Assessment of post-harvest losses in marketing of leafy vegetables in Oriade local government area of Ilesa: Implications for food security

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ABSTRACT

Leafy vegetables offer both nutritional benefits and great economic potentials in boosting food security, yet their perishable nature may lead to huge post-harvest losses and food insufficiency. The study assessed post-harvest losses in the marketing of leafy vegetables in Oriade Local Government Area (LGA) of Osun State. It describes the socio-economic characteristics of the leafy vegetable marketers, causes of post-harvest losses of leafy vegetables and compares the mean post-harvest losses by socioeconomic characteristics of the leafy vegetable marketers. A two-stage sampling procedure was used to select a sample of 120 leafy vegetable marketers from four purposively selected markets in the LGA (Ilo, Ijebu-Jesa, Ijeda and Iwoye). Primary data were collected with the aid of a structured interview schedule. Independent t-test and One-way analysis of variance were used to compare differences in mean losses. Results show that the respondents' mean age, household size and monthly income were 41.2 years, 4 people and N8,547.50, respectively. Majority of the respondents were female (70.8%) and had no formal education (62.8%). The three causes of post-harvest losses with highest weighted mean scores were the problem of insects and pests (2.39), the perishable nature of leafy vegetables (2.38) and the bad state of rural roads (2.35). The mean post-harvest losses during the dry seasons were significantly lower than the mean post-harvest losses during the raining seasons ($t=5.78$; $p<0.01$). In conclusion, pests/insects, bad roads and perishable nature of leafy vegetables were the most significant causes of post-harvest losses. Hence, extension officers should encourage farmers to use insecticides/pesticides to control pest and diseases on their farms; government should make rural roads accessible for easy transportation of vegetables and marketers should buy the quantity of vegetables they can sell in a day at a time.

Keywords: Food security, Leafy vegetables, Mean losses, Post-harvest

Introduction

Agriculture has been described as the backbone and resilient sustainer of the Nigerian economy and engine of national development in terms of provision of employment and livelihood for people of Nigeria (Izuchukwu, 2011; Mohammed, 2016 and Oluwaseyi, 2017). Nigeria is blessed with an abundance of natural resources sufficient enough to meet the food and nutritional requirement of the populace as well as to help other nations of the world.

One of the goals of Nigeria's agricultural development policy is to ensure that the nation produces enough food for all (Metu, Okeyika, and Maduka, 2016). Achieving this goal, however, has been a great challenge for many years and more challenging in recent times in the face of global coronavirus pandemic. Post-harvest losses in agricultural products have been attributed to the poor road network and transport problems (Gogo, Opiyo, Ulrichs and Huyskens-Keil, 2018). With the attendance restriction in movement due to COVID-19 pandemic, such losses may increase drastically thereby contributing to the food insecurity situation in Nigeria. According to Ilaboya, Atikpo, Omofuma, Askhame and Umukoro (2012), facilitating access of agricultural products to market is one of the effective ways of ensuring food security. Not only that agricultural product should get to the market, but they should also get to the final consumers in good quality and time.

Vegetables are important sources of vitamins and minerals needed for the maintenance of good health and its production has great economic potential in boosting food security. Marketing of vegetables also provides employment opportunities for many Nigerians and also serve as a source of livelihood. Although vegetables are of great nutritional value, they are perishable except under intensive care through harvest and post-harvest process.

Vegetables are edible seeds, root, bulb, stem, tuber or leaves of any numerous of herbaceous plant that can be consumed fresh either cooked or raw by man (Sinha, Hui, Evranuz, Siddiq, and Ahmed, 2010). Vegetables can be classified into three – leafy vegetables, fruity vegetables and root

vegetables. According to Alvino and Barbieri (2016), leafy vegetables are a wide group of horticultural plants that roughly can be defined as "vegetables cultivated for the edible part constituted of foliar structures, comprising lamina, petiole, midrib and veins". Common examples of leafy vegetables in Nigeria include lettuce, cabbage and amaranths. In terms of the nutritional benefits, leafy vegetables are the most nutritious food plants that provide essential micronutrients and vitamins to meet the daily nutrient requirements for human diet (Iheanacho *et al.,* 2009). The low caloric value of leafy vegetables also makes them ideal for weight management and can offer numerous health benefits including reduced risk of obesity, cardiovascular disease and high blood pressure (Ejoh *et al.,* 2007; Ejoh and Samuel, 2016). Leafy vegetables are found almost everywhere and there has been an increase in the trading and commercial activities of these produce and products.

