODOLOGY

Agricultural institutions and research centres involved in post-harvest research in the zone were surveyed for recommended grain storage technologies. These organizations were:

- Nigerian Stored Products. Research Institute (NSPRI), Ibadan:

i. International Institute for Tropical Agriculture (IITA), Ibadan;
ii. Institute for Agricultural Research and Training (IAR&T), Ibadan;
iii. Crop Storage Unit (CSU) of Federal Ministry of Agriculture, Ibadan;
iv. Department of Agricultural Engineering, University of Ibadan;

v. Department of Agricultural Engineering, Obafemi Awolowo University, lle-Ife;
vi. Post-harvest Centre of Federal University of Technology, Akure;

Thereafter a purposive sampling of Oyo, Ondo and Ogun States was done based on geographical location as regards grains production and handling. Then a multi-stage sampling of respondents was carried out.

Half of agricultural zones were purposively sampled from each State of study. In each zone two urban communities with population of more than 5,000 people were purposively sampled based on ADPs' recommendations of grain productions and handling in each case. Ondo State with only two agricultural zones had 4 urban communities sampled from one agricultural zone. Purposive random sampling of 5 farmers, 5 traders and 5 housewives was done in each of 4 urban communities in each State. A total of 180 respondents were interviewed for the study. In Oyo State, Ibadan, Shaki, Igbetti and Iddo were sampled whereas in Ogun State, Iperu, Obafemi-Owode, Abeokuta and Odeda were sampled. Urban communities sampled in Ondo State were, Akure, Owo, Oke-Agbe and Ikare.

Descriptive units in Likert type scale of very high, high, average, low and very low were converted to normalize standard scores to identify favourable determinants. Proportions of each descriptive unit were converted to cumulative proportion and cumulative proportion at mid-point calculated. The sigma score of each cumulative proportion at mid-point was found from the Table of normal deviates z corresponding to proportions p of a dichotomized unit normal distribution. The lowest sigma (z) score was added to sigma score of all descriptive units. These scores were then rounded up to the nearest figure.

Determinants were categorized into situational factors, communication factors, technology attributes, perceived incentives and perceived disincentives.

Determinants with z – rounded progressively from 0 to 2 and up to 3 were adjudged favourable. Hypotheses were tested with Chi-square, Pearson Product Moment Correlation and Coefficient of Concordance.

RESULTS AND DISCUSSION

Ages of respondents in relation to grains storage from Table 1 follows the normal distribution pattern. Many respondents do not store grains in the early parts of their life. The necessity to store grains occurs in the later part of life before it declines at old age. Importance of grain storage to meet social demands is very high with respondents between the ages of 31 to 60 years. Grains are used for consumption, for seed, for feed and for payment of wages in kind (FAO 1979). More than half of the respondents (55%) were female, mostly housewives, while the rest were male most of who were traders. Nwaubani et al (2007) discovered no significant relationship between gender and adoption of modern food storage technologies in rural communities of Edo State Nigeria, signifying that gender is not crucial in rural grain storage since most post-harvest activities are carried out by women. Less than one-fifth of the respondents (17.8%) had no formal education while more than one quarter (29.8%) had tertiary education. The rest (30.0% and 27.8%) had primary and secondary education respectively. This revealed the level of education in urban South-west Nigeria. Some authors have highlighted the importance of proper education in the use of improved farm practices (Ochu 2000, Alfred 2000). Quantity of grains stored revealed the subsistence level of grain holdings in urban Southwest Nigeria. More than three-quarter of the respondents (76.7%) stored between 1 to 20kg of grains while one-tenth (10.6%) stored between 21-40kg bags. Higher quantities of between 81-100, and over 100kg bags were stored by very few respondents respectively (3.3%). Salunkhe et al 1985 contended that commercial storage is usually done at large scale level. This can be bulk storage by government agencies which have adequate economic and technical support or by agro-industrialists as well as big time farmers. There is need for aggressive extension work in the study area to sustain the food security needs.

