Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.13, No.6, 2022

Evaluation of Factors Driving Post-Harvest Losses among Arable Crop Farmers in Ogbomoso, Oyo State, Nigeria

*Lawal Olusola Lawal [1, 2], Ibrahim Aliyu Usman[1, 2], Aminu Hussaini Adamu[1, 4], Muritala Damola Sekinat[3], Odigie Eromosele and Teodosio Macuacua L.[1]
1. College of Resource Utilization and Environmental Sciences, China Agricultural University, Beijing, China
2. Federal Department of Agricultural Extension, Federal Ministry of agriculture and Rural Development, Nigeria
3. Derived savanna station, Forest Research Institute of Nigeria, Ibadan
4. Hadejia Jama'are River Basin development Authority, Ministry of Water Resources, Nigeria
*Corresponding Author: ademolaoluwanisola@gmail.com

Abstract
The problem of post-harvest loss is a major challenge facing the attainment of food security and livelihood of farmers in Nigeria. In a world of diminishing agricultural resources like arable lands and water with a continuous increase in the demand for food due to population increase, any little investment in the reduction in post-harvest losses will not only translate to making more food available but also improve the income of farmers. This study evaluated the factors driving postharvest losses among arable crop farmers, the level of knowledge and skills about post-harvest handling among arable crop farmers in Ogbomoso, Oyo state, Nigeria. Multistage random sampling techniques were used to select 120 respondents from three (3) Local Government Areas (LGAs) in the study area. Collected data were analyzed using simple descriptive statistics such as frequency counts and percentages with result presented in charts and tables. Findings revealed that majority (70%) of the respondents were between the age range of 41-70 years and most (82%) were small scale farmers cultivating less than 1-3ha with only 18% of them cultivating 3-5ha. Majority of the respondents were also male (69%) and had no formal education (59%). Leading drivers of postharvest losses among respondents were found to include poor transportation network, lack of modern storage/processing facilities, lack of local processing industries, inadequate training about modern post-harvest handling techniques and high cost of processing equipment. The study also finds out that majority (73%) of the farmers had not received any form of training about postharvest handling in the last two (2) farming year. The study recommends an improvement in infrastructural facilities like good roads for easy and timely evacuation produce, stable power supply to increase processing activities and also farmers' training/enlightenment on post-harvest handling activities and local development of post-harvest technologies.
Keywords: Post-harvest losses, spoilage, Storage, Transportation, food security, Nigeria.
DOI: 10.7176/JNSR/13-6-01
Publication date: March 31st 2022

Introduction

Agriculture is one of the most important sectors of the Nigerian economy. This is because it contributes more than 30% of the total annual GDP, employs about 70% of the labor 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). Nigeria's diverse climate make it possible to produce virtually all agricultural products that can be grown in the tropical and semi-tropical areas of the world. Nigeria is among the leading producers of many food and cash crops in the Africa continent and globally. Annually, farmers produce a lot to boost the economy but most are lost at post-harvest stage. Agricultural losses are one of the greatest problems facing agricultural production in Nigeria and concern everyone from the research scientists to the extension workers/ marketers in the field to the farmers on the farm and to the government policy formulators. The rapid rise expected in the global population will go hand in hand with an increase in the food demand. The ability of the world to provide sufficient and safe food to a growing population is becoming vulnerable due to environmental degradation and climate changes. In the past few years, postharvest loss reduction has achieved high importance and is increasingly being quoted as a sustainable means to reduce global hunger and malnutrition and reduce carbon emissions (HLPE, 2014, Lipinski et al., 2013, Kitinoja, 2016). Since the World Bank report on "Missing Food" in Africa (World Bank, 2011) and the "Global Food Losses and Food Waste" report (FAO, 2011) estimated that one-third of all foods were being lost, many new reports have been published on this topic.

