



Analysis of Post-Harvest Losses in the Production and Marketing of Fresh Tomato in Kano State, Nigeria

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ABSTRACT

The study analysed post-harvest losses of fresh tomato marketing at various stages of the food supply chain viz. farm, wholesale and retail market levels in three Local Government Areas (LGAs) of Kano State namely; Kura, Tofa and Wudil. Multi-stage sampling technique was used for sample selection. A pretested questionnaire was used to collect data from the respondents selected randomly. A proportion of 10% of actors was chosen from a sample frame of 1604. The sample size comprises 96 producers, 21 wholesalers and 43 retailers making a total of 160 respondents. The data collected were analysed using descriptive statistics and the Post-harvest loss estimation model. The results of the analysis revealed that the major causes of tomato post-harvest losses were physical fruit damage, pest and disease attack, and varietal characteristics. The losses were greater during harvest for producers and greater during storage for the marketers. To reduce problems associated with post-harvest losses, the study recommends training farmers on post-harvest handling technologies, providing improved packaging, storage, and transportation facilities at affordable prices, harvesting produce at the proper maturity stage, and avoiding the avoidance of rough handling of fruits to reduce physical damage.

Keywords: Tomatoes, Post-harvest losses, Production, Marketing, Kano State, Nigeria.

INTRODUCTION

Nigeria is one of the leading producers of tomatoes and other vegetables in Sub Sahara Africa. The crop is grown in the country's diverse agroecological zones ranging from humid in the southern to sub-humid in the middle belt and semi-arid/arid in the country's northern parts. Yet produce is lost at an alarming rate of 30-50% yearly due to poor pre- and post-harvest practices (Charles, 2009). Estimates of production losses in developing countries are hard to evaluate. Post-harvest losses of fruit and vegetables in some African countries have been estimated to reach 50%

(FAO, 2008). Both quantitative and qualitative losses occur in horticultural commodities between harvest and consumption (Kader and Rolle, 2004). In Agriculture, post-harvest handling is the stage of crop production immediately following harvest. It includes sorting, cleaning, packing, transportation and storing (Mrema and Rolle, 2002).

Tomato (*Solanum lycopersicum*) is a staple fruit vegetable. Babalola *et al.*, (2010) reported that fresh fruits and vegetables are very important sources of vitamins and minerals which are essential for human health. Tomato is a major vegetable crop that has achieved tremendous popularity over the last century (Wener, 2000). Tomato, aside from being tasty, promotes a healthy nutritional balance diet as it is a good source of lycopene (a very powerful antioxidant) that helps to prevent the development of many forms of cancer (Wener, 2000). Despite Nigeria's great potential for producing tomatoes and other vegetables, unfortunately, they are not only seasonal but highly perishable and deteriorate a few days after harvest, losing almost all their required quality attributes and some could likely result in total waste.

The marketing of farm produce in Nigeria is affected by numerous problems in addition to certain features of farming which are unique to the industry (Ebong, 2000). This includes the seasonality of production; which subjects a country's production to changes based on irrigation facilities, perishability of the product; which is very high for fruits and vegetables, the bulkiness of the product; which adds to transportation inconveniences, storage, and labour cost; the quality of the products such as colour, freshness, smell etc. As a result of these special characteristics, the post-harvest activities of these commodities must be managed properly as crops begin to deteriorate the moment they are harvested (Bourne, 1983). Post-harvest losses which decrease returns to the investment of fruits and vegetables occur mainly because of inadequate infrastructure, poor handling poor marketing knowledge and low investment in value addition (Prigojin *et al.*, 2004). It tends to prevent an adequate supply of and accessibility of fresh tomatoes, thereby causing wide variations in the prices of the commodity. Mukaminega (2008)



suggested that losses of fruits and vegetables also occur in transit due to long distances to markets, poor and inadequate infrastructures, and methods of transportation which subject it to microbial, mechanical, and physiological damages among other factors. These losses can have a serious implications on the farmers' and traders' welfare and the food security of consumers at large. The extent of these losses at the different stages of commodity movement from production to consumption is not adequately understood. To ensure good quality tomato products, with high economic and marketable potentials, certain questions must be addressed. These include the following:

1. What are the causes of tomato post-harvest losses?
2. What are the quantities and values of fresh tomatoes lost at harvest and post-harvest stages?

In view of the above-discussed factors, it is pertinent to reduce post-harvest losses along the fresh tomato supply chain to ensure a sufficient supply of the commodity, in both quality and quantity, to every consumer. Hence, this study was carried out to analyse fresh tomato post-harvest losses in the production and marketing segments in Kano State, Nigeria.

