



**ANALYSIS OF SOCIO-ECONOMIC CHARACTERISTICS AND POST-HARVEST
LOSS STORAGE FACILITIES USED BY VEGETABLE CROPS VALUE CHAIN
ACTORS IN ADAMAWA STATE, NIGERIA**

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ABSTRACT

The study was carried out on analysis of socio-economic characteristics and post-harvest loss storage facilities used by vegetable crops value chain actors in Adamawa State, Nigeria. Multi-stage sampling procedure was used to select 526 respondents (210 farmers, 89 wholesalers, 128 retailers and 99 processors). Data were collected using structured questionnaire and analysed using descriptive statistics. The results showed that majority (96.70%) of the vegetable tomato, pepper and okra farmers were female, about 98% were male wholesalers, 76.60% were male retailers and at processors level, majority (78.80%) were male. The marital status showed that, 90.50% of the farmers were married, for the wholesalers, 97.80% were married, for the retailers about 90% were married and at processors level, 86.90% were married. The results also, revealed that, 66.70% of the farmers were into farming as their major occupation. Similarly, 33.70% of the wholesalers were engaged in marketing of different types of vegetable crops as their occupation and 52.30% of the retailers were into marketing of different crops. Mean age of farmers was 40.20 years with minimum age of 19.00 years and maximum age of 68.00 years with a standard deviation of 9.90. For the wholesalers', the mean age was 44.50 years, the maximum and minimum years were 73.00 years and 22.00 years, respectively, within a standard deviation was 10.25. The minimum household size is 1.00 and maximum is 22.00 persons with a standard deviation is 4.26. Similarly, for the wholesalers, the result shows that the household size was 8 persons with a minimum of 1 and maximum of 32 persons with standard deviation of 57.00. The minimum farming experience was 2.00 years and the maximum was 49.00 years with standard deviation of 7.29. Also, for the wholesalers, the result shows that, the mean marketing experience was 14.00 years with minimum of 3.00 years, maximum of 37.00 years and standard deviation of 8.12. The result revealed that, for the farmers, the mean annual income was ₦240,811.90 with the minimum annual income of ₦7,500 and maximum annual income of ₦1,100,000, with standard deviation of 217,09.87. Also, for the wholesalers, the result shows that the mean annual income was ₦99,213.48 with minimum annual income of ₦20,000, and maximum annual income of ₦4,000,000 with standard deviation of 145,909.79. The findings showed that 72.86% of the farmers used open field (or open place) to store their harvested vegetable crops usually under tree shades temporarily before taken it to the market for sale. The mean distance that will take farmers to sell their vegetable crops was 16.89 km with standard deviation of 0.34 and range of 2.00. The study concluded that it takes a minimum of 1.00 day and a maximum of 2.00 days with the mean of 1.32 day for the retailers to sell their vegetable crops immediately when they purchased to consumers. It was recommended for provision of sustainable good storage facilities to the actors in the post-harvest chain by the government and stakeholders.

Keywords: Vegetable, Post-harvest loss, Storage, Distance, Experience.



INTRODUCTION

Vegetables can generate income for the farmers because of its high market demand, hence it is profitable and they are an important feature of Nigerian's diet that a traditional meal without it is assumed to be incomplete. In developing countries, the consumption of vegetables is generally lower than the Food and Agriculture Organisation (FAO, 2016) recommendation of 75kg per year in habitant, that is, 206g per day per capita. Vegetables supply most of the nutrients that are deficient in other food materials. These include supply of minerals, especially calcium and iron, acid neutralizers, e.g., okra, neutralizes the acid produced from some fruits. Vegetables prevent constipation and promote digestion as a result of fibers/roughages obtained from okra, cucumber; amaranthus, lettuce and cabbage. They are rich sources of vitamins A, B, and C which helps to lower susceptibility to infection, e.g., carrots, sweet corn, amaranthus and celosia provide vitamin A; bitter leaf and water leaf. Some vegetables are rich sources of carbohydrate e.g., potatoes, sweet corn, carrot etc. Green beans and peas are cheap sources of protein. *Vernonia* (Bitter leaf), amaranthus and *telfeira* provide some amount of protein in human diet (FAO, 2014). Vegetables are generally needed to have balanced diets and overcome nutritional deficiencies and they make our staple food more palatable and enhance their intake (Leelananda *et al.*, 2021).

Postharvest loss reduces the food available for consumption and, therefore, has direct impacts on food security, nutrition, and household welfare. Food loss also tightens food markets and increases food prices particularly in the lean season by cutting part of the food supply in the markets (Barret *et al.*, 2017). Post-harvest loss reduction strategies offer unique income and food security opportunities for the over 200 million people that face food insecurity in the sub-Saharan Africa (FAO, 2019; Kikulwe *et al.*, 2018). In Nigeria, between 30-45% of food crop produced particularly vegetable crops is wasted (Isaac *et al.*, 2016), despite the fact that several indigenous technologies like sun-drying, drying under fire among others exist to reduce these enormous losses in crops.

Post-harvest loss is one of the concerns of food security and global hunger in many countries. The extent of fruit and vegetable loss reaches up to 50.00% (Aysel *et al.*, 2019). Post-harvest losses can be caused by a wide variety of factors, ranging from growing conditions to handling at retail level. Not only are losses clearly a waste of food but they also represent a similar waste of human effort, farm inputs, livelihoods, investments and scarce resources such as water (Kitinoja and Barret, 2015). Until recently, knowledge of post-harvest handling such as improve storage, packaging and handling techniques are practically non-existents with perishable crops and even if they existed, they were not easily accessible by the indigenes in the producing areas, so this allows for considerable losses of produce.

Since vegetables can change hands so many times in the post-harvest sector, a high level of management is necessary to ensure that quality is maintained. Each time someone fails to be conscientious in carrying out his or her assigned responsibility, quality is irreversibly sacrificed. Those involved in the handling of vegetable products are the producers, middlemen, retailer/marketing specialist and consumers. Appropriate post-harvest handling practices are important to minimize post-harvest losses and to maintain the quality of fruits and vegetables (Aujla *et al.*, 2011).

The socio-economic factors tend to influence households' vegetable crop production, marketing and are central in decision making with the main objective of meeting their subsistence needs and incomes. The socio-economic characteristics includes; age, sex, marital status, farm size, household size, farming experience, labour availability have influence in vegetable crops productivity.



Olubunmi *et al.* (2017) in their studies of assessment of dry season garden egg production among small-scale holder farmers in Edu Local Government Area of Kwara State, Nigeria reported that 100% of the farmers were male, 28.40% had age range of between 26-36 years, 80.00% were married, 91.70% had Islam as their religion, 31.75 had quaranic education, 47.70% had farming experience between 6-10 years .Similarly, 46.70% had household size of between 6-10 persons, 65% had farm size less than 0.51 ha and 76.60% had farming as their major occupation.

Rahiel *et al.* (2018) in their study on the assessment of production potential and post-harvest losses of fruits and vegetables in Northern Region of Ethiopia. reported that 92.00% of the respondents were male, 47.00% had age range of between 31-40 years, 67.00% were not educated, and 79.40% of the respondents have access to market. Busari *et al.* (2015) in their study on food security and post-harvest loss in fruit and vegetable marketing in Lagos Metropolis, Nigeria reported that 52.00% of the farmers had age range of between 40-60 years, 61.66% had primary education, 70.00% were male and 30% had 1-9 years of farming experience.

