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THE EFFECT OF POSTHARVEST LOSSES OF YAM TUBER ON HOUSEHOLD FOOD AVAILABILITY IN ZONE A AGRICULTURAL AREA OF BENUE STATE, NIGERIA

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Abstract
The study examines the effect of postharvest losses of yam tuber on household food availability in Zone A agricultural area of Benue state, Nigeria. The main thrust of the study was to; investigate the causes of postharvest losses of yam tuber and explore the effect of postharvest losses of yam tuber on household food availability. This study adopts Adoption theory as a theoretical framework. Questionnaires were used as instruments for data collection. A sample size of three hundred and seventy-nine (379) respondents was used for the study. Findings from the study revealed causes of postharvest loss to include; Microorganisms such as fungi and bacterial, mechanical factors such as injuring/cutting, activities of some wild animals such as rodents, monkeys, and mice, lack of good practice and technology, poor extension services and postharvest. The cluster means of 2.98 with a standard deviation of .77 was found to be above the cut-off point of 2.50 on all the causes. The test of hypothesis shows ANOVA result as F-value = 487.783; p < 0.05. This result invariably shows that postharvest loss of yam tuber affects food availability. Regression estimates presented showed that there is a significant effect of postharvest loss on yam tuber since the significant level of .000 is less than the critical value of 0.05. Based on the above, the study concludes that postharvest loss has a negative effect on yam tuber leading to a reduction in food availability. The study recommends the establishment of yam processing factories to reduce the extent of post-harvest losses of yam tubers, the

construction of access roads to yam producing areas to reduce post-harvest losses of yam tubers, and employment of extension agents to educate farmers in the area of post-harvest losses of yam.

Keywords; Postharvest, Losses, Yam tuber, Household, Food Availability.

Introduction

Postharvest losses of food are an issue of great concern in the global community. This is essential because, about one-third of the food produced in the world for human consumption every year, which is approximately 1.3 billion tonnes gets lost after harvest. By implication, 30% to 40% of all food crops produced in the world for human consumption are never consumed due to quantitative and qualitative losses, which is able to feed 37 million people in their entire lifetime (FAO, 2018). In developed and developing tropical countries, both quantitative and qualitative losses of agricultural products occur at all stages in the postharvest chain, from harvesting, through handling, storage, processing, packaging, transportation, and marketing until crops are delivered to the final consumers.

According to FAO (2014) when compared to other African countries, Nigeria has one of the highest per capita food output; it accounts for about 70% of the world production of yams and 19% of the global market (Hillocks, 2016). According to Earth (2014) Nigeria produces 8.41%, 1.09%, 2.85%, and 0.38% of the world production of root and tubers, cereals, legumes, and meat respectively. Nkama, Adamu and Igwe (2014) painted a dire picture of the situation when they posit that 20%-30%, 5%, 10%-20%, and 20%-67% of maize, rice, cassava, and yam are lost respectively at post-harvest-stored levels in Nigeria. Furthermore, they maintained that 35%-100%, 20%-80%, 20%-95%, 20%-50%, 70%, and 40%- 100% of plantain, banana, citrus, tomatoes, pineapple, and pawpaw are lost respectively at post-harvest levels. The available statistics show that an alarming percentage of crops that are produced in Nigeria is lost at one stage or the other at post-harvest levels. Benue State is not an exception to issues affecting post-harvest losses in other parts of Nigeria.

Also, it is distressing to note that while many resources are being devoted to planting crops irrigation, fertilizer application, and crop protection measures for increased productivity little is being done to minimize post-harvest losses. A reduction in post-harvest food loss could guarantee an increase in food availability thereby reducing the need for food importation and consequently impact positively the welfare of farmers (Adams, 2017; Orhevba, 2016).