Post-harvest losses are more than just a waste of farm produce, it's a colossal waste of all the cumulative resources that went into production and has a direct economic impact on the income of farmers and contributes to food insecurity. Postharvest losses result in the wastage of resources such as land, water, fertilizer, herbicide, seeds, and seedlings and so on that are used in the production of crops that are not consumed or utilized for other purposes(Abbas *et al.*, 2018). Due to the position they occupy in the entire food chain network, Smallholder farmers suffer a great deal of economic loss as a result of post-harvest loss. The direct impact of PHLs is on the

livelihoods of farmers and other supply chain actors who depend solely on income from their produce for survival (Justina, Hirawaty and Isima, 2019). Reducing post-harvest losses have been identified as a vital aspect in the fight against hunger, raising farmers' income and improve food security especially in the world's poorest countries should give priority to the issue of crop losses (FAO, 2010). In Sub-Saharan Africa, as much as 50% of fruits and vegetables, 40% of roots and tubers, and 20% of cereals are lost before they even hit the market (Biteye, Mamadou. 2016). This huge level of waste if reduced to a minimal level will substantially increases availability of food and help in alleviating poverty among smallholder farmers through improvement in their incomes and ultimately contributes to ensuring food security for African households

All crops are subject of deterioration or spoilage at different stage and time immediately it's been harvested. The moment a crop is harvested from the soil or detached from its parental stock, it commences deterioration. However, the rate and level of this damage is influenced by so many factors which may either be internal/biological, external/environmental or socio-economic in nature. Understanding and having knowledge about factors causing losses at different stages of the post-harvest value chain and having required skills on best practices in post-harvest handling will definitely go a long way in assisting farmers to reduce much of these wastes. As a result of over-dependence on rain fed farming in Nigeria coupled with inadequate/poor storage and processing facilities, there are usually glut of farm produce during harvest season and farmers are mostly left with the option of selling produce at lower price or risk losing them to deterioration/spoilage. Even when the farmers decide to take their produce to the market, they are often constrained by problems of transportation such as poor road network and inefficient mode of conveying their produce to the market (Adepoju, 2014). This occurrence has over the years deprived farmers deserved economic reward for their efforts and has also contributed significantly to the non-attainment of food security in Nigeria. Eradication or great reduction of postharvest losses is therefore important to bring increasing food security and reduce suffering both rural and urban households.

A reduction in post-harvest food loss could guarantee increase in food availability thereby reducing the need for food importation and consequently impact positively on the welfare of farmers (Adesina, 2012). This is important to Nigeria if the country is to meet its goal of food self- sufficiency. Most of the available studies on post-harvest losses in Nigeria were carried out using the urban markets as case studies (Adeoye et al., 2009). The near neglect of the local smallholder farmers who constitute the bulk of upstream sector of agricultural production and who are most affected by post-harvest losses in terms of decreased market efficiency and severe reduction in income which have a negative impact on their livelihood. Ogbomoso is one of the leading blocks in agricultural production in Oyo state having agriculture plays a vital role in its economy and any effort towards the reduction of postharvest losses will have a ripple effect on many household incomes and further contribute ensuring food security among other benefits.

Despite the elaborated agricultural programmes, Ogbomoso is still unable to provide sufficient food within the purchasing power of everyone. Besides economic factors, the supply of food in the city is limited by losses due to wastage and spoilage. Though no one knows how much food lost between harvest and consumption, but post-harvest management complements efforts to enhance food security through improved farm level productivity, thus tending to benefit producers, and more specifically, the rural farmers. Post-harvest management reduces post-harvest losses thus, generates income, improves product quality and safety, and contributes to food and nutritional security. It is against this background that an analysis of the post- harvest management strategies by farmers is deemed important.

Today, one of the main global challenges is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. According to the FAO, food production will need to grow by 70% to feed world population which will reach 9 billion by 2050. Further trends like increasing urban population, shift of lifestyle and diet patterns of the rising middle class in emerging economies along with climate change put considerable pressure strain on the planet's resources: declining freshwater resources and biodiversity, loss of fertile land, etc. Consequently, there is a need for an integrated and innovative approach to the global effort of ensuring sustainable food production and consumption (Nellemann et al., 2009; World Economic Forum 2009; FAO/OECD, 2011; Foresight, 2011; EU ERA-NET SUSFOOD 2012-2014). The provision of adequate and affordable food for all is the fundamental basis for food security. Although there is remarkable progress made in increasing food production worldwide, approximately half of the populations in developing countries do not have access to adequate food supplies; thus the food security problem is worsening. There are many reasons for this, one of which is food losses occurring throughout the supply chain from production, harvesting, processing and marketing. In its recent report "Global food losses and food waste" the FAO (2011) reported that roughly one-third of food production for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year. Evidence suggested that these losses tend to be highest in those countries where the need for food is greatest (Swedish Institute for food and Biotechnology, SIK).