Table 1: Socio-economic Characteristics of Respondents

Variables	Frequency	Percentage
Age (Years)		
20-30	13	7.2
31-40	44	24.4
41-50	65	36.1
51-60	40	22.2
61-70	16	8.9
71-80	2	1.1
Gender		
Male	81	45
Female	99	55

Variables	Frequency	Percentage
Educational Status		
No for Education	32	17.8
Primary Education	44	24.4
Secondary Education	54	30.0
Tertiary Education	50	27.8
Quantity of Grains Stored in 100kg bags		
1-20	138	76.7
21-40	19	10.6
41-60	10	5.6
61-80	1	0.6
81-100	6	3.3
>100	6	3.3

Recommended Food Grains Storage Technologies

Many institutions in South-West Nigeria have developed grain storage technologies at domestic, farm and commercial levels. Nigerian Stored Products Research Institute (NSPRI) recommended that for effective storage, wholesome grains should be sorted out from infected/infested and damaged ones. It must be kept at safe moisture level ranging from 9-15% depending on the type of grain, treated and stored in recommended storage structure. It then produced structures like oil-drums with tight-fitting caps, plastic containers and polythene-lined sacks for domestic storage. Improved cribs have been developed for farm level storage, while stores and warehouses and inert atmosphere silos are recommended for commercial level storage of grains. The Crop Storage Unit (CSU) developed modified oil drum for household use coupled with galvanized iron sheet of different capacities; 1 metric tonne, 600kg, 400kg, 300kg and 150kg respectively. For farm level storage 2 metric tonne and 5 metric tonne indoor structures as well as 10 metric tonne reinforce concrete cement were developed. International Institute for Tropical Agriculture (IITA) adapted the ventilated crib while Centre for Post Harvest Studies Obafemi Awolowo University developed a laterite concrete silo which was still at its pilot stage. Food Storage Research Laboratory, Federal University of Technology, Akure developed a wooden silo which is only for training and demonstration purposes.

Use of Indigenous and Recommended Food Grains Storage Technologies.

Levels of use of recommended grain storage technologies were observed to be nearly even among farmers, traders and housewives (Table 2).

Table 2: Levels of Use of Recommended Storage Technologies

Recommended Technology	Farmers Frequency	%	Traders Frequency	%	Housewives Frequency	%	Total Frequency	%
Sorting of Grains	57	(31.7)	54	(30.0)	59	(32.8)	170	(94.4)
Determination of moisture content	59	(32.8)	59	(32.8)	60	(33.3)	178	(98.9)
Pre-Storage Treatment	52	(28.9)	34	(18.9)	42	(23.3)	128	(71.1)
Storage in modern structure	32	(17.8)	26	(14.4)	34	(18.9)	92	(51.1)

Use of various levels of recommended storage technologies for effective grain storage recorded high score among sorting of grains (94.4%), determination of moisture content (98.9%) and pre-storage treatment of grains (71.1%). However, the most important level of recommendation, storage in modern structure, recorded the lowest score with just half of the respondents (51.1%) using modern grain storage structure in urban Southwest Nigeria. This situation needs attention for sustainability of food security system.

Table 3: Use of indigenous and recommended storage structures

Technology	Farmers Freq. %	Traders Freq. %	Housewives Freq. %	Farmers Freq. %
Indigenous				
Platform	0.00	0.00	0.00	0.00
Mud Rhumbu	0.00	0.00	0.00	0.00
Local Crib	10 (5.55)	1 (0.55)	1 (0.55)	12 (6.66)
Ceiling Top under Roof	0.00	0.00	1 (0.55)	1 (0.55)
Hanging over Fireplaces	0.00	0.00	0.00	0.00
Sacks	18 (10.0)	30 (16.66)	20 (11.11)	68 (37.77)
Bowls	0.00	3 (1.66)	4 (2.22)	7 (3.88)

