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Assessment of Post Harvest Losses of Some Selected Crops in Eight Local Government Areas of Rivers State, Nigeria

F.F. Olayemi, J.A. Adegbola, E.I. Bamishaiye and E.F. Awagu
Nigerian Stored Products Research Institute, P.M.B. 3032, Kano, Nigeria

Corresponding Author: E.I. Bamishaiye, Nigerian Stored Products Research Institute, P.M.B. 3032, Kano, Nigeria Tel: (+234) 8037732371

ABSTRACT

Nigeria produces a wide range of agricultural produces which are lost at one level or the other at post harvest stage leading to wastage in human effort, farm inputs and investments. The survey was aimed at investigating the level and cause(s) of post harvest losses of some selected produce in eight (8) local government areas which were zoned into three namely A (Degema, Bonny and Port Harcourt), B (Omuma and Oyigbo) and C (Ahoada West and Emohua). A total of four hundred and fifty (450) farmers were randomly selected. Investigative survey research Approach method by means of structured questionnaire was used to collect vital information. The crop production Pattern reveals that Zone A is noted for fish production; Zone B is into more of cassava production while in Zone C, 92% of them farm cassava and 10% are into vegetable farming. Results show that all farmers in Zone C, 65% in A and 11.75% in Zone B do not consult any body on problems associated with food storage. It was also observed generally that the percentage sold is more than processed, stored and consumed at post harvest stage. It reveals that all farmers in all zones use the traditional method of storage for all produce. The mean value of postharvest losses in the zones were 35% for fish, 37.33% for yam, 27.67% for cassava, 20.33% for maize, 27% for plantain and 33% for vegetable. It was therefore, concluded that losses experienced are generally on the high side and needs to be minimized.

Key words: Postharvest, losses, fish, cassava, vegetables, yam

INTRODUCTION

Agriculture is a major sector of the Nigeria economy, it contributes more than 30% of the total annual GDP, employs about 70% of the labour force, accounts for over 70% of the non-oil exports and, perhaps, most importantly, provides over 80% of the food needs of the country (Adegboye, 2004). The sector is being transformed by commercialization at the small, medium and large-scale enterprise levels (Olomola, 2007). Nigeria's diverse climate, from the tropical areas of the coast to the arid zone of the north, make it possible to produce virtually all agricultural products that can be grown in the tropical and semitropical areas of the world. Yearly, farmers produce a lot to boost the economy but most are lost at post harvest stage. The post-harvest technological scenario in cereals, grain legumes, oilseeds, fruits, vegetables, tubers, roots etc. of Nigerians present a dismal picture and are mostly comprised of traditional techniques practiced by growers, traders and the processors resulting in considerable deterioration of physical and nutritional qualities of harvested crops (Oni and Obiakor, 2002). Crops can be classified into various categories based on their degree

of perishability: durable crops (cereals, pulses, oilseeds, spices and condiments), semi-perishable crops (Potato, Onion, sweet potato, cassava) and perishable crops (fruits and vegetables) (Amiruzzaman, 2001). Post harvest losses of these crops ranges between 20-40%, because harvesting, processing/storage techniques are inefficient; as a result, supply is unstable (Mrema and Rolle, 2002). In under-developed and developing tropical countries, both quantitative and qualitative losses of agricultural products occur at all stages in the post-harvest chain, from harvesting, through handling, storage, processing packaging, transportation and marketing until crops are delivered to the final consumers. Post-harvest losses are not only of perishable crops but also grains, livestock and fish. It is estimated that as much as 25% of fruits, 40% vegetables and 15-20% grains are wasted after harvest. Hence, the elimination of post-harvest losses of agricultural products is important to boost food security and availability in these countries (Mrema and Rolle, 2002). Post harvest losses can be caused by a wide variety of factors, ranging from growing conditions to handling at retail level. Not only are losses clearly a waste of food but they also represent a similar waste of human effort, farm inputs, livelihoods, investments and scarce resources such as water (WRI., 1998). Major technical roles of the sector are the reduction of food losses and the enhancement of food safety and quality. This survey was conducted in order to know the level and cause(s) of post harvest losses being experienced by farmers in these communities in Rivers state and to familiarize them with new and effective technologies of checking post harvest losses.