Study Objectives

Objectives of the study were to:

- i. Identify the causes of post-harvest losses in the production and marketing segments of fresh tomato in Kano State, Nigeria; and
- ii. Estimate the quantities and values of tomatoes lost at harvest and post-harvest stages in Kano State, Nigeria.

RESEARCH METHODOLOGY

Area of Study

The study was carried out in Kano State, Nigeria, which is a major tomato-producing state in the country. The state is in the Northern part of Nigeria between latitudes $10^{\circ} 33'$ to $12^{\circ} 37' N$, and longitude $7^{\circ} 34'$ to $9^{\circ} 25' E$. It has two agroecological zones, viz Northern Guinea Savannah, which constitutes its southern part, and the Sudan Savannah, which constitute the remaining parts of the state. It has annual rainfall ranging

between 600 and 1200mm in the Guinea Savannah, and between 300 and 600mm in the Sudan Savannah. The length of growing periods (LGP) ranges from 150–200 days in the Guinea Savannah and 90–150 days in the Sudan Savannah Zones. According to the 2006 National Population Census, Kano state has an estimated population of 9,383,683 people (National Population Commission, 2006). Tomato production and consumption are popular among the teeming population of Kano State. The major occupation of inhabitants of the state is farming, while notable crops grown include groundnut, cowpea, rice, tomatoes, maize and guinea corn.

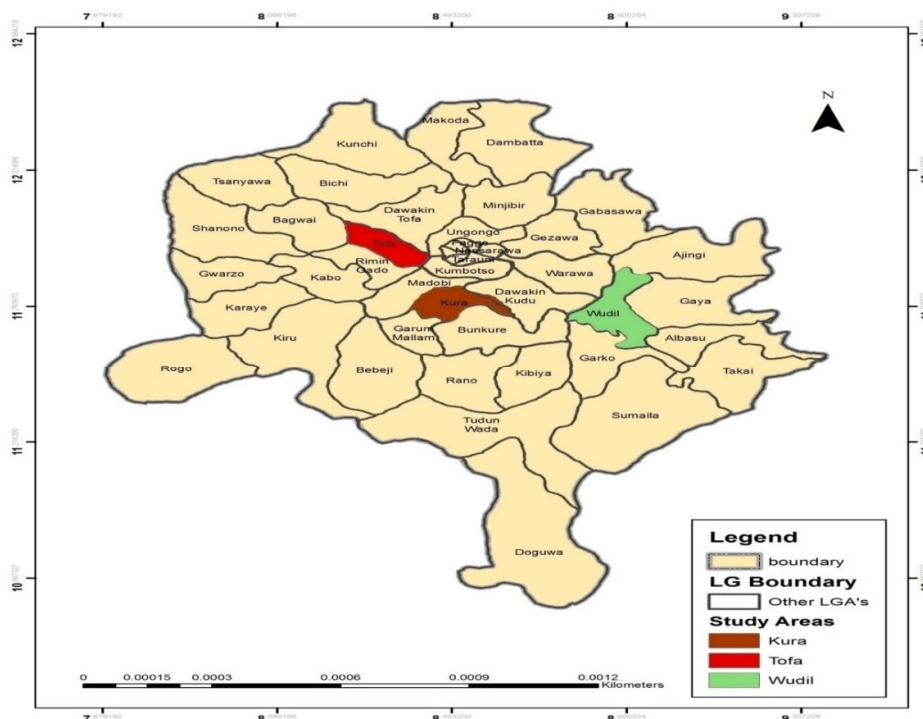


Figure 1: Map of Kano State Showing the Study area. Adopted from Baḡa *et al* (2021)

Methods of Sampling and Data Collection

This study used a multi-stage sampling technique to select its samples. In the first state, three Local Government Areas were selected which include Kura, Tofa and Wudil. The second stage involved the purposive selection of two villages for farmers' selection, and one village for traders' selection,



from each of the LGAs selected in the first stage, from which 10% of the farmers' and traders' population were randomly selected. This gave a total of 96 producers, 21 wholesalers and 43 retailers included in the study, to make a total of 160 respondents. The study used primary data as its main source of information. Data for the study were collected using structured questionnaires which were administered to the selected fresh tomato producers and marketers. Data collected include information on the causes of post-harvest losses among fresh tomato producers and marketers as well as quantities and values associated with these losses.

Table 1: Summary of Sampling of Fresh Tomato Producers

ZONE	LGA	Villages	Sampling Frame	Sample size
Zone I	Kura	Imawa	211	21
		Karfi	231	23
Zone II	Tofa	Dindere	151	15
		Yelwa Karama	148	15
Zone III	Wudil	Muncika	121	12
		Tsuburi	99	10
		Total	961	96

Source: Field Survey, 2020

Table 2: Summary of Sampling of Marketers

ZONE	LGA	Villages	Actors	Sampling frame	Sample size
Zone I	Kura	Gun Dutse	Wholesalers	103	10
			Retailers	109	11
Zone II	Tofa	Tofa	Wholesalers	58	6
			Retailers	184	18
Zone III	Wudil	Wudil	Wholesalers	48	5
			Retailers	141	14
			Total	643	64

Source: Field Survey, 2020

Tools of Data Analysis

A combination of analytical techniques was used to analyse the elicited data. They include descriptive statistics and the Post-Harvest Loss Estimation (PHLE) Model. The tools are specified below:

Descriptive statistics

Descriptive statistic tools such as frequency counts, percentages, mean, minimum, maximum, variance and standard deviation were used to identify causes of post-harvest loss with the aim of achieving objective 1 of the study.

Post-Harvest Loss Estimation (PHLE) Model

The PHLE model was adopted from the work of Bada *et al.* (2021). The model was used to estimate quantities and values of tomatoes lost at harvest and post-harvest stages by the producers and marketers. The PHLE model is expressed as:

$$TPHL = \sum_{n=1}^n [\Sigma H_i + \Sigma S_i + \Sigma P_i + \Sigma R_i + \Sigma T_i] \dots \dots \dots (1)$$

Where:

TPHL = Total Post-Harvest Losses (kg)

H_i, S_i, P_i, R_i and T_i are losses during harvesting, sorting, packaging, storage and transportation respectively.

Total Post-Harvest Loss Index is given by:

$$TPHLI = \frac{TPHL}{TH} \dots \dots \dots (2)$$

Where:

TPHLI = Total Post-harvest loss index,

TPHL = Total post-harvest loss (kg)

TH = Total harvest (kg)

Values of losses were determined by multiplying the quantities of fresh tomatoes lost by the unit price.

RESULTS AND DISCUSSION

Causes of Tomato Post-Harvest Losses

Producers and marketers were provided with several options to select the major causes of Post-harvest losses in tomato production and marketing. Marketing of fresh tomato involves picking, cleaning, standardizing, grading, packaging, storage, transportation, loading/unloading and



retailing. Tomato post-harvest losses takes place at all these stages. The results of causes of these losses are presented in Table 3.

Table 3: Causes of Tomato Post-Harvest Losses

Causes	Producers (n=96)		Wholesalers (n=21)		Retailers (n=43)	
	frequency	%	frequency	%	Frequency	%
Physical fruit damage						
Is a cause	89	92.7	21	100	39	90.7
Not a cause	7	7.3	0	0	4	9.3
Pest and diseases						
Is a cause	96	100	17	81	35	81.4
Not a cause	0	0	4	19	8	18.6
Varietal characteristics						
Is a cause	55	57.3	5	23.8	10	23.3
Not a cause	41	42.7	16	76.2	33	76.7
Excess fruit watering						
Is a cause	66	68.8	1	4.8	0	0
Not a cause	30	31.2	20	95.2	43	100
Time of harvest						
Is a cause	82	85.4	8	38.1	10	23.3
Not a cause	14	14.6	13	61.9	33	76.7

Source: Field Survey, 2020

From Table 3, at the farm level, 92.7% of the producers indicated that physical fruit damage was the major cause of tomato post-harvest loss. All (100%) of the producers indicated that pests and disease were the major causes of post-harvest loss, while 57.3% reported varietal characteristics as a cause of tomato loss. At the market level, all (100%) the wholesalers and 90.7% of the retailers confirmed that physical fruit damage was the cause of post-harvest loss of fresh fruits of tomatoes. Also, 81% of wholesalers and 81.4% of retailers indicated that pest and disease attack is a cause of post-harvest loss. Furthermore, few (23.8%) of wholesalers and 23.3% of retailers indicated that varietal characteristic was the cause of post-harvest loss of tomato. These findings are consistent with the findings of Adeoye *et al.* (2009) who reported that the major

causes of economic losses to the tomato marketers in the Ibadan metropolis included physiological, pathological, and mechanical damage.