Benue state is acclaimed as the largest producer of yam in Nigeria and West Africa at large, with the largest yam market in Zaki Biam, Ukum local government area, Tor-Donga and Abaji in Katsina-Ala local government area of Benue State and other numerous yam markets across the state. The general expectation is that the available yam markets should provide an avenue whereby yam farming households can sell surplus yam produce so as to generate enormous financial income, which will translate into a good standard of living and also ensure the continuous availability of sufficient quality food for household consumption. However, the current situation in Benue State is different, there has been a prevailing significant level of postharvest losses of yam which have affected the standard of living and food security of yam farmers and the society at large.

Statement of the Problem

Yam scientifically called 'Dioscorea' is a staple food that provides a good number of calories, dietary fiber, and carbohydrates. More than 60 million people in West Africa live on yam as a source of food as well as a source of income, however, loss of agricultural produce after harvest is one of the problems facing developing countries especially Nigeria today (Adams, 2017). The incidence of high levels of post-harvest losses of food such as yam is attributed to the non-industrialization of the agricultural sector. According to Bourne, (2014) about 45% of the Yam produced in Nigeria is lost annually after harvest. There is an indication that the high level of post-harvest loss of yam tubers in zone A area in Benue state has posed a challenge to the three indexes of food security such as availability, accessibility, and affordability.

According to Fox and Fimeche (2013), successive governments in Nigeria had initiated policies and programs aimed at increasing agriculture production such as Operation Feed the Nation (OFN), Green Revolution (GR), Anchor Borrowers' Programme, Establishment of Agricultural Research institutes, among others has not translated to good post-harvest management practices or system in Nigeria. This worrisome situation can be seen as most yams produced in zone A, are lost in various markets, storehouses, and homes, representing a wasted investment and loss of income on the side of farmers, loss of revenue by the Government, and at the same time, polluting the environment.

Although a lot of related research work has been done in this regard little has been done on the effects of post-harvest losses of yam on food security in the zone area of Benue state. For Example, Adejo (2017) focused on the post-harvest management practices of yam and farmers' Information Needs in the North Central of Nigeria. Also, Shambe (2017) focused on the post-harvest losses of yam tubers in Benue State. And more so, Agba, Ode, Ugbem & Nwafor (2019) focused on the Analysis of post-harvest losses of yam in the North-East Zone of Benue State. This study investigates the effect of postharvest losses of yam tuber on household food availability in Zone A agricultural area of Benue state, Nigeria. Specifically, the study is aimed at (i) investigating the causes of postharvest losses of yam tuber. (ii) explore the effect of postharvest losses of yam tuber on household food availability in Benue state, Nigeria.

The study hypothesis

Ho_1: Postharvest losses of yam tubers has no effect on household food availability in the study area.

Literature review and theoretical framework

The effects of Post-Harvest Losses of Yam Tuber on Household Food availability

Global food production has reached a record high in recent years; however, one-third of all food produced for human consumption is lost or wasted, equivalent to 1.3 billion tons. Post-harvest food loss is a leading cause of food insecurity for millions of families across the world (Bourne, 2014). Achieving zero hunger by 2030 will require that no more food is lost or wasted. Post-harvest food losses do not affect farmers/producers only but significantly endanger the livelihoods of other stakeholders across the value chain by reducing valuable incomes and profitability.

Looking at food security globally, the number of people experiencing food insecurity in the United States and other developed nations makes up only about two percent of the global total (FAO, 2014). The United Nations Food and Agriculture Organization states that 925 million people in the world are undernourished. The largest percentage of undernourished people live in Asia and the Pacific Islands, followed by Sub-Saharan Africa (FAO, 2014). Fortunately, there is enough food in the world today for everyone to have the nourishment they need for a healthy and productive life (FAO, 2014). A key factor in addressing the world's food security challenges is improving the availability, access, and utilization of food across global communities

Reducing Post-harvest losses to food security is a global issue. According to recent data from the United States Department of Agriculture (USDA), approximately 14.7% of U.S. households experience low or very low food security (USDA, 2017). This equates to nearly 50 million people in the United States, including about 17 million children (USDA, 2017). In response to food insecurity, the U.S. government offers food assistance to low-income families through the Supplemental Nutrition Assistance Program (SNAP). The federal government of Nigeria also reintroduced school breakfast and lunch programs in 2016. Some community-based organizations, such as food banks help address families' immediate food needs, while others work to address the root causes of food insecurity, improve local access to nutritious food, and provide community-based nutrition education (Bourne, 2014; Atanda, Pessu, Agoda, Isong and Ikotun (2015).