MATERIALS AND METHODS

The study was conducted between March and September, 2010. A preliminary survey was carried out to identify the major food produce in the state. The survey was conducted in eight Local Government Areas of Rivers state and was zoned into A, B and C. They comprise of Degema, Bonny, and Port Harcourt for Zone A, Tai, Omuma and Oyigbo for Zone B, while Ahoada West and Emohua for Zone C. Rivers State has arable marshy vegetation, well-drained, highly acidic fluvisol. The total annual rainfall is about 2400 mm and temperature ranges from 25 to 38°C in the dry season (Wokoma, 2008).

A total of four hundred and fifty farmers were randomly selected with the help of the Community Development Co-ordinating committee of the communities. They are specifically fish, yam, cassava, maize, plantain and vegetable farmers with so many years of experience. The survey was conducted using the method of Investigative Survey Research Approach (ISRA) (Anazodo *et al.*, 1986). Information was collected using structured questionnaire which sought for the following information: personal information like age, family size, years of experience and level of education, the periods, crop storage awareness, structures used and for how long, loss during storage and processing method and degree of post harvest losses of agricultural produce. The study also took some personal observation to get salient information that would help identify problems faced by the farmers.

Statistical analysis: The tools of analysis used for this study is descriptive statistics of the Explanatory Variables (both qualitative and quantitative). These involve the use of central tendency including the mean frequency distribution and percentages.

RESULTS AND DISCUSSION

Personal characteristics of respondents: Results of Table 1 show that farming in all the zones is largely practiced by females (77.3%). This corroborates the findings of a study financed by

Table 1: Personal characteristics of respondents (n = 450)

Variables	Frequency	Percentage
Gender		
Female	348	77.30
Male	102	22.70
Marital status		
Married	380	84.50
Single	70	15.50
Age (years)		
30 and below	50	11.11
31-40	76	16.89
41-50	243	54.00
51 and above	81	18.00
Level of educational		
Did not go to school	148	32.89
Primary school	185	41.11
Secondary school	99	22.00
Post-secondary education	18	4.00
Farming experience (years)		
10 and below	81	18.00
11-15	95	21.11
16-20	148	32.89
21 and above	126	28.00
Family size		
3 and below	59	13.11
4-6	108	24.00
7-9	198	44.00
10 and above	85	18.89

the United Nations Development Programme (UNDP) which revealed that women make up some 60-80% of agricultural labour force in Nigeria (The World Bank, 2003). Ironically, women are known to be more involved in agricultural activities than men in Sub-Saharan African (SSA) countries, Nigeria inclusive. As much as 73% were involved in cash crops, arable and vegetable gardening, while postharvest activities had 16% and agro forestry, 15% (Afolabi, 2008). Their involvement in agriculture in Nigeria has attracted greater attention in recent years. Most respondents were married (84.5%) while two-third (32.9%) had no educational experience which may hinder their acceptance of improved storage technologies since education facilitates farmers' adoption of innovations (Onemolease, 2005).

The study reveals that young people (age 30 below) are the set with the least percentage (11.11%) indicating that young people venturing into farming is decreasing because of the migration of youths to urban settlements in search of white-collar jobs. The result also supports the work of Ekong (2003) which proved that farming in Nigeria is dominated by older farmers especially between ages 41-50.

