



## CAUSES OF FRESH TOMATO (*LYCOPERSICO lycopersicum*) LOSSES AMONG SUPPLY CHAIN ACTORS IN BAUCHI STATE, NIGERIA

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### ABSTRACT

The study was conducted to examine the causes of fresh tomato losses in Bauchi State, Nigeria. A multi-stage sampling procedure was used to select 808 supply chain actors comprising of 301 producers, 105 wholesalers, 252 retailers and 150 consumers. Data were collected through the use of a structured questionnaire. The data were analysed using descriptive statistics such as frequency distribution, percentage, mean, minimum, maximum standard deviations and graph. Comparing among the supply chain actors for modes of transportation, the result reveals that most (25.23% 23.63% and 29.96%) of the producers, wholesalers and retailers used busses, lorry, pickups and cars, respectively, for their transportation, while half (50%) of the consumers used tricycle for transportation. Also, the result shows that majority (47.16%, 47.09% and 57.27%) of the producers, wholesalers and retailers, respectively, depended on personal savings as their source of capital. The result reveals that 75.38% of fresh tomato consumers obtained information from marketers. Producers (34.88%) obtained their information from fellow farmers, while 31.16% and 38.71% of the wholesalers and retailers obtained information from fellow marketers. The result also reveals that producers, wholesalers and retailers collectively agreed that high temperature with mean of 3.00, 3.00 and 2.92 was a real cause of fresh tomato loss. Further, the result shows that, of the quantities of 524.82, 162.52 and 22 produced and purchased by producers, wholesalers and retailers, 15.39%, 12.72% and 8.69% were lost. The result reveals that producers, wholesalers and retailers collectively agreed that high temperature with mean of 3.00, 3.00 and 2.92 was a real cause of fresh tomato loss. It was concluded that high temperature, lack of ready market, disease, storage facilities and car brake-down contributed significantly to fresh tomato losses among the supply chain actors. The study recommended that large cold storage facility can be made available, to reduce fresh tomato losses.

**Keywords:** Actors, Bauchi State, Causes, Fresh tomato, Losses.



## INTRODUCTION

Tomato loss is a major problem in the supply chain of fresh tomato. It happens during harvesting, processing, transportation, wholesaling, retailing and during cooking process. About 40% to 50% fruits and vegetable are lost before they reach consumers (WFLO, 2010). Pathogen such as virus and nematodes can cause large tomato losses. However, fungi and bacteria have been reported as the major micro-organisms that can cause huge tomato lost (Ebimieowei *et al.*, 2013). Soil borne fungi such as *Phytophthora capsici* has also been found to be responsible for late blight in tomato crops (Lamour and Hausbeak, 2004). In addition, Ebimieowei *et al.* (2013) listed other soil borne diseases that also cause severe losses in tomato to include *Alternaria septorai* leaf spot in tomatoes *Fusarium oxysporum* responsible for *fusarium* wilt. Other causes of tomato spoilage include poor packaging material such as the weakly woven baskets, which according to Kutama *et al.* (2007) do not withstand rough handling. Also, poor handling, poor transport system and lack of cold storage also speeds tomato spoilage. This is because they increase the growth of micro-organisms resulting from physiological nature of production (Olayemi *et al.*, 2010).

Olson (2004) reported that 36% and 44% of damage in tomato is caused by physiological disorder. Such physiological disorder includes Blossom end, rot fruit cracking, sun scold and Blotchy ripening (Dorais *et al.*, 2001; and Peet, 2009). Severe damage in tomato can also be experienced from infected previously used baskets, farm tools and plant used for separating between baskets when transporting tomatoes (Idah *et al.*, 2007). Tomato owners love to use the 911 lorry to transport their tomatoes. This is because of its large capacity and enough ventilation qualities. However, in the absence of such vehicles, transporters are pressured and forced to use any available kinds of vehicles including poorly ventilated mode of transportation. A poorly ventilated hastening the growth of micro-organisms that encourage tomato spoilage.