Post-harvest loss may occur for instance, if there is poor management at pre and post-harvest stages and poor handling of produce during transit and storage. Post-harvest loss of any agricultural produce may also threaten the sustainable use of scarce resources for food production (Kitijonga, 2010, Munhuewyi, 2012). Elimination of post-harvest losses in the marketing of leafy vegetables is important to boost food security and availability and also prevent waste of human effort, farm inputs, investments and scarce resources such as water, seed, fertiliser, soil nutrient (Adeyemi, 2010). Despite the nutritional benefits and economic advantage of leafy vegetables, the evidence is scarce in the literature on post-harvest losses of agricultural produce such as leafy vegetable in Nigeria except for the work of Adebooye and Farinde (1997) on review of postharvest losses in fruits and vegetables in Nigeria over two decades ago. Although Olayemi *et al.,* (2012) assessed postharvest losses of some selected crops in eight LGAs in Rivers State, Nigeria less than a decade ago, their emphasis, however, was not on leafy vegetables. Most of other studies on vegetables and leafy vegetables in Nigeria either addressed the chemical components of leafy vegetables (Mensah *et al*., 2008; Sobukola *et al.,* 2010; Inam *et al.,* 2016 and Ajayi *et al.,* 2018); health benefits (Adegoke *et al*., 2018; Ejoh and Samuel, 2016); efficiency of production (Adeoye, 2020); or the mineral and nutritional composition (Iheneacho *et al*., 2009; Asaolu *et al.,* 2012; Akinwunmi, 2016; Oyedele, 2017; Okewole *et al*., 2018; Akintayo, 2019 and Sha'a *et al*., 2020). There is therefore, a dearth of much-needed data upon which policy and programmes addressing post-harvest losses of leafy vegetables can be based. Hence, this study assessed the postharvest losses in the course of marketing leafy vegetables among marketers in Oriade Local Government Area of Osun State, Nigeria. The study specifically:

i) described the socioeconomic characteristics of leafy vegetable marketers;
ii) identified the causes of post-harvest losses of leafy vegetables; and
iii) compared the estimates of the mean post-harvest losses by socioeconomic characteristics of the leafy vegetable marketers.

METHODOLOGY

The study was conducted in Oriade Local Government Area (LGA) of Osun State Nigeria. The LGA shared boundary with Ekiti State on one side and Ondo State on another. The study population consists of leafy vegetable marketers. A two-stage sampling technique was used to select a sample of 120 leafy vegetable marketers. In the first stage, four rural community markets were purposively selected in the LGA namely: Ilo, Ijebu-Jesa, Ijeda and Iwoye, based on their abundant production of leafy vegetable throughout the year and high concentration of vegetable marketers in the area. In the second stage, out of the list of 600 vegetable marketers provided by their Associations, a proportion of twenty percent (20%) was selected from each community market, thus, 50 marketers were selected out of a total of 250 in Ilo, 30 out of 150 in Ijebu-Jesa and 20 each out of 100 in Ijeda and Iwoye, respectively, making a total of 120 vegetable marketers in the LGA.

Primary data were collected with the aid of structured interview schedule on socioeconomic characteristics of the leafy vegetable marketers such as age, education, marital status, religion, gender, household size, monthly income and years of experience in leafy vegetable marketing. Data on types of leafy vegetables, post-harvest losses in leafy vegetables, three years preceding the survey (2016, 2017 and 2018), causes of postharvest losses, market constraints were also collected.

Descriptive statistics such as frequency distribution, means, standard deviation and weighted mean score were used to describe some variables of the study while independent t-test and one-way analysis of variance to compare differences in mean losses in leafy vegetables by socioeconomic variables.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the leafy vegetable marketers

Table 1 shows the result of the description of the socioeconomic characteristics of the respondents engaged in leafy vegetable marketing. These characteristics included age, religion, gender marital status, household size, years of education, vegetable marketing experience, and membership of cooperative society as well as the annual income of leafy vegetable marketers.