Post-harvest loss has a more serious and far reaching impact on the food security situation of Sub-Sahara African countries given the low yield level of agricultural production. According to data from Food and Agriculture Organization (FAO) and World Bank, post-harvest losses of cereals alone in sub-Saharan Africa ranged between

5 to 40 %, worth around $4 billion (Zorya et al., 2011). The figures are on the high side in Nigeria and according to (Oguntuase), problem of post-harvest losses poses serious implications for food security in Nigeria as the country is said to be losing about $9billion annually due to post harvest losses in the agricultural sector(Independent Newspaper, 2017). Food security cannot be guaranteed only through increasing production without an equal and corresponding effort towards reduction in post-harvest losses. Major efforts have always been concentrated on how to increase production without corresponding efforts on how to reduce losses. Loss of food crops especially along the post-harvest stage, have been identified as one of the major causes of food security problems in most developing countries and in Nigeria in particular(Adepoju, 2014). Therefore, it is not enough to increase production but efforts must be equally made on how to minimize post-harvest loss to ensure food security and improve income and social status of Nigerian farmers.

Reduction in post-harvest losses offers the particular advantage of increasing food availability without requiring additional land, water, labor, energy and agricultural inputs(Naziri *et al.*, 2014). With more than 60% of Nigerians employed in the agricultural sector, finding practical solutions to post-harvest losses will play a vital role in improving the livelihood of many and bring about a sustainable development in the sector(Abbas *et al.*, 2018). In view of this, this paper therefore seeks to identify the drivers and the impact of PHL on farmer's income and food security in the country with the aim of suggesting practical solutions to all stakeholders (Government & its agencies, policy makers, research institutes and farmers) involved on how to work together in solving this problem towards achieving food security. Evaluation of drivers of for post-harvest losses has been highlighted as the focus of this study. It is hoped that the results and findings of this study will be of great help to farmers, consumers and agriculture extension workers, in fact, to the nation as a whole.

As an effort towards ensuring that Ogbomoso people have a better access to enough food for healthy living throughout the year, and that farmers have adequate financial reward for their efforts, special attention has to be paid to the postharvest issues. In order to successfully achieve this, there is need to identify causes and drivers of these losses and bridge the knowledge and skill gaps that exist in post-harvest handling, storage and processing capacity among smallholder farmers which therefore justifies the overall purpose of this study. The general objective of the study is to evaluate factors driving post-harvest losses among arable crop farmers in Ogbomoso, Oyo State, Nigeria

To meet the general objective, the study will focus on the following specific objective:

- Examine the personal characteristics of smallholder farmers in the study area
- Identify major drivers of postharvest losses among smallholder farmers in the study area
- Determine the level of knowledge of smallholder farmers on the various postharvest activities
- Evaluate the level of acquired modern skills and training about various post-harvest handling activities

Materials and methods

Description of the study area

This study was carried out in Ogbomosho area of Oyo state. Ogbomosho is an ancient Yoruba city founded in the mid-17th century, with five (5) local government area (LGA) of its own; Ogbomosho is the second largest city in Oyo state after Ibadan. Located on Latitude 8.133°N and on Longitude 4.250°E of the equator and with an elevation of 342 m above sea level, the predominant vegetation zone in Ogbomosho is derived savannah with mean annual rainfall of 1.247 mm and an average temperature of 27°C. Farming is a popular occupation among inhabitants with interest in Permanent crops like: Cashew, Mango, Oil palm and arable crops like: Cassava, Yam, Maize, Potatoes, vegetables etc.

