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Factors influencing Post-Harvest Losses of Fresh Tomato in the Distribution Channel in Lusaka Markets

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Abstract

The aim of the study was to establish the causes of postharvest losses of fresh tomatoes in Lusaka District, Zambia. The specific objectives were to: investigate the factors that influence the losses of tomato in the distribution chain at markets in Lusaka; determine the effects of post-harvest losses on tomato on stakeholders; and identify mitigating strategies to be adopted to reduce post-harvest losses in the distribution chain. Purposive sampling was employed in selecting respondents in the study area. Data was collected using structured and semi-structured questionnaires. Results on socio-demographic characteristics revealed that the majority (about 88%) of the tomato traders were female. This suggested that the supply chain of tomatoes is dominated by women, and thus a successful fight against post-harvest losses will empower women. The qualitative responses linked the causes of tomato PHL to excess exposure to high temperatures and direct sunlight in trading places, poor packaging, improper storage, and over-reliance on the Soweto market for tomato sales. Capital loss was the major effect of tomato losses, affecting the livelihoods of families of tomato traders. Technocrats also saw greenhouse gas emissions from organic waste as another negative effect. A number of mitigating measures were proposed for traders, the government, and the Zambia National Farmers Union. They include the processing of excess tomatoes on the markets, encouraging distributors to distribute to other markets within and outside Lusaka, unlike the current situation where most of them deliver their produce to the Soweto market, the use of information and communication technology (ICT) in the supply chain at markets, and the adoption and use of cold storage facilities in markets. Transporters should drive slowly on feeder roads while lobbying governments for the development of tarred roads linking farms to markets.

Keywords: Post-harvest losses of tomato, effects on traders, mitigating strategies

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1. Introduction

Post-harvest losses (PHL) are a common phenomenon in the supply chain of fresh food. It was defined by the Committee for Economic and Commercial Cooperation of the Organization of Islamic Cooperation (COMCEC) in

2016 as food damage or degradation of food during different stages of the food supply chain. In other words, these are the losses that are incurred by farmers and traders between the farm gate and prior to retail and consumption. Another definition of PHL is one adopted by the World

Resources Institute (WRI), which considers food loss to occur before products reach consumers and food waste to be a near-consumer issue of underutilization (WRI, 2022). COMCEC defines on-farm losses as all losses during the agricultural production stage until the completion of harvesting. Post-harvest losses refer to measurable quantitative and qualitative losses after they have been harvested (Jaspreet Aulakh, 2013). Food waste is defined as food losses at the near-consumer stages of the supply chain (Chetna Chauhan, 2021). Post-harvest losses (PHL) of fresh tomatoes are a perpetual contentious issue, especially on open markets. In Zambia, Soweto Market, situated in the capital city, Lusaka, is the largest trading market for fresh vegetables, including tomatoes. Experiences of PHL on fresh tomatoes are ongoing and raise concerns among stakeholders in the tomato supply chain. Fruits and vegetables Secretary General Gideon Kalima said 40–50% of tomatoes go to waste on the market every year (Kalunga, 2023). The recent news articles also showed the unsightly grim picture of huge tomato losses, including at Soweto Market (Lusaka City Council, 2022).

1.2. Problem Statement

The population of Lusaka continues to grow and is expected to reach 5 million by the year 2035 (Central Statistics Office, 2022). The demand for food supplies is also expected to increase. Post-harvest losses in the distribution chain exacerbate the problem of food shortages. These losses also translate into a waste of the various farming inputs that the farmers use, such as seed, pesticides, water, land, labor, and equipment. Various factors are documented globally in various literatures as potential causes (Malumo, 2018; Nawa, 2021; FAO, 2021). However, the factors attributed to the PHL of tomatoes in Lusaka have not only been speculated. Tomatoes worth thousands of kwacha rotting at Lusaka's Soweto Market are attributed to factors such as the abundance of the commodity, which has also resulted in a rapid and steep drop in prices (Malumo, 2018). This did not, however, establish the reason why there were high tomato losses, as growing tomatoes in abundance is a good thing. Furthermore, there is a need in the markets to avoid further losses. Since the losses of tomatoes have been recurring for years now, it is undeniable that the current practices are not working well in reducing losses as part of the supply chain.

