American Journal of Marketing Research
Vol. 7, No. 3, 2021, pp. 35-43
http://www.aiscience.org/journal/ajmr
ISSN: 2381-750X (Print); ISSN: 2381-7518 (Online)

Effects of Post-Harvest Losses on Profitability of Fresh Tomato (*Solanum lycopersicum*) Production and Marketing in Kano State, Nigeria

Mohammed Mustapha Bada[1], Aminu Suleiman[2], Amina Mustapha[2], Ashafa Salisu Sambo[3, *], Kabir Abdulaziz[4]

[1]Bank of Agriculture, Maiduguri Main Branch, Maiduguri, Nigeria
[2]Department of Agricultural Economics and Extension, Bayero University, Kano, Nigeria
[3]Department of Agricultural Extension and Management, Nuhu Bamalli Polytechnic Zaria, Samaru-Kataf Campus, Samaru-Kataf, Nigeria
[4]Agricultural Research Council of Nigeria, Mabushi-Abuja, Nigeria

Abstract

The study analysed post-harvest losses and profitability of fresh tomato production and marketing at various stages of food supply chain viz. farm, wholesale and retail market levels in three Local Government Areas of Kano State, Nigeria namely; Kura, Tofa and Wudil. The primary objective of the study was to determine the effects of post-harvest losses on profitability of fresh tomato production and marketing. A multi-stage sampling technique was used for samples selection. A pretested questionnaire was used to collect data from the respondents selected randomly. A proportion of 10% of actors were chosen from a sample frame of 1604. The sample size comprises of 96 producers, 21 wholesalers and 43 retailers making a total of 160 respondents. Data collected were analysed using descriptive statistics, post-harvest loss estimation model, gross margin analysis, marketing margin analysis and multiple regression analysis. The results of the analysis revealed that majority of fresh tomato producers and marketers were within their active working age of 28-47 years, married with low level of formal education. The study also revealed that tomato production and marketing was a profitable business with return per naira invested of ₦1.88, ₦0.60 and ₦0.19 for producers, wholesalers and retailers respectively. Finally, the result from multiple regression analysis indicated that all the independent variables had negative coefficients indicating an inverse relationship between values of post-harvest losses and gross profit of tomato production and marketing. At the farm level, the values of losses at harvest and during transportation were significant at P≤0.01, while values of losses during sorting and packaging were significant at P≤0.05. At the wholesale market level, the values of loss during sorting and transportation significant at P≤0.01 and P≤0.1 respectively. At the retail market level, the values of loss during packaging and storage were significant at P≤0.01, during sorting significant at P≤0.1 while value of loss during transportation was significant at P≤0.05. To reduce problems associated with post-harvest losses, the study therefore recommends training of farmers on post-harvest handling technologies, provision of good storage facilities at affordable prices, establishment of local tomato processing plants and encourage the public to accept processed agricultural products.

Keywords

Fresh Tomato, Marketing, Post-harvest Losses, Production, Profitability

Received: August 30, 2021 / Accepted: September 24, 2021 / Published online: October 15, 2021

* Corresponding author
E-mail address: ashafasambo@gmail.com (A. S. Sambo)

1. Introduction

Tomato (*Solanum lycopersicum*) is perhaps the world's most important vegetable crop. Its fruits are produced and consumed world-wide (over 135,000,000 tons/year). Tomato has a role to play in the developing economies; its production provides job opportunities to farmers, processors, marketers etc. thus raising their income. Tomato contributed to a healthy well balanced diet. They are rich in minerals, vitamins, essential amino acids, sugars and dietary fibres. Tomato contains much vitamins B and C, iron and phosphorus [4]. Tomato aside from being tasty, promotes 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 [13]. However, tomato is a perishable crop and deteriorate few days after harvest, loosing almost all its required quality attributes and some could likely result to total waste. It is distressing to note that much is being devoted to planting crop, so many resources spent on irrigation, fertilizer application and crop protection management could only to be waste in few days after harvest. Post-harvest losses have been highlighted as one of the determinants of the food problems in most developing countries like Nigeria [4].