Post-harvest food losses are one of the important sources of food insecurity in Africa. According to FAO (2016), pre-and postharvest food crop loss among African countries is estimated at about 10%, which is higher than the global average. Although it has been difficult to quantify post-harvest storage losses, some claim that as much as 20% of yam tubers may be lost to pest attacks in storage. Tropical root and tuber crops such as cassava, yam, and cocoyam are important household food security and income-generating crops in many African countries (FAO, 2016), and over 5 million people are said to depend on these crops for food,

feeds, and income. Thus, losses associated with these crops limit the potential income of the farmers, threatens food security, and exacerbates conditions of poverty among rural households, whose income stream depends on the ability to store excess farm produce for a later date. Although farmers have been known to practice indigenous storage of farm produce, these have been known to be less effective compared to modern storage methods. According to FAO (2015), and Omoruyi, Orhue, Ake-obo and Akhimien (2014) produce stored under the traditional system usually does not keep long and farmers usually suffer great losses.

Agricultural production uses 2.5 Tm3 of water per year and over 3% of the total global energy consumption, and estimated yam losses of about 30-50% of total production translate to wasting 1.47-1.96 Gha (global hectares or 4931 million hectares) of arable land, 0.75-1.25 Tm3 of water and 1% to 1.5% of global energy (Fox and Fimeche 2013). This shows that yam losses have negative environmental impacts on land, water, and non-renewable resources such as fertilizer and energy that are used to produce, process, handle and transport yam that no one consumes. Postharvest loss reduction will increase yam availability and improvement the standard of living of yam farmers.

Losses after harvest of both quantity (weight losses) and quality deprive farmers of the full benefits of their labor. Food losses do not merely reduce the food available for human consumption but also cause negative externalities to society through costs of waste management, greenhouse gas production, and loss of scarce resources used in production (FAO 2015). Food losses especially yam contribute to high prices by removing part of the food supply from the market. Postharvest losses of yam significantly endanger the livelihoods of stakeholders across the value chain by reducing valuable incomes and profitability. 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.

Theoretical Framework

This study adopts Adoption theory as a theoretical framework that explains the relationship between post-harvest losses of yam tuber on household food security in Benue State. This model gained its brilliant manifestation from the work of Rogers (2003). According to this theory, the adoption of an innovation is the decision of an individual or group to use or apply an innovation. The adoption process according to Rogers (2003) consists of five stages or steps that an individual goes through in adoption and innovation. The stages are:

Awareness stage: This stage starts when the individual first hears or becomes aware or finds out about the existence of the innovation or technology. The individual at this stage lacks details concerning the way it works, how to use it, and also the cost and benefits of the innovation apart from probably knowing its name.

Interest stage: is when the individual develops an interest and actively seeks further information about the innovation such as how it works and what its potentials are.

Evaluation stage: is when the individual weighs up the advantages and a mental evaluation by asking self-questions such as "is it worth it?" "Can I do it?" "Do I have enough resources? "will it be beneficial to me and my family?" if the advantages outweigh the disadvantages, especially with regards to the capital outlay against what else they might do with the same amount of money and the satisfaction they will derive from these alternatives.

Trial stage: Is usually experienced by most individuals that decide to accept the innovation and involves the testing of the innovation on a small scale to determine its relevance and usefulness of the innovation.

Adoption stage: is the final stage when the individual applies the innovation on a large scale and continues to use it in preference to old methods. This, however, does not mean that the adopter will continue to use the innovation forever but will tend to use it until when a better innovation comes along or has a problem with the present one due to some other reasons. The stage is based on mental or practical evaluation by the individual to make a final decision as to whether to adopt or reject.