In the context of the distribution channel, tomato farming and selling present a number of other challenges besides just a short shelf life. A check by Sunday Mail at Lusaka's biggest market found some boxes of tomatoes being sold for as low as K13. Early this year, a box of tomatoes fetched as much as K300 (Daily Mail, 2018). A number of tomato traders at Soweto Market regretted having invested in tomato production due to the massive PHL's they incurred, with a monetary investment value of over K5, 000 for one person (Malumo, 2018). Postharvest losses pose a major risk to the sustainability of national food

systems. Surveys have estimated that 33% of fresh produce tomatoes are lost during the postharvest handling chain (Nawa, 2018). These losses are often much higher in urban areas like Lusaka, as they are target markets for traders who move from farms surrounding the city (Nawa, 2016; Malumo, 2018; and JCTR, 2020). It appears that the traders are less informed about the distribution channel and lack of market research for their commodities to survive PHL (Zambia Chamber of Commerce, 2021). Furthermore, the extent of the effect of the losses of those closely involved, such as the traders, is usually left unnoticed and undocumented.

2. Empirical Literature review

The term 'Post-Harvest Loss' (PHL) refers to measurable quantitative losses and qualitative food loss in the post-harvest system (Kiaya, 2014). Post-harvest losses can be categorized into quantitative, qualitative, and economic losses (Kiaya, 2014). Quantitative losses refer to physical losses, measured as losses in weight or volume, of food that are unacceptable for human consumption and readily discarded (Regmi, 2013). Qualitative losses occur because of either an altered physical condition, perceived substandard value, deterioration in texture, wilting, flavor, change in color, or nutritional value (E.O. Gogo a b, 2017). Economic losses are losses in potential revenue or income and could be due to the reduced quality or quantity of produce (Tuovila, 2023). Economic losses are the ultimate challenge that farmers and traders want to overcome, as they want their businesses to be sustainable as well as profitable. Supply Chain Management (SCM) is the management of the flow of goods and services and includes all processes that transform raw materials into final products (Ali, 2023). It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace for the seller (Meindl, 2007). Supply chain management, or the management of flows, is the channel through which products and/or services are delivered to the market. Bsaikrisna (2016) asserts that there are five major flows in any supply chain: product flow, financial flow, information flow, value flow, and risk flow. An effectively implemented supply chain management system increases the profitability of its organization through reduced waste, reduced holding costs, reduced transportation costs, and reduced ordering costs. If the supply chain is not managed well, the business may incur avoidable costs such as increased holding costs, production waste, product expiration, or compromised quality of goods (Coleman, 2015). Effective supply chain management improves the financial position of an organization by delivering value linked to the organization's corporate strategy. It plays a significant role in customer satisfaction through the delivery of products and services. Good supply chain management is critical to reducing operating costs from procurement activities, through operations and

logistics functions, and throughout the whole supply chain. The scale of profitability for large organizations is relative to the management of their supply chain (CIPS, 2023). Supply chains are composed of four major elements: procurement, operations, distribution, and integration (Donne, 2013). The supply chain segment involved in delivering products to the consumer is known as the distribution channel (Hayes, 2022). It involves the movement and storage of usable products from the point of production to the point of consumption. Farmers in Zambia deliver their produce to consumers via different channels; sometimes they take their produce to market places on their own. In Lusaka markets, at times they engage hawkers who sell on their behalf, and at other times they agree to a contract of supply chain to stores that buy from them at a fixed rate and fixed daily supply quantity. The other method is where traders and consumers come to buy directly from the farm. The most popular way of selling for large-scale commercial farmers is by taking the produce to the market and engaging the hawkers to sell it on the farmer's behalf. When the farmers deliver their produce to the market places, they meet other fellow farmers and sellers who also come to sell their produce, sometimes a different crop and sometimes exactly the same. In the market, demand and supply forces come into play; availability or scarcity, coupled with the need and urgency of the product from the customer, determine the selling price of the products. On a good day, when there are few farmers selling a particular produce, the farmer can demand a higher price for their product because it is scarce, thereby making more profits out of it, while on a bad day, when there are many sellers of the same product, the seller will offer to sell the product at a lower price because all farmers want to make a sale and not go back to the farm with the products. About 25% to 30% of global food produced is lost between on-farm food production and its storage at the retail facility, largely due to poor supply chain management practices (Chen, 2020). Post-Harvest Losses of fresh tomatoes occur in the distribution channel, which is after harvest but before the point of consumption. Postharvest losses and waste in the supply chain of fruit and vegetables are as high as 13–38% before the produce even reaches the consumer (Gustafsson, Cederberg, Sonesson, & Emanuelsson, 2013). The distribution of tomatoes is sensitive because they have a short shelf life and are fragile; they must generate revenue for the seller before they become stale or go bad. Shelf life is the maximum time that a food product can be relied upon to retain its quality characteristics (A Shelf Life Guide, 2018). Fresh tomatoes have a relatively short shelf life as compared to processed foods, either dried or pre-packed with preservatives added.