Crop production pattern: Table 2 summarized data obtained from crop production pattern in all the zones. Zone A is noted for fish production as 60% of the farmers are into the business; this could be due to the location of the communities' as they are in the riverine areas. In zone B, the farmers are into more of cassava production than others, fish is not farmed at all while in

Table 2: Crop production pattern of farmers in zone A, B, C

Zones	Agricultural produce	Farmers involved (%)	Mean annual production per	Production range
A	Fish	60	28 baskets	2-50
	Yam	30	277 tubers	24-500
	Cassava	30	55 bags	10-80
	Maize	25	16 bags	2-50
	Plantain	15	45 bunches	40-50
	Vegetable	15	27 bunches	10-40
B	Fish	*	*	*
	Yam	87	1,522 tubers	50-4,000
	Cassava	93	986 bags	10-7,000
	Maize	75	16 bags	4-3,000
	Plantain	62	402 bunches	25-4,000
	Vegetable	75	191 bunches	10-1,000
C	Fish	*	*	*
	Yam	54	305 tubers	20-1,000
	Cassava	92	933 bags	100-2,000
	Maize	39	50 bags	50-2,500
	Plantain	**	**	**
	Vegetable	10	35 bunches	10-60

*Production of fish is insignificant in the zone. **Crops not commonly produced in the zone

Zone C, 92% of them farm cassava and only 10% are into vegetable farming. In all the zones, it can be said that the communities farm more of cassava to any other crop and can be concluded that the soil supports the growth of cassava and yam which are roots and tuber crops. The production range of all crops is highest in Zone B and least in Zone A, this is expected as percentage of farmers involved is also high, this may be attributed to inhabitants of Zone A having other sources of livelihood apart from farming business.

Storage awareness: Table 3 below shows data on crop storage awareness in the three communities. Results show that 100% of farmers in Zone C, 65% in A and 11.75% in Zone B do not consult any body on problems associated with food storage. The 70% of farmers in Zone B go further to consult agricultural extension agents which are professionals in their areas of jurisdiction while Zone C do not, this may be that extension agents are not readily available or they do not need their services. The human element in postharvest handling of commodities is extremely important; most handlers involved directly in harvesting, packaging, transporting and marketing in developing countries have limited or no appreciation for the need for, or how, to maintain quality. An effective and far-reaching educational (extension) program on these aspects is needed critically now and will continue to be essential in the future. Zone B (70%) are more likely to have gained knowledge and experience on food storage practices, processing and in other areas.

Post harvest activities of farmers: Table 4 reveals the post harvest activities of the farmers in all zones. Generally, it reveals that all the farmers sell most of their produce after harvest, consumed more, store and process less. It was observed that in Zone A, the percentage of fish consumed by the farmers is higher than that stored or processed, they believe that it is better consumed than to subject it to spoilage. Fish deteriorate fast after harvest; the spoilage process

Table 3: Crop storage awareness of farmers in the zones

Zones	Consult nobody (%)	Consult experienced farmers (%)	Consult agricultural extension agents (%)
A	65.00	20.00	15.00
B	11.75	18.25	70.00
C	100.00	0.00	0.00

Table 4: Post harvest activities of farmers in Zone A, B, C

Zone	Agricultural produce	Mean % sold	Mean % stored	Mean % processed	Mean % consumed
A	Fish	64.71	13.80	7.14	14.29
	Yam	41.67	33.33	33.30	21.67
	Cassava	55.00	0.00	15.00	30.00
	Maize	40.00	15.00	5.00	40.00
	Plantain	60.00	0.00	0.00	40.00
	Vegetable	65.00	2.50	2.50	30.00
B	Fish	*	*	*	*
	Yam	43.25	21.75	0.00	35.00
	Cassava	55.50	0.00	33.75	10.75
	Maize	49.33	20.00	9.67	21.00
	Plantain	60.00	0.00	2.50	37.50
	Vegetable	52.50	3.50	11.25	32.75
C	Fish	*	*	*	*
	Yam	38.50	20.36	0.00	41.14
	Cassava	55.00	0.00	30.00	15.00
	Maize	50.00	10.00	0.00	40.00
	Plantain	**	**	**	**
	Vegetable	60.00	0.00	5.00	35.00

*Production of fish is insignificant in the zone. ** Crops not commonly produced in the zone