Recommended				
Improved crib	10 (5.55)	2 (1.11)	1 (0.55)	13 (7.22)
Stores and Warehouses	15 (8.33)	14 (7.77)	1 (0.55)	30 (16.66)
Drum and Hermetic Containers	6 (3.33)	4 (2.22)	18 (10.0)	28 (15.55)
Polyethylene-lined bags	1 (0.55)	4 (2.22)	14 (7.77)	19 (10.55)
Silos	0.00	2 (1.11)	0.00	2 (1.11)

In urban Southwest Nigeria, use of recommended grain storage structures (51.1%) was about the same with that of indigenous structures (48.9%). Sacks constituted the most commonly used indigenous structure (37.77%). While this is confirming the subsistence level of grains holding, there is need for aggressive extension work, especially among traders and housewives so as to sustain grain holdings for food security.

Table 4: Determinants of Use of Recommended Food Grains Storage Technologies

Determinants	Standard Scores (Z-rounded)				
	Very High	High	Average	Low	Very Low
Situational Factors					
Literacy	0	1	1	2	2
Capital Availability	0	1	1	2	3
Tradition	0	1	1	2	2
Storage Duration	0	1	2	2	3*
Need Based Technology	0	1	2	2	3*
Communication Factors					
Extension Agent Contact	0	1	2	2	3*
Adoption by Peers	0	1	2	2	3*
Media Presentation	0	1	2	2	3*
Cooperative Society Initiative	0	1	2	2	3*
Local Leader Presentation	0	1	2	3	3*
Technology Attributes					
Technology Cost	0	1	1	2	3
Efficiency of Technology	0	1	2	2	3*
Accessibility of Technology	0	1	2	2	3*
Flexibility of Technology	0	1	2	2	3*
Stored Quantity	0	1	2	3	3*
Technology Location	0	1	1	2	3
Perceived Incentives					
Credit Facilities	0	1	1	2	2
Participatory Technology Development	0	1	1	2	3
Government Subsidy	0	1	1	2	2
Perceived Disincentives					
Produce Pilferage	0	1	1	2	3
Technology Maintenance	0	1	2	2	3*

*Favourable Determinants with Progressive Z-rounded scores from 0 to 2 and up to 3.

Table 4 presents data on factors considered necessary for use of recommended grain storage technologies in this study. The factors were categorized into situational factors, communication factors, technology attributes, perceived incentives and perceived disincentives. Of all the situational factors, only storage duration and need based technology were considered favourable, while all the communication factors (extension agent contact, adoption by peers, media presentation, cooperative society initiatives and local leader presentation) were considered favourable. This finding has buttressed the assertion that interpersonal communication is very important in extension work (Adekoya and Ajayi 2000, Torimiro, Adedoyin and Alao 2000) and that urban dwellers assess education information through mass media (Apantaku 2000). The use of various sources of information simultaneously will contribute to the sustainability of food security education in urban Southwest Nigeria. Technology attributes that were favourable are; efficiency of technology, accessibility of technology, flexibility of technology and stored quantity. These have confirmed the earlier work of Rogers (1995) that an innovation is judged through triability, relative advantage, compatibility, observability and complexity.

All the perceived incentives; credit facilities, participatory technology development, government subsidy was not considered favourable for use of recommended food grains storage technologies. The implication here is that urban dwellers are favourably disposed to the use of recommended storage technologies in as much as the technology is relevant, socially desirable, and economically attainable. Of the two perceived disincentives (produce pilferage, technology maintenance) only technology maintenance is considered favourable. This centred on the ability to be able to maintain the technology at low cost. It is important to develop technologies that are economically feasible to small holders.

Other Problems of Grains Storage

Apart from problems of pests, insects, moulds, rodents, birds and other vertebrates, respondents were asked to indicate other areas they have problems in carrying out effective grain storage.