Today, one of the main global challenges is how to avoid food waste for a growing world population while ensuring long-term sustainable development. In some African, Caribbean, and Pacific (ACP) countries, where there is tropical weather and poorly developed infrastructure, PHL and wastage are inevitable on a regular basis, as high as 40–

50% (Spore, 2011).

3. Theoretical Literature review

This section presents a business model that integrates theoretical assumptions from the literature review. Three theories have been discussed in relation to post-harvest losses of tomatoes and the profitability of tomato farming. Adom et al. (2018) define a theoretical framework as an existing theory in a field of inquiry that is related to and/or reflects the hypothesis of a study or a blueprint that is often 'borrowed' by the researcher to build his or her own house or research inquiry. This study focused on two theories, which are demand and supply and business profitability.

3.1. Demand and supply theories

The law of supply and demand is a theory that explains the interaction between the sellers of a resource and the buyers of that resource (Whelan, 1996). The theory defines the relationship between the price of a given good or product and the willingness of people to either buy or sell it.

There are four laws that govern supply and demand:

1. If supply increases and demand stays the same, the price will go down.
2. If supply decreases and demand stays the same, the price will go up.
3. If the supply stays the same and demand increases, the price will go up.
4. If supply stays the same and demand decreases, the price will go down.

The market will reach equilibrium when the quantity demanded and the quantity supplied are equal. The equilibrium point will shift from time to time as external factors influence a change in quantity demanded or quantity supplied.

3.2. Business Profitability

Profitability is the ability of a business to earn a profit. A profit is total revenue less total expenses. Total revenue is all the money earned in the course of doing business, while total expenses are all the money spent in the course of doing business.

While the demand for tomatoes is increasing steadily with time as the population grows, price stability has not been attained. Much of this price volatility comes from sporadic changes in supply. A bumper crop or crop disaster in a major production region can change tomato prices quickly. Tomato supply and demand are seldom equal, and that is what leads to sporadic changes in selling prices.

3.3. Stakeholder Theory

According to Dr. F. Edward Freeman, a professor at the

University of Virginia, stakeholder theory is an idea about how business really works. It says that for any business to be considered successful, it has to create value for anyone affected by its operations. These could be customers, suppliers, employees, communities, and financiers. With the stakeholder theory, there is the expectation that corporations will make efforts to mitigate or reduce conflicts between stakeholders. The theory also incorporates the interests of any third parties that have some level of dependence on the corporation. The Friedman doctrine, also known as shareholder theory or stockholder theory, is an alternative theory. It shows another way of understanding how companies and people create value and trade with each other. The theory holds that the social responsibility of a business is to increase its profits; it also holds the view that the only duty of a corporation is to maximize the profits accruing to its shareholders. According to Milton Friedman, a company is obligated only to shareholders. I.e., the company must make a profit for its shareholders.

4. Research Methodology

A research approach is said to be data inquiry strategies and methods that extend the decisions from general assumptions to thorough methods of data gathering and reasoning (Creswell, 2014). Basically, a research approach is determined by the nature of a study. While a study that utilizes statistics and any numeric data would adopt a quantitative approach, on the other hand, an inquiry that utilizes non-numeric and non-statistic data would use a qualitative approach to data collection. Therefore, this research used a qualitative approach to data collection as it relied mainly on the data type, which was in the form of text. This approach ensured that it provided an opportunity for the intensive analysis of many specific details often overlooked by other approaches (Creswell, 2014). A qualitative approach was useful in this study as it best explained particular problems and scenarios through the use of respondents lived experiences and their knowledge of the issues of PHL sought at Soweto Market.

4.1. Research Design

The research used an exploratory research design to identify tomato distributors in Lusaka. Furthermore, to determine the challenges and opportunities faced in the distribution channel, The study used structured and semi-structured questionnaires for personal interviews and observations in collecting data. The exploratory design was used to gain insight into tomato farming as a viable business venture in Lusaka. The selection of the design was supported by Cooper and Schindler (2003), who assert that exploration is useful when the researcher lacks a clear idea of the problems they will meet during the study. To get more information, the researcher needed to do an explanation to just learn something about the dilemma facing the traders.