Age of the respondents was 41.2±11.5 years. At least two-fifths (40.83%) were less than 40 years of age, while the bulk of the marketers (59.2%) were 40 years of age and above. This analysis shows that most of the marketers engaged in leafy vegetable marketing in the study area were at their middle age and as such have the energy to market leafy vegetables. The result of religious affiliations revealed the two major religions flourish in the study area with adherents of Christianity having dominance (47.5%) compared with Islamic religion (34.2%). Less than 1 in 5 of the marketers were not adherents of the two major religions in Nigeria. As expected, the percentage distribution of the respondents by sex showed that the bulk of the vegetable marketers were female (70.8%) compared with 29.2 percent of male who were into vegetable marketing. In terms of household size, more than half (54.2%) of the marketers had less than 4 people in their household, while 45.8 percent had 5 or more people in their households. The mean household size was 4.0±2.0 people. This suggests a moderate household size for the sample of the leafy vegetable marketers in the study. We classified education into three – those who have no education at all, those who have formal education and those who have adult education. We considered adult education as informal education (Obasi, 2014). Table 1 shows the distribution of the marketers according to these three categories of education. The majority (62.8%) of the leafy vegetable marketers in the sample had no formal education; 21.5 percent had one form of formal education or the other while 15.7 percent had adult education. This finding suggests that most of the marketers engaging in leafy vegetable marketing were not educated. A consideration of the marital status of the marketers also show that the majority (78.3%) were married as at the time of the survey while 10 percent were still single. A substantial percentage of the marketers were widowed, separated or divorced (11.7%).

Furthermore, results in Table 1 reveals that 65.0 percent of the marketers earned a monthly income of less than ₦10,000; at least 3 in 10 (30.8%) earned between ₦10,000 and ₦19,999 while less than 5 percent earned at least ₦20,000 per month. The leafy vegetable marketers earned between ₦2,300 and ₦30,000 monthly with a mean income of ₦8,547.5±₦4,518.73. By implication, on average, leafy vegetable marketing alone fetches at least ₦8,500 monthly for the marketers in the study area. This is less than the minimum salary of the civil servant of N18,000 per month.

The distribution of marketers according to membership of cooperative society shows that 62.5 percent of the vegetable marketers were members of cooperative society compared with 37.5 percent who were non-members. This shows that most of the leafy vegetable marketers belonged to a cooperative society and as such may have access to loan facilities to support their vegetable business.

Table 1: Distribution of the socioeconomic characteristics of leafy vegetable marketers (n=120)

Variable	Frequency	Percentage (100%)
Age		
Below 40 years	49	40.8
40 years or more	71	59.2
Mean/Std, 41.2 / 11.5 years		
Religion		
Christianity	57	47.5
Islam	41	34.2
Others	22	18.3
Gender		
Male	35	29.2
Female	85	70.8
Household size		
Less than 5	65	54.2
5 and above	55	45.8
Mean/Std, 4/2 persons		

Variable	Frequency	Percentage (100%)
Educational qualification		
No formal education	75	62.8
Formal education	26	21.5
Adult education	19	15.7
Marital status		
Single	12	10.0
Married	94	78.3
Others	14	11.7
Marketing experience (years)		
Below 10 years	49	40.8
10 years and above	71	59.2
Membership of the cooperative society		
Yes	75	62.5
No	45	37.5
Monthly income (₦) on Leafy vegetables		
Less than 10,000	78	65.0
10,000- 19,999	37	30.8
20000 and above	5	4.2
Mean/Std ₦8,547:50/ ₦4,518:73		

Source: Field Survey, 2019

Types of leafy vegetable marketed

Five types of leafy vegetables were reported by the marketers. These are *Telfairia occidentalis, Celosia argentea, Amaranthus hybridus, Corchorus olitorous* and *Solanum macrocarpon.* Results in Table 2 show that most marketers traded in more than one type of leafy vegetables. For example, 52.1 percent traded in *Amaranthus hybridus and Corchorus olitorous;* 27.4 percent traded in all the five vegetables while 14.1 percent traded in *Amaranthus hybridus* only. This finding shows that most of the marketer traded in at least two types of vegetables except for *Amaranthus hybridus.*