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James *et al.* (2017) in their study on the analysis of the level of post-harvest losses in orange marketing case study of yanlemo orange market in Kano State, Nigeria reported that, 100% of the marketers were male, 62.50% had age range of between 18-29 years, and 47.50% had secondary education, 62.50% had 1-10 years of trading experience and 92.50% belong to membership association. Wahab *et al.* (2017) in their study on comparative of fruits post-harvest losses and socio-economic levels of fruit marketers in Osogbo Metropolis of Osun State, Nigeria reveals that 100% of the marketers were female, 28.30% had age range of between 49-58 years, 73.30% were married, 66.7% had household size of between 6-10 persons and 36.6% had less than 1 year of marketing experience.

Ndirangu *et al.* (2017) in their study on the determinants of post-harvest losses among high moisture contents vegetable traders in Kenya reported that, 74.30% of the traders were female, 81.80% were 60 and above years in age and majority had secondary education. Tsado



(2015) in his study on the quality of post-harvest handling of marketable okra fruits sold in Minna, Niger State, Nigeria study reported that, 34.00% of the marketers are between the ages of 31-40 years, 77.30% were male, 74.74% were married, 37.30% had primary education and 52.00% had marketing experience of between 15-20 years. Mbuk *et al.* (2011) in their studies on the factors influencing losses of tomatoes in urban market in Uyo, Nigeria reported that 98.30% of the retailers were female, 66.70% had age range of between 21-40 years, 56.70% had range of between 1-6 years of formal education, 63.30% had trading experience of between 1-6 years, 63.30% had household size of between 4-6 persons and 31.70% had monthly income of between ₦81000-₦110,000. Adewumi *et al.* (2010) in their studies on the determinants of mildew maize by small-scale farmers in Kwara State, Nigeria reported that 82.00% of the marketers were female, the mean age of the respondents was 35 years and 82.00% of the respondents were into full time marketing business.

Ilori *et al.* (2016) in their studies on non-parametric analysis of post-harvest losses in tomatoes marketers in bodija market in Ibadan, Oyo State, Nigeria. reported that, majority of the actors were dominated by male, 88.70% were farmers, 100% were wholesalers and 55.30% were retailers. The average age of farmers, wholesalers and retailers was 46, 38 and 32.00 years respectively. About 28.00% of farmers had no formal education, 60.00% of wholesalers and retailers attain level of education. The average farming experience was 14 years while wholesalers and retailers were having 6 and 5 years in marketing. Majority of the actors were married and the average farm size for farmers was 2.7ha.

Muroyiwa *et al.* (2020) in their studies on the integration of post-harvest management in agricultural policy and strategies to minimise post-harvest loss in Lesotho. reported that, 76.7% of the marketers were female, 55% of the marketers were between the age brackets of 40-49 years, 45% had no formal education, 63.30% of the marketers were married, 46.40% of the marketers had 10 years and above of marketing experience and 78.33% of the marketers had small holder as their size of business. Busari *et al.* (2015) in their studies on food security and post-harvest loss in fruit and vegetable marketing in Lagos Metropolis, Nigeria reported that 72.00% of the fruits and vegetable marketers had age brackets of between 30-49 years, 50.00% were married, 69.00% were female. About 72.00% of the marketers had primary education, 49.00% of the marketers had between 10-19 years of marketing experience and with mean annual income of between ₦81500 and ₦ 130405.83.

MATERIALS AND METHODS

The Study Area

Adamawa State, Nigeria was the study area and has abundant water bodies (River Benue, River Gongola and River Yedzaram) and favourable weather that promotes the cultivation of many crops especially vegetables. The State was created in 1991 from the defunct Gongola State and is located in the north-eastern part of Nigeria between Latitude 7⁰N and 11N⁰ and Longitude 11⁰E and 14⁰E (National Geospatial Intelligence Agency, 2012).

The State is bordered to the north-east by Borno State, Gombe State to the west, Taraba State to the south-west and has a national border to the east with Cameroon. The State occupies land area of 36, 917 km². The State has a projected population figure of 4,502,155 people at a population growth rate of 30.00% annually (National Population Commission [NPC], 2018). The State has two seasons, the tropical wet and dry climate and two ecological zones namely the Guinea and Sudan Savannah. Mean annual rainfall ranges from 700-1600 mm and average minimum and maximum temperatures of 25.9⁰C and 39.4⁰C (NIMET, 2019). There are 21 Local Government Areas (LGAs) in the State namely: Fufore, Ganye, Gombi, Guyuk,



Hong, Jada, Shelleng, Demsa, Madagali, Maiha, Mayo-Belwa, Michika, Mubi-North, Mubi-South Numan, Song, Yola-North, Yola-South, Girei, Toundo and Lamurde.

There are over 80 ethnic groups found in the State. Some of the ethnic groups include: Fulani, Verre, Chamba, Kilba, Kwah, Waja, Tambo, Libo, Bura, Kilba, Bachama Lunguda, Kanakuru and Fali. The people of Adamawa State are noted for its rich cultural heritage which reflects in its history, i.e., dances, dress patterns, craftsmanship, music, and her cordial relationships. The three main religions are Islam, Christianity and traditionalism (National Population Commission [NPC], 2018). Majority of the people in Adamawa State are farmers. Cattle rearing are also a major occupation, while village communities living at the banks of Rivers Gongola and Benue and their tributaries engaged in fishing and farming. Crops such as maize, rice, millet, guinea corn, sugarcane, cotton, cocoa, groundnut and vegetable crop such as onion, tomato, pepper, amaranthus, okra and jute are grown successfully. There are abundant deposits of mineral ore in the state such as marble, limestone, coal and graphite (National Population Commission [NPC], 2018, AADP, 2019).

Sampling Procedure

Adamawa State is divided into four (4) Agricultural zones (Zones I, II, III and IV) for administrative conveniences. A multi-stage sampling procedures was used in the selection of the respondents. In the first stage, one LGA from Zone I and two LGAs from Zone II were selected. Similarly, four LGAs from Zone III and three LGAs from Zone IV were selected. The selection of the LGAs was purposive because of predominance of farmers and marketers that are engaged in vegetable crops production and marketing, thus, making a total of 10 LGAs. In the second stage, random sampling procedure was used to select 23 villages spread across LGAs from the four AADP Zones as shown in Table 1.

In the third stage, the selection of markets and marketers (wholesalers, retailers and processors) was done randomly based on high economic activities in those market. Hence, three markets were selected in Zone I, four markets in Zone II, nine markets in Zone III and four markets in Zone IV making a total of 19 markets. In the fourth stage, Yamane formula of determining sample size at 5% expected margin error and 95% confidence was used to determine the sample size of the respondents (farmers, wholesalers, retailers and processors). A proportionate sampling allocation procedure was used to determine the number of respondents that was selected from each village and market. A total of 526 respondents were randomly selected for the study, in the order of 210 farmers, 89 wholesalers, 128 retailers and 99 processors (Tables 1-2).