4.2. Data Collection Tools

Primary data was collected mainly through in-depth personal interviews, participation surveys, and observations in the

daily businesses of the traders, while secondary data was obtained from books, articles, journals, magazines, electronic, and print media. In some cases, informal interviews were done to get an insight on what is involved in the distribution of tomatoes as a business. Armstrong (2009) adds that interviews can be structured (i.e., the interviewer has to cover predetermined areas) or unstructured (i.e., in-depth interviews that aim to obtain information on feelings and attitudes). The qualitative research method was used in the collection of data. This method was used because “the qualitative approach is likely to be associated with an inductive approach to the gathering of theory, often using an interpretivism model, allowing the existence of multiple perspectives and constructing knowledge rather than seeking to find it in reality” (Greener, 2008, p. 17). The researcher collected multiple forms of data and spent a considerable amount of time in a natural setting gathering information.

4.3. Study Population

According to Mwanza (2015), population refers to the total number of observations included in the research. The population of the study consisted of 387 traders at Lusaka Soweto Market, Lusaka City Council personnel, and personnel from the Ministry of Commerce and Trade.

4.4. Sample and Sampling procedure

The population statistic of registered tomato traders at Soweto Market was 387 (LCC). The actual population is expected to be larger, as some do not register while others are in the habit of trading from different stands on different days. The researcher used Slovin’s formula to come up with the minimum sample size.

The formula permitted the researcher to have a minimum sample size of 197.

$$n = \frac{N}{1 + N(e)^2} \quad \text{Where; } n = \text{Sample Size} \\ N = \text{Population} \\ e = \text{Margin of error at 5\%}$$

$$n = \frac{387}{1 + 387(0.05)^2} = 196.7$$

There were a total of 13 tomato transporters found in the area under study, and the researcher administered questionnaires to all the transporters.

Armstrong (2009, p. 210) asserts, “Sampling involves the analysis of attitudes, opinions, and facts about products or services planned or on offer by a representative number of people from the population under study.” A sample size is a specified or preferred number of respondents from whom the desirable information is derived (Zamboni, 2018). Regarding the exact number of preferred respondents in a qualitative study, scholars (Saunders et al., 2007; Mwanza, 2015; and Creswell, 2018) argue that the number ought to be large enough to guarantee an adequate description of the phenomenon. At the same time, the sample size shouldn’t be so large that it will lead to respondents repeating responses, which can be adequately received from a smaller number, as the goal of qualitative research is to attain saturation of data inflow.

The number was found to be adequate to facilitate the saturation of information. This sample size yielded the appropriate data pertaining to the phenomenon under investigation.

4.5. Sampling Design

This study used a non-probability sampling technique. In particular, a purposeful sampling design was used. Cooper and Schindler (2003) note that a non-probability sample conforms to certain criteria called purposive sampling. It was used to sample Soweto market traders and the respondents to this study. Purposive sampling was chosen because of the unique nature of the Soweto market, such as its level of activity and population of traders. This design further enabled the researcher to logically choose a sample that would give the causes and effects of PHL in fresh tomatoes.

4.6. Data Analysis

Qualitative data was compiled and organized in Excel spreadsheets according to themes identified from research questions and responses. The data were further analyzed using content analysis to gain meaning from interviews and observation using themes drawn from the research objectives.

5. Results and Discussions

5.1. Response Rate

200 questionnaires were distributed to 200 tomato traders at Soweto Market, while 13 questionnaires were distributed to 13 transporters. The non-responses were due to several factors, including busy market schedules. Then some who answered were not accessed during the collection of questionnaires. Then, out of the 13 transporters, 12 responses were received.