(Rigor mortis) will start within 12 h of their catch in the high ambient temperatures of the tropics (Berkel *et al.*, 2004). Rigor mortis is the process through which fish loses its flexibility due to stiffening of fish mussels after few hour of its death (Adebowale *et al.*, 2008). Most fish species degrade as a result of digestive enzymes and lipases, microbial spoilage from surface bacteria and oxidation (AMEC, 2003). Yam stored (33%) and processed (33%) in Zone A is greater than the ones consumed 21.67%), in Zone B and C, yam stored is relatively low as that consumed, in both zones; they don't process it at all. Even in Zone C, the percentage consumed is more than the sold. Ekunwe *et al.* (2008) reported that yam is a highly valued staple food crop in Nigeria, with over 600 species currently grown around the world but only three species are known to grow best in West Africa. Yam storage is very important as some of them will be used as planting seeds for the next season. The most important root and tuber crops in tropical Africa are yams, cassava, sweet potatoes and cocoyam (Okoedo-Okojie and Onemolease, 2009). Yams are usually stored in open areas after harvesting, with very little protection from the elements. The yam tuber consists of living tissue and although these tissues are dormant at the time of harvesting, some metabolic activities continue at a slower pace during storage (Knoth, 1993). Respiration in the tissues utilizes the stored food material which is mainly carbohydrate, with the evolution of carbon dioxide and water vapor. Higher temperatures quicken the respiratory processes by bringing dormant tissues back to activity. In general, for every 10-degree rise in temperature, there is a doubling of the

respiratory rate in plant tissues Thus, with the high temperatures prevalent in tropical countries, respiration is the major source of weight loss in stored yams and food loss can be extremely high.

The percentage of cassava consumed in Zone A is more than the stored and processed one. This shows that the farmers planted only for themselves and not for the public. In zone B and C, percentage processed and consumed is low as compared to mean sold. It is interesting to know that all farmers in the zones do not store cassava at all, this indicates that at off- season, it will be very expensive to buy as they will depend on cassava from neighboring communities or states. Although, Cassava does not store as well as yams do. Cassava has a shelf life that is generally accepted to be of the order of 24-48 h after harvest (Westby, undated). The food security potential of cassava is negated by the vulnerability of the crop to deterioration shortly after harvest, limiting its contribution to incomes. The roots and leaves also contain various amounts of cyanide which at high levels, are toxic to both humans and animals. Therefore, after harvest, cassava has to be quickly converted into suitable forms of low cyanide levels with longer and stable shelf life (Amoah *et al*., 2010). Apart from respiratory losses, cassava tissue becomes soft and rotten after exposure to the atmosphere for only a few days (Knoth, 1993). Udo and Umoren (2011) reported the use of cassava as part of the ingredients in formulating fish feed as it serves as source of energy, thereby reducing the importation of foreign feeds. Better still, processing into products like meat balls made from cassava flour (Ikhlas *et al*., 2011) and stable products like Gari is highly encouraged. The percentage of maize stored in Zone A, B and C looks encouraging, this may be because maize is durable crop which can be stored if properly pre-treated. Although, the percentage consumed and sold in all the zones is still on the high side, the percentage processed is low. During the post-harvest period, cereal and legume crops are subject to losses due to a variety of causes-chemical changes, insect damage, rodent attack and growth of microorganisms. By far the greatest losses occur through insect attack (Knoth, 1993).