Sampling procedure and sample size

A multiple-stage selection process was carried out to select 120 respondents for the study. In the first stage, three (3) Local Government Areas (LGAs) were purposively selected namely Ogbomosho north, Ogbomosho south and Orire LG out of the five (5) LGAs that constitutes Ogbomoso. At the second stage, four communities were selected from each of the LGAs based on their prominence in farming activities. Lastly, ten (10) respondents were selected randomly from each of the communities to make 40 respondents from each of the three selected LGAs and total of 120 respondents.

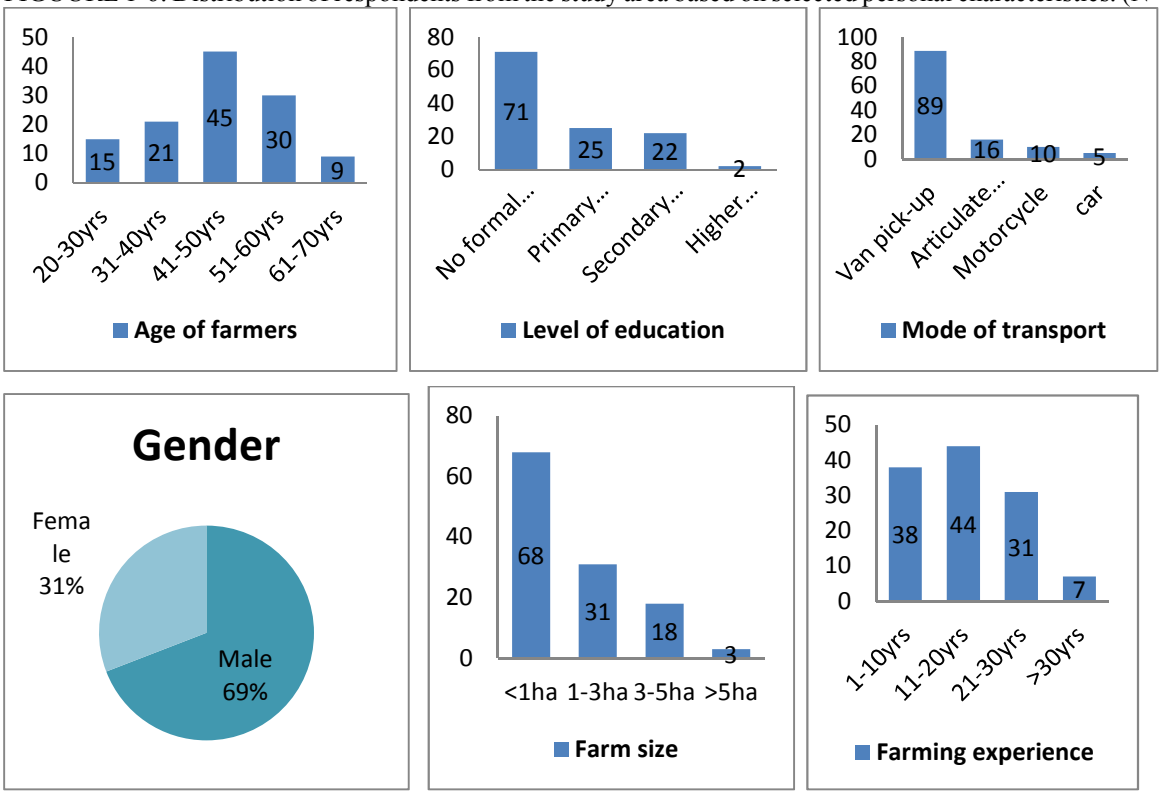
Instrument and data collection

The study was carried out in October 2021 following the pretest conducted one month earlier. The major instrument for data collection was the questionnaire. The instrument elicited information on socio-economic characteristics of farmers, causes drivers of losses among respondents, knowledge and skills about post-harvest activities. The structured questionnaire was administered to both illiterate and literate farmers by the researcher with the help of some trained personnel. The questionnaire was administered to illiterate farmer by the researcher who read and explained the items on the instrument and ticked the answered chosen by the farmers. The questionnaire contained closed and open ended questions which were answered by the respondents.

Population of the study
The population for this study was all arable crop farmers Ogbomoso area of Oyo state of Nigeria.