Table 2: Distribution of the respondents according to types of vegetable marketed (n=120)

Types of vegetables	Frequency	Percentage
Telfairia occidentalis	1	0.8
Celosia argentea	1	0.8
Amaranthus hybridus	17	14.1
Corchorus olitorous	2	2.1
Amaranthus hybridus & Corchorus olitorous	62	52.1
Telifairia occidentalis, Amaranthus hybridus and Corchorus olitorous	1	0.8
Amaranthus hybridus & Corchorus olitorous, solanum macrocarpon	3	2.5
All	33	27.3

Source: Field Survey, 2019

Causes of post-harvest losses of leafy vegetables

According to the leafy vegetable marketers, six causes of post-harvest losses were identified. Table 3 shows the six reasons identified as causes of post-harvest losses of leafy vegetables by the extent of post-harvest loss. The majority of the marketers ranked the problem of insects and pests as very high (47.5%) and moderately high (44.2%). Poor demand for leafy vegetable by consumers and market glut were each ranked moderately low by at least seven out of every ten marketers. The three causes of post-harvest losses with highest Weighted Mean Scores (WMS) were the problem of insects and pests (2.39) ranked number one, the perishable nature of leafy vegetables (2.38) ranked 2nd and the bad state of rural roads (2.35) ranked 3rd. The least of the six causes identified by the marketers was poor handling of vegetables. Earlier studies have also identified poor handling of leafy vegetables as a major cause of post-harvest losses (Gogo *et al.,* 2018; Apolot *et al.,* 2020), but it was the least of the causes according to this study among the marketers. Other studies have attributed physiological and environmental factors as the primary causes of post-harvest losses of vegetables (Sudheer and Indira, 2007) as a result of the perishable nature of leafy vegetables. Physiological

deterioration of freshly harvested leafy vegetables due to high temperature (Ladaniya, 2008) may affect the shelf-life and as such may reduce the nutritional quality of the product.

Table 3: Distribution of the marketers according to the causes of post-harvest losses (n=120)

S/N	*Causes of post-harvest losses	Very high	Moderately high loss	Low loss	**WMS	Rank
1.	The problem of insects and pests	57(47.5)	53(44.2)	10(8.3)	2.39	1
2.	The problem of the perishable nature of vegetables	54(44.6)	57(47.9)	9(7.4)	2.38	2
3.	The bad state of rural roads	55(45.8)	53 (44.2)	12 (10.0)	2.35	3
4.	Market glut	20(16.5)	84(70.3)	16(13.2)	2.03	4
5.	Poor demand for vegetable by consumers	12(9.9)	84(70.3)	24(19.8)	1.90	5
6	Poor handling of vegetables	26(21.5)	49(41.3)	45(37.2)	1.84	6

Source: Field Survey, 2019
*** Multiple responses**
****WMS =Weighted Mean Score**

Mean post-harvest losses in leafy vegetables by socioeconomic characteristics

Results in Table 4 compared the current estimates of mean post-harvest losses according to selected socioeconomic characteristics of leafy vegetable marketers during the dry and rainy seasons. The mean postharvest losses were higher in both dry and rainy seasons for younger marketers below age 40 years compared with their elderly counterparts who were 40 years or higher. This result indicates that younger marketers on the average recorded higher loss than the elderly. There may be many reasons for this finding. Firstly, the elderly marketers may be more experienced than the younger marketers in the marketing business. In another way, the younger marketers may be overzealous by buying more than what they could market in a day without taking cognizance of the perishable nature of the product. The mean difference in post-harvest loss by age of respondents was, however, not statistically significant. Male vegetable marketers on the average recorded a lower post-harvest loss in dry (₦615.71) and the rainy season (₦1,014.29) than the female marketers who on the average recorded ₦703.53 during the dry but higher (₦1,070.71) rainy season. Further analysis shows that the mean difference in postharvest losses between male and female marketers was not significant for both dry (₦615.71for male, ₦703.53 for female) and rainy seasons (₦1,014.29 for male, ₦1,070.71 for female). The implication of this finding is that post-harvest loss of leafy vegetable is independent of the gender of the marketers. Leafy vegetable marketers who had adult education on the average recorded the highest losses (₦2,036.84**)** compared with those who had formal education (₦1,833.08**)** and those with no education (₦1,620.00). However, the mean differences in post-harvest loss were not statistically significant. This finding also suggests that experience of post-harvest loss have nothing to do with the level of education of the marketer and as such loss may occur irrespective of the level or education.