Adeoye *et al.* (2009) reported that mechanical damage in economic postharvest losses rank' first, followed by pathogenic damage and physiological damage as least. Ebimieowei (2013) also observed that, use of dirty water to clean tomatoes as well as the disposal of rotten tomatoes around packing houses contribute to microbial growth that leads to tomato spoilage. Some even load it on tankers which result to tomatoes falling on the way due to poor roads. Such tomatoes are completely lost on the way. This lost reduces the profit gain, resulting into low income for the supply chain actors and also reduces the utility for consumers. It is against this background that the study examines the quantity sold and causes of fresh tomato losses among supply chain actors.

## MATERIALS AND METHODS

### The Study Area

The study was conducted in Bauchi State, Nigeria. Bauchi State is divided into three (3) agricultural zones namely: Northern, Central and Western zones. The state is made up of twenty local government areas which are Bauchi, Kirfi, Alkalari, Toro, Dass, Tafawa-Balewa, and Bogoro in the Western Zone; Zaki, Itas-Gadau, Gamawa, Jama'are, Katagum, Dambam,



Giade, Shira and Misau in the Northern zone, and Darazo, Warji, Ningi and Ganjuwa are in the central zone. Bauchi State is located in the Northern Guinea Savannah Ecological zone of Nigeria. It lies between latitude  $9^{\circ} 3'$  and  $12^{\circ} 3'$  North of the equator and longitudes  $8^{\circ} 50'$  and  $11^{\circ}$  East of the Greenwich Meridian. Bauchi State occupies a total land area of  $49,119\text{km}^2$  representing about 15% of the Nigerian's total land mass (Bauchi State Agricultural Development Programme [BSADP], 2015). The State has an estimated population of 4,889,811.2 (NBS, 2015). Majority of the inhabitants are Geremawa, Hausa, Fulani, Sayawa, Jarawa and others. Most (80%) of the farmers of Bauchi State are predominantly subsistence farmers. The farmers in the state practice both dry and rainy seasons farming. They produce vegetables such as tomato, pepper, okra, lettuce, cabbage, amaranth among others. Other major crops produced include rice, maize, millet, cowpea, acha, groundnut, sesame and guinea corn. They also keep livestock such as goats, sheep, cattle, and poultry too.

The temperature range is  $9.11^{\circ}\text{C}$  minimum and  $40.55^{\circ}\text{C}$  maximum (BSADP, 2015). Bauchi State is characterized by a dust atmosphere referred to as harmattan with visibility being low as 100m. Secondly, is the southwest Maritime air mass. This wind system is responsible for the rainy season experienced in the State. The mean annual rain fall ranges from 700mm in extreme north (Zaki) and 1300mm in the southern part (Toro) of the State. The State is characterized by two (2) distinct seasons (the rainy and dry seasons). The rainy season begins from May and ends October and the dry season starts November and ends in April.

### **Sampling Techniques**

The target population for the study is the fresh tomato small scale producers, wholesalers, retailers and consumers. A preliminary survey was conducted in order to identify the major tomato producing and marketing areas in each zone. A multi-stage sampling procedure was employed. First, a purposive sampling technique was used to select three (3) local government areas (LGAs) from each zone and two villages from each of the selected LGAs. This gave the total number of nine LGAs and 18 villages. The purposive selection of both the LGAs and villages was based on the fact that they are the major tomato producers in the areas. These LGAs and their villages in bracket were as follows: Northern zone; Jama'are (Dogon-Jeji and Gongo); Zaki (Sakwa and Ariri); Misau (Zindi and Misau); Central zone: Warji (Badeyaso and Wando); Ningi (Kafin Zaki and Tsangaya), Ganjuwa (Filin-Shagari and Marbini); and in the Western zone; Toro (Tilde and Ganye); Kirfi (Badara and Baba) and Dass (Dabandak and Wandu).

Also, using the same reason for selection as above, a purposive sampling technique was used to select two (2) markets from each zone. These markets were Jama'are and Misau in the northern zone; Cheledi and Toro in the Western zone while Ningi and Soro were from Central zone. In addition, Muda-Lawal market was also chosen being a collection centre for fresh tomato in Bauchi State. A list of both small scale tomato farmers (1,524) and Retailers (1,278) were obtained and used as the sample frame. This was achieved with the help of some key informants such as government officials from BSADP and from leaders of tomato farmers and marketers association.