Yamane formula for determining sampling size is expressed as:

$$n = \frac{N}{1 + N(e)^2} \quad \dots (1)$$

where;

n = Sample size,

N = Total population

e = Margin of error

Proportionate Sampling Allocation Procedure reported by Kothari (2004) is expressed as:

$$n_{th} = (Nh) \frac{n}{N} \quad \dots (2)$$

where;

n_{th} = Sample taken from the h^{th} stratum,

N_h = Sample population of the h^{th} stratum,

n = Sample size, and



N = Total population

Table 1: Sample size and Selection Procedure for Farmers

Zones	LGA	Wards	Villages	Sample frame	Farmers Sample size
Zone I	Mubi-North	Muchalla	Muchalla	120	13
		Fali	Mijulu	107	12
Sub-total				227	25
Zone II	Girei	Hayin Gada	Badirisa	65	7
	Song	Labundo	Labundo	80	9
		Loko 1	Loko	100	11
		Loko 2	Loko Ciki	70	8
		Dumne	Dumne	55	6
Sub-total				370	41
Zone III	Fufore	Dasin	Dasin Hausa	90	10
		Gurin	Mayine	75	8
	Yola South	Ngurore	Ngurore	85	9
		Ngurore 1	Corner wire	60	7
	Mayo-Belwa	Nasarawo	Nasarawo Dikko	53	6
		Jereng	Wuro Mayo	110	12
	Ganye	Ganye 1	Buwangal	80	9
		Tapare	Luggere	100	11
		Sugu	Sugu	70	8
Sub-total				723	80
Zone IV	Numan	Imbru	Imbru	95	11
		Bare	Bare	85	9
		Opalo	Opalo	67	7
	Larmude	Kabawa	Kabawa	70	8
		Lafiya	Luggere	88	10
		Bodwai	Katambare	103	11
	Shelleng	Bakata	Kula	75	8
Sub-total				583	64
Total		23	23	1,903	210

Source: Field Survey (2019)

Table 2: Sample Size and Selection Plan for Marketers

Zones	LGA	Markets	Wholesalers		Retailers		Processors	
			Sample frame	Sample size	Sample frame	Sample size	Sample frame	Sample size
Zone I	Mubi North	Fali	14	7	90	10	56	7
		Muchalla	10	5	80	9	64	6
		Mubi Main	9	5	60	7	48	5
	Sub-total		33	17	230	26	168	18
Zone II	Song	Loko	7	4	74	8	65	7
		Jabbi-	5	3	40	4	35	4
		Lamba	6	3	55	6	62	6
		Girei	3	2	45	5	30	3
		Bareki	21	12	214	22	192	20
	Sub-total							
Zone III	Fufore	Chigari	4	2	66	7	60	6
		Malabo	6	3	45	5	30	3
	Mayo-Belwa Ganye	Mayo-Belwa	8	4	60	7	45	5
			9	5	50	6	50	5
		Ganye New						
	Yola-North		27	14	87	10	75	8
		Gwari	15	8	70	8	60	6
		Modern	6	3	40	4	38	4
	Sub-total	Old	8	4	65	7	55	6
		Friday	83	42	483	54	413	43
	Zone IV	Numan	Hayin Gada	10	5	61	7	53
Cross			5	3	48	5	30	3
Lamurde		Lafiya Cross	7	4	70	8	60	6
Shelleng			6	3	56	6	40	4
		Kula	28	15	235	26	183	18
Sub-total								
Total		19	219	89	1,162	128	956	99

Method of Data Collection

Structured questionnaire was used to collect primary data by the researcher. Trained enumerators (22) and extension agents (12) were involved in the administration of the questionnaire. The questionnaire was designed for all the major value chain actors in post-harvest handling chain and post-harvest storage handling facilities (farmers, wholesalers, retailers and processors). The data collected was based on 2019 cropping season from January to May for dry season and from June to October for the rainy season.



Method of Data Analysis

Data collected were analysed using descriptive statistics such as mean, frequency and percentage to achieve objectives of the study as presented and discussed in the results and discussion section of this paper.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Value Chain Actors

Socio-economic status of the farmers has a significant relationship with the productivity of different crops as it is an important indicator of mental attitude and socio-economic soundness of the farmers. It becomes an imperturbable parameter in relation to productivity, which needs to be examined in order to have more returns from vegetable crop production as both of these factors highly depend upon each other (Iheke *et al.* 2008). The socio-economic characteristics of the respondents is particularly important in the decision-making process in the agricultural sector.

The socio-economic characteristics play a significant role in farmers' decision-making process by influencing their willingness to adopt an innovation which helps in raising the productivity of their farm and by implication their living standard (Mary, 2021). The socio-economic characteristics considered here include the qualitative and quantitative characteristics of the respondents. The qualitative characteristics are sex, marital status, level of education, primary occupation, and sources of capital while the quantitative characteristics are age, household size, years of experience and annual income (Tables 3 and 4).

Sex is important in agriculture as it determines the type of farming activity a farmer performs (Iorzua *et al.*, 2020). Agricultural activities that require strenuous efforts such as bush clearing, bed making, watering, etc. are best performed by male, while less strenuous one like harvesting, processing, etc. are performed by female. Table 3 shows that, 96.70% were male and 3.30 % were female at farmers' level, this implies that strenuous activities like farming are done by men who have the energy and ability to withstand hard labour than the female. About 97.80% were male and 2.20 % were female at the wholesalers' level. This implies that, marketing of these vegetable crops at wholesale is dominated by male who have the resources more available at their disposal than their female counterpart. More so, at retailers' level, 76.60% were male while 23.40% were female. Here the result shows that male is the majority at the retailers' level. Similarly, at processors level the result shows that, 78.80% were male while 21.20% were female. The implication is that, the female is at disadvantage financially even though processing of vegetables is usually carried out by the female but now taking over by the male. This study agrees with the study of Barret *et al.* (2017) in their study who reported that, 52.00% of the farmers in Africa are within the age range of between 40-60 years.

Marital status means living singly or a matrimonial relationship which includes past and presents (Ibrahim and Alero, 2012). The marital status of Table 3 shows that, 90.50% were married while 9.50% were single at farmers' level. Also, for the wholesalers, it was found out that, 97.80% were married while 2.20% were single. This implies that female don't participate at wholesale marketing of the vegetables crops apart from competition by their male counterparts and their low level of income to be purchasing such goods for sales in which they don't have most money. Similarly, for the retailers it could be found that, 89.80% of them were married while 10.20% were single. So also, at processors level, 86.90% were married while 13.10% were single. Married men are involved more into processing to meet up with socio economic challenges affecting them. This study agrees with the findings of Tsado (2015) who found that, 74.74% of the vegetable farmers in Minna, Niger State, Nigeria, were married



Education is regarded as an avenue for attaining managerial skills. This then increases their awareness in respect of new technology and practice which in turn increases their output. It is true that a person who is well educated is more likely to approach new technology more positively, logically and analytically (Khan *et al.*, 2020). From Table 3 shows that, 53.30% of the farmers had quranic education and the implication is that they do not have western education that will help them in decision making and to manage post-harvest loss of the crops they grow and 5.70% of the farmers have never been to school which is devastating towards attaining effective post-harvest loss management strategies. This agrees with the findings of James *et al.* (2017) in their study on the analysis of the level of post-harvest losses in orange marketing case study of yanlemo orange market in Kano State, Nigeria reported that, 47.50% had secondary education.