A comparison of mean difference in post-harvest losses according to religious affiliation showed that Christians experience greater loss on the average during the dry season (₦706.14) compared with adherents of Islamic religion (₦652.43). The mean post-harvest loss was nearly the same between Christians and Muslims during the rainy season (₦1,085.26 vs ₦1,081.71). This indicates post-harvest loss does not necessarily happen as a result of religious affiliation. There were variations in mean post-harvest losses by the level of income with those in the middle category (₦10,000-₦19,999) reporting the highest loss in both dry and rainy seasons than those earning below ₦10,000 and those earning ₦20,000 and above. Leafy vegetable marketers who were members of cooperative society on the average reported a lower loss in both seasons compared with their counterparts who were non-members. Surprisingly, marketers with longer years of experience (10years and above) in vegetable marketing recorded higher loss (₦1,758.45) than those with less than 10 years in the business (₦1,694.08**).** This suggests that experience may not be enough in reducing post-harvest loss in vegetable marketing. Although some variations were recorded in the mean post-harvest losses by socioeconomic characteristics of the marketers, the losses were consistently higher during the rainy season than the dry season possibly because production of vegetable is higher during the rainy season. Also, the moisture content of the leafy vegetable is higher during the rainy

season than that of dry season. Hence, the rate of spoilage is higher which leads to a greater loss.

Table 4: Mean post-harvest losses in leafy vegetables by socioeconomic characteristics (n =120)

Post-harvest losses (₦)	The year 2018		
	Dry	**Rain**	**Total**
Age			
Below 40	687.75	1081.84	1769.59
40 and above	671.12	1035.21	1706.34
t-statistic; p value	**0.214; (ns)**	**0.416; (ns)**	**0.350, (ns)**
Gender			
Male	615.71	1014.29	1630.00
Female	703.53	1070.71	1774.24
t-statistic; p-value	**1.051; (ns)**	**0.465; (ns)**	**0.740; (ns)**
Education			
No education	632.00	988.00	1620.00
Formal education	725.00	1108.08	1833.08
Adult education	794.74	1242.11	2036.84
F statistic; p-value	**1.38; (ns)**	**1.50; (ns)**	**1.60**
Religion			
Christianity	706.14	1085.26	1791.40
Islam	652.43	1081.71	1734.15
Others	652.27	922.73	1575.00
F statistic; p-value	**0.25 (ns)**	**0.64(ns)**	**0.39(ns)**
Income			
<10,000.00	668.59	1025.77	1694.36
10,000-19999	700.00	1091.89	1791.89
20,000+	660.00	1220.00	1880.00
F statistic: p-value	0.08 **(ns)**	0.35 **(ns)**	0.19 **(ns)**
Membership of the cooperative society			
Yes	643.33	1018.00	1661.33
No	735.55	1114.67	1850.22
t-statistic; p-value	**1.18 (ns)**	**0.85 (ns)**	**1.03 (ns)**
Years of experience			
<10 years	670.40	1023.67	1694.08
10years +	683.10	1075.35	1758.45
t-statistic; p-value	**0.16 (ns)**	**0.46 (ns)**	**0.36 (ns)**

Mean differences in post-harvest losses between dry and rain seasons (2016-2018)