Estimate of production losses in developing countries like Nigeria are hard to evaluate. Post-harvest losses of fruit and vegetables in some African countries have been estimated to reach 50% [7]. Both quantitative and qualitative losses occur in horticultural commodities between harvest and consumption [8]. Post-harvest loss is much more painful and costlier than pre-harvest loss both in terms of money and man-hours [5]. Post-harvest losses which decrease returns of fruits and vegetables occur mainly because of inadequate infrastructure, poor handling and marketing knowledge [12]. The non-availability of these facilities to local farmers implies that farmers will always have to sell their produce at throwaway prices as they cannot keep the highly perishable products for an extended period of time [6]. This has great implications on the income of farmers and could consequently result into a rapid decline in their welfare. Post-harvest loss tends to prevent adequate supply of and accessibility of fresh tomatoes, thereby causing wide variation in prices of the commodity.

Reducing post-harvest losses will have a positive impact on the livelihood of the producers and marketers as well as make tomato available to consumers all year round [10]. In order to reduce problems associated with post-harvest losses in marketing of tomato in the study area, there is need to improve tomato marketing system in the study area. This however requires detailed information on the socio-economic characteristics of tomato producers and marketers, the cost and returns of tomato marketing, the relationship between total harvest and losses at harvest and post-harvest stages and effects of post-harvest losses on profitability of tomato production and marketing. Consequent upon the factors enumerated above, reducing post-harvest losses are very important because sufficient food both in quality and quantity needs to be available to every inhabitant in our planet. It is against this background that this study was set-up to examine the effects of post-harvest losses on profitability of fresh tomato production and marketing in Kano State, Nigeria.

Study Objectives

The objectives of the study were to:

i. Describe the socioeconomic characteristics of fresh tomato farmers and marketers in Kano State, Nigeria;

ii. estimate the profitability of fresh tomato production and marketing;

iii. determine the relationship between total harvest and the losses of fresh tomato at harvest and post-harvest stages; and

iv. determine the effects of the losses on the profit levels of fresh tomato producers and marketers.

2. Research Methodology

2.1. Study Area

The study was carried out in Kano state. The choice of this area was premised on the fact that tomato is one of the major crops produced in the state. The state lies in the northern part of Nigeria between latitudes 10° 33′ to 12° 37′N, and longitude 7° 34′ to 9° 25′E. According to Kano State Government (2006) [9], the Southern part of the state lies in the northern Guinea Savannah Agro-ecological zone while the remaining northern part is covered by the Sudan Savannah. The annual rainfall varies from 600-1200 mm in the Guinea Savannah to 300-600 mm in the Sudan Savannah. The Length of Growing Periods (LGP) ranges from 90-150 days in the Sudan and 150-200 days in the Guinea Savannah Zone. The 2006 National Population Census estimates Kano State's population at 9,383,683 [11]. Tomato consumption is popular among teeming population of Kano State. The major occupation of populace of the state is farming, while major crops grown include groundnut, cowpea, rice, tomatoes and maize.