Data analysis
Descriptive statistics such as frequency counts, percentages and ranks were used to analyze the demographic and socio-economic variables and other data gathered from the study while results were presented in tables and charts for better illustration.

Results and discussion
Personal characteristics of respondents
FIGUURE 1-6: Distribution of respondents from the study area based on selected personal characteristics. (N=120)



Source: Field survey, 2021

The result of the socio-economic characteristics of respondents' shows that majority of the farmers (69%) were male and 31% female. This could be attributed to the cultural land allocation norm of the study area which favors men over women in land ownership. Also the result shows that only 30% of the farmers were of active age (20-40yrs) while the majority 70% was between 41-70yrs. This indicates that farming activities is majorly done by people above the youthful and active age of 40years in the study area. The study also revealed that majority (59%) of respondents had no form of formal education and only 18% had secondary school education. This corroborate the findings of (Adepoju, 2014). With respect to farm size, the result shows that majority of the farmers are small-scale farmers with 56% having less than 1ha and only 3% of them having up to 5ha of farmland. Lastly, the main mode of transportation of produce from the farm is through the use of 'pick-up' vans employed by more than 70% of the respondents.

Drivers of post-harvest losses

Table 1: Drivers of post-harvest losses among respondents

DRIVING FACTORS	FREQUENCY (%)	RANK
Inadequate training about modern post-harvest handling techniques	103 (86%)	4th
Lack of modern storage / processing facilities	115 (96%)	2nd
High cost of post-harvest & processing equipment	110 (92%)	3rd
Poor transportation network	116 (97%)	1st
Lack of local processing industries	101 (84%)	5th
Lack of access to market (off-takers)	85 (71%)	8th
Poor power supply	98 (82%)	7th
Theft & herdsmen attacks	59 (50%)	9th
Storage pest attacks	100 (84%)	6th

Field survey, 2021

The table above shows response of farmers about factors driving post-harvest losses. The result revealed that among all factors assessed, Poor transportation network, lack of modern storage/processing facilities, High cost of post-harvest & processing equipment, inadequate training about modern post-harvest handling techniques, Lack of local processing industries and ranked, lack of local processing industries and storage pest attacks ranked 1st, 2nd, 3rd,4th,5th and 6th with 97%, 96%, 92%,86%, 84% and 84% respectively while factors poor power supply, lack of access to market (off-takers) and theft/herdsmen attack were ranked 7th, 8th and 9th with 82%, 71%, and 50% respectively. This result is in agreement with the findings of Seid et al. (2013) who found inadequate storage facilities and inadequate transport facilities to be significant factors contributing to post- harvest losses of maize and commercial horticultural crops respectively.

Level of knowledge about post-harvest handling and activities

Table 2: Knowledge/awareness about post-harvest handling among respondents

KNOWLEDGE	FREQUENCY (%)
Harvesting crop too early or too late contributes to losses	30 (25%)
Physical injuries during harvest expose crop to spoilage	102 (85%)
Improper storage material and condition contribute a lot to losses	90 (75%)
Storing produce that's not well dried contributes spoilage and waste	111 (93%)
Breaking down of vehicles on bad road which delay produce in getting to markets contribute to losses	117 (97%)
Improper arrangement and use of inappropriate packing items contributes to breakages and spoilage during transportation	114 (95%)
Not sorting/Storing good and bad produce together will increase rate of spoilage	42 (35%)
Location of cottage industries in rural areas will create market for produce & contribute to reducing losses	90 (75%)
Processing increases the economic value of produce	84 (70%)
Processing prolong the shelf life of produce	78 (65%)

Field survey, 2021

The table above shows the level of knowledge and awareness of the farmers in the study area on various post-harvest activities. The result reveals that the farmers have an appreciable level of knowledge about post-harvest activities which may be attributed to their long years of living, long years of farming experience and indigenous knowledge. However, they were found to be lacking knowledge in few important areas of post-harvest chain; about how harvesting too late or too early contributes to losses and how not sorting produce and storing good & bad produce together can increase level of spoilage where their responses were not correct.

Level of skills and training about post-harvest handling activities

Table 3: Distribution of respondents based on level of training/skills on modern post-harvest handling activities

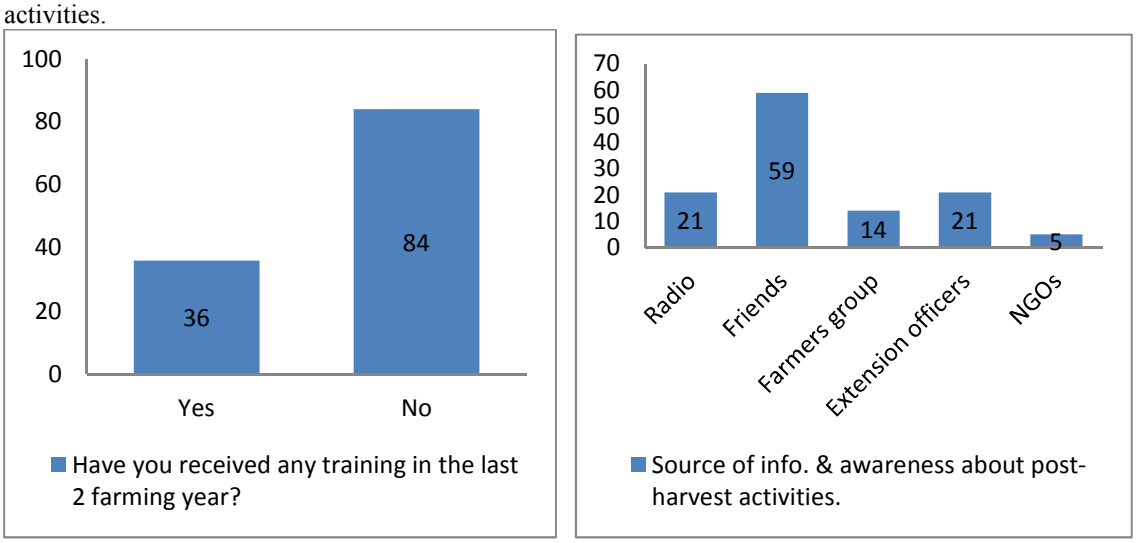
Skills	Yes	No
Best harvesting techniques	80(66%)	40(34%)
Best storage practice & skills	70(58%)	50(42%)
Sorting, packing and transporting skills	43(35%)	77(65%)
Processing and value addition skills & techniques	30(25%)	90(75%)
Cold chain storage skills	12(10%)	108(90%)

Field survey, 2021

The result in the table above reveals the level of skills and training of farmers on various modern post-harvest

activities. The result shows a low level of skills and training among farmers in the study area. While about half of respondent affirm to have storage skills, vast majority 90%, 75% and 65% have no skills about cold chain storage, processing/value addition and sorting/packing skills. Many of these areas where farmers lack skills are important channels where a lot of wastage occurs in the post-harvest value chain. The implication of this is that farmers in the study area are lacking in training of modern post-harvest handling skill which is very important in reducing post-harvest losses.

Figure 7-8: Distribution of respondents based on their access to training and information concerning post-harvest activities.



Field survey, 2021

Figures above reveals that majority (73%) of the farmers have not received any form of training about post-harvest handling in the last two farming years. Also, about half of the farmers get information and awareness concerning post-harvest handling from friends which means a low access to extension officers. This means that majority of farmers in the study area are lacking in training and information concerning post-harvest chain thereby dwelling much on local and unimproved methods. Also, farmers in the study area get most of their information about post-harvest from friend and this depicts a low linkage and access to extension service. This findings is in line with works of (Oluwatusin, 2017).

CONCLUSION, SUMMARY AND RECOMMENDATION

Conclusion

While increasing primary food production is paramount to meet the future increase in final demand, tensions between production and access to food can also be reduced by tapping into the potential to reduce food losses. Efficient solutions exist along the whole food chain, for reducing total amounts of food lost and wasted. Actions should not only be directed towards isolated parts of the chain, since what is done (or not done) in one part has effects in others. In low income countries, measures should foremost have a producer perspective, e.g. by improving harvest techniques, farmer education, storage facilities and cooling chains. In industrialized countries on the other hand, solutions at producer and industrial level would only be marginal if consumers continue to waste at current levels. Consumer households need to be informed and change the behavior which causes the current high levels of food waste.

It is discouraging and counter-productive for farmers after channeling so much of their limited resources to production, to lose the harvested produce before it gets to the market or consumers due to factors beyond their control. This connotes a waste of productive resources as well as a significant reduction in expected income and consequently affects the livelihood and welfare of the farmers. The problem of post-harvest losses, which has long not been recognized as one of the major factors responsible for food insecurity in Nigeria, should be of utmost priority to all stakeholders in any effort at achieving food self-sufficiency. The constraints encountered by the farmers also need to be effectively addressed

Waste of farm produce without satisfying the purpose of feeding a final consumer is a complete waste of resources, time and effort that was employed in the entire production cycle. This includes land, capital used in purchasing of all inputs used, wages for labor and managerial efforts are all wasted on futility due to lack of storage/processing facilities and market for produce. This doesn't only threatens food security but also has a great financial implication especially to the poor smallholder in Nigeria as most of the money used is from their penury savings or sometimes from loan and this contributes to them unable to pay back.

Summary
The problem of post-harvest loss is a major challenge facing the attainment of food security and livelihood of farmers in Nigeria. In a world of diminishing agricultural resources like arable lands and water with a continuous increase in the demand for food due to population increase, any little investment in the reduction in post-harvest losses will not only translate to making more food available but also improve the income of farmers. This study evaluated the factors driving postharvest losses among arable crop farmers, the level of knowledge and skills about post-harvest handling among arable crop farmers in Ogbomoso, Oyo state, Nigeria. Multistage random sampling techniques were used to select 120 respondents from three (3) Local Government Areas (LGAs) in the study area. Collected data were analyzed using simple descriptive statistics such as frequency counts and percentages with result presented in charts and tables. Findings revealed that majority (70%) of the respondents were between the age range of 41-70 years and most (82%) were small scale farmers cultivating less than 1-3ha with only 18% of them cultivating 3-5ha. Majority of the respondents were also male (69%) and had no formal education (59%). Leading drivers of postharvest losses among respondents were found to include poor transportation network, lack of modern storage/processing facilities, lack of local processing industries, inadequate training about modern post-harvest handling techniques and high cost of processing equipment.

The study finds out that poor transportation network, lack of modern storage/processing facilities, lack of local processing industries, inadequate training about modern post-harvest handling techniques and high cost of processing equipment as the leading drivers of post-harvest losses among farmers in the study area. While the farmers were found to possess some good indigenous knowledge about post-harvest handling which may be attributed to their long years of farming experience, they were found to be lacking in modern up-to-date formal skills, training and awareness about post-harvest handling and activities. Also, about 75% of the smallholder farmers in the study area have not received any form of training about post-harvest handling activities in the last two (2) farming years and majority among them get their information about post-harvest handling from friends and colleague which depict a low access to agricultural extension services among smallholder farmers in the study area.

Recommendations
Based on the results and findings of the study, the following recommendations are made:

- Government should intensify efforts and investment in rural infrastructural facilities such as access and linkage roads, stable electricity and storage facilities.
- The adequate training of farmers on post-harvest crop handling techniques as well as the provision of good storage facilities that could help prevents crop losses especially at the farm level.
- Government should also put in place policies that will encourage the inclusion of local raw materials in processed goods
- Government at levels should increase budgetary allocation to the agricultural extension service so as to allow them organize regular trainings, seminars and workshops for farmers on latest developments in agriculture and especially about latest post-harvest handling techniques/technology.
- Research institution such as National Stored Product Research Institutes (NSPRI) and National Center for Agricultural Mechanization (NCAM) should increase on developing more affordable post-harvest technologies and equipment for smallholder farmers.
- Research institutes should also improve on the dissemination and awareness on best practices in post-harvest handling among local smallholder farmers.
- Farmers should prioritize the formation and joining of farmer's co-operatives, this will allow them to achieve many things such as: easy access to trainings, credit and loan facilities, improved access to off-takers and better access to quality farm inputs at cheaper rates.
- Farmers should endeavor to always take advantage of training opportunities present and put information and skills acquired to use in their farming activities.