Table 3: Socio-economic Characteristics (Qualitative Variables) of the Value Chain Actors

Characteristics	Farmers (n=210) F (%)	Wholesalers (n=89) F (%)	Retailers (n=128) F (%)	Processors (n=99) F (%)
Sex				
Male	203(96.70)	87(97.80)	98(76.60)	78(78.80)
Female	7(3.30)	2(2.20)	30(23.40)	21(21.20)
Marital status				
Married	190(90.50)	87(97.80)	115(89.80)	86(86.90)
Single	20(9.50)	2(2.20)	13(10.20)	13(13.10)
Educational Level				
Never Been to School	12(5.70)	9(10.10)	19(14.80)	5(5.10)
Quranic Education	112(53.30)	21(23.60)	25(21.90)	19(19.20)
Primary Education	14(6.70)	14(15.70)	12(9.40)	13(13.10)
Secondary Education	47(22.40)	36(40.40)	52(40.60)	52(52.50)
Tertiary Education	25(11.90)	9(10.10)	17(13.30)	10(10.10)
Secondary Occupation				
Civil Servant	15(7.10)	21(23.60)	20(15.60)	4(4.00)
Farming	140(66.70)	22(24.70)	33(25.80)	20(20.20)
Marketing	27(12.90)	30(33.70)	67(52.30)	69(60.70)
Rearing	7(3.30)	3(3.40)	1(8.00)	1(1.00)
Fishing	7(3.30)	9(10.10)	1(8.00)	-
Transportation	4(1.90)	1(1.10)	2(1.60)	1(1.00)
Artisan	10(4.80)	3(3.40)	4(3.10)	4(4.00)
Sources of capital				
Personal Savings	171(81.40)	77(86.50)	81(63.30)	71(71.79)
Bank (Loan)	15(7.10)	4(4.50)	4(3.10)	23(23.20)
Friends/Relatives	16(7.60)	8(9.00)	30(23.40)	5(5.10)
Cooperatives	6(2.90)		13(10.20)	
Others	2(1.00)			

Note: Figures in parentheses are the percentages.

Source: Field Survey (2019)



Also, the result for the wholesalers' shows that, 40.40% had secondary education and 10.10% had tertiary education. With this, the wholesalers have the capacity and knowledge that they could apply towards reducing losses in post-harvest of the crops. More so, the result shows that, 40.60% of the retailers have secondary education and 21.90% had quranic education implying that the respondents can apply their knowledge in the marketing of crops and also strategies that they will adopt to in reducing post-harvest loss of the different crops they marketed. This agrees with the finding of Ajagbe *et al.* (2014) in their study on assessment of post-harvest practices among tomato farmers and processors in Abeokuta North Local Government Area of Ogun State, Nigeria found out that, 56.00% of the vegetable crop farmers had secondary education. Similarly, the result shows that, 52.50% of the processors had secondary education, implying that majority of the respondents have a level of education they will apply in attaining effective marketing and reducing post-harvest loss of crops they marketed. This result agrees with findings of Ndirangu *et al.* (2017) in their study on the determinants of post-harvest losses among high moisture contents vegetable traders in Kenya reported that, majority of the farmers had secondary education. The study also agrees with result of Mashau *et al.* (2012) in their study on assessment of post-harvest losses of fruits at tshakluma fruit market in Limpopo Province, South Africa found out that, 44.00% of the marketers had primary education.

Occupation plays a major role in determining financial status of the people (Ngowi and Saleijo, 2019). Table 3 revealed that, 66.70% of the farmers were into farming as their major occupation. This implies that, these respondents engaged in farming activities to boost the production of vegetable crops. Similarly, 33.70% of the wholesalers were engaged in marketing of different types of vegetable crops as their occupation while 24.70% was into farming. Also, 52.30% of the retailers were into marketing of different crops while 28.80% were into farming. Similarly, for the processors, 60.70% were into marketing of different types of crops, while 20.20% were into farming.

This implies that, majority of the major actors (wholesalers, retailers and processors) were into marketing activities which they specialised hence, efficiency is improved through adoption of strategies of post-harvest loss management practices of reducing losses across the post-harvest chain and that will lead to increase output and profit. This study agrees with the findings of Adewumi *et al.* (2010) in their study on the determinants of mildew maize by small-scale farmers in Kwara State, Nigeria, reported that, 82.00% of the farmers were into full time marketing business.

Sources of capital are the different ways in which the respondents get money to finance their enterprise. According to Wahab *et al.* (2017) in their study on the comparative of fruits post-harvest losses and socio-economic levels of fruit marketers in Osogbo Metropolis of Osun State, Nigeria, reported that, availability and accessibility of capital tend to have a great influence in the marketing process as it requires considerable investment fund in the areas of bulk purchase. Similarly, Table 3 shows that, 81.40% of the farmers get their finance from their own personal savings. Personal savings has been an oldest method of savings that is interest free among the farmers, while 18.60% of the farmers obtained their finances from others sources such as banks, friends/relatives, loans and others. Also, for the wholesalers, 86.50% obtained their finance through personal savings while 13.50% of the wholesalers get their finances from friends/relatives and the likes. Similarly, 63.30% of the retailers obtained their finances from their own personal savings, while 39.30% obtain their finances from other sources. Similarly, 71.70% of the processors get their sources of capital from their personal savings and while 28.30% of them got their sources of finance from other sources.



The implication is that, the respondents have some capital base that will make them to continue in the marketing of the vegetable crops, however since most of them are small-scale in operation it becomes hardly for them to invest in post-harvest technology especially buying and maintenance of refrigerator. This agrees with the findings of Samuel *et al.* (2016) in their study on the efficiency of vegetable marketing in Peri-Urban Areas of Ogun State, Nigeria; found out that, 75.80% of the retailers had personal saving as their sources of credit. The implication is that even though the respondents' capital base was their savings it will not be enough for them to invest more in the post-harvest technology as it requires huge capital.

Age plays an important role in determining the output realized on farms. Mbah (2016) reported that the younger the producer is, the more adventurous and receptive to new ideas. Table 4 shows that, the quantitative mean age of farmers was 40.20 years. The minimum age was 19.00 years, while the maximum age was 68.00 years with a standard deviation of 9.90. This implies that, the farmers are in the active age category, hence are expected to have higher outputs of crops. It is assumed that as the age of the farmer increases his experience in post-harvest handling also increases and in turn helps to reduce post-harvest losses. This result agrees with the findings of Olubunmi *et al.* (2017) in their study reported that, 28.40% of the small-holders' farmers in Edu L.G.A of Kwara State were within the age range of between 26-36 years. For the wholesalers', the mean age was 44.50 years, the maximum and minimum years were 73.00 years and 22.00 years respectively within a standard deviation was 10.25. This implies that, the wholesalers were in their active stage of life hence can participate effectively in marketing operations. Also, they are energetic especially carrying in of bags and baskets of tomatoes and peppers. This study agrees with the findings of Peter *et al.* (2017) who reported that, the mean age of small holder vegetable farmers in Mashonal and East Province of Zimbabwe was about 50.00 years. Similarly for the retailers, the mean age was 39.50 years with minimum and maximum ages of 18.00 years and 70.00 years respectively standard deviation was 10.59. The implication is that, they are active and can-do vigorous work. This agrees with the findings of Hagos *et al.* (2017) in their study on value chain analysis of tomato production in Ahferon Woreda, Ethiopia, who reported that age of the household head affected choice of direct consumer marketing outlet negatively and significantly both at 10.00% and 5.00% levels. This indicates that, older producers are more likely to choose the closest market outlet; this is due to the fact that aged households may not likely travel to long distance and their preference was farmer traders marketing outlet.