This theory is applicable to this study based on the fact that the adoption process requires the acquisition and processing of information about an innovation followed by behavioral change. The adoption process stated above does not always follow the sequence in practice and depends on the technology and the individual in question. Yam is a staple food that is produced locally with elementary farm implements like cutlass and hoe. Yam farmers in rural areas experience post-harvest loss of yam from harvesting,

transportation, storage, and marketing. These are eventually some of the post-harvest stages in yam production. With the adoption of innovation, farmers can have access to fertilizers, and pesticides that control pest and herbicides that control weeds thus reducing post-harvest losses incurred by yam farmers in the area. Most farmers go through a logical, problem solving process known as adoption process when considering any new technology or innovation. A farmer's decision about whether or not to adopt recommended agricultural practices is recognized to occur over a period of time in stages rather than instantaneous

Methods

The study was conducted in zone A agricultural area of Benue state, the zone has seven local government area which include; Katsina ala, Ukum, Vandeikya, Ushongo, Konshisha, Buruku and Logo local government area. The researcher purposively selected Ukum, Katsina-ala and Logo because the three local government areas are more involved in yam production. The population of the study comprises of male and female who are farmers. According Benue Agricultural and Rural Development Authority (BNARDA) (2021), the selected local government area has 1920 farmers. Based on Taro Yamane (1967) sample size determination formula as thus: $n = \frac{N}{1+N(e)2}$. The study arrives at 400 respondents. Snow-balling sampling technique was employed. The researcher/research assistance snow-balled from one farmer to the other in each of the clusters selected until the required sample size was obtained. This technique was used because the researcher intended to select only yam famers who had registered with All Farmers Association of Nigeria, Benue state branch only. The instrument for data collection for this research is questionnaire. The instrument is framed in a five-point rating scale with response strongly agree (SA=5), Agree (A=4) undecided (3) Disagree (D=2) and Strongly Disagree (SD=1) respectively. The study adopted a quantitative method of data analysis using frequencies, distribution tables, simple percentages, and mean and standard deviation to answer the research questions. In answering the research question, the cut-off point of 2.50 was used for decision-making. Mean scores of 2.50 and above were considered as positive responses and accepted as having the desired influence. While those below the cut-off point of 2.50 were rejected as having no influence. Also, ANOVA and Regression were used to test the hypothesis.

RESULTS

Table 1 socio-demographic characteristics of respondents

Option	Frequency (N=379)	Percentage (%)
Sex		
Male	139	36
Female	240	64
Age		
16-22 years	188	50
22-26 years	127	34
30 and above	64	16
Marital status		
Married	98	26
Single	197	52
Other specify	84	22
Educational attainment		
Non formal education	-	
Primary school	10	3
Secondary school	177	47
Tertiary	192	50

Source: field survey 2022.

Table 4.1 reveals that 36% of the respondents were male while 64% of the respondents were female, 50% of the respondents were between 16-22 years, 35% were within the age bracket of 22-26 years while

those between 30 and above years were 16% respondents This implies that respondent who were between 22-26 years were more involved in the study.

Data on the marital status of the respondents reveals that the majority 52%) of the respondents were single men and women, 26% of the respondents were married, and 22% of the respondents belong to the other categories. Data on the educational attainment of respondents shows that none of the respondents had a certificate, those are probably cleaners, 3% of the respondents were primary school pupils, 47% of the respondent have a secondary certificate while 50% of the respondent have a tertiary certificate. This finding reveals that most of the respondents in the study area were educated persons.