A simple random sampling technique was used. The use of this technique was to ensure that each member of the target population is given equal chance of being selected. Thus, 20% of both farmers and retailers from the selected areas were chosen. This gave the total number of 301 farmers and 252 retailers from the sampling frame of 1,524 and 1,278, respectively. All the 105 identified wholesalers in the three (3) zones were observed for the study. This was because their population was considered not very large. Also, using accidental sampling procedure, 150 consumers were selected. In all, 808 respondents were randomly selected and interviewed for the study.

### Method of Data Collection

Primary data were collected from a field survey. Information pertaining quantity sold and causes of fresh tomato losses were collected and use for the study. The data were collected with the help of some trained enumerators guided by the researcher. The trained enumerators were obtained from the various ADP headquarters of each selected LGAs. The data were collected over the period of twelve months, beginning from July, 2016 to June 2017.

### Analytical Techniques

Data were analysed through the use of descriptive statistics, such as graph, frequency distribution, percentages, mean and standard deviation.

## RESULTS AND DISCUSSION

Figure 1 shows that 524.82, 162.52 and 22 baskets of fresh tomato were handled by producers, wholesalers and retailers, respectively. The result further reveals that, of the quantity handled by producers, wholesalers and retailers 395.15, 125.14 and 18.24 baskets were sold and 80.77, 20.68 and 1.87 baskets were lost, respectively. Also, the result shows that about 48.9, 16.7 and 1.89 baskets were consumed and given as gift, respectively. The implication is that supply chain actors loose certain quantity of their product after harvest and during marketing.

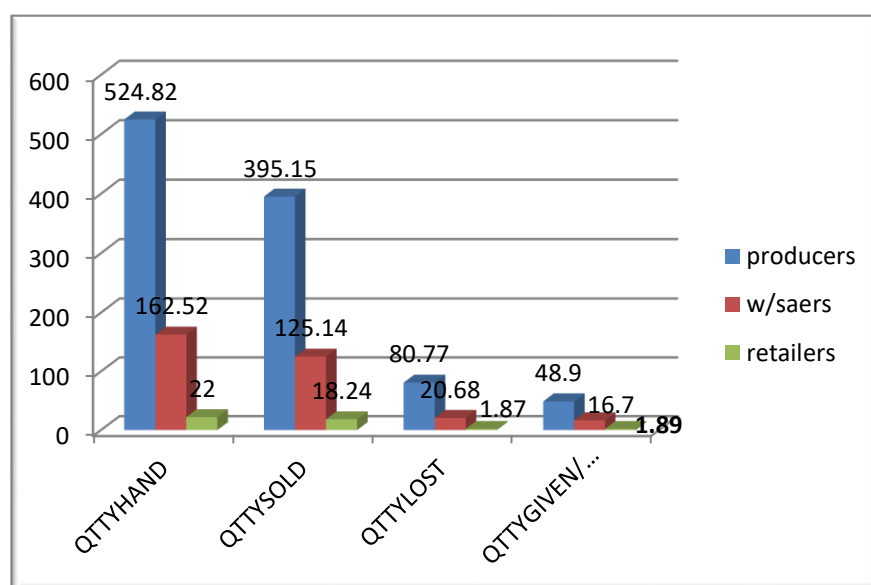


Figure 1: *Quantity handled by the supply actors of fresh tomato*



### **Supply Chain Actors by Mode of Transportation, Source of Capital and Information**

Table 1 reveals that 25.23% and 23.89% of the producers used lorry and buses. Similarly, wholesalers (23.62%) used lorry, 29.96% of the retailers used pick-up vans, buses and cars as their means of transportation. Most (50.34%) of the consumers used tri-cycle as the means of transportation, 23.49% used motorcycle and personal cars.