Also, for the processors, the mean age was 37.90 years, with the minimum age of 20.00 years and maximum age of 63.00 years and standard deviation is 19.00. This implies here that; processors are in their active age of marketing of such processed crops. The result agrees with the findings of Changule *et al.* (2011) in their study on economic evaluation of post-harvest losses in tomato in Lahur District of Maharashtra, State reveals that 50.00% of the respondents had age range of between 29-39 years, 56.66% had family size of between 4-6 persons, 38.33% had secondary education and 56.66% had medium farm size.

This refers to the total number of individuals that live under the same roof and feed from the same pot (Ibrahim and Aleiro, 2012). Household size is an important socioeconomic variable that determine the availability of family labour supply (Iheke *et al.*, 2008). According to Mohammed *et al.* (2013) in their study on economic analysis of cattle marketing in Gombe Metropolis, Nigeria reported that, householders are those individuals that are eating from the same pot and their consumption unit is equal to their production unit. Table 4 shows that, the mean household size of the farmers was 7.00 people. The minimum household size is 1.00 and maximum is 22.00 persons with a standard deviation is 4.26. This implies that, the more the



household number they more they provide labour at farm. This agrees with the findings of Adepoju (2014) who reported that, 60.00% tomato farmers in Ogbomosho, Osun State Nigeria had household size of between 7.00 and 12.00 persons. Similarly, for the wholesalers, the result shows that the household size was 8 persons with a minimum of 1 and maximum of 32 persons with standard deviation of 57.00. This implies that, there is sufficient labour supply that will assist the household head in the course of marketing of these crops. This study agrees with the findings of Olubunmi *et al.* (2017) who reported that, 46.79% of small holder farmers in Edu LGA of Kwara State had household size of between 6-10 persons.

Table 4: Socio-economic Characteristics (Quantitative Variables) of the Value Chain Actors

Actors		Age (years)	Household size	Experience (Years)	Annual income (₦)
Farmers	Mean	40.16	7.00	11.50	240811.90
	Standard Deviation	9.90	4.26	7.29	217009.87
	Minimum	19.00	1.00	2.00	7500.00
	Maximum	68.00	22.00	49.00	1100000.00
Wholesalers	Mean	44.50	8.00	14.00	99213.48
	Standard Deviation	10.25	5.57	8.12	145909.79
	Minimum	22.00	1.00	3.00	20000.00
	Maximum	73.00	32.00	37.00	4000000.00
Retailers	Mean	39.50	7.00	10.31	61480.16.00
	Standard Deviation	10.59	1.16	6.52	33,183.69.00
	Minimum	18.00	1.00	2.00	15000.00
	Maximum	70.00	24.00	30.00	550000.00
Processors	Mean	37.89	6.00	9.00	126994.00
	Standard Deviation	19.50	4.95	7.30	103639.00
	Minimum	20.00	1.00	2.00	7000.00
	Maximum	63.00	27.00	60.00	700000.00

Source: Field Survey (2019)

Similarly, for the retailers Table 4 shows that, the household size was 7.00 persons with a minimum of 1.00 person and a maximum of 24.00 people with standard deviation of 16.00. This also implies adequate labour supply that would meet up marketing challenges and operations. This study agrees with the findings of Mohammed *et al.* (2016) who reported that, 49.4% small-scale farmers in Koinadugu District Northern Sierra Leone had household size of between 6-10 person. For the processors, the result shows that, the mean household size was 6.00 persons with minimum of 1.00 person and maximum of 27.00 person with standard deviation of 4.95. This implies that, there is adequate labour supply to house head for ease of various marketing operation in the study area. This agrees with findings of Ajagbe *et al.* (2014) who reported that 60.00% of tomato farmers and processors in Abeokuta North Local Government of Ogun State had a household size of between 6-10 persons.

Marketing experience and measures the distinction on individual marketers is involve in marketing. According to Mubi *et al.* (2012) in their study on cattle marketing in Mubi Area of Adamawa State, Nigeria reported that, marketing experience enables traders to adequately organise and managed their businesses in expectation of better profit. Table 4 shows that, the



mean farming experience years of farmers was 11.5 years. This indicates that the farmers have some reasonable experience in farming of the different vegetable crops and can handle the loss involved in post-harvest of the crops. The minimum farming experience was 2.00 years and the maximum was 49.00 years with standard deviation of 7.29. Also, for the wholesalers, the result shows that, the mean marketing experience was 14.00 years with minimum of 3.00 years, maximum of 37.00 years and standard deviation of 8.12.

This implies that, the wholesalers are well experienced in marketing and could possess the knowledge of handling of post-harvest losses in crops. Similarly, for the retailers, the result for years of marketing experience shows that, the mean experience in marketing was 10.31 years with minimum of marketing experience was 2.00 years and maximum of 30.00 year and the standard deviation of 6.52. This implies that, the retailers were well experienced in retail marketing of vegetable crops and. Also, for the processors, the mean marketing experience was 9.00 years with minimum of 2.00 years, and maximum of 60.00 years and the standard deviation of 7.30.

This also implies that processors are well experienced in marketing of such processed vegetable crops. This agrees with the findings of Asare *et al.* (2017) who reported in Central Region of Ghana had 6-10 years of marketing experience while 54.44% of the retailers had only 1-5 years of marketing experience.

Household income includes income of the householder and all other people of 15.00 years and above in the household, whether they are related to the householder or not. It can also indicate all that capital accrued to any individual from the sales of property or earn through work paid (Gloria, 2019). The result from Table 4 shows that, for the farmers, the mean annual income was ₦240,811.90 with the minimum annual income of ₦7,500 and maximum annual income of ₦1,100,000, with standard deviation of 217,09.87.

This study agrees with Mbuk *et al.* (2011) reported that 31.7% of tomato marketers in Urban marketing of Uyo, had monthly income of between ₦81000- ₦110,000. Also, for the wholesalers, the result shows that the mean annual income was ₦99,213.48 with minimum annual income of ₦20,000, and maximum annual income of ₦4,000,000 with standard deviation of 145,909.79. This implies that the marketers have the capacity to employ post-harvest technologies that could help in to reducing crop waste in order to further boost their businesses This agrees with the findings of Busari *et al.* (2015) who reported that 72.00% of the fruits and vegetable marketers in Lagos Metropolis had mean annual income of between ₦81500 and ₦130405.83.

Similarly, for the retailers, the result shows the mean annual income was ₦361,480.16 with minimum and maximum annual incomes of ₦15000 and ₦550,000, respectively. The retailers were also making some profits by implication. The standard deviation is 331,830.69. Also, for the processors, the result shows that the mean annual income was ₦126,994.00 with minimum annual income of ₦7000 and maximum ₦700,000 with standard deviation of 103,639.00.