Table 2: Mean Ratings and Standard Deviation as causes of Postharvest losses of Yam tuber

Item no	Item description	SA	A	D	SD	$\bar{X}$	STD	Decision
5	Microorganisms such as fungi and bacteria are causes of postharvest losses of yam.	32	49	13	6	3.07	0.83	Accepted
6	Mechanical factors such as injuring/cutting of yam by a farmer are a cause of postharvest loss of yam.	47	33	14	6	3.21	0.90	Accepted
7	Activities of some wild animals such as rodents, monkey, and mice are some of the causes of postharvest loss of yam.	28	52	11	9	2.99	0.87	Accepted
8	Lack of good practice and technology are some of the causes of postharvest loss of yam	62	38	-	-	2.90	0.49	Accepted
9	Poor extension services and postharvest reduction are some of the causes of postharvest loss	46	37	17	-	2.71	0.74	Accepted
	Cluster mean/standard deviation					**2.98**	**0.77**	**Accepted**

Source: Field Survey, 2022.

Data in Table 2 showed mean ratings for items 5-9 as 3.07, 3.21, 2.99, 2.90, and 2.71 respectively with their corresponding standard deviation of 0.83, 0.90, 0.87, 0.49 & 0.74 all the mean ratings are above the cut-off point of 2.50. This means that the respondents had agreed that Microorganism such as fungi and bacterial are causes of postharvest losses of yam, mechanical factors such as injuring/cutting of yam by a farmer is a cause of postharvest loss of yam, activities of some wild animal such as rodents, monkey, mice are some of the causes of postharvest loss of yam, lack of good practice and technology are some of the causes of postharvest loss of yam and poor extension services and postharvest reduction are some of the causes of postharvest loss. The cluster means of 2.98 with a standard deviation of **.**77 is also found to be above the cut-off point of 2.50. It then means that some of these causes remain challenges of postharvest losses of yam tuber in Zone A agricultural area of Benue state.

Test of hypothesis

Ho: Postharvest losses of yam tuber have no effect on household food availability in the study area.

Table 3 of the effect of postharvest losses of yam tuber on household food availability

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	81.091	7	11.584	487.783	.000[b]
	Residual	298.5	508	.024		
	Total	378.155	515			

Table 4; Linear Regression predicting the effect of postharvest loss of Yam tuber on household food availability.

Variable	Unstandardized Beta (B)	Standard error for unstandardized beta Se B	Standardized beta β	t-value	significant level/P
Constant	365	0.183		1.993	0.01
Postharvest loss and yam tuber household food accessibility	81.091	0.029	.496	16.662	0.00
R square	0. 870				

Source: Field Survey 2022.

Note: Regression is significant at P<0.05 level (2-tailed)

The result presented in Table 3 ANOVA shows that there is a statistically significant influence of postharvest-losses of yam tuber on household food availability in Zone A Agricultural area Benue State, Nigeria, given that F-value 487.783; $p < 0.05$. By this result, the null hypothesis, which states that Postharvest losses of yam tuber have no effect on household food availability in Zone A area of Benue State, Nigeria, is rejected, while the alternate hypothesis was retained. Hence the significant value is less than 0.05, there is a statistically significant effect of postharvest loss on yam tuber in the study area.

In table 4, the regression presented in the above table shows that postharvest loss has effect on food accessibility in the study area. The regression estimates presented showed that there is significant effect of postharvest loss on yam tuber since the significant level of **.**000 is less than the critical value of 0.05. The Table equally showed that a unit increase in the postharvest loss will lead to 81.091 increase in losses of yam tuber. Therefore, we reject the null hypothesis that Postharvest losses of yam tuber have no effect on household food availability in the study area. The study has shown that postharvest losses of yam tuber have effect on household food availability in the study area.