Table 5: Analysis of other problems of grain storage by respondents

Problems of grain storage	Frequency	Percentage
Drying	47	26.1
Expired Chemicals or Adulterated	82	45.6
Lack of Initial Capital to Invest	64	35.6
Marketing Outlets	28	15.6

From Table 5 above, more than one quarter of respondents (26.1%) had problem of grain drying. This is very common with the production of early maize. The necessity arises for governmental and non-governmental organizations to not only finance research into crop drying, but also provide mechanized dryers for cooperative groups on agreed terms. Less than half of the respondents (45.6%) had problem about purchase of expired or adulterated chemicals. The implication here is that there is need for legislative control over sales of agro-chemicals. More than one third of the respondents (35.6%) lacked initial capital to invest on grain storage. Credit facilities, loans, subsidies should be provided for post-harvest activities as it is done for crop production. Few respondents (15.6%) had problems of marketing their produce. Extension should encourage cooperative actions while government should introduce the concept of Buyer of Last Resort.

Table 6: Analyses of socio-economic characteristics of respondents and use of modern grain storage technology

Variables	Cal.	df	p	Decision
Gender	X^2=7.04	1	0.05	S
Educational Status	X^2=5.5	3	0.05	NS
Age	r=0.91	4	0.05	S
Quantity of Grains Stored	r=0.98	4	0.05	S

S = Significant NS = Not Significant

The Chi-square results in the table above showed that there is significant relationship between gender and use of modern grain storage technology (X^2cal = 7.04 X^2tab = 3.84) while educational status is not significantly related in urban Southwest Nigeria (X^2cal = 5.5 X^2tab = 7.82). The implication is that extension should critically look into the areas of addressing urban grain storage technologies especially among traders and housewives and not concentrate on farmers alone.

Correlation analyses revealed significant relationships between age and use of modern grain storage technology (r_{cal} = 0.91, r_{tab}=0.81), as well as quantity of grains stored (r_{cal} = 0.98, r_{tab} =0.81). Planning for sustainability of food security programme should concentrate on old people while extension should critically address the needs of large holders. The second hypothesis revealed a significant difference among farmers', traders' and housewives' levels of use of recommended grain storage technologies in urban southwest Nigeria (W = 2213.4, X^2_{cal} = 19920.6).

Table 7: Coefficient of concordance analysis of use of modern storage levels among farmers, traders and housewives

Variables	W	X^2_{cal}	X^2_{tab}	Decision
Use levels	2213.4	19920.6	9.49	S

S = Significant at 0.05

It is necessary that factors important and relevant for adoption of technologies by different users be employed (Mariyono 2007, Carletto et al 2007, Devereux 1998). For sustainability of food

security in the study area, extension should not only focus on farmers, but critically look into important roles of traders and housewives in food storage for food security.

SUMMARY AND RECOMMENDATIONS

There was development of recommended food grains storage technologies in Southwest Nigeria. The technologies were developed for domestic, farm and commercial uses. They are therefore suitable for farmers, traders and housewives. Use of recommended technologies was high at levels of sorting, drying and pre-storage treatment of grains whereas the most important level of storage in modern structure recorded an average score. Apart from few situational factors and perceived disincentives, technology attributes and communication factors are important factors for use of food grains storage technologies in urban Southwest Nigeria. Incentives are not important. There were other problems of grain storage apart from pests; drying, sales of expired or adulterated chemicals, lack of initial capital to invest and marketing outlets.

Based on the findings from this study, the following recommendations were made.

1 Efforts should be made towards linking research and recipients (farmers, traders and housewives) in the areas of urban grain storage.
2 Various communication channels should be used simultaneously to reach urban dwellers.
3 There is need for legislative control over sales, distribution and use of agro-chemicals, especially pesticides.
4 Governments at various levels and organized private sector should go into commercial warehousing of grains.

REFERENCES

Adekoya, A. E. and Ajayi, M. A. 2000: Assessment of farmers' awareness and practices of land management techniques in Iddo Local Government Area of Oyo State. Journal of Environmental Extension, Vol. 1, No. 2, 2000, 98-104.