Quantities and Values of Post-Harvest Losses of Tomato at Each Critical Stage

The post-harvest losses were estimated at producer, wholesale, and retail market levels along the fresh tomato supply chain. The unit selling price was used to value the post-harvest losses incurred. The losses at the producer level were estimated at different stages, viz. harvesting, sorting/grading, packaging, storage, and transportation, whereas the losses at the market level were estimated at sorting, packaging, storage, and transportation. The results of the analysis were presented in Table 4. From the Table, the extent of losses varied from one stage to another. On the overall basis at the farm level, the maximum loss was estimated at harvest (8999.7kg/ha) and the corresponding maximum value also at harvest is ₦630,000.1. This is in agreement with the findings of Sharma and Singh (2011) who observed that maximum losses in tomato, onion, pea, potato, radish, capsicum and cabbage in Uttarakhand were during the harvesting stage.

On the marketers' side, the post-harvest losses at wholesale and retail levels have been estimated at different stages. The extent of losses and corresponding values varied from wholesaler to retailer as well as at the different stages along the supply chain. From Table 4, it can be seen on the overall basis; the maximum quantity of tomatoes lost, and the corresponding value of loss were recorded at the wholesale market level during storage with a maximum quantity of 120009.9kg of tomato lost and a corresponding value of ₦600,000.2. However, at the retail market level, the maximum quantity of the loss of tomato and its corresponding value was recorded at the storage stage of the supply chain, which amounted to an average quantity of 1500.1kg and an average value of ₦20,000.2. This is contrary to the findings of Sharma and Singh (2011) which observed that maximum losses were estimated during the selling stage in most vegetable crops.



Table 4: Quantities and Values of Tomato Post-Harvest Losses at Various Critical Stages

Actors	Stage	Quantity of Tomato lost (kg/ha)					Value of loss (₹/ha)				
		Min	Max	Mean	SD	Var.	Min	Max	Mean	SD	Var.
Producers	Harvest	24	8999.7	1019	1234.5	1.52E6	600.2	630000.1	50300.2	94483.7	8.93E9
	Sorting	12	2400.2	282.6	448.7	2.01E5	299.9	100000.2	11760.1	18334.5	3.36E8
	Packaging	24	1889.6	226.9	298.3	8.94E4	300.1	120000.3	10700.3	17934.2	3.22E8
	Storage	48	1500.2	92.6	289.3	8.37E8	2800.1	225000.4	7894	27983.5	7.83E8
	Transportation	60.1	2400.1	300.8	495.4	2.45E5	599.6	300000.1	15840.4	40724.9	1.66E9
	Total	168	17193	1921.9			4600.2	1375000.2	96494		
Wholesalers	Sorting	2.5	2999.6	424.5	715.9	5.13E5	185.1	174999.8	19570.2	39227	1.54E9
	Packaging	2.5	3000.3	407.9	789.1	6.23E5	210.2	174999.9	18040.1	39823.9	1.59E9
	Storage	10.2	120009.9	58110.1	261652.9	6.85E10	499.8	600000.2	290499	1308300	3.73E10
	Transportation	5	42000.3	2583	9091.2	8.26E7	320.1	240000.3	138901	531200.7	2.82E11
	Total	20.2	167999.9	61525.4			1215	1189999.7	467011		
Retailers	Sorting	1.3	300.3	40.7	78.9	6.24E3	80.2	7000.2	915.5	1594.7	2.54E6
	Packaging	1.1	299.8	26.6	71.6	5.12E3	79.9	6999.9	575.3	1348.7	1.82E6
	Storage	1.2	1500.1	83.06	252.8	6.39E4	112	20000.2	1703.2	3939.4	1.55E7
	Transportation	0.5	299.9	25.7	76.01	5.78E3	65	7500.2	584.6	1478.9	2.19E6
	Total	3.7	2400.1	176.06			337	41500.1	3778.4		

Source: Field Survey, 2020

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it can be concluded that tomato production and marketing is an important enterprise among farmers and marketers in Kano state. However, there were high incidences of post-harvest losses of tomatoes as a result of mechanical, pathological as well as physiological causes. These losses can reduce the quantities of tomatoes traded and the expected income, hence farmers' and traders' welfare. The losses were greatest during harvest for producers and highest during storage for wholesalers and retailers. This has serious implications for food security and welfare as it is bound to affect the affordability of fresh tomato produce to consumers and the welfare of the producers and traders. Furthermore, the study made the following recommendations:

1. Training initiatives on the harvesting of perishable products such as tomatoes should be encouraged and follow-ups, feedback and adoption measurement should be conducted periodically for sustainability.
2. There should be readily available markets for the produce. The markets must be well organised and road networks linking producing areas to consuming areas must be improved in order to reduce transit losses of fresh tomato produce.
3. Harvesting of produce at proper maturity stage should be encouraged.
4. Improved packaging, storage and transportation facilities should be made available to curb the incidences of post-harvest losses at these stages of the supply chain.
5. Rough handling of fresh produce should be avoided to reduce physical fruit damage.

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