Discussion of Findings

The paper examines the effect of postharvest losses of yam tuber on household food availability in Zone A agricultural area of Benue state, Nigeria. The paper reveals the causes of postharvest loss in the study area to include; Microorganism such as fungi and bacterial are causes of postharvest losses of yam, mechanical factors such as injuring/cutting of yam by a farmer is a cause of postharvest loss of yam, activities of some wild animal such as rodents, monkey, mice are some of the causes of postharvest loss of yam, lack of good practice and technology are some of the causes of postharvest loss of yam and poor extension services and postharvest reduction are some of the causes of postharvest loss. The cluster means of 2.98 with a standard deviation of **.**77 is also found to be above the cut-off point of 2.50. These findings are in line with Bourne (2014), who posits that the Consumption of food by rodents, birds, monkeys, and other large animals causes the direct disappearance of food. Sometimes the level of contamination of food by the excreta, hair, and feathers of animals and birds is so high, that it makes the food not consumable for mankind. Microorganisms (e.g., fungi and bacteria) cause damage to stored foods. Micro-organisms usually directly consume small amounts of food but they damage the food to the point that it becomes unacceptable because of rotting or other defects.

The result presented in Table 3 ANOVA shows that there is a statistically significant effect of postharvest-losses of yam tuber on household food availability in Zone A Agricultural area Benue State, Nigeria, given that F-value 487.783; $p < 0.05$. This result invariably shows that postharvest loss of yam tuber affects food availability hence the most quantity of the yams produces in Zaki-Biam, Tor-Donga is lost due to the activities of farmers as well as infestation by microorganisms.

In table 4, the regression estimates presented showed that there is a significant effect of postharvest loss on yam tuber since the significant level of **.**000 is less than the critical value of 0.05. The findings also showed that a unit increase in the postharvest loss will lead to 81.091 increase in losses of yam tuber. The

findings have also showed that postharvest losses of yam tuber have effect on household food availability in the study area. Based on this, effort should be made to reduce postharvest loss in other to improve on household food availability in the study area. The findings is in line with the finding of FAO (2018), who finds that post-harvest food losses are one of the important sources of food insecurity in Africa. pre- and postharvest food crop loss among African countries is estimated at about 10%, which is higher than the global average. Although it has been difficult to quantify post-harvest storage losses, some claim that as much as 20% of yam tubers may be lost to pest attack in storage thus affecting food security.

Conclusion

Post-harvest losses of yam tuber in zone A agricultural area of Benue state cannot be overemphasized. The income of farmers is thus lost and yam tuber continues to be lost at every stage of the harvesting process due to a lack of yam tuber processing companies, extension service, bad roads, and lack of ready market and storage facilities in the study area. This study concludes that apart from the government and all stakeholders involved in the production of yam tuber should put all hands on deck to provide the necessary and needed apparatus so as to reduce postharvest loss of yam tuber and above all improve seedlings of yam tuber should be made available to farmers. These seedlings should be the ones that can compete and cope with the template climate of sub-Saharan Africa, so that this variety will not perish as soon as possible during and after harvesting.

Recommendations

Based on the findings the following recommendations were made;

i. Establishment of yam tuber processing factories to reduce the extent of post-harvest losses of yam tuber. The utilization of yam tuber in Nigeria is still low; the establishment of yam tuber processing industries either by government or private individual that utilizes yam tuber as raw materials for its products would to a large extend reduce the extent of post-harvest losses of yam tuber and would encourage yam tuber farming in the country. Processing of yam tuber would also reduce the county's dependence on imported yam tuber paste and would stimulate economic growth.
ii. Construction of access roads to yam tuber producing areas by government to reduce post-harvest losses of yam tuber.
iii. Extension service should be revived in Benue state and Nigeria at large by mass employment of extension agents to reduce post-harvest losses of yam tuber. The objective of agricultural extension service is to facilitate farmers' access to information and knowledge that will improve their living condition. However, inadequate extension agents in the country are some of the problems militating against the success of extension service in the country. Thus, the study recommended mass employment of extension agents in the state and Nigeria as whole to serve as teachers to farmers on ways of reducing post-harvest losses of farm produce such as yam tuber.
iv. Provision of ready market for yam tuber produce by the government and the private sector. Lack of ready market for yam tuber produce in Nigeria was discovered as another cause of post-harvest losses of yam tuber. Government and the private sector should provide ready market for yam tuber produce by buying the excess produce produced by farmers to prevent loss which is sometime attributed to the seasonality of the product.
v. Government should encourage and fund researches on post-harvest management. Over the years, the Nigeria government has been mostly concern with increasing food production in the country without given due attention to what can be done with excess production after harvest. This has contributed to post-harvest loss of farm produce in the country. Therefore, government policies aimed at increasing food production in the country should be complemented with government policies aimed at managing farm produce after harvest.