Alfred, S. D. 2000: Effect of Socio-economic characteristics of farmers on food crop marketing in Yagba East Local Government Area of Kogi State, Nigeria. Proceedings of 6th Annual Conference of Agricultural Extension Society of Nigeria 10-12, April 2000, 151-156.

Apantaku, S. O. 2000: Influence of Extension Education on Land Pollution Reduction in Abeokuta Area of Ogun State, Nigeria. Journal of Environmental Extension, Vol. 1, No. 1, 17-20.

Carlleto, C. Kirk, A.,Winters, P. and Davis, B. 2007: Non-traditional crops, traditional constraints; the adoption and diffusion of export crops among Guatemalan small holders. Policy Research working paper. Latin America and Carribean WPS 4347m Vol. 1, No. 1.

Devereux, S. 1998: The need for adequate information and institutions. In food insecurity in ACP countries; Policy and Programme interventions affecting vulnerable groups. Proceedings of a CTA seminar Leuven, Belgium 26-30, October 1998, pp. 112-139.

FAO 1990: Agricultural engineering in Development, design and construction guideline for village stores. FAO Agricultural Sciences Bulletin 82, 1.

FAO 1989: Prevention of post-harvest food losses, fruits, vegetables and root crops; a training manual. FAO, Rome 1989, 1.

FAO 1979: Proceeding and storage of food grains by rural families. Agricultural Science Bulletin, Prov. FAO, Rome.

Hindmarsh, P. and Trotter, B. 1990: Developments in grain storage for food security. Overseas Development National Resources Institute, Chatham, Maritime, Kent, UK. In Storage and Food Technology. Developing World Agriculture Grosvenor Press International, London 126-132.

Mariyono, J. 2007: Adoption and diffusion of integrated pest management technology. A case study of irrigated farm rice in Togjakarta Province, Indonesia. Journal of Agricultural Technology 3(1); 39-50.

NAMC 2002: The food security effects of deregulation of agricultural marketing in South Africa. National Agricultural Marketing Council (NAMC) Pretoria ECI.

Nwaubani, S. I., Abiodun, A. A., Ogundele, B. A., Olahan, S., Balogun, S. A.: Assessment of post-harvest crop storage losses in rural communities of Edo State of Nigeria. Nigerian Journal of Rural Sociology, Vol. 7, Nos. 1 and 2, 100-106.

Ochu, A. O. 2000: Promoting agricultural and rural development through information, education and communication in Middle Belt Nigeria. Proceedings of the 6th Annual National Conference of the Agricultural Extension Society of Nigeria, 10-12th April 2000, 137-143.

Olumeko, D. O. 1998: The Role of Crop Storage Unit in the National Food Security Programme. Proceedings of National Workshop on Post-Harvest Food Loss Prevention, organized by Crop Storage

Unit of Federal Department of Agriculture, June 1998, 29-39.

Rogers, E.M. 1995: Diffusion of Innovations; A 4th Edition. The Free Press, New York

Rose, D. and Charlton, K. E. 2002: Quantitative indicators from a food expenditure survey to target the food insecure. South African Journal of Nutrition, 132:3235-3242.

Salunkhe, D. K., Kadam, S. S., Chavan,J.K 1985: Post harvest biotechnology of food legumes CRC Press Incorporation Boca Raton, Florida.

Talabi, A. E. 1998: Overview of the National Food Security Programme. Strategic Grain Reserve Experience; Paper presented at the National Workshop on Post Harvest Food Loss/Prevention, organised by CSU, Federal Department of Agriculture, June, 1998, 20-28.

Torimiro, D. O., Adedoyin, S. F., Alao, J. A. 2000: Forms of Communication used for strengthening agricultural technologies dissemination in Ogun State, Nigeria. Proceedings of Sixth Annual Conference of Agricultural Extension Society of Nigeria 10th-12th April 2000, 183-198.