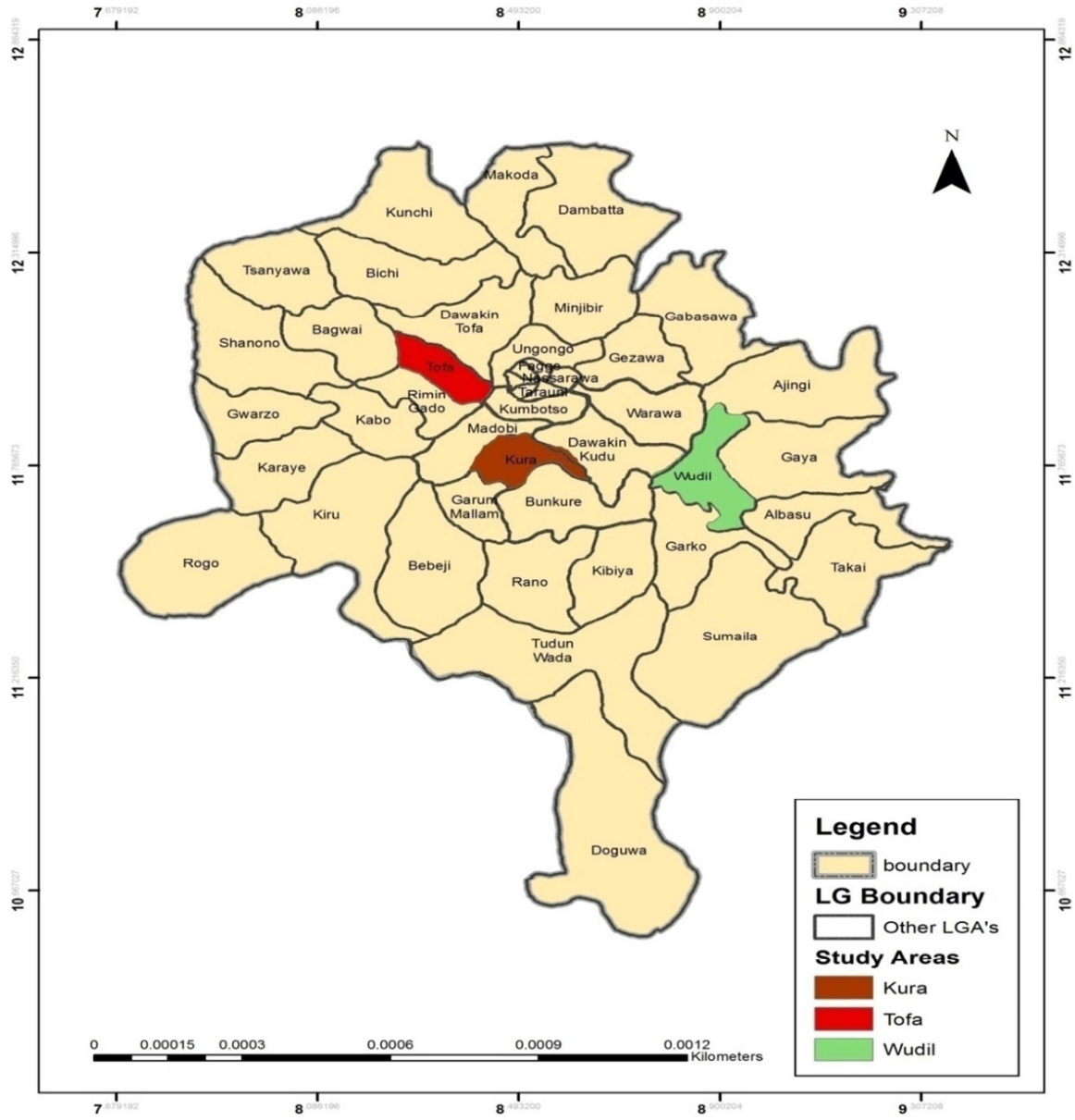

Figure 1. Map of Kano State Showing the Study area.

2.2. Methods of Sampling and Data Collection

Multi-stage sampling technique was used to select three Local Government Areas (LGAs) of Kano State based on the concentration of tomato farmers and marketers. As a result, Kura, Tofa and Wudil LGAs were selected from which 96 producers, 21 wholesalers and 43 retailers were selected at random to make a total of 160 respondents. Data for the study were collected from primary sources. Primary data were collected with the aid of structured questionnaires which were administered to the selected fresh tomato producers and marketers. Data collected include those on socio-economic characteristics of the producers and marketers such as gender, educational qualification, marital status, years of farming and marketing experience; costs and returns of fresh tomato production and marketing as well as causes of post-harvest losses and quantities and values associated with these losses.

Table 1. Summary of Sampling of 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, 2018.

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, 2018.

2.3. Analytical Techniques

A combination of analytical techniques was used to analyse the elicited data. These include descriptive statistics, Post-Harvest Loss Estimation (PHLE) model, gross margin analysis, marketing margin analysis and multiple regression model.

2.3.1. Descriptive Statistics

Descriptive statistic tools such as frequency counts, percentages, mean, minimum, maximum, variance and standard deviation were employed in describing the socio economic characteristics of the tomato producers and marketers

2.3.2. Post-Harvest Loss Estimation Model (PHLE)

The PHLE model was used to determine the relationship between total harvest and losses at harvest and post-harvest stages. The model is specified as thus:

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

Where:

TPHL = Total Post-Harvest Losses (kg)

$\sum$ = Summation

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:

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

Where:

TPHLI = Total Post-harvest loss index,

TPHL = Total post-harvest loss (kg)

TH = Total harvest (kg)

2.3.4. Gross and Marketing Margin Analyses

Gross and marketing margin analyses were used to determine costs, returns and profitability of tomato production and marketing respectively in Kano State, Nigeria. They are important tools for determining profitability of business enterprises. The tools are specified below:

$$GM = GI - TVC \quad (3)$$

Where:

GM = Gross Margin (₦/ha)

GI = Gross Income (₦/ha)

TVC = Total Variable Cost (₦/ha)

Marketing Margin = Selling Price - Purchasing Price

$$Percentage\ Marketing\ Margin = \frac{\text{Selling Price} - \text{Purchase Price}}{\text{Selling Price}} \text{ x } 100 \quad (4)$$

2.3.3. Multiple Regression Models

Multiple regression models were used to determine the effects of post-harvest losses on profitability of fresh tomato production and marketing in Kano State, Nigeria. The models are specified at production, wholesale and retail levels as follows:

At Farm Level:

$$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + e_i \quad (5)$$

Where:

Y_i = Dependent variable representing profit (₦)

X_1 = Value of loss during harvest (₦)

X_2 = Value of loss during sorting (₦)

X_3 = Value of loss during packaging (₦)

X_4 = Value of loss during storage (₦)

X_5 = Value of loss during transportation (₦)

β_0 = Intercept

β_1–β_5 = Regression coefficients of the respective explanatory variables

At Wholesale and Retail Levels:

$$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + e_i \quad (6)$$

Where:

Y_i = Dependent variable representing profit (₦)

X_1 = Value of loss during sorting (₦)

X_2 = Value of loss during packaging (₦)

X_3 = Value of loss during storage (₦)

X_4 = Value of loss during transportation (₦)

β_0 = Intercept

β_1–β_4 = Regression coefficients of the respective explanatory variables

3. Results and Discussion

3.1. Socio-economic Characteristics of Tomato Producers and Marketers

Tables 3 and 4 present the socioeconomic characteristics of fresh tomato farmers and marketers in Kano State, Nigeria. The result indicated that majority (55.9%) of the producers were in their middle ages of between 28-47 years, that of wholesalers (52.5%) and 48.7% of retailers were between 28-47 years. This shows that tomato production and marketing is dominated by middle aged people in the studied location. The dominance of those in their active and productive age has an implication on sustainability of the enterprise as experience is passed on from generation to generation. The result also indicates that majority (59.4%) of tomato producers had household sizes between 1-10 persons, 47.7% of wholesalers had household sizes between 11-20 persons, and retailers (51.2%) ranging between 1-10 persons. This is a very common practice in Northern Nigeria due to extended family nature of their households and polygamous marriages. In this situation, the family members provide labour to farming and marketing activities in the households.

Furthermore, the result shows that majority (42.7%) of tomato farmers had from 1-10 years of experience, 38.1% of wholesalers had 11-20 years marketing experience, while 39.5% of retailers had experience of between 1-10 years in fresh tomato marketing. This indicates that majority of the respondents were well experience in their business which would influence their efficiency due to knowledge about local conditions.

Table 3. Age, Household size and Experience in Tomato Production/Marketing of Tomato Producers and Marketers.

Variable	Producers		Wholesalers		Retailers	
	Frequency	%	Frequency	%	Frequency	%
Age (Years)						
18-27	21	21.7	1	4.8	5	11.7
28-37	26	26.8	5	23.8	11	25.5
38-47	28	29.1	6	28.7	10	23.2
48-57	15	15.6	7	33.4	11	25.5
58-67	6	6.2	1	4.8	3	7.0
68-77	0	0	1	4.8	3	7.0
Total	96	100	21	100	43	100
Household size						
1-10	57	59.4	7	33.4	22	51.2
11-20	32	33.3	10	47.7	15	34.9
21-30	7	7.2	1	4.8	2	4.6
31-40	0	0	3	14.3	3	7.0
41-50	0	0	0	0	1	2.3
Total	96	100	21	100	43	100
Production/marketing experience						
1-10	41	42.7	4	19.2	17	39.5
11-20	32	33.3	8	38.1	11	25.6
21-30	17	17.7	6	28.6	7	16.3
31-40	5	5.3	3	14.3	6	14.0
41-50	1	1.04	0	0	2	4.6
Total	96	100	21	100	43	100

Source: Field Survey, 2018.

From Table 4, the results indicated that all (100%) the producers and wholesalers were found to be males while 86% of the retailers are males and the remaining 14% were females. This is as a result that Tomato production and marketing is dominated by men in most of the areas in Northern Nigeria, probably due to the nature of the activities involved as well as cultural and religious settings of the area in which land is mainly allocated to men. Also the result indicated that a high proportion (82.3%, 90.5%, and 86%) of tomato producers, wholesalers and retailers respectively were married. This

implies that majority of the respondents were responsible men, can take technical decisions on their own and can put more effort to sustain domestic household demand. This finding is in consonance with that of Ayandiji and Adeniyi (2011) [3] who reported that majority (86.4%) of the tomato farmers in Imeko-Afon LGA were married. With respect to educational status of the respondents, majority (37.5%) of the producers, 52.4% wholesalers, and 55.8% of the retailers had Islamic education while 30.2%, 33.3% and 25.3% producers, wholesalers and retailers respectively had only primary education. This could affect the degree or level of acceptance and subsequent adoption of improved technologies.

Table 4. Gender, Marital Status and Level of Education of Fresh Tomato Farmers and Marketers.

Variable	Producers		Wholesalers		Retailers	
	Frequency	%	Frequency	%	Frequency	%
Gender						
Male	96	100	21	100	37	86
Female	0	0	0	0	6	14
Total	96	100	21	100	43	100
Marital status						
Single	17	17.7	2	9.5	6	14
Married	79	82.3	19	90.5	37	86
Total	96	100	21	100	43	100
Level of education						
Primary	29	30.2	7	33.3	11	25.3
Secondary	18	18.8	3	14.3	7	16.3
Tertiary	11	11.5	0	0	1	2.3
Adult literacy class	2	2.1	0	0	0	0
Islamic Literacy	36	37.5	11	52.4	24	55.8
Total	96	100	21	100	43	100

Source: Field Survey, 2018.

3.2. Volume and Losses of Tomatoes Harvested or Purchased

The relationship between the total tomatoes purchased or harvested and total post-harvest loss and loss at harvest and post-harvest stages were determined using the loss index. The loss index is defined as the ratio of loss at harvest and post-harvest stages to total tomato harvested or purchased. The results of the analysis are presented in Tables 5. The table depicts the results of the analysis of total post-harvest loss indices of producers, wholesalers and retailers. The total tomato harvested or purchased was used as the base value to calculate the loss indices.

Table 5. Total Post-harvest Loss Indices of Producers, Wholesalers and Retailers.

Total Post-harvest Loss Index	Minimum	Maximum	Mean
Producers	0.0253	0.86	0.202
Wholesalers	0.0943	0.91	0.471
Retailers	0.03	0.92	0.383

Source: Field Survey, 2018.

Results in Table 5 shows that at the farm level, the minimum and maximum total post-harvest loss indices were 0.025 and 0.86 respectively. The mean loss index value at farm level is 0.202 indicating that 20.2% of the total tomato harvested was lost as a result of harvest and post-harvest activities. At the wholesale market level, the minimum and maximum total post-harvest loss indices were 0.09 and 0.91 respectively. The mean loss index value is 0.47 indicating that 47% of tomato purchased was lost as a result of post-harvest activities. Consequently, at the retail market level, the minimum and maximum total post-harvest loss indices were 0.03 and 0.92 respectively. The mean loss index value is 0.383 indicating 38.3% of tomato purchased at retail level was lost as a result of post-harvest activities.