Storage Facilities Used by the Vegetable Crops Value Chain Actors

Table 5 shows that, 72.86% of the farmers used open field (or open place) to store their harvested vegetable crops usually under tree shades temporarily before taken it to the market for sale. Similarly, 23.81% of the farmers used market store to keep their vegetable crop before sales while, 3.33% of farmers use their own houses to store their vegetable crops before selling. The implication is that, if the vegetable crops do not get to market from the farm in time for sales will get perished easily. This agrees with the finding of Ashish *et al.* (2018) in their study



on post-harvest loss in potato and factors affecting post-harvest loss at farm level in Chhattisgarh who reported that maximum share of losses among different operations of marketing were found in storage being 19.79 % of the total losses at market level.

Table 5: Vegetable crops value chain actors according to type of storage used, duration and distance from farm/ purchase point to point of sale

Variables	Farmers (n=210)	Wholesalers (n=89)	Retailers (n=128)	Processors (n= 99)
Frequency				
Storage facilities used				
Living house	07(03.33)	03(03.40)	22(17.19)	33(33.10)
Market store	50(23.81)	31(32.40)	36(28.13)	51(51.70)
Open field/place	153(72.86)	55(64.20)	70(54.69)	15(15.20)
Day/s taken before selling the crop				
Mean	1.00	1.04	1.12	2.01
Range	2.00	2.00	0.16	0.72
Standard dev.	0.34	0.27	1.00	3.00
Min.	1/00	1.00	1.00	1.00
Max	3.00	3.00	2.00	4.00
Distance from farm/purchase point to point of sale(km)				
Mean	16.89	24.36	12.71	65.64
Range	399.80	15.52	0.62	988.80
Std. Dev.	32.39	148.00	499.50	166.18
Min.	20.00	1.00	10.00	20.00
Max.	400.00	400.00	500.00	1000.00

Note: Figures in parentheses are percentages
Source: Field Survey (2019)

Also, the result (Table 5) shows that, 32.40% of the wholesalers used market store to keep their vegetable crops for sales, 64.20% use open place to keep their vegetable crops, while 3.40% used their own houses to store. By implication vegetable crops are prone to deterioration when exposed to outside environment for a long time. The study agrees with that of Olabode *et al.* (2016) in their study on marketing analysis of indigenous leafy vegetables in the Tropics reported that, majority of vegetable crops harvested are stored in an open place. Furthermore, the result also shows that, 28.13% of the retailers used market stores to keep their vegetable crops, 17.19% use their living house, while majority (54.69%) of the retailers used open place to keep their vegetable crops. The implication is that as majority of the respondents' store their crops in the open place, the vegetable crops will easily spoil due to exposure to unfavourable weather conditions and this can also affect their profits in the course of the business. The study agrees with Olayemi *et al.* (2012) who reported that baskets, jute bags and sack bags with mango leaves were the most common containers used for storage among small scale holder tomato marketers in Kano State. The content easily deteriorates with time. The baskets are categorized according to their sizes which also serve as pricing unit in the marketing of the produce.

Similarly, the result shows that, 51.70% of the processors keep their vegetables crops inside market store, 15.20% while 33.10% store their produce in their own house. The study agrees with Chebanga *et al.* (2018) who reported that processing losses were reported by the



traders in Mutare Zimbabwe The study also agrees with the finding of Mehmood *et al.* (2011) in their study on factors affecting post-harvest losses of citrus who reported that high percentage losses in citrus could be explained by the fact that during handling, fruits are infected with various pathogens which are not visible prior to handling but will cause decay. They therefore, advised that fruits free from any contamination of microbes, pests, rodents, insects and dust as a means of preventing fruits quality loss. Dirty handling environment could be the source of fruits contamination and quality loss from microbes, pest or insect all of which contribute to the spread of diseases to fruits.

Days Taking Before Selling of the Vegetable Crop Among the Value Chain Actors

Table 5 shows that, farmers take minimum of 1.00 day and maximum 3.00 days and a mean of 1.09 days to sell their vegetable crops. The standard deviation was 0.34 while the range was 2.00. The implication is that since vegetable crops get perishable so easily the farmers don't waste time in selling them to marketers immediately, they are harvested from the farms. The result indicates that, it takes a minimum of 1.00 day and a maximum of 3 days with the mean of 1.1day for the wholesalers to sell their vegetable crops that was purchased. The standard deviation was 0.27 with the range of 2.00 it could be deducted that; the marketers were afraid of loss due deterioration hence they sell the vegetable crops they purchased immediately to avoid any loss that they might incurred. The study agrees with the finding of Porat *et al.* (2018) in their study on post-harvest losses of fruit and vegetables during retail and in consumers' homes: Quantifications, causes, and means of prevention, reported that transition time of the vegetable crops should be as short as possible, while during loading and unloading of farm produce, care should be put into consideration so as not to damage the crops.

The result also shows that, it takes a minimum of 1.00 day and a maximum of 2.00 days with the mean of 1.32 day for the retailers to sell their vegetable crops immediately when they purchased to consumers as any delay in not selling the produce will get perish and by implication, they do make loss and the standard deviation was 0.16 with range of 1.00. Similarly, for the processors, the result reveals that, 24.20% take day/s before they sell their products. By implication since most of the vegetable crops are dry and processed hardly will any form of spoilage affects the crops preserved for sales and that is why it can last for long time without getting spoilt. This study agrees with the findings of Ashish *et al.* (2018) in their study on post-harvest loss in potato and factors affecting post-harvest loss at farm level in Chhattisgarh, reported that contribution of losses in sorting and grading was found maximum among different operations at retailer level being 19.07% to the total losses at market level and by implication causes a great loss to the retailers' income.

Distance Taken from Farm/Purchase Point to Point of Sale of the Vegetable Crops By the Value Chain Actors

The result shows that, the mean distance that will take farmers to sell their vegetable crops was 16.89 km with standard deviation of 0.34 and range of 2.00. The implication is that the farmers take the advantage of nearby markets to sell their products thereby avoiding loss that may incur due to spoilage and other factors as bad roads and so on this agrees with the findings of Yahaya and Mardiyya (2019) who reported that, most of the respondents take few kilometres to sell out their fruit consignments. The fruits deteriorate as they take long time in the market, time of exposure to sunlight, rain, and dust as well as dirt environment.

The longer time fruits stay in the market the higher they change in texture, aroma, flavour, spoilage and softening. Similarly, for the wholesalers' level, the result shows that the



mean distance from the point of purchase to the point of sales was 24.36 km with standard deviation of 15.52 and range of 149.90. The implication is that the marketers take advantage of the available market and the short distances to sell their crops hence reducing any loss that will occur. This study agrees with the finding of Muroyiwa *et al.* (2020) in their study on integration of post-harvest management in agricultural policy and strategies to minimise post-harvest loss in Lesotho. reported that, distance to markets has the potential of increasing post-harvest losses as such produce require special storage facilities in order to retain quality and freshness. In such cases when markets are far there are high chances of increased post-harvest losses.