Acknowledgement
We appreciate the support and guidance of Professor Zhenling Cui towards the success of this research. Our appreciation also goes to all smallholder farmers that participated in this research. This work was supported by the Bill & Melinda Gates Foundation (OPP1209192) and the "Sino-Africa Friendship" China Government Scholarship (2019-1442).

REFERENCES
Abbas, A. M. *et al.* (2018) 'REDUCING POSTHARVEST LOSSES IN NIGERIA ' S PATHWAY TO SUSTAINABLE AGRICULTURE . AGRICULTURAL SECTOR :', 5(2), pp. 16–21.
Adegboye, R.O. (2004). Land, agriculture and food security in Nigeria. 3rd Faculty Lecture, Faculty of Agriculture,

University of Ilorin, Nigeria.
Adepoju, A. O. (2014) 'Post-harvest losses and welfare of tomato farmers in Ogbomosho , Osun state , Nigeria', 5(2), pp. 8–13. doi: 10.5897/JSPPR2014.0160.
Blakeney, M. (2019) *Food loss and food waste: Causes and solutions*, *Food Loss and Food Waste: Causes and Solutions*. doi: 10.4337/9781788975391.
Bolarin, F. M. and Bosa, S. (2015) 'Post Harvest Losses: A Dilemma in Ensuring Food Security in Nigeria', *Journal of Natural Sciences Research*, 5(7), pp. 2225–921. Available at: http://www.iiste.org/Journals/index.php/JNSR/article/viewFile/21502/22098.
Campus, A. *et al.* (2021) 'Strategies adopted by maize farmers to minimize post-harvest losses in Delta State , Nigeria', 17, pp. 237–256.
FAO (2010).Global hunger declining but still unacceptably high: International Hunger Targets Difficult to Reach. Economic and Social Development Department September 2010. Rome: FAO, Rome.
FAO (2011) .Global food losses and food waste. Food and Agriculture Organization of the United Nations, Rome, 2011
FAO. IFAD (2012) The State of Food Insecurity in the World 2012: economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition. Rome: FAO; 2014.
Justina, K., Hirawaty, N. and Isima, K. (2019) 'Small-scale postharvest practices among plantain farmers and traders : A potential for reducing losses in rivers state , Nigeria', *Scientific African*. Elsevier B.V., 4, p. e00086. doi: 10.1016/j.sciaf.2019.e00086.
Kader, A. A. (2005) 'Increasing food availability by reducing postharvest losses of fresh produce', in *Acta Horticulturae*. doi: 10.17660/ActaHortic.2005.682.296.
Kiaya, V. (2014) 'Post-Harvest Losses and Strategies To Reduce Them', *The Journal of Agricultural Science*, 149(3–4), pp. 49–57. doi: 10.13031/aim.20152189434.
Kumar, D. and Kalita, P. (2017) 'Reducing Postharvest Losses during Storage of Grain Crops to Strengthen Food Security in Developing Countries', *Foods*. doi: 10.3390/foods6010008.
Naziri, D. *et al.* (2014) 'The diversity of postharvest losses in cassava value chains in selected developing countries', *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 115(2), pp. 111–123.
Oluwatusin, F. M. (2017) 'Analysis of Postharvest Losses Management among Cassava Farmers in Nigeria', 15(1), pp. 114–121. doi: 10.7537/marsnsj150117.15.Keywords.
Onemolease, E.A., (2005). Impact of the Agricultural Development Programme (ADP) activities in arable crop production on rural poverty alleviation in EdoState, Nigeria. Ph.d Thesis (unpublished), University of Benin, Benin City, Edo State, Nigeria, p. 123.
Seid H, Hassen B, Yitbarek WH (2013). Postharvest Loss Assessment of Commercial Horticultural Crops in South Wollo, Ethiopia" Challenges and Opportunities". Food Sci. Quality Manage. 17:34-39.
Taiwo-Oguntuase, S. Curtailing $9bn post -harvest losses in Nigeria. Retrieved from https://independent.ng/curtailing- 9bn-post-harvest-losses-nigeria/; October 5, 2017.