REFERENCE

Adejo PE (2017) Post-Harvest Management Practices of Yam and Farmers' Information Needs in the NorthCentral of Nigeria. J Nutraceuticals Food Sci. Vol. 2 No. 3:9

Adams, J.M. (2017). A review of the literature concerning losses in stored cereals and pulses, published since 1964.Trop. Sci., 19: 1-28.

Atanda, S.A., Pessu, P.O., Agoda, S., Isong, I.U. and Ikotun, I. (2015). *The concepts and problems of post-harvest food losses in perishable crops*. African Journal of Food Science, 5(11), 603-613.

Benue Agricultural and Rural Development Authority (BNARDA) (2021). Farmers database, annual report, Makurdi, Benue State.

Bourne, M.C. (2014). *Post-harvest Food Losses - The neglected dimension in increasing the world food supply*. Cornell University International Agriculture Mimeograph, 53, 49.

Earth, T. (2014). Agriculture and food Nigeria. http: earthtrends.wri.org.

Food and Agricultural Organization (FAO) (2014). *Food Lost Prevention in Perishable Crops*, FAO, Agriculture Services Bulleting, Rome. A new hunger report. [online], available: http://www.fao.org/news/story/en/item/161819/icode/[10th October, 2014].

Food and Agriculture Organisation (FAO) (2015). *Patterns of Urban Food Consumption in Developing Countries*. Perspective from the 1980's; Food and Nutrition Division, FAO, Rome, Italy.

Food and Agriculture Organisation (FAO) (2016). Production Year Book for 1986, *Food and Agriculture Organisation of the United Nation*, Rome, Italy.

Food and Agriculture Organisation (FAO) (2018). Global hunger declining but still unacceptable high: International Hunger Forgets Difficult to Reach. Economic and Social Development Department September 2010 Rome.

Fox, T. and Fimeche, C. (2013). "Global food Waste Not, Want Not." IMechE. England and Wales.

Hillocks, R. (2016). Cassava in Africa. In hillocks R., Thresh J and Bellotti AC (eds). Cassava biology, production and utilization. CABI publishing. *horticultural produce*. Food and Agriculture Organization of the United Nations http://www.fao.org/tc/exact/sustainable-agriculture-platform-pilot-website/post

Nkama, I., Adamu, D.J.M. and Igwe, J.O. (2014). *Food Loss and Conservation under Arid Environment.* Annals of Borno Journal, 11 (12), 191-204.

Omoruyi, S.A. Orhue, U.X. Ake-obo, A.A. and Akhimien, C.I. (2014). Prescribed agricultural science for senior secondary schools, Benin City: Idodo Umeh Publications Limited, pp. 4 – 6

Orhevba, B.A. (2016). Effect of pre-Storage Treatment and Storage Conditions on Some Quality of Stored Yam Tubers. Unpublished M.Eng Thesis, Federal University of Technology, Minna, Nigeria, 4(2): 439-473.

Rogers, E. M. (2003). Diffusion of innovation, 3rd edition Rev.ed. Communication of innovation. The free Pres, New York, USA.

Sambe T. (2017). Growth and production of yam tuber under different irrigation intervals. *RSAA. Expt. Station, 466*, 92-95.

United States Department of Agriculture (USDA) (2017). Regional Project for the Development of Community-based Technology Transfer Centres in Support of Food Production towards Food Security in Africa (CTTC).

Yamane, T. (1967). Statistics: An introductory analysis (2nd Edition). New York: Harper and Row.