Plantain cannot be stored for a long period of time except when processed into plantain chips (Pikuda and Ilelaboye, 2009) and in Ghana, plantain has been processed into Ofam, Kakro (blended over-ripe fruit of plantains mixed with corn flour (about 30%), powdered chilies, salt and other spices. The paste thus formed is molded into balls and fried in vegetable oil) (Dzomeku *et al*., 2006). In Zone A and B, the percentage sold and consumed is high. Plantain can be processed into chips for sale. Post-harvest physiological activities in plantains consist of ripening changes upon exposure to high environmental temperatures. Metabolic activities result in the utilization of carbohydrate and the release of carbon dioxide and oxygen. To extend the shelf life of plantain, Agoreyo *et al*. (2007) researched into the use of controlled atmosphere technology to control Ethylene (a gas which under physiological conditions has been known since the beginning of the past century to be used by plants as a signaling molecule for regulating a variety of developmental processes and stress responses) production. As ripening proceeds, the plantain becomes more susceptible to mechanical damages under poor storage conditions. In most of West Africa bunches of plantains are piled into open trucks for transportation to the markets and many of the plantains are crushed by the weight upon them (Orraca-Tetteh, 1978). Therefore, it becomes urgent to transport plantains in the green, unripe state as quickly as possible. Fungal attack on damaged plantains results in further wastage of the ripe crop. Vegetables are perishable plants which begin to deteriorate after some few hours of harvest (Grolleaud, 1997). Mostly, poor handling is one of the major factors that encourage the on-set of deterioration. Percentages of Vegetables sold in all the zones are high because it is cheap and eaten almost daily. However, incidence of immediate vegetable spoilage can be attributed to the presence of destructive vegetable diseases like

soft rot. Vegetables coming from the field may be already infected although they may not yet show visible symptoms at harvest which later on may cause severe damage because of high air temperature, humidity and poor transport management (Bhat *et al.*, 2010). Zone A and B store a little percentage while Zone C does not store at all.

Crop storage practices in all zones: Farmers use various methods and types of facilities to store their crops. Table 5 described the crop storage practices in Zone A. it was generally observed that 50% of the fish farmers smoke and store fish in bags or baskets while only 10% store fresh in cold rooms. Ayeloja *et al.* (2011) posit that in spite of the significance of fish in human nutrition and health, an estimated 40% of total fish landing in Nigeria is lost at post harvest stage. Storing in cold rooms may be expensive to maintain due to erratic power supply in the state. Most of the yam farmers use the traditional yam barn method while 5% use trench storage method for 1-3 months. Also, it was observed that all farmers interviewed in Zone A did not store cassava at all; they produce for immediate consumption and sale. This practice does not encourage processing for export thereby limiting revenue that would have accrued to the nation via export. It was also observed that 10% of farmers that attempted storing maize dry and keep the grains in bags and sacks for 2-3 months. Generally, in maize storage, insect pests are the main problems (Naz *et al.*, 2003). Storage of grains in Nigeria has a new dimension using advanced technologies like hermetic storage structures, use of silo that can stay for as long as 1-3 years (Agboola, 2001). Plantain farmers do not store at all while 10% of the vegetable farmers store the dried fruits for 1-2 months.

Table 6 shows the crop storage practice of farmers in Zone B. In this zone, there are no fish farmers. Furthermore, 70% of yam farmers store using the traditional yam barn for 1-4 months, all farmers consume and sell their cassava after harvest while 50% of the maize farmers store in bags and sacks for 1-3 months and 10% over fire places. Storing maize over fire place serves as a

Table 5: Crop storage practices of farmers in Zone A

Agricultural produce	Storage method	Storage period	Farmer involved (%)
Fish	a) Smoked and stored in bags or baskets	1-3 months	50
	b) Stored fresh in cold rooms	1-4 months	10
Yam	a) Traditional yam barn	1-2 months	25
	b) Trench storage with sand	1-3 months	5
Cassava	No storage method for the tuber	-	
Maize	Store dry grains in bags and sacks	2-3 months	10
Plantain	No definite storage method	-	100
Vegetables	Store dry fruits like pepper in bags and tins	1-2 months	10

Table 6: Crop storage practices of farmers in Zone B

Agricultural produce	Storage method	Storage period	Farmer involved (%)
Fish	*	*	*
Yam	Traditional yam barn.	1-4 months	70
Cassava	No storage method for the tuber	-	100
Maize	a) Store dry grains in bags and sacks	1-3 months	50
	b) Over fire places	-	10
Plantain	No definite storage method	-	-
Vegetables	Store dry fruits like pepper in bags and tins	1-2 months	10

*Crops not commonly produced in the zone

Table 7: Crop storage practices of farmers in Zone C

Agricultural produce	Storage method	Storage period	Farmer involved (%)
Fish	*	*	*
Yam	Traditional yam barn	1-2 months	30
Cassava	No storage method for the tuber	-	100
Maize	a) Store dry grains in bags and sacks	1-3 months	20
	b) Over fire places	1-3 months	15
Plantain	*	*	*
Vegetables	No definite storage method for fresh leafy vegetables and fruits	-	80

*Crops not commonly produced in the zone

source for seeds for the next planting season. Again, all the plantain farmers had no definite storage structure while 10% store dried pepper in bags.