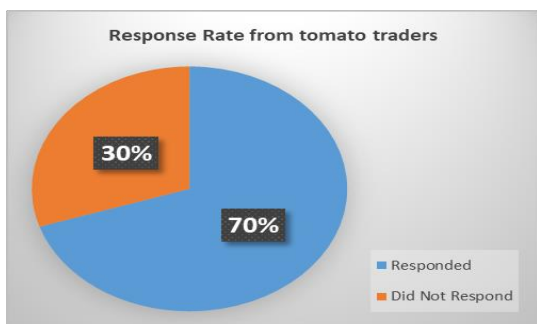


Figure 1: Response Rate from traders

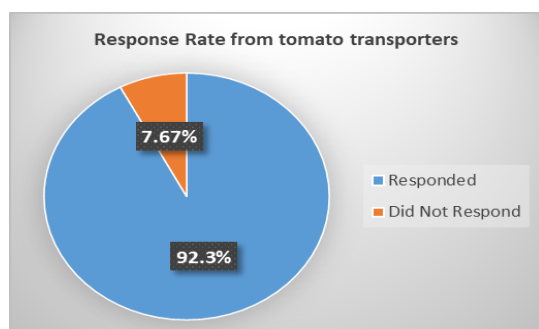


Figure 2: Response rate from transporters

5.2. Demographic information

Gender of Respondents

The researcher conducted a census of the responsive respondents by gender from traders and transporters. Below are tables with the distribution of gender of the respondents of traders and transporters.

Table 1: Gender distribution of traders

Males	Females	TOTAL
15	125	140
10.71%	89.29%	100%

Table 2: Gender distribution of transporter

Males	Females	TOTAL
12	0	12
100%	0%	100%

From table 2, it can be seen that females have not engaged in the transportation of tomatoes. Despite the number of females that drive, driving jobs have for long been perceived as jobs for males and thus have been dominated by males

Demographics of respondents by level of education

Education, or formal education in this context, is the process of enlightening individuals with theories and applying knowledge to interact with the environment from an informed point of view. To this effect, the variable of the level of education of respondents was significant to the study in a bid to find out how much insight the researcher will get from the respondents. Participants who could not read or write were advised to seek interpretation from any person they trusted.

Below are tables with the distribution of the level of education of the respondents among traders and transporters.

Table 3: Level of Education of tomato traders

S/ N	LEVEL OF EDUCATION	FRE QUE NCY	PERCE NT	GENDER	
				M	F
1.	Tertiary	35	25.01%	0	35
2.	Secondary School	45	32.14%	3	42
3.	Primary	45	32.14%	5	40
4.	No formal education	15	10.71%	7	8
TOTAL		140	100%	15	125

The data on table 3 shows that out of the 140 trader respondents to this study, 25.01% had attained tertiary education level. 32.14/% participants had attained secondary education level. 32.14% had attended primary education while 10.71% had no formal education. Clearly seen, the study was dominated by respondents who attained

some level of education.

83 out of the 140 respondents were able to answer the questionnaire without help. This represented a literacy level of 59.28%.

Table 4: Level of Education of tomato transporters

S/N	LEVEL OF EDUCATION	FREQ UENCY	PER CENT	GENDER	
				M	F
1.	Tertiary	3	25.00%	3	0
2.	Secondary School	5	41.67%	5	0
3.	Primary	4	33.33%	4	0
4.	No formal education	0	0.0%	0	0
TOTAL		12	100%	12	0

The data in Table 4 shows that out of the 12 transporter respondents to this study, 25.0% had attained tertiary education. 41.67% of participants had attained secondary education. 33.33% had attended primary school, while 0% had no formal education. Clearly, the study was dominated by respondents who attained some level of education.

It was also determined that all the transporters were in possession of a valid license permitting them to drive trucks. Thus, all transporters were qualified for the task.

12 out of the 12 respondents were able to answer the questionnaire without help. This represented a literacy level of 100%.

Demographics of respondents by years in business

Experience plays a major role in business management. It helps with decision-making, understanding the weather pattern, demand, pricing, storage, packaging, and recovering from a setback. People with more experience will generally have more knowledge and understanding of the business. They will know the weather patterns and how they will affect the business. In the event of a setback, they will also be more capable of recovering.

Table 5: Years in Business of Tomato Traders

S/N	YEARS IN BUSINESS	FREQ UENCY	PERC ENT	GENDER	
				M	F
1	Under 1 year	30	21.43%	10	20
2	Between 1 and 3 years	45	32.14%	5	40
3	Over 3 years	65	46.43%	0	65
TOTAL		140	100%	15	125

The data in Table 4 shows that out of the 140 participants in this study, 21.44% had less than one-year experience in business. 32.14% of participants had between 1 and 3 years. 46.43% had over 3 years' experience in business. As can be seen from the table, the study was dominated by individuals with more than 3 years of business experience.

From the table above, it can also be seen that women persevere in the business of trading in tomatoes while men do not. It can be concluded that men engage in this business as a stop-gap measure while waiting for other business opportunities.