Also, for the retailers, the result shows that the mean distance from point of purchase to the point of sale was 12.71 km with standard deviation of 0.62 and a range of 49.90. By implication, the marketers take the advantage of the nearby market to sell their crops for the fact that the crops get perishable easily and means of storing such crops are not available, and even when available, it is too costly. The result agrees with the finding of Ayandaji *et al.* (2011) in their study on determinants of post-harvest loss among tomato farmers in Imeko-Afon Local Government Area of Ogun State Nigeria, reported that high losses of tomatoes due to long distance to the market They also emphasized that post-harvest loss could also be attributed to the time it takes in transportation because tomatoes are perishable. Also, for the processors, the result indicates that the mean distance from the point of purchase to the point of sell was 65.64 km with standard deviation of 16.62 and range of 98.99.

By implication most of the respondents sell their products within the nearby or closer markets taking advantages of the availability of consumers. Moreover, the products they sell are usually in dried forms therefore cases of spoilages encountered by other marketers are not severe. The study agrees with that of Ashenafi *et al.* (2017) in their study on assessment of post-harvest loss of food product along the supply chain in Central Ethiopia who reported that poor quality products for processing and physical loss during cleaning, washing and drying activities were the main reasons for losses at processing operation. The incidences of mould and deterioration in quality due to exposure to air were another cause of loss at the processor level.

CONCLUSION AND RECOMMENDATIONS

The study concluded that there was adequate labour supply to house head for ease of various marketing operation in the study area. This indicates that the farmers have some reasonable experience in farming of the different vegetable crops and can handle the loss involved in post-harvest of the crops. The minimum farming experience was 2.00 years and the maximum was 49.00 years with standard deviation of 7.29. Also, for the wholesalers, the result shows that, the mean marketing experience was 14.00 years with minimum of 3.00 years, maximum of 37.00 years and standard deviation of 8.12. The retailers were also making some profits by implication. The standard deviation is 331,830.69. Also, for the processors, the result shows that the mean annual income was ₦126,994.00 with minimum annual income of ₦7000 and maximum ₦700,000 with standard deviation of 103,639.00. The implication is that, if the vegetable crops do not get to market from the farm in time for sales, it will get perished easily. The study therefore, recommended as follows:

1. Roads linking farms to market should be improved to reduce transit losses.
2. Provision of good storage facilities to the actors in the post-harvest chain by the government and stakeholders.



3. Government and stakeholders should promote the establishment of farm produce processing industries that can add value especially vegetable crops that are produced by farmers and marketed in the country.

REFERENCES

- Adamawa Agricultural Development Project [AADP] (2019). Annual project report.
- Adepoju, A. O. (2014). Post-harvest losses and welfare of tomato farmers in Ogbomosho, Osun State, Nigeria. *Journal of Stored Products and Post-harvest Research*, **2**(4):120-132
- Adewumi, M. O., Ayinde, O. G., Olawinji, G. B. and Babalola, G. A. (2010). Determinants of mildew maize by small-scale farmers in Kwara State, Nigeria. *Journal of Science and Frontier Research*, **10**(11): 32-35.
- Ajagbe, B O., Oyediran, W. O., Omoare, A. M. And Soffowora. O. O. (2014). Assessment of post-harvest practices among tomato farmers and processors in Abeokuta North Local Government Area of Ogun State, Nigeria. *International Journal of Education and Research*, **2**(3):1-12.
- Asare, B. E., Mensah, W. D., Van, P. G. C. and Abole. E. (2017). Farmers agronomic practices in management of the tomato (*Solanum lycopersicon*. L) yellow leaf curl virus in Central Region of Ghana. *Journal of Agricultural Extension*, **21**(2):62-67.
- Ashenafi, C.T., Tadesse, K.A., Testafe, B. and Girma, G. (2017). Assessment of post-harvest loss of warge food product along the supllly chain in Central Ethiopia. *African Journal of Agricultural Research*, **12**(3):760-763.
- Ashish, R., Gauraha, A. K. and Chandrakar, K. (2018). Post-harvest loss in potato and factors affecting post-harvest loss at farm level in Chhattisgarh. *Journal of pharmacognosy and Phytochemistry*, **7**(3):3122-3124.
- Aujla, K. M., Shah, N. A., Ishaq, M. and Fraooq, A. (2011). Post-harvest losses and marketing of grapes in Pakistan. *Sarhad Journal of Agriculture*, **27**(3): 485-490.
- Ayandaji, A. O., Adeniyi, O. R. and Omidiji, D. (2011). Determinants of post-harvest loss among tomato farmers in Imeko-Afon Local Government Area of Ogun State. *Nigeria Global Journal of Science Frontier Research*, **11**(5):22-28.
- Aysel, E., Derya, K. Y. and Fahrettin, G. (2019). Strategies to reduce post-harvest loss for fruits and vegetables. *Journal of Scientific and Technological Research*, **5**(3):29-38.
- Barret, C. B., Christiansen, L. Sheshan, M and Shimless, A. (2017). On the transformation of rural Africa. *Journal of African Economies*, **26**(1):11-35.
- Busari, A. O., Idris, A. K. M. and Lawal, A, O. (2015). Food security and post-harvest loss in fruit and vegetable marketing in Lagos Metropolis, Nigeria. *Journal of Agriculture and Food Sciences*, **3**(3): 52-58
- Changule, R. B., Shelke, R. D. and Mane, B. B. (2011). Economic evaluation of post-harvest losses in tomato in Lahur District of Mahorasha, State. *Journal of Agricultural Economics and Statistics*, **2**(1):38-41.
- Chebanga, F., Mukamba, K., Moses, S. and Mtaita, T. (2018). Post-harvest losses to agricultural product traders in Mutare, Zimbabwe. *Journal of Scientific Agriculture*, **2**:26-38.
- FAO (2019). The state of food security and nutrition in the World: Safeguarding against economic slowdowns and downturns. Rome:
- FAO. (2014). Global Food Losses and Food Waste-Extent, Causes and Prevention. FAO: Rome, Italy.



- FAO. (2016). The state of food and agriculture: Climate change, agriculture and food security. Food and Agriculture Organization of the United Nations. Retrieved 23 October 2016, from www.fao.org/publications.
- FAOSTAT. (2017). Food and Agriculture Organization of the United Nations. Retrieved February 21, 2017, from <http://www.fao.org/faostat/en/#data/QC>
- Gloria, G.G. (2019). Household Income. An American Community Survey Brief. Pp13.
- Hagos, G., Girmay, S. and Hruy, G. (2017). Value chain analysis of tomato production in Ahferon Woreda, Ethiopia. *Proceedings of Regional Workshop on Promotion of Best Practices of Value Chain in Vegetable Production in Tigray*, Dec 02, 2017, Pp129-150.
- Ibrahim, S. S. and Alero, H. M. (2012). An analysis of farmers access to formal credit in rural areas of Nigeria. *African Journal of Agricultural Research*, **7**(47):6249-6253
- Iheke, O. R., Obasi, O. I. and Nwankwo, J. C. (2008). Socioeconomic determinants of allocative efficiency of arable crop farmers in Ikwuano Local Government Area of Abia State, Nigeria. *Proceedings of 42nd Annual Conference of Agricultural Society of Nigeria (ASN)*, PP809-812.
- Ilori, T. A., Dauda, T. O., Adeniran, A. A., and Ademujó, A. O. D. (2016). Non parametric analysis of post-harvest losses in tomatoes marketers in bodija market in Ibadan, Oyo State, Nigeria. *European Journal of Academic Essays*, **3**(6): 200-206.
- Iorzua, D.A., Ikwuba, A.A., Aan, J. T. and Nwafor. S.C. (2020). Post-harvest loss of socioeconomic sustenance of yam farmers in Southern Zone of Nasarawa State, Nigeria. *Journal of Scientific Research and Report*, **26** (8):88-98.
- Isaac, K. O., Gerald, K. A., Etarnam, K. A., Ernest, K. K. and Harrison, A. (2016). Post-harvest handling practices and treatment methods for tomato handlers in Developing Countries. *Journal of Advances in Agriculture*, **1**(1):1-8.
- James, D., Bamishayi, O. M., Shamsudeen, J., William, O. and Zainab, M. (2017). Analysis of the level of post-harvest losses in orange marketing case study of yanlemo orange market in Kano State, Nigeria. *International Journal of Agriculture and Earth Science*, **5**(2):17-24.
- Khan, H, S, Chaudrhy, K. M, Ashrafi, U. and Ejaz, K. (2020). An investigation of the problems faced by vegetable growers regarding post-harvest practices in District Faisalabad, Punjab, Pakistan. *Biological and Clinical Sciences Research Journal*, **15**:1-7.
- Kikulwe, E. M., Okurut, S., Ajambo, S., Nowakunda, K., Stoian, D., and Naziri, D. (2018). Post-harvest losses and their determinants: A challenge to creating a sustainable cooking banana value chain in Uganda. *Journal of Sustainability*, 10:23-81.
- Kitinaja, L and Barret, D. M. (2015). Extension of small-scale post-harvest horticultural technologies. *Journal of Food and Agriculture*, **5**:441-445.
- Leelananda, R., Guunathiaka, D. M. C. Pathirana, S. M. and Fernanado, T. N. (2021). Reducing post-harvest loss in fruits and vegetables for ensuring food security. *Journal of Food Processing and Technology*, **9** (1):7-16.
- Mary, K. (2021). Socio-economic determinants of post-harvest losses in the grape value chain in Dodoma Municipality and Chamwino District, Tanzania. *African Journal of Economic Review*, **9**(2): 288-305
- Mashau, M. E., Moyane, J. N. and Jidean, A. (2012). Assesment of post-harvest losses of fruits at tshakluma fruit market in Limpopo Province, South Aafrica. *African Journal of Agricultural Research*, **7**(29):4145-4150.
- Mbah, E. N. (2016). Occupational diversification by rural women in Anambra State, Nigeria. Lap Lambert Academic Publishing, Pp 93.



- Mbuk, E. M., Bassey, W. E. and Udoh, E. J. (2011). Factors influencing losses of tomatoes in urban market in Uyo, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, **7**(2):40-46.
- Mehmood, Y., Naeem, A. B., Ahmad, M., Anjum, M. B, and Sabir, M. (2011). Factors affecting post-harvest losses of citrus. *Journal of Agriculture and Environmental Science*, **10**(5): 934-937.
- Mohammed, S., Isiaka, A. and Zaharadeen, D. (2013). Economic analysis of cattle marketing in Gombe Metropolis, Nigeria. *Journal of Agricultural and Rural Development*, **3**(12):960-965.
- Mohammed, P. N., Mohammed, S. and Elizabeth, T. B. (2016). The impact of vegetable farming in the livelihood of small-scale farmers in Koinadugu Districts Northern Sierra Leone. *Global Journal of Bio-Science and Biotechnology*, **5**(1), 42-49.
- Mubi, A. A., Michika, S. A. and Midau, A. (2012). Cattle Marketing in Mubi Area of Adamawa State, Nigeria. *Agriculture and Biology Journal of North America*, **4**(3):199-204.
- Muroyiwa, B., Shokopa, L., Likoetha, P. and Rantio, M. (2020). Integration of post-harvest management in agricultural policy and strategies to minimise post-harvest loss in Lesotho. *Journal of Development and Agricultural Economics*, **12**(2):84-94.
- National Geospatial Intelligence Agency (2019) annual report Washington, USA.
- Ndirangu, S., Christopher, K., Mutwiwa, U., Kamwere, M. and Joseph, M. (2017). Determinants of post-harvest losses among high moisture contents vegetable traders in Kenya. *Journal of Post-harvest Technology*, **5**(2):37-46
- Ngowi, E. R. and Selejio, O. (2019). Post-harvest -loss and adoption of improved post -harvest storage technologies by smallholder maize farmers in Tanzania. *African Journal of Economic Review* **7**(1): 249 - 267.
- NIMET (2019) Nigerian Metrological annual weather report.21Pp
- NPC (2018) National population census report, Adamawa State, National Population Commission, Adamawa State, Nigeria.
- Olabode, I. A., Adetula, O. A., Akinwumi, G. S. and Layede, A. A. (2016). Marketing analysis of indigenous leafy vegetables in the tropics. *International Journal of Vegetable Science*, **23**(3):226-232.
- Olayemi, F. F., Adegbola, J. A., Bamishaiye, E. I and Daura, A. M. (2012). Assessment of post-harvest loss challenges of small-scale farm holders of tomatoes, bell and pepper in some Local Government Area of Kano State, Nigeria. *Bayero Journal of Pure and Applied Sciences*, **3**:39-42.
- Olubunmi, A. D., Abdulazeez, M. L., Khadijat, B. O. and Tauheed, A. A. (2017). Assessment of dry season garden egg production among small-scale holder farmers in Edu Local Government Area of Kwara State, Nigeria. *Journal of Agricultural Science*, **62**(10):89-103.
- Peter, M., Abbyssinia, M., Amon, J., Babatope, A. and Saul, N. (2017). Factors influencing number of post-harvest practices adopted by small holders' vegetable farmers in Mashonal and East Province of Zimbabwe. *International Journal of Development and Sustainability*, **6**(1):1774-1790.
- Porat, R., Lichter, A., Terry, L. A., Harker, R., and Buzby, J. (2018). Post-harvest losses of fruit and vegetables during retail and in consumers' homes: Quantifications, causes, and means of prevention. *African Journal of Agricultural Research*, **12**(14):1196-1203.



- Rahiel, H. A., Zenebe, A. K., Leake, G. and Weldegerima, B. (2018). Assessment of production potential and post-harvest losses of fruits and vegetables in Northern Region of Ethiopia. *Journal and Food Science*, **7**(29):1-8.
- Samuel, O. I., Abiodun, O. O. and Joel, O. I. (2016). Efficiency of vegetable marketing in Peri-Urban Areas of Ogun State, Nigeria. *Journal of Agricultural Science*, **8**(3):142-150.
- Tsado, E. K. (2015). Quality of post-harvest handling of marketable okra fruits sold in Minna, Niger State, Nigeria. *Journal of Agriculture and Forestry Research*, **3**(5):33-45.
- Wahab, M. J., Durodola, O. S and Ibikunle, D. R. (2017). Comparative of fruits post-harvest losses and socio-economic levels of fruit marketers in Osogbo Metropolis of Osun State, Nigeria. *International Journal of Scientific Invention*, **1**(1):1-5.
- Yahaya, S. M. and Mardiyya, A. Y. (2019): Review of post-harvest losses of fruit and vegetables. *Journal of Scientific and Technical Research*, **13**(4):10193-10199.