Figure 1 shows the mean losses in post-harvest of leafy vegetables according to season between the year 2016 and 2018**.** Further analysis in Table **5** compared the overall mean differences in post-harvest losses by season (dry and rain) for the year 2016, 2017 and 2018 as well as all the three years combined using independent t-test. For the year 2016, the mean difference in post-harvest losses between the two seasons was significantly different. This is because the p-value associated with the t-statistic of -2.77 is small ($p<0.01$). At a 95 percent confidence level, the mean post-harvest loss for the dry season in 2016 was between ₦702.16 and ₦884.50. Similarly, the mean post-harvest loss for rain season in 2016 was between ₦970.61 and ₦1,792.62. The results were similar for years 2017 and 2018 and all the three years combined. Further analysis showed that for each of the three years and all the three years combined, the mean post-harvest losses during the dry seasons were significantly lower than the mean post-harvest losses during the raining seasons. These results suggest that vegetable marketers experience post-harvest loss all year round, irrespective of the seasons but experienced higher loss during the rainy season. The higher loss probably occurred because the supply of vegetables exceeded the quantity demanded by the consumers.

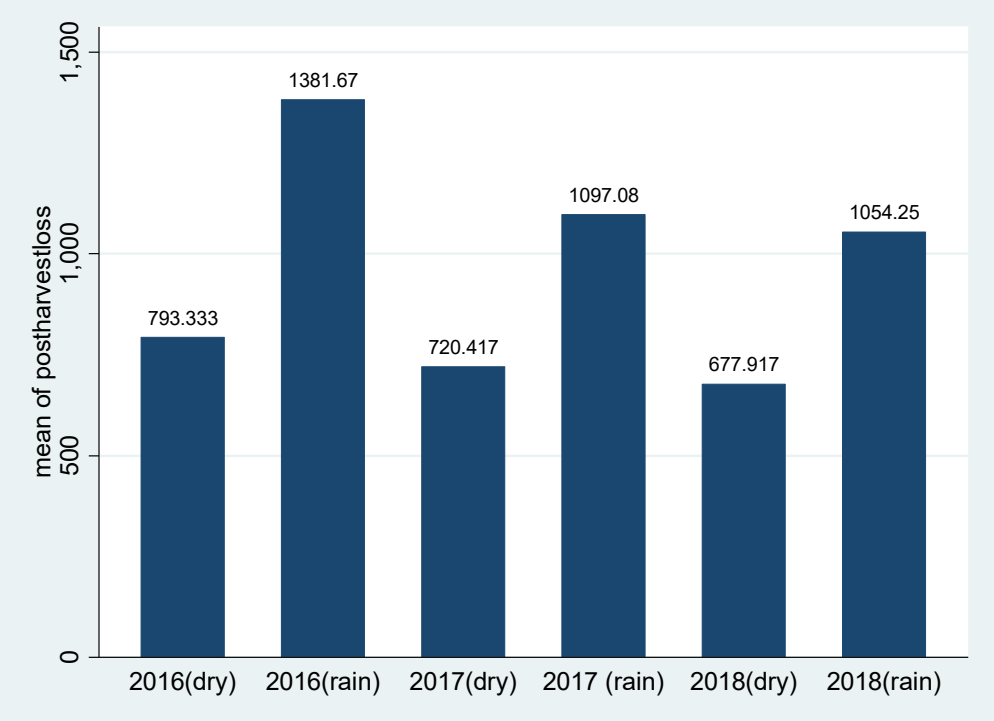

Fig 1: Trends in mean post-harvest losses per month by each season and year (2016-2018)

Table 5: Test of significance of mean differences in yearly post-harvest losses between dry and rain seasons (2016-2018)

The year 2016	**Season**	**Mean (₦)**	**Std Error**	**95% C.I.**
	Dry	793.33	46.04	702.16 - 884.50
	Rain	1381.67	207.60	970.61 - 1792.72
	Difference	588.34	107.79	
t= -2.77; p<0.01				
Year 2017	**Season**	**Mean**	**Std Error**	**95% C.I.**
	Dry	720.42	40.47	640.27 - 800.56
	Rain	1097.08	47.86	1002.32 - 1191.85
	Difference	376.67	62.68	
t= 6.01 ; p<0.01				
The year 2018	**Season**	**Mean**	**Std Error**	**95% C.I.**
	Dry	677.92	38.01	602.66 - 753.18
	Rain	1054.25	54.92	945.49 - 1163.01
	Difference	376.33	66.80	
t= 5.63 ; p<0.01				
All the 3 years	**Season**	**Mean**	**Std Error**	**95% C.I.**
Combined	Dry	730.56	24.11	683.14 - 777.97
	Rain	1177.67	73.53	1033.06 - 1322.27
	Difference	447.11	77.38	
t=5.78 ; p<0.01				