Table 6: Years in Business of Transporters

S/N	YEARS IN BUSINESS	FREQ UENCY	PERC ENT	GENDER	
				M	F
1.	Under 1 year	5	41.67%	5	0
2.	Between 1 and 3 years	4	33.33%	4	0
3.	Over 3 years	3	25.00%	3	0
TOTAL		12	100%	12	0

The data in Table 6 shows that out of the 12 participants in this study, 41.67% had less than one-year experience in business. 33.33% of participants had between 1 and 3 years. 25% had over 3 years' experience in business.

From the table above, it can also be seen that women persevere in the business of trading in tomatoes while men do not. It can be concluded that men engage in this business as a stop-gap measure while waiting for other business opportunities.

5.3. Factors causing post-harvest losses of tomatoes at Soweto Market from stakeholders

A number of stakeholders in tomato trading and business in general were engaged in interviews regarding the potential causes of PHL in fresh tomatoes at Soweto Market. These were technocrats from the local government, transporters, and traders. Respondents from the local government bemoaned the lack of technical knowledge amongst the traders and farmers who invested in the trading of tomatoes. The respondents cited a lack of knowledge on forecasting weather trends to plan ahead of harvest, the quantity to harvest, and when to be ready for market. While small-scale traders cited price drops by big traders and the absence of cold storage facilities to preserve their fresh tomatoes. Below are some of the common responses that were collected from technocrats, distributors, and traders.

Inability by traders to forecast the weather pattern on trading days

Technocrats from the local government stated that the traders and farmers of tomatoes at Soweto Market who were involved in the business had inadequate knowledge of weather forecasting. They said that farmers did not have knowledge or instruments for forecasting weather trends, especially in the summer and rainy season, which are the months that contribute to high levels of PHL at Soweto Market. They wished traders and farmers could be guided on when to plant and pluck a lot of tomatoes for the market and when not to.

Direct exposure to sunlight and heat

Tomato exposure to direct sunlight and heat for prolonged hours was another cause of PHL cited by traders

and technocrats. They argued that perishable goods required storage spaces that would facilitate temperature control as well as retain the nutritional value of the fruit. To this effect, they stated that the lack of a cold storage facility at Soweto Market to store fresh, unsold tomatoes contributed to this loss.

Poor packaging and handling

Poor packaging and handling were also cited as contributors to the PHL phenomenon. The two terms were sometimes referred to interchangeably. Technocrats from the Lusaka City Council in charge of trading in the Soweto market alluded to the manner in which traders and farmers packaged their tomatoes in the cases and boxes that would contain the tomatoes. What was said is that they could see a non-orderly manner of packing tomatoes, which could result in smashed tomatoes when offloading them.

Drastic price drops by big traders

This trend of drastic price drops by some big tomato traders was mentioned a lot by the small traders. They asserted that, since the Soweto market is a trading space open to everyone, when competition is stiff., big traders with bulky tomatoes would drastically reduce the market price to their artificial price, forcing clients to buy from them rapidly. They would use this loss strategy to gain by selling off in bulk. While this is happening, the small traders will lose market share and clients until the bulk traders finish their products. This largely contributed to the to the loss of anticipated profits, especially for small-scale traders and farmers.

5.4. Post-harvest losses of tomatoes at Soweto Market

The researcher conducted a tour around the market to ascertain the post-harvest losses and how the traders disposed of the unsold and unusable tomatoes. From the observations, it was established that traders often had unsold boxes of tomatoes disposed of after trading hours. Below is a picture of disposed tomatoes that went bad after excessive exposure to heat after being left under direct sunlight for some time.

Effects of Post-Harvest Losses on the Traders

There are several effects suffered by various stakeholders in the distribution chain of tomatoes as a result of post-harvest losses. The effects of PHL on fresh tomatoes were found to be wide. In turn, they hampered the value chain. In this regard, the effects were said to be on farmers and traders for waste of resources, transporters who were not paid-up front, customer dissatisfaction, and environmental degradation for disposing of organic substances.

Waste of traders' resources: Traders were highly affected in that the resources put in to purchase the tomatoes sometimes could not be recovered if PHL were high. The effect was quite detrimental, as it often left them financially distressed.

Compromised pay to transporters: Transporters who

are not paid upfront—those who are hired and promised to be paid afterwards—usually suffer when the tomato has not sold as was imagined by the trader. Such instances tend to affect the continuity of transporters in the value chain.

Environmental Impact: The environment was found to be another area that was affected by PHL. This was usually the case when the rotten tomato was disposed of carelessly on the ground and dumped as waste. Technically, the dead organic matter contributed to the accumulation of greