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POSTHARVEST MANAGEMENT OF AGRICULTURAL PRODUCE AS KEY TO SUSTAINABLE FOOD SECURITY IN NORTHEAST NIGERIA

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Abstract

Northeast Nigeria faces persistent food insecurity exacerbated by climate change, conflict, and poor post-harvest management, leading to significant agricultural losses hence food security challenges. This study investigates how improved postharvest management practices can enhance sustainable food security in the region. Focusing on smallholder farmers in Borno, Adamawa, and Yobe states, the study employs a mixed-methods approach combining quantitative surveys of 400 farmers, qualitative interviews with agricultural experts, and field observations of post-harvest handling techniques. Findings of the study reveals that post-harvest losses for staple crops (maize, sorghum, cowpea) exceed 30-40% due to inadequate drying, poor storage (e.g., use of porous sacks and open-air granaries), and pest infestations. However, pilot interventions with hermetic storage bags and solar dryers demonstrated a 50-60% reduction in losses. Therefore the study recommended scaling up low-cost storage technologies through Government interventions and improving rural infrastructure to reduce post-harvest losses in northeast Nigeria as it offers a pathway to resilience for vulnerable farming communities while contributing to SDG 2 (Zero Hunger).

Keywords: Post-harvest losses, hermetic storage, smallholder farmers, food preservation, Nigeria, resilience.

INTRODUCTION

The production of agricultural crops have increased in recent years, but the development and adoption of post harvest technology is lacking and resulting in huge post harvest losses. Food provides not only essential nutrients ne eded for life but also other bioactive compounds like neutraceuticals or antioxi dants for health promotion and disease prevention (Kader,2002).Forinstance,theconsumption of fruits and vegetables has been strongly ass ociated with reduced risk of CVD, Cancer, Diabetes, and age related functional de cline. The right to food is one of the most basic rights of hu man being, as no living creature can live without food. In northeast Nigeria, a number of factors are associated with the post-harvest losses of horticultural crops like perishability of the co mmodities, poor economic condition of the farmers, lack of production planning, poor infrastructural set up of cultivation, storage and packaging operations, and lack of a dequate post harvest handling facilities (Yahia, 2019). It is estimated that every year there is 16-36% post harvest losses in fruit crops due to mechanical, microbial and physiological losses. Highly perishable agricultural produce are also the most highly nutritious hence they need much more attention and strategies to ensure availabilty, quality and acceptability to consumers after harvest. Post harvest management has attained a central stage in the present situation due to increasing human population and shrinking of agricultural land and other resources.

Kitinoja and Kader(2002 stated that the main element of postharvest management of horticultural crops comprise of pre-harvest factors, harvesting, market preparation (pre-cooling, sorting, grading, packaging and on-farm storage), transportation, storage, value addition/processing and by-product waste management. The minimization of loss or wastage of agricultural produce is the ultimate goal of post harvest management strategies. The global challenge today is on how to ensure food security in a sustainable manner which is safe to mankind and the environment. According to the FAO (2015), food production will need to increase by 70% to feed world population which will reach 9 billion by 2050. Hence, there is need for thorough understanding of agro-ecosystem functions. One of such agro-ecosystems is postharvest management of agricultural produce. Presently the number of food insecure population is increasing day by day which is unacceptable. However, each year

and worldwide, massive quantities of food are lost due to spoilage and infestations on the journey to consumers. In some African, Caribbean and Pacific (ACP) countries, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can be as high as 40-50%. Obviously, one of the major ways of strengthening food security for sustainable development is by reducing these losses through effective postharvest management practices.

The goal of post-harvest management could be seen in light of the fact that different crops are harvested and managed by various means depending on the end utilization. Whether the produce will be used for new plantings the following year, for forage being processed into livestock feed, or even for crops to be developed for a special use, the grower must be aware of harvesting and storage requirements toward a quality product. The main motive or goal of postharvest management is to prevent losses, increase shelf life of product, product availability and affordability throughout the year, employment opportunities, improve economic status and living condition of the farmer, and reduces shortages of food and nonfood crop products, guarantees world food supply and demand and thus support general livelihood systems (Thompson, 2015).

To understand the concept of post-harvest management, there is the need to understand the concept of pre-harvest and post-harvest loss. Pre-harvest losses refers to those losses encountered during crop growth and establishment either as a result of date or time of planting, nutrient status of the soil upon which the crop is cultivated, moisture availability or stress, pest and disease attack, destruction by domestic or wild animals, drought, flood, high temperature among others. The term "postharvest loss" – (PHL) on the other hand refers to measurable quantitative and qualitative food loss in the postharvest system. This system comprises of interconnected activities from the time of harvest through crop processing, marketing and food preparation, to the final decision by the consumer to eat or discard the food. Therefore, it can be categorically stated that Postharvest losses refers to quantitative and qualitative losses that occurred to a crop after harvesting due to series of operation the crops undergoes in the field such as inappropriate pre-harvest handling, inadequate farming equipment as well as poor crop handling, poor drying systems and poor storage system. It can also be defined as the degradation in both quantity and quality of a food product

from harvest to consumption. It is worthy to note therefore that interventions with hermetic storage bags and solar dryers brings about reduction in losses. However, systemic barriers, including limited access to credit, weak market linkages, and insufficient extension services significantly affects food security in the region. Therefore, reducing PHL through effective uses of today's crops, improving productivity on existing farmland, and sustainably bringing additional acreage into production is critical to facing the challenge of feeding the ever increasing human population in northeast Nigeria.

Yahia (2019), posit that Postharvest technology is directed to the conservation of produce, process goods and value adding to make the agricultural produce more readily usable and economically more rewarding. Postharvest technology is gaining importance for increasing agricultural productivity and stimulating the interest of farmers or growers to become producer-cum-processor by utilizing the technologies in all aspect of the production process. Postharvest technology is interdisciplinary science and technique applied to agricultural produce after harvest for its production, conservation, processing, packaging, distribution, marketing and utilization to meet the food and nutritional requirements of the people in relation to their needs. According to Yahia (2019), Postharvest technology involves all treatments or processes that occur from time of harvesting until the foodstuff reaches the final consumer, conveying/transportation, handling, storage, processing/preservation, packaging, marketing and utilization etc. are components of the postharvest technology. There are many examples of promising postharvest management technology or practices. These range from training in improved handling and storage hygiene to the use of efficient techniques for harvesting hermetically sealed bags and household metallic silos and are supported by enhancing the technical capabilities of local blacksmiths in silo construction.

Yahia and Carrillo-Lopez (2019) observed that the choice of technology package depends on circumstances, such as the scale of production, crop type, prevailing climatic conditions, and the farmers‟ affordability and willingness to pay (which are linked to social, cultural and economic implications of adoption). Postharvest technologies can contribute to food security in multiple ways. They can reduce PHL, thereby increasing the amount of food available for consumption by farmers and poor rural and urban consumers. They further observed that the control of the Larger Grain Borer (LGB) or Prostephanus truncanus

greatly reduced the loss of maize in on-farm storage among smallholders in a number of African countries, thus improving their food security. The benefits to consumers from reducing losses include lower prices and improved food security. In addition, postharvest activities such as processing and marketing can create employment (and thus income) and better food security in the agricultural sector. Therefore, reducing PHL clearly complements other efforts to enhance food security through improved farm-level productivity. Techniques to reduce food losses require cultural and economic adaption. This is so because all food losses occur at a particular socio-cultural environment.

Statement of the problem

The number of food insecure population is increasing day by day which is unacceptable. Each year and worldwide, massive quantities of food are lost due to spoilage and infestations on the journey to consumers. In some African countries, Nigeria in particular and especially the northeast, where tropical weather and poorly developed infrastructure contribute to the problem, wastage can regularly be as high as 40-50%. Obviously, one of the major ways of strengthening food security for sustainable development is by reducing these losses through effective postharvest management practices.

The production of agricultural crops in the northeast have also increased in recent years, but the development and adoption of post harvest technology is lacking and resulting in huge post harvest losses. It is estimated that every year there is 16-36% post harvest losses in fruit crops due to mechanical, microbial and physiological losses. Also, highly perishable agricultural produce are also the most highly nutritious hence they need much more attention and strategies to ensure availabilty, quality and acceptability to consumers after harvest. Therefore, this study determines the causes of postharvest losses and postharvest management technology available to farmers in the region with a view to finding solutions associated with these challenges hence improving foodsecurity in the region.

PURPOSE OF THE STUDY

The main purpose of the study is to determine postharvest management practices of agricultural produce by peasant farmers as key to sustainable food security in Northeast Nigeria. The specific objectives are:

1. Determine the causes of post-harvest losses of agricultural produce in Northeast Nigeria.
2. Determine the post-harvest management technology available to farmers in Northeast Nigeria.

RESEARCH QUESTIONS

1. What are the causes of post-harvest losses of agricultural produce in Northeast Nigeria?
2. What are the post-harvest management technology available to farmers in Northeast Nigeria?

METHODOLOGY

The design adopted for this study was descriptive survey research design. The study was conducted in Adamawa, Borno and Yobe states in the northeast geo-political zone of Nigeria. Northeast lies between latitude 7° 11″N and longitude 11° 14″E. The target population of the study was 400 farmers and agricultural officials from states ministries of agriculture. Stratified random sampling technique was employed to select the nine farming communities covering three senatorial districts in the three states of Adamawa, Borno and Yobe states. Random sampling by ballot was used in selecting 400 farmers and agricultural officials across the nine farming communities. The instrument for data collection was a structured questionnaire named Postharvest Management Practices of Agricultural Produce by Peasant Farmers (PHMPAPPF). The questionnaire has two parts: part one was on demographic information covering communities' name and location. Part 2 covers types of postharvest management practices of agricultural produce by peasant farmers and barriers to postharvest management practices of agricultural produce in Northeast Nigeria. The questionnaire has a four-point response options structure of: SA= Strongly Agree (4), A= Agree (3) DA= Disagree (2) and SDA= Strongly Disagree (1). The instrument was validated by three lecturers from the Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola. Cronbach alpha was used in determining the internal consistency of the instrument, which gave a coefficient value of 0.83. The collection of data for the study was mixed method. Semi structured interview was used by the research assistant to interpret the questionnaire to the respondents who cannot read or write in English language. Where respondents can read or write in English, the questionnaire is administered to them directly. The data collected was analyzed using percentages, mean and

standard deviation. Real limits of numbers was used. Therefore, a mean of 3.5 – 4.0 = SA, 2.5 – 3.49 = A, 1.5 – 2.49 = DA and 1.0 -1.49= SDA.

Results and Discussion

Research Question one:

What are the causes of post-harvest losses of agricultural produce in Northeast Nigeria?

Table 1: Mean and Standard Deviation of Responses of Farmers and Agricultural Officials on Causes of Post-harvest Losses of Agricultural Produce in Northeast Nigeria

SN	Indices on post-harvest losses of agricultural produce in northeast Nigeria	Mean N1 (370)	S.D	Mean N2 (30)	S.D	Remark
1.	Inadequate drying of agricultural produce	4.00	0.00	4.00	0.00	AGREE
2.	Pest and disease attack.	3.47	0.50	3.49	0.50	AGREE
3	Poor storage facilities for grain and pulse crops	3.67	0.47	3.69	0.46	AGREE
4.	None availability of cold storage rooms for perishable produce	3.89	0.32	3.97	0.16	AGREE
5.	Poor transport network to transport produce from rural to urban centers	3.06	0.53	3.51	0.50	AGREE
6.	Inappropriate pre-harvest handling	3.73	0.44	4.00	0.00	AGREE
7.	Inadequate storage equipment	3.00	0.75	2.75	0.49	AGREE
8.	Poor crop handling during harvest	3.79	0.41	3.49	0.50	AGREE
9.	Poor drying systems	3.65	0.48	3.51	0.50	AGREE
10.	Inclement weather conditions	4.00	0.00	3.50	0.50	AGREE
	Grand Mean	**3.53**	**0.42**	**3.65**	**0.31**	

Sources: Authors' field survey, 2025

The analysis of the results in Table I reveals that respondents in the study area agrees with all the indices listed under causes of postharvest losses in the northeast. The grand mean of 3.53 and 3.65 of the two categories of the respondents implies agreement with all the statements.

Research Question two:

What are the post-harvest management technology available to farmers in Northeast Nigeria?

Table 1I: Mean and Standard Deviation of Responses of Farmers and Agricultural Officials on Causes of Post-harvest Losses of Agricultural Produce in Northeast Nigeria

SN	Indices on post-harvest management technology available to farmers in Northeast Nigeria	Mean N1 (370)	S.D	Mean N2 (30)	S.D	Remark
1.	The use of hermetically sealed containers	3.80	0.01	4.00	0.00	AGREE
2.	Household metallic silos	3.42	0.54	3.4	0.50	AGREE
3	Use of bags and sacks	3.76	0.46	3.9	0.46	AGREE
4.	Cold Storage facilities for fresh products	2.5	0.32	2.6	0.15	AGREE
5.	Use of cartons for Packaging of fresh products,	3.06	0.51	3.57	0.51	AGREE
6.	Use of modern shelves in Marketing and utilization	3.83	0.42	4.00	0.00	AGREE
7.	Use of specialized Conveyance or trucks for /transportation of produce	3.20	0.74	2.95	0.49	AGREE
8.	Use of threshers in harvesting	3.80	0.41	3.69	0.50	AGREE
9.	Milling machines	3.56	0.48	3.58	0.50	AGREE
10.	Use of chemicals	3.90	0.00	3.60	0.50	AGREE
	Grand Mean	**3.51**	**0.41**	**3.55**	**0.33**	

Sources: Authors' field survey, 2025

From the analysis of the results in Table II, the results shows that respondents in the study area agrees with all the indices listed under postharvest management technology available to farmers in the northeast. The grand mean of 3.51 and 3.55 of the two categories of the respondents implies agreement with all the statements.

Findings of the study

1. Respondents in the study area agrees with all the indices listed as causes of post-harvest losses in north east Nigeria.
2. All the respondent in the study area also agrees on the indices listed under post-harvest management technology available to farmers in northeast,

Discussions of findings

Results from Table I reveals that inadequate drying, inclement weather condition, poor storage facilities, poor handling among others are the major causes of post-harvest losses of crop produce in

northeast Nigeria. This findings aligns with Cantwell (2003) who suggested that careful postharvest handling would reduce the rate of respiration and the rate of other processes that cause deterioration and quality loss (water loss, many biochemical changes, softening, etc. He further observed that careful, clean, and efficient handling of produce such as banana, pear, mango, guava, tomatoes etc is more important than the sophistication of the postharvest equipment used. This findings is in contrast with Gross, Wang, and Saltveit (2002) who reported that the causes of post-harvest losses of the produce is tied to the product quality, looks or appearance. They observed that injured areas on products lead to increased postharvest decay and water loss. Cuts, punctures, abrasions, crushing and bruising all cause significant quality losses. In some cases, products may appear undamaged, but may be bruised internally (melons). Reduce physical damage by reducing the number of steps in which the product is directly handled. They further suggested that the ideal situation is to harvest and directly pack the product into the container in which the product will be marketed (tomatoes, mangoes, pears, bananas are the classic example). For most crops this is not feasible, but at least the number of handling steps should be minimized.

Similarly, Wills et al.(2016) reported that hharvesting of crops either manually or mechanically can cause mechanical bruising, cutting, wounding or breaking of product etc; they observed that damages or loss can also occur due to developmental growth like sprouting, rooting and germination or due to parasitic diseases or pest attack. However, Gorny (2001) reported that agricultural produce damages can also be due to physiological deterioration as a result of enzymatic actions, inadequate preservative technique, poor storage facilities and lack of good infrastructure and poor planning. These factors can lead to both qualitative, quantitative, economic and general scarcity hence affecting food security and therefore the need for effective postharvest management for sustainable development.

Findings emanating from the study as shown in Table II reveals that proper storage of farm produce is very essential activity in post-harvest management because it preserve the shelf life of the crop product. This findings aligns with Yahia (2019), who reported that storage can be done through granaries, clay pots, gourds, bags, sacks, metal drums and bins, baskets, underground pits, bins of stone or mud plaster. According

to him, factors that influences choice of storage facilities includes quantity of the produce, period or duration of the storage required, availability of construction materials and the cost of the construction material. The pillars of good storage practices includes: crop to be stored should be in good condition; the store should equally be kept in good condition, provides shade where necessary and practicing good storage hygiene; inspection of the store and the crop regularly.

The findings also implies that Postharvest technology has capability to meet food requirement of growing population by eliminating avoidable losses making more nutritive food items. It may also have the potential of causing capital drain from rural to urban areas, decreased employment opportunities in the rural areas. Yahia (2019) observed that the use postharvest technology can helps generate more employment and income and that investment in postharvest measures is more economical and time saving than that the production activity to obtain the same amount of particular commodity. Through economic growth and social development poverty will be reduced in the study area. Therefore, postharvest technology has the capacity to enhance employment opportunities for rural farmers because postharvest technology has potential to create rural industries.

It is important to note that the use of postharvest technology has the potential of adding value to agricultural produce in the region. This observations aligns with Kader (2002) who stated that value addition is an inter-disciplinary science and technique applied to ag ricultural produce after harvest for protection, conserv ation, processing, packaging, distribution, marketing and utilization leading to meet the fo od, nutritional and livelihood security of the people in relation to their needs. Value additi on deals with chain of operations right from harvesting till utilization by the consu mer. In broader vision, it deals with variety of operations like deciding economic maturity standards, grading, post-harvest processing, wastemanagement, fortification, packaging, labeling, storage and marketing. Therefore, the use of appropriate postharvest technology especially in the northeast becomes handy.

Kitinoja and Kader (2002) were of the view that in postharvest management, marketing is the last operation of post harvest system. Although, produce can b e marketed at different points in the agro-food chain particularly from the

growing place (orchard), stores, wholesale markets and reta il markets. Fresh fruit and vegetables in excessive delays in marketing at wholes ale markets during gluts lead to losses in quantity as well as quality. Thus, the duration be tween harvesting, storage and marketing should be as short as possible.

Conclusion

This study concludes that post-harvest management system encompasses a sequence of activities and operations covering technical and economic activities. These activities includes harvesting, field drying, threshing, cleaning, additional drying, storage, processing, transporting, marketing, quality control, nutrition, extension, information and communication, administration and management. Therefore, much care is needed in transporting, storage or threshing place. Postharvest management activities here includes shaking of pods, biting grains between teeth, walking on dried pods, rattling grains in a tin, feeling grain by touching and smelling, observing physical appearance, pressing between thumb etc. Drying has the advantage of reducing bulkiness of product, reduce crop loss, increase shelf life, reserve viability of seed, reduce moulds or afflatoxin on seeds, ease of packaging and transportation.

Recommendations

Based on the findings emanating from the study, the following recommendations are made:

1. There is need to enlighten peasant farmers in the region on the various causes associated with food wastages to avoid falling into food shortages and economic waste. Government also needs to provide supports to the peasant farmers to handle causes of postharvest losses of agricultural produce in the region.
2. As a measure of goodwill, State Governments as well as NGO's need to support farmers in the region to acquire appropriate postharvest management technology that is suitable to their local conditions.

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