Majority (47.16%, 47.09% and 57.27%) of the producers wholesalers and retailers respectively, sourced their funds from personal savings. Only 16.46% of the producers, 15.25% of wholesalers and 5.0% of the retailers sourced their funds through formal means. The implication is that most of the supply chain actors will not be able to expand their farming business due to little personal savings and will not be able to purchase improved farm inputs. This could also be due to the difficulties associated with accessing funds from formal sources. This finding agrees with Usman and Bakari (2013) who reposted 80% of tomato business in Adamawa State to have sourced their money from personal saving. The major reason why tomato farmers and marketers prefer to source money from non-formal sources could be due to lack of collateral means which serve as a prerequisite in accessing funds from formal sources as well as due to high interest rate charged by these formal institutions. Also, could be because formal sources of funds are not easy to come by these days (Atman *et al.*, 2017). Baba and Alhassan (2017) also reported 56%, 100% and 55.6% for producers, wholesalers and retailers of rice in Niger State.

The result on source of information reveals that about (34.88%) of the farmers obtained information from their fellows farmers about (31.16% and 38.71%) of wholesalers and retailers obtained their information from their fellow marketers. The result shows that majority (75.38%) of consumes obtained information from marketers. The implication is that consumers depend on whatever prices that are given to them by the marketers. This also means that whatever costs incurred by the marketers consumers are at the receiving end. This finding agree with Baba and Alhassan (2017), that producers and marketers coordinate among themselves by belonging to cooperative that increases their access to information, inputs, credits and also information regarding how to increase farm size.



**Table 1:** Supply Chain Actors by Mode of Transportation, Source of Capital and Information

Variables	Producers (n = 301)		Wholesaler (n = 105)		Retailers (n = 252)		Consumer (n = 150)	
	Frq.	%	Frq.	%	Frq.	%	Frq.	%
<b>Mode of transportation</b>								
Lorries	285	23.89	94	23.62	0	0.0	0	0.0
Pick-up van	221	18.52	105	10.54	252	29.96	7	2.35
Busses	301	25.23	105	10.54	252	29.96	0	0.0
Motor cycle	111	9.30	8	2.01	60	7.13	70	23.49
Car	275	23.05	86	21.61	252	29.96	1	0.30
Tri-cycle (keke)	0	0.0	0	0.0	25	2.97	150	50.34
Personal	0	0.0	5	1.26	0	0.0	70	23.49
<b>Source of capital</b>								
Agricultural Bank	105	16.46	34	15.25	22	5.00	0	0.0
Friends/relatives	121	18.96	40	17.94	65	14.77	0	0.0
Personal savings	301	47.16	105	47.09	525	57.27	0	0.0
Money lenders	111	17.40	44	17.72	101	22.95	0	0.0
<b>Source of information</b>								
Cooperative	235	27.24	91	27.00	186	20.89	0	0.0
Marketers	228	26.41	105	31.16	525	38.71	150	75.38
Farmers	301	34.88	94	27.89	182	27.96	0	0.0
Media	99	11.47	47	13.95	81	12.44	30	12.08
Neighbours	0	0.0	0	0.0	0	0.0	19	9.55

Source: Field Survey (2017)

### Supply Chain Actors by Means of Communication and Main Occupation

The result on means of communication shows that 29.48%, 40.23% and 41.10% of producers wholesalers and retailers use Global System Mobile (GSM) as their means of communication. About 20.27%, 40.23% and 41.10% of producers, wholesalers and retailers, respectively used marketers as means of communication this means that marketers of fresh tomato in Bauchi State use GSM and their fellow marketers in communication while Producers used GSM and their fellow farmers. The use of GSM by all the supply chain actors could be due to ease of access to finding information on prices and buyers of their products. Also due to the nature of their product as a highly perishable product prefer faster means of communication and response such as the use of mobile phones to get to buyers on time. Similar observation was made by Atman *et al.* (2017) that use of mobile phone among other ICT gadgets was on the higher (88.9%) side.

Comparing between the supply actors the result shows that 81.40% of producers were farmers. Only 81.40% of them were involved in both farming and trading majority of the Wholesalers were marketers and 4.7% of them were into marketing and farming further 80.16% of the retailers depended on marketing only 19.84% of them engaged in both marketing and farming. About 17.33% of the Consumers were farmers 46.67% were civil servant, 36.6% were into other forms of business. The implication is that majority of Consumers of tomato in Bauchi





State were civil servants. Shettima *et al.* (2016) also reported that majority (28.3%) of fresh tomato consumers in Kano metropolis were civil servants. This result in the case of producers, support the findings of Olowa and Olowa (2017); Osanyinlusi and Adenegan (2016) that majority of the rural populace are predominantly farmers.

**Table 1:** Supply Chain Actors by Source of Communication and Main Occupation **Contn'd.**

Variables	Producers (n = 301)		Wholesaler (n = 105)		Retailers (n = 252)		Consumer (n = 150)	
	Freq.	%	Freq.	%	Freq	%	Freq.	%
<b>Means of communication</b>								
Use of GSM	301	29.48	105	40.23	252	41.10	0	0.0
Computers	21	2.00	4	1.53	0	0.0	0	0.0
Fellow farmers	245	24.00	0	0.0	0	0.0	0	0.0
Fellow marketers	207	20.27	105	40.23	252	41.10	0	0.0
Radio/television	103	10.09	0	0.0	0	0.0	0	0.0
Extension agents	144	14.10	47	18.01	109	17.80	0	0.0
<b>Main occupation</b>								
Farming only	245	81.40	0	0.0	0	0.0	26	17.33
Civil servant	0	0.0	0	0.0	0	0.0	70	46.67
Farming/trading	56	18.60	5	4.7	50	19.84	0	0.0
Trading only	0	0.0	100	5.27	202	80.16	0	0.0
Other jobs	0	0.0	0	0.0	0	0.0	54	36.00

Source: Field Survey (2017)

### **Causes of Fresh Tomato Losses among Actors in Bauchi State**

The result in Table 2 compared the SCAs in Bauchi State for causes of fresh tomato losses. The result reveals that, Producers in all the three zones agreed that, high temperature with mean of 3.00 was a major cause of tomato loss. This implies that high temperature has severe effect on tomato losses. Therefore, to reduce its effect, large cold storage facilities should be adopted. Olowa and Olowa (2017), also reported hot weather as an accelerator of food wastage. Poor handling (mean = 3.00), stocking pattern (mean = 3.00), drying process (mean = 3.00), tomato variety (mean = 3.00) and long distance (mean = 3.00) were also considered as having severe effect on tomato losses by Central zone Producers in the state. This means that, Central zone producers experience more severe cases on tomato losses than Producers in Western and Northern zones. For wholesalers, on the effect of no ready market



(mean = 3.00) diseased tomatoes (mean = 3.00), vehicle breakdown (mean = 3.00) and storage problem (mean = 3.00) wholesalers among the three zones in Bauchi State were of the opinion that, the effect these factors on tomato losses is severe. This implies that the listed factors have serious effect on the cause of fresh tomato losses in Bauchi State. The result (Table 2), further reveals that retailers were of the view that diseased tomatoes (mean=3.00) is a very severe factor causing fresh tomato losses. Also, Bauchi State retailers saw lack of ready market (2.96) as a severe cause of tomato spoilage. The implication is that diseased and lack of ready market for fresh tomato as major causes of tomato losses among retailers in Bauchi State. This study supports the findings of Ghost (2009) and Ebimiewei *et al.* (2013) who reported fungi and bacteria as the source of 10%-30% spoilage in most tomatoes produced Nigeria.

**Table 2:** Causes of Fresh Tomato Losses among Actors in Bauchi State

Causes	Producers (n = 301)				Wholesalers (n = 105)				Retailers (n = 252)			
	Min	Max	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max	Mean	Std. dev.
No ready market	1	3	1.95	0.753	3	3	3.00	0.000	2	3	2.96	0.186
Disease tomatoes	2	3	1.45	0.499	3	3	3.00	0.000	3	3	3.00	0.000
Weak basket	1	3	1.48	0.614	2	2	2.00	0.000	1	3	1.89	0.496
Poor handling	3	3	2.53	0.661	2	2	2.00	0.000	1	2	1.37	0.485
Stocking pattern	2	3	2.81	0.390	2	2	2.00	0.000	1	2	1.73	0.447
Car breakdown	1	3	2.05	0.819	3	3	3.00	0.000	1	3	1.90	0.548
Storage problem	1	3	1.61	0.743	3	3	3.00	0.000	2	3	2.10	0.294
Drying process	2	3	2.84	0.370	1	1	1.00	0.000	1	3	1.91	0.717
Tomato variety	1	3	2.52	0.641	2	2	2.00	0.000	2	3	2.77	0.424
Long distance	1	3	2.83	0.451	2	3	2.17	0.379	1	2	1.21	0.411
High temperature	1	2	3.00	0.000	3	3	3.00	0.000	2	3	2.92	0.271

Note: Decision Rule: Factor with mean  $\geq 2.00$  is a true cause of tomato loses otherwise not.

Source: Field survey (2017)

### Causes of Fresh Tomato Losses among Actors in the Three Zones of Bauchi State

Table 3 presents the mean distribution of the causes of fresh tomato losses for producers among Central, Western and Northern zones in Bauchi State. Producers of fresh tomato gave their opinions as to the level of severity of each of the listed cause of fresh tomato losses. The result reveals that no ready market (mean = 1.90 and 1.97) for central and Northern zones, respectively; diseased tomato (mean = 1.61, 1.23 and 1.53); weak basket (mean = 1.31, 1.77





and 1.48) for central western and northern zones, respectively, were regarded as no causes of fresh tomato loss. However, no ready market (mean = 2.00) was considered as a major cause of fresh tomato loss. The reason could be because most of the tomato produced in Bauchi State are channel to Western zone with Muda-lawal market in the zone as the major tomato market. As a result, makes tomato over flow the western zone markets, couple with the fact that it was on season period for the tomato in the state. Vehicle break down (mean = 1.56) in northern zone, storage problem (mean = 1.10 and 1.87) in central and western zone, respectively, were also considered as no major causes of fresh tomato loss. This implies that fresh tomato loss is not mainly caused by any factor with mean of less than 2.00 among producers. All other listed causes of fresh tomato loss were regarded by the Producers in the three zones as major causes of tomato loss as indicated by their means of 2.00 to 3.00. This indicates that to reduce tomato losses in the three zones among producers in Bauchi state, require putting measures that will reduce the effect of these factors with the mean of 2.00 to 3.00.

**Table 3:** Causes of Fresh Tomato Losses among Actors in the Three Zones of Bauchi State

Causes	Producers			Wholesalers			Retailers		
	CZ	WZ	NZ	CZ	WZ	NZ	CZ	WZ	NZ
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
No ready market	1.90	2.00	1.97	3.00	3.00	3.00	2.98	2.94	3.00
Disease tomatoes	1.61	1.23	1.53	3.00	3.00	3.00	3.00	3.00	3.00
Weak basket	1.31	1.77	1.48	2.00	2.00	2.00	2.04	1.92	2.03
Poor handling	3.00	2.01	2.64	2.00	2.00	2.00	1.30	1.32	1.53
Stocking pattern	3.00	2.71	2.53	2.00	2.00	2.00	2.00	1.76	1.47
Car breakdown	2.54	2.84	1.56	3.00	3.00	3.00	2.06	1.90	1.78
Storage problem	1.10	1.87	2.12	3.00	3.00	3.00	2.00	2.00	2.33
Drying process	3.00	2.66	2.83	1.00	1.00	1.00	2.16	2.00	1.57
Tomato variety	3.00	2.00	2.47	2.00	2.00	2.00	2.90	2.80	2.61
Long distance	3.00	1.67	2.48	2.00	2.00	2.00	1.00	1.22	1.35
High temperature	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	2.72
Over supply	2.00	2.48	2.35	3.00	3.00	2.00	3.00	3.00	2.72

Note: Decision Rule: Factor with mean  $\geq 2.00$  is a true cause of tomato losses otherwise not;

CZ = Central Zone, WZ = Western Zone, NZ = Northern zone

Source: Field survey (2017)

The result in the Table 3 also presents the mean distribution of causes of tomato losses for wholesalers between the three zones (Central, Western and Northern) in Bauchi state.



Wholesalers are of the opinion that drying process (mean = 1.00, 1.00 and 1.00) is not a very serious factors causing fresh tomato losses at wholesale level. Also, all wholesalers are seen from the Table 3 to consider the effect of no ready market (mean = 3.00, 3.00, 3.00); diseased tomato (mean = 3.00, 3.00, 3.00); weak basket (mean 2.00, 2.00, 2.00); poor handlings (mean = 2.00, 2.00 2.00). stocking pattern (mean = 2.00, 2.00, 2.00); car breakdown (mean = 3.00, 3.00,3.00); storage problem (mean = 3.00, 3.00, 3.00); tomato variety (mean = 2.00, 2.00, 2.00); long distance (mean = 2.00, 2.00, 2.00); high temperature (mean = 3.00, 3.00, 2.00); and over supply (mean = 3.00, 3.00, 2.00) in Central, Western and Northern zones, respectively, that these factors were major causes of fresh tomato losses. This result is in line with what is obtainable also among producers. Therefore necessary measures should be taken to put in place facilities such as good transport system, use of improved seed, cold storage facilities to reduce tomato losses.

Table 3 further presents the mean distribution of the causes of fresh tomato losses among retailers in Central Western and Northern zones in Bauchi State. Retailers of fresh tomato gave their opinions as to the level of severity of each of the listed causes of fresh tomato losses. The result show that poor handling (mean = 1.30, 1.32, 1.53) and long distance (mean = 1.20, 1.22, 1.35) were considered by all retailers in Central Western and Northern zone respectively, drying process (mean = 1.57) for Northern zone were also not regarded to have serious effect on fresh tomato loss. Weak basket (mean = 1.92) for Western zone was also regarded as not to have severe effect on fresh tomato loss. All other listed 3.00 were considered to have severe effect on fresh tomato loss by the retailers. This indicates that their effect on fresh tomato is severe. James *et al.* (2017) reported pest and disease (62.5%), poor market patronage (52.5%) and poor facilities (87.5%) to be major cause of post-harvest losses. Ugonna (2015) also reported processing technology to be responsible for 45% losses of tomatoes in Nigeria.

### **Causes of Fresh Tomato Losses Associated with Consumers in Bauchi State**

Table 4 reveals the result of consumers on causes of fresh tomato losses. The result shows that all (100%) of the consumers agree that they experience losses. The implication is that from production point to consumption point fresh tomatoes are lost.

### **CONCLUSION AND RECOMMENDATIONS**

The study was conducted in order to examine the causes of fresh tomato losses among supply chain actors (SCAs) in Bauchi State. The result showed that producers and wholesalers were of the opinion that high temperature was a major cause of fresh tomato loss. Wholesalers and retailers reported disease as the cause of tomato loss. The result also shows that, wholesalers in the three zones agreed that all the listed factors other than the factor drying process, contribute to fresh tomato loss. The study therefore, recommended the provision of large cold storage facilities around fresh tomato collecting centres and the use of improved seed. This would help reduce tomato loss resulting from high temperature and diseases, respectively.



## REFERENCES

- 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. *Journal of Science*, **1**(8): 7-92.
- Atman, F. M., Suleman, Y., Usman, B. A. Mohammed, R. and Ahmed, H. (2017). *The role of agricultural information and communication technology in Zaria Local Government Area Kaduna State, Nigeria*. Proceedings of the 31<sup>st</sup> Annual conference of Nigeria (FAMAN) held at Abubakar Tafawa Balewa University, Bauchi Nigeria. Pp.196-203
- Baba, K. M. Alhassan, U. (2017). Coordination and profit margin in rice value chain in Niger State, Nigeria. Proceeding of the 31<sup>st</sup> Annual Conference of Farm Management Association of Nigeria (FAMAN), held at Abubakar Tafawa Balewa University, Bauchi, Nigeria on 9<sup>th</sup> – 12<sup>th</sup> October, 2017. Pp.656-665.
- Bauchi State Agricultural Development Programme (2015). *BSADP at a glance*. A pamphlet prepared by P.E.M sub-program.
- Dorais, M., Papadopoulos, A. P. and Gosseline, A. (2001). Green house tomato fruit quality. In: Janick J. (Ed). *Horticultural Review*, **5**: 239-319.
- Ebimiewei, E., Nwazoma, A. B. and Bawa, D. D. S. (2013). Postharvest spoilage of tomato (*Lycopersicon esculentum* mill.) and control strategies in Nigeria. *Journal of Biology. Agriculture and Health Care*, **3**(10): 51-62.
- Ghost, A. (2009). Identification of micro-organisms for spoilage of tomato (*lycopersicon esculentum*) fruit. *Journal of Phytology*, **1**(6): 415-416.
- Idah, P. A., Ajiegiri, E. and Yisa, M. G. (2007). Fruit vegetables handling and transportation in Nigeria. *AU Journal of Technology*, **10**: 175-183.
- James, D., Bamishayi, O. M., Usman, Y., Bashir, B. B., Olukunde, T. and Idris, D. (2017). *Assessment of the post-harvest losses of tomato marketing in Yankaba fruit and vegetable market of Kano State Nigeria*. Processing of the 31<sup>st</sup> FAMAN National Conference, held at 1000 seat lecture theatre, AbubakarTafawa University, Bauchi on 9<sup>th</sup>-12 October, Pp .409-418.
- Kutama, A. S., Aliyu, S. S. and Mohammed, I. (2007). Fungal pathogens associated with tomato wicker baskets. *SWJ*. **2**: 38-39
- National Bureau of Statistics [NBS] (2016). *Demographic statistic bulleting 2<sup>nd</sup> Series. A publicatoion of demographic statistics division*. Pp.1 -15.
- Lamour, K. H. and Hausbeck, M. K. (2004). *Fruit rot of tomato caused by Phytophthora capsici*. In: Proc. Annu. Tomato Dis. Workshop, 14th. Michigan State Uni-versity, East Lansing. Pp.65-69.
- National Bureau of Statistics [NBS] (2016). *Demographic statistic bulleting 2<sup>nd</sup> Series. A publicatoion of demographic statistics division*. Pp.1 -15.
- Osanyinlusi, O. I. and Adenegan, K. O. (2016). The Determinants aof Rice Farmers Productivity in Ekiti State Nigeria. *Greener Journal of Agricultural Sciences*, **6**(2): 049 058, <http://doi.org/10.15580/GJAS.2016.2.122615174>.



- Olayemi, J. K. (2010). Improved marketing as a strategy for general increase food production of Nigeria experience. *West African Journal of Agricultural Economics*, **1**(1): 21-26.
- Olson, S. M. (2004). *Physiological, nutritional and other disorder of tomato fruit*. University of Florida IFAS extension Hs-954.EDIS website at <http://edis.ifas.ufl.edu>
- Olowa, O. W. and Olowa, O. A. (2017). *Analysis of food waste attitude among peri-Urban household in Ogun State Nigeria*. Proceeding of the 31<sup>st</sup> FAMAN National Conference, held at 1000 seat lecture theatre, Abubakar Tafawa University, Bauchi on 9<sup>th</sup>-12 October. Pp. 409-418.
- Peet, M. M. (2009). *Physiological disorder in tomato fruit development*. *Aista Horticulture*, **821**: 151-160
- Ugonna, C. U., Jolaoso, M. A. and Onwualu, A. P. (2015). Tomato Value chain in Nigeria: Issues, challenges and strategies. *Journal of Scientific Research and Reports*, **7**(7): 501-505.
- Usman, J. and Bakari, U. M. (2013). Profitability of small scale dry tomato season tomato (*Lycopersicon esculentum* Mill) production in Adamawa State, Nigeria. *ARPN Journal of Technology*, **3**(6): 604-610.
- Shettima, B. G., Ibrahim, A. A. and Zangoma, B. A. (2016). Economic efficiency of irrigated production in Borno State Nigeria: A stochastic Frontier Cost function Approach. *Asian Journal of Agriculture Extension, Economics and Sociology*, **12**(4):1-14.
- WFLO (2010). *Identification of Appropriate Postharvest Technologies for Improving Market Access and Incomes for Small Horticultural Farmers in Sub-Saharan Africa and South Asia*. WFLO Grant Final Report to the Bill & Melinda Gates Foundation, March 2010. 318Pp.