3.3. Costs, Returns and Profitability of Fresh Tomato Production and Marketing

Table 6 presents the result of analysis evaluating the profitability of fresh tomato production in Kano State, Nigeria.

Table 6. Gross Margin Analysis Result of Fresh Tomato Production.

Variables	Amount (₦)	Percentage
Total variable cost	258,610	
Total revenue	744,690	
Gross Margin	486080	46.2
Total revenue without PHLs	1,310,700	
Gross margin without PHLs	1,052,140	100
Reduction in Gross margin due to loss	566060	53.8

Source: Field Survey, 2018.

The unit selling price was used to value the post-harvest losses incurred. Results in Table 6 indicated that the gross margin after post-harvest loss was ₦486080 which was much lower than the gross margin without loss of ₦1,052,140. This implies a 53.8% reduction in gross margin as a result of post-harvest losses incurred by farmers and showed the great extent to which post-harvest losses reduced the income of farmers in the study area and consequently their welfare. This is slightly different from the findings of Abimbola (2014) [1], in which the percentage reduction in gross margin was 95.5%. The low percentage of gross profit margin is an indication that a farmer retained a low percentage of each Naira of sales with little left over for other expenses as net profit; this in-turn has negative welfare implication for the farmers.

3.4. Profitability of Fresh Tomato Marketing in Kano State

Table 7 present the results of the analysis evaluating the profitability of fresh tomato marketing in the study area. As in the case of gross margin, the unit selling price was used to value the post-harvest losses incurred. From the table, marketing margin with loss (₦15.69/kg) for the wholesaler was much lower than the marketing margin without post-harvest loss of ₦223.39/kg. Consequently, the marketing margin realized by a retailer was ₦8.86/kg which was also much lower than the marketing margin without post-harvest loss of ₦448.27. Therefore, the reduction in marketing margin was estimated at 92.97% for wholesalers and 98.02% for retailers. This is in agreement with the findings of Adeoye (2009) [2] in which the reduction in marketing margin for *Roma* and *VT563/JM94/44* tomato varieties were 85% and 94% respectively. The low percentage is an indication that marketers retained only a low percentage of each Naira of sales. This in-turn has negative welfare implication for the marketers.

Table 7. Results of Fresh Tomato Marketing Margin among Wholesalers and Retailers.

Variables	Wholesalers		Retailers	
	Amount (₦)	Percentage	Amount (₦)	Percentage
Purchasing price/kg	26.08		46.88	
Selling price/kg	41.76		55.74	
Marketing margin	15.69	7.021	8.86	1.98
Marketing margin without PHL(s)	223.39	100	448.27	100
Reduction in marketing margin due to loss	207.7	92.97	439.41	98.02

Source: Field Survey, 2018.

3.5. Effects of Post-harvest Losses on Profitability of Tomato Production and Marketing

The effects of post-harvest losses at production and marketing levels on profitability of tomato production and marketing were determined using regression analyses. The results of the analyses are presented in Tables 8, 9 and 10.

Table 8. Result of Regression Analysis Showing Effects of PHLs on Producers' Profit.

Variables	B	SE	T	Sig.
Constant (X_0)	-16.345	8.76	-1.161	0.249
Value of PHL at harvest	-5.5043	1.657	-3.321	0.001
Value of PHL at sorting	-19.487	7.676	-2.539	0.013
Value of PHL at packaging	-17.940	8.461	-2.120	0.037
Value of PHL at storage	-9.3272	10.241	-0.911	0.365
Value of PHL at transportation	-26.771	5.610	-4.772	0.000
R^2	0.687			
R^2 adjusted	0.653			
F. value	21.366 sig. at 1%			

Source: Field survey, 2018.

3.6. Effects of PHLs on Producers' Profit

Table 8 depicts a summary of the results obtained from the multiple regression analysis at the farm level. From the above estimation, the value of adjusted coefficient of determination (R^2) of the multiple regression was found to be 0.653 indicating that 65.3% of the total variation in the dependent variable was explained by the estimated explanatory variables (values of PHL at harvest, sorting, packaging, storage, and transportation) which had a significant joint impact on the dependent variable. The result shows that all the independent variables have an inverse relationship with the dependent variable. A negative association between the values of post-harvest losses and profit level implies that the higher the value of post-harvest losses, the lower the profit level and consequently welfare of the farmers. This is in agreement with

the findings of Abimbola (2014) [1], who reported that the value of post-harvest losses had a negative impact on the per-capita income and welfare of the farmers. The value of post-harvest loss at harvest was significant at P≤0.01; values of losses during sorting and packaging were significant at P≤0.05. The value of loss during transportation was found to be highly significant (0.000) at P≤0.01. The high significance during transportation might be due to longer distances between production centres in the north and consumption areas in the south. An increase in the distance from the farm to the market will increase the quantity of fruit loss. This is because the longer the distance of the market from the farm, the longer the time it will take for the produce to get to the market and so, the losses will increase because of congestion and packaging of the tomato together for a long time.

Table 9. Result of Regression Analysis Showing Effects of PHLs on Wholesalers' Profit.

Variables	B	SE	t	Sig.
Constant (X_0)	-18.881	17.806	-1.007	0.330
Value of PHL at sorting (X_1)	-25.283	7.377	-3.427	0.004
Value of PHL at packaging (X_2)	-11.940	10.270	-1.163	0.263
Value of PHL at storage (X_3)	-7.683	6.167	-1.246	0.232
Value of PHL at transportation (X_4)	-1.937	1.382	-1.401	0.081
R^2	0.851			
R^2 adjusted	0.812			
F. value	21.501 sig. at 1%			

Source: Field survey, 2018.

3.7. Effects of PHLs on Wholesalers' Profit

The regression analysis carried out to determine the effect of post-harvest losses on profitability of tomato marketing at wholesale market level gave an empirical result which was subjected to F-test. The value of F statistics (21.501) was found to be significant at P≤0.01. This implies that all the explanatory variables had a joint impact on the dependent variable. The overall fitness of the model is shown by the value of adjusted R^2 that is 0.812 indicating that about 81.2% of the total variation in the dependent variable was explained by the estimated explanatory variables. The coefficients show that all the variables have inverse relationship with profit level. The value of loss during sorting and transportation were found to be significant at P≤0.01 and P≤0.1 respectively. The value of loss during packaging and storage were found not to be significant. This might be due to the fact that proper packaging is carried out by the wholesalers compared to the producers. Also, in the case of storage, majority of the wholesalers do not perform the storage function as they try to discharge their entire commodity to retailers and consumers on time without delay.

Table 10. Result of the Regression Analysis Showing Effects of PHLs on Retailers' Profit.

Variables	B	SE	T	Sig.
Constant (X_0)	-10.299	11.381	-1.109	0.275
Value of PHL at sorting (X_1)	-6.769	3.975	-1.703	0.097
Value of PHL at packaging (X_2)	-13.692	4.485	-3.053	0.004
Value of PHL at storage (X_3)	-7.492	1.442	-5.194	0.000
Value of PHL at transportation (X_4)	-4.960	1.869	-2.654	0.012
R^2	0.721			
R^2 adjusted	0.681			
F-value	21.573 Sig. at 1%			

Source: Field Survey, 2018.

3.8. Effects of PHLs on Retailers' Profit

Table 10 presents the result of regression analysis of effect of post-harvest losses on profitability of fresh tomato marketing at retail market level. The overall fitness of the model is shown by the value of R-square adjusted (0.681) i.e. about 68.1% of the total variations in the dependent variable was explained by the estimated explanatory variables. The value of F-statistics (25.573) was found to be significant at P‹0.01 implying that all the explanatory variables had a joint impact on the dependent variable. The coefficients show that all the independent variables have negative coefficient. The values of post-harvest losses during sorting, packaging, storage and transportation were found to be significant at P≤0.1, P≤0.01, P≤0.01 and P≤0.05 respectively. The value of post-harvest loss during storage was found to be highly significant with a P-value of 0.000 indicating that the losses encountered during storage were more severe. This is due to the fact that retailers spend more days per marketing cycle compared to wholesalers as well as producers. The more the days the fruit

spends in the market, the more the loss. This is in consonance with the findings of Ayandiji, A. O. R. and Adeniyi, O. D. (2011) [3] who reported that increase in tomato losses was due to more days the fruit spent in the market before it is been sold to the consumers completely.

4. Conclusion and Recommendation

Based on the findings of this study, it is concluded that tomato production and marketing is an important enterprise among farmers and marketers in Kano state. It is also concluded that the enterprises are profitable among fresh tomato farmers, wholesalers and retailers in the study area. Although this is not without limitations as the profits were greatly reduced by post-harvest losses realized at both harvest and post-harvest stages.

Based on the findings of this study, the following recommendations were made:

a. Adequate training of farmers and marketers on post-harvest crop handling techniques as well as the provision of good storage facilities that could help prevent crop losses especially at the farm level.

b. There should be readily available markets for the produce. The markets must be well organised and also the road network must be improved in order to reduce transit losses of the produce.

c. Harvesting of produce at proper maturity stage should be encouraged and rough handling should be avoided to reduce physical damage.

d. Establishment of cottage industries processing tomato into tomato ketchup, juice and purees should be encouraged.

References

[1] Abimbola, O. Adepoju. (2014). "Post-harvest Losses and Welfare of Tomato Farmers in Ogbomosho, Osun State, Nigeria". *Journal of Stored Products and Post-harvest Research*. Vol. 5 (2). Pp. 8-13.

[2] Adeoye, I. B, Odeleye, O. M. O., Babalola, S. O. and Afolayan, S. O. (2009). "Economic Analysis of Tomato Losses in Ibadan Metropolis, Oyo State, Nigeria". *African Journal of Basic and Applied Sciences*. Vol. 1 (5-6). Pp. 87-92, National Horticultural Research Institute.

[3] Ayandiji, A. O. R. and Adeniyi, O. D. (2011). "Determinant of Post-harvest Losses Among Tomato Farmers in Imeko-Afon Local Government Area of Ogun State, Nigeria". *Global Journal of Science Frontier Research*. Vol. 11, Issue 5. Pp. 22-28.

[4] Babalola, D. A.; Makinde, Y. O.; Omonona, B. T. and Oyekanmi, M. O. (2010). "Determinants of Post-harvest losses in Tomato Production: a case study of Imeko-Afon Local government area of Ogun state". *Journal of life and physical science*. Acta SATECH 3 (2): 14-18.

[5] Dasgupta, M. K. and Mandal, N. C. (1989). Post-Harvest Pathology of Perishables. Nepal Agricultural Research Council Online Library. Accessed on 15th January, 2018, 5:00 pm.

[6] Ebong. V. O. (2000), "Agribusiness Management in a Developing: the Nigeria Perspective". Uyo, Dorand Publishers.

[7] FAO (2004), "The Role of Post-Harvest Management in Assuring the Quality and Safety of Horticultural Produce". FAO Agricultural services Bulletin 152.

[8] Kader, A. A. and Rolle, R. S. (2004). "The Role of Post-harvest Management in Assuring the Quality and Safety of Horticultural Crops". Food and Agricultural Organization of the United Nations, Rome. Agricultural Service Bulletin 152. Pp. 52.

[9] Kano State Government (2006). "National Population Commission Census Report". Pp. 30-35.

[10] Mrema, C. G and Rolle, S. R. (2002), "Status of the Post-harvest Sector and its Contribution to Agricultural Development and Economic Growth." Proceedings of the 9th JIRCAS International Symposium 2002. Value Addition to Agricultural Products, Ibaraki, Japan.

[11] National Population Commission (2006): Human Population Figures of Census in Nigeria.

[12] Prigojin, F. H.; Allatn, M.; Izzat, I.; Ajalin, A.; Masari I. M. and M. Bader, (2004). "Survey on Post-harvest losses of Tomatoes and Grapes". ACTA Horticultural in proceeding of the 5th International Post-harvest Symposium. Verona, Italy (June 6-11), 2004.

[13] Wener, Z. H., (2000). "Agriculture Support Online Vegetables Consultant". www.agrisupportonline.com