CONCLUSION AND RECOMMENDATIONS

The study concluded that the most traded leafy vegetables are *Amaranthus hybridus and Corchorus olitorous.* Also, majority of leafy vegetable marketers experienced postharvest losses during dry and rainy season between 2016 and 2018 but with higher loss during rainy seasons. Although the post-harvest losses decline by year from 2016 to 2018, the amount of loss was however substantial. Post-harvest loss was mainly attributed to the effect of pests/insects and bad

roads. To reduce post-harvest losses, we therefore, recommended that extension workers should encourage farmers to use insecticides or pesticides to control pest and diseases on their farms; government should make rural roads accessible for easy transportation of vegetables from rural communities to the urban centres or markets. Marketers should also be encouraged to buy the quantity of vegetables they can market in a day because of the perishable nature of the product.

REFERENCES

Adebooye, O. C., & Farinde, A. J. (1997). A Review of Postharvest Losses in Fruits and Vegetables in Nigeria: The Need for an Extension Strategy. *Journal of Agricultural Extension*, *1*.

Adegoke, A. O., Agbonlahor, M., Aladejebi, J. O., & Ajakpovi, A. P. (2018). A Socio-Economic Assessment of Nursing Mothers' consumption of Leafy Vegetables in Abeokuta Metropolis of Ogun State Nigeria. *FUOYE Journal of Agriculture and Human Ecology*, *1*(1).

Adeoye, I. B. (2020). Factors Affecting Efficiency of Vegetable Production in Nigeria: A Review. In *Agricultural Economics*. Intech Open.

Adeyemi, H. M. (2010). Food Security: Agriculture and Gender Relations in Post-harvest Storage. *African Research Review*, 4(4).

Ajayi, O. B., Bamidele, T. J., Malachi, O. I., & Oladejo, A. A. (2018). Comparative proximate, minerals and antinutrient analysis of selected Nigerian leafy vegetables. *Journal of Applied Life Sciences International*, 1-8.

Akintayo, O. I., Lawal, B. O., Oyedele, D. J., & Adebooye, O. C. (2019). Marketing of indigenous leafy vegetables by farmers in Oyo State, Nigeria: constraints and opportunities. *Acta horticulturae*.

Akinwunmi, O. A., & Omotayo, F. O. (2016). Proximate analysis and nutritive values of ten common vegetables in south-west (Yoruba land) Nigeria. *Communications in Applied Sciences*, *4*(2).

Alvino, A., & Barbieri, B. (2016). Vegetables of temperate climates: leafy vegetables. The Encyclopedia of Food and Health. Academic Press, Oxford, 393-400.

Apolot, M. G., Acham, H., Ssozi, J., Namutebi, A., Masanza, M., Jagwe, J., & Deborah, R. (2020). Postharvest practices along supply chains of Solanum Aethiopicum (shum) and Amaranthus lividus (linn) leafy vegetables in Wakiso and Kampala Districts, Uganda. African Journal of Food, Agriculture, Nutrition and Development, 20(3), 15978-15991.

Asaolu, S. S., Adefemi, O. S., Oyakilome, I. G., Ajibulu, K. E., & Asaolu, M. F. (2012). Proximate and mineral composition of Nigerian leafy vegetables. *Journal of food Research*, *1*(3), 214.

Ejoh, R. A., Nkonga, D. V., Inocent, G., & Moses, M. C. (2007) Nutritional components of some non-conventional leafy vegetables consumed in Cameroon. Pak J Nutr 6(6):712–717

Ejoh, S. I., & Samuel, F. O. (2016). Identification of traditional green leafy vegetable benefits to consumers and level of utilisation in a rural farming community in southwest Nigeria: qualitative findings. *West Afr J Food Nutr*, *13*(1), 10-23.

Gogo, E. O., Opiyo, A., Ulrichs, C., & Huyskens-Keil, S. (2018). Loss of African indigenous leafy vegetables along the supply chain. *International Journal of Vegetable Science,* 24(4), 361-382.