Storage pattern in Zone C looks like that of Zone B as shown in Table 7. There are no plantain and fish farmer in the zone. No storage method for cassava and vegetables. Yam and maize are stored using traditional methods for 1-3 months.

In summary, Table 5-7 described some of the storage method adopted by the farmers in Zone A-C. According to Ibrahim *et al.* (2009), Cassava, maize and yam are food security crops, hence, they should not only be cultivated but efforts should be geared towards their storage. It was observed that all the farmers in all zones use the traditional method of storage like storing maize over fire places, sacks and tins which may not be too effective leading to post harvest loss of agricultural produce. Storing fresh fish in cold rooms may be expensive to maintain because of the erratic power supply which makes the farmers source for external energy. Mrema and Rolle (2002) reported that these technologies which are, in general, applied by subsistence farmers are very rudimentary and labor-intensive. They are focused on handling household food requirements and any surplus is sold in local market outlets these attest to why the farmers sold more of their produce compared to those being stored and processed. Storage period of 1-3 months on the average is expected as most their storage methods may not support long term period. This short period also may affect the availability as they may not be available in time of scarcity. Adoption of developed storage structures should be encouraged as they will reduce wastages and efforts.

Degree of post harvest losses of agricultural produce in the zone: Table 8 is a summary of the degree of post harvest losses of different agricultural produce in the three zones. The losses are those occurring during harvest, post harvest handling and storage of agricultural produce. Data in the Table 8 show that the bulk of post harvest losses in cassava, plantain and vegetables were mainly due to post harvest handling. For example, losses due to post harvest handling were 27% in Zone A, 25% in Zone B and 30% in Zone C. For vegetables, only a small percentage of crop were lost during storage representing 8% in Zone A, 6% in Zone B while the bulk of losses were obtained from post harvest handling represented by 30, 36 and 30%, respectively for Zone A, B and C. the small losses obtained during storage of vegetables are because they do not store the produce in significant quantities in the zones. For fish, 35% is lost from post harvest handling and during storage for Zone A, the only zone that produces fish. In general, Zone C losses more yams (42%), followed by A (38%) and least in B (32%).

Table 8: Degree of post harvest losses of agricultural produce in the zone (mean %)

	Fish (mean %)			Yam (mean %)			Cassava (mean %)			Maize (mean %)			Plantain (mean %)			Vegetable (mean %)		
Zone	PH	ST	Total	PH	ST	Total	PH	ST	Total	PH	ST	Total	PH	ST	Total	PH	ST	Total
A	25	10	35	15	23	38	28	*	28	13	10	23	26	*	26	30	8	38
B	**	**	**	12	20	32	25	*	25	10	8	18	28	*	28	26	6	32
C	**	**	**	17	25	42	30	*	30	12	8	20	**	**	**	**	*	30
Mean	35.00			37.33			27.67			20.33			27.00			33.00		

*Production of fish is insignificant in the zone. **Crops not commonly produced in the zone

Also, in cassava production, Zone C has the highest losses (30%), followed by A (28%) and least in 25% in B. In maize, zone A, had the highest losses of 23% and followed by Zone C with 20% and least in B with 18%. For vegetables, the total loss is highest in Zone A, followed by B and least in C.

In general, farmers in the three zones had the highest mean losses in yam 37.33%, followed by fish 35%, vegetables 33.33%, cassava 27.67%, plantain 27 and 20.33% for maize.

One major factor that contributes to the high storage losses in yam, cassava and plantain is poor cultural practices, for example, yam, cassava and plantain flour are not commonly used in these zones. The damaged crops that would have been otherwise salvaged by processing into stable products like flour are sold at give-away prices or allowed to rot. Also, dearth of storage awareness and effective post harvest handling technique are the major factors to the losses of agricultural produce in the different zones.

CONCLUSION

The results of the study indicated that the farmers in the study area experienced serious postharvest losses particularly due to poor post harvest handling measures.

Improvement of these age-old practices and development of new technologies through organized research efforts have become necessary to prevent huge post-harvest losses of root crops, grains, and horticultural crops with a view to meeting the demand for food. However, there is an immediate and pressing need for more and improved storage and handling facilities and improved marketing structure on farm produce and more concern for the needs of the small and medium size farmer.

RECOMMENDATIONS

As a result of the analysis from the survey, we hereby recommend the following;

- Extension activities of ADPs need to be intensified in these zones especially A and C to create more awareness on the storage needs for agricultural produce
- Training programmes should be held in each community to achieve a more result oriented training at the grassroots
- Technologies which have been developed by some Agricultural Research Institutes like Nigerian Stored Products Research Institute (NSPRI) should be adopted to check these losses.

REFERENCES

AMEC, 2003. Management of wastes from Atlantic seafood processing operations. Final Report, AMEC Earth and Environmental Limited, Dartmouth, Nova Scotia, Canada. http://aczisc.dal.ca/nparpt.pdf.

Adebowale, B.A., C.O. Jayeola, L.N. Dongo and S.B. Orisajo, 2008. Comparative quality assessment of fish (*Clarias gariepinus*) smoked with cocoa pod husk and three other different smoking materials. J. Food Technol., 6: 5-8.

Adegboye, R.O., 2004. Land, agriculture and food security in Nigeria. 3rd Faculty Lecture, Faculty of Agriculture, University of Ilorin, Nigeria.

Afolabi, M.M., 2008. Women as pillars of national economy in Nigeria: A study of economic activities of rural women in six local government areas of Ondo State. Proceedings of the International Association for Feminist Economics Summer Conference, June 19-July 21, Torino, Italy, pp: 1-14.

Agboola, S.D. 2001. Current status of the controlled atmosphere storage in Nigeria. J. Food Technol. Afr., 6: 30-36.

Agoreyo, B.O., K.D. Golden, H.N. Asemota and A.U. Osagie, 2007. Postharvest biochemistry of the plantain (*Musa paradisiacal* L.). J. Biol. Sci., 7: 136-144.

Amiruzzaman, M., 2001. Post-Harvest Processing, Handling and Storage of Crops. Bangladesh Agricultural Research Institute, Gazipur, Bangladesh..

Amoah, R.S., L.K. Sam-Amoah, C.A. Boahen and F. Duah, 2010. Estimation of the material losses and gari recovery rate during the processing of varieties and ages of cassava into gari. Asian J. Agric. Res., 4: 71-79.

Anazodo, U.G.N., T.O. Abimbola and J.A. Dairo, 1986. Agricultural machinery inventory: Type and condition in Nigeria. A National Investigative Survey Report, Federal Department of Agriculture, Federal Ministry of Agriculture and Natural Resources, Lagos, Nigeria.

Ayeloja, A.A., F.O.A. George, S.O. Obasa and L.O. Sanni, 2011. Effect of Post-slaughter Time Intervals on the Quality of the African Catfish, *C larias gariepinus* (Burchell, 1822). Am. J. Food Technol., 6: 790-797.

Berkel, B.M., B.V. Boogaard and C. Heijnen, 2004. Preservation of Fish and Meat. Agromisa Foundation, Wageningen, The Netherlands, pp: 78-80.

Bhat, K.A., S.D. Masood, N.A. Bhat, M.A. Bhat and S.M. Razvi *et al*., 2010. Current status of post harvest soft rot in vegetables: A review. Asian J. Plant Sci., 9: 200-208.

Dzomeku, B.M., M. Osei-Owusu, A.A. Ankomah, E. Akyeampong and S.K. Darkey, 2006. Sensory evaluation of some cooking bananas in Ghana. J. Applied Sci., 6: 835-837.

Ekong, E.E., 2003. An Introduction to Rural Sociology. Dove Educational Publishers, Uyo, Nigeria pp: 25-26.

Ekunwe, P.A., S.I. Orewa and C.O. Emokaro, 2008. Resource-use efficiency in yam production in delta and Kogi States of Nigeria. Asian J. Agric. Res., 2: 61-69.

Grolleaud, M., 1997. Post-Harvest Losses: Discovering the Full Story. Food and Agriculture Organization, Rome, Italy..

Ibrahim, H., M. Bello and H. Ibrahim, 2009. Food security and resource allocation among farming households in North Central Nigeria. Pak. J. Nutr., 8: 1235-1239.

Ikhlas, B., N. Huda and I. Noryati, 2011. Chemical composition and physicochemical properties of meatballs prepared from mechanically deboned quail meat using various types of flour. Int. J. Poult. Sci., 10: 30-37.

Knoth, J., 1993. Traditional Storage of Yams and Cassava and its Improvement. TZ-Verlag, Rossdorf, Humburg, Germany, pp: 116.

Mrema, C.G. and S.R. Rolle, 2002. Status of the postharvest sector and its contribution to agricultural development and economic growth. Proceeding of the 9th JIRCAS International Symposium, (JIRCAS-08), Value-Addition to Agricultural Products, Ibaraki, Japan, pp: 13-20.

Naz F., M. Hussain, Faridullah and M. Din, 2003. Insects Pests of Maiz and Their Losses Asian J. Plant Sci., 2: 412-414.

Okoedo-Okojie, D.U. and E.A. Onemolease, 2009. Factors affecting the adoption of yam storage technologies in the Northern ecological zone of Edo State, Nigeria. J. Hum. Ecol., 27: 155-160.

Olomola, A.S., 2007. Strategies for managing the opportunities and challenges of the current agricultural commodity booms in SSA. Seminar Papers on Managing Commodity Booms in Sub-Saharan Africa, A Publication of the AERC Senior Policy Seminar IX, African Economic Research Consortium (AERC), Nairobi, Kenya.

Onemolease, E.A., 2005. Impact of the Agricultural Development Programme (ADP) activities in arable crop production on rural poverty alleviation in Edo State, Nigeria. Ph.D. Thesis, University of Benin

Oni, K.C. and S.I. Obiakor, 2002. Post harvest food loss prevention: The role of the National Centre for Agricultural Mechanization (NCAM) Ilorin under the FGN/UNDP first country Cooperation (ccf-1) framework. Proceedings of National Seminar for Cooperating Agencies under the CCF-I Framework on Post Harvest Food Loss Prevention, April 18-19, Ibadan, pp: 1-10.

Orraca-Tetteh, R., 1978. A note on post-harvest physiology and storage of Nigerian crops. Food Nutr. Bull., 1: 40-43.

Pikuda, O.O. and N.O.A. Ilelaboye, 2009. Proximate composition of street snacks purchased from selected motor parks in Lagos. Pak. J. Nutr., 8: 1657-1660.

The World Bank, 2003. Nigeria: Women in Agriculture. In: Sharing Experiences-Examples of Participating Approaches, The World Bank Group (Ed.). The World Bank Participating Sourcebook, Washington, DC..

Udo, I.U. and U.E. Umoren, 2011. Nutritional evaluation of some locally available ingredients use for least-cost ration formulation for African catfish (*Clarias gariepinus*) in Nigeria. Asian J. Agric. Res.,

Wokoma, E.C.W., 2008. Preliminary report on diseases of tomato in Choba, Rivers State. J. Applied Sci. Environ. Manage., 12: 117-121.

WRI., 1998. Disappearing food; how big are postharvest losses. World Resources Institute, Washington, DC., USA. http://www.wri.org/publication/content/8386.