Iheanacho, K. M., & Udebuani, A. C. (2009). Nutritional composition of some leafy vegetables consumed in Imo state, Nigeria. *Journal of Applied Sciences and Environmental Management, 13(3).*

Ilaboya, I., Atikpo, E., Omofuma, F., Asekhame, F. and Umukoro, L. (2012) Causes, Effects and Way forward to Food Insecurity. Iranica *Journal of Energy & Environment,* 3, 180-188.

Inam, E., Ibanga, F., & Essien, J. (2016). Bioaccumulation and cancer risk of polycyclic aromatic hydrocarbons in leafy vegetables grown in soils within automobile repair complex and environ in Uyo, Nigeria. *Environmental Monitoring and Assessment*, *188*(12), 681.

Izuchukwu, O. (2011). Analysis of the contribution of the agricultural sector on the Nigerian economic development. *World review of business research*, *1*(1), 191-200.

Kitijonga, L. (2010). Identification of appropriate postharvest technologies for improving market access and incomes for small horticultural farmers in Sub-Saharan Africa and South Asia. WFLO Grant Final Report. Grant number 52198

Ladaniya, M. S. (2008). Commercial fresh citrus cultivars and producing countries. *Citrus Fruit: Biology, Technology and Evaluation. Academic Press, San Diego*, 13-65.

Mensah, J. K., Okoli, R. I., Ohaju-Obodo, J. O., & Eifediyi, K. (2008). Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people

of Nigeria. *African Journal of Biotechnology*, *7*(14).

Metu, Amaka G. and Okeyika, Kenechukwu O. and Maduka, Olisa D. (2016) Achieving Sustainable Food Security in Nigeria: Challenges and Way Forward. In: 3rd International Conference on African Development Issues (CU-ICADI), May 9-May 11 2016, Covenant University, Ota, Nigeria

Mohammed, M. (2016). Towards a diversified Nigerian economy, the contribution of agriculture to the GDP of Nigeria. *International Journal of Economics, Commerce and Management*, *4*(4), 581-590.

Munhuewyi, K. (2012). Postharvest losses and changes in quality of vegetables from retail to consumer: a case study of tomato, cabbage and carrot (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Okewole, S. A., Oyekunle, L. O., Akande, O. O., Adebisi, T. T., & Olubode, T. P. (2018). Nutritional compositions of selected green leafy vegetables in Oyo State, Nigeria. *Asian Journal of Applied Chemistry Research*, 1-7.

Olayemi, F. F., Adegbola, J. A., Bamishaiye, E. I., & Awagu, E. F. (2012). Assessment of post-harvest losses of some selected crops in eight local government areas of rivers state, Nigeria. *Asian journal of rural development,* 2(1), 13-23.

Oluwaseyi, A. B. (2017). The prospects of agriculture in Nigeria: How our fathers lost their way-a review. *Asian Journal of Economics, Business and Accounting*, 1-30.

Oyedele, D. J., Adebooye, O. C., Akintayo, O. I., & Lawal, B. O. (2017, November). Marketing of indigenous leafy vegetables by farmers in Oyo State, Nigeria: constraints and opportunities. In *African Vegetables Forum 1238* (pp. 193-198).

Sha'a, K. K., & Pwakangdi, S. A. (2020). Antioxidant Activities, Nutritional Composition and Antinutritional Properties of Two Leafy Vegetables (Cleome rutidosperma and Cassia tora) Consumed in Adamawa State, Nigeria. *Asian Food Science Journal*, 18-27.

Sinha, N., Hui, Y. H., Evranuz, E. Ö., Siddiq, M., & Ahmed, J. (2010). Handbook of vegetables and vegetable processing. John Wiley & Sons.

Sobukola, O. P., Adeniran, O. M., Odedairo, A. A., & Kajihausa, O. E. (2010). Heavy metal levels of some fruits and leafy vegetables from selected markets in Lagos, Nigeria. *African Journal of Food Science*, *4*(6), 389-393.

Sudheer, K. P., & Indira, V. (2007). *Post-harvest technology of horticultural crops* (Vol. 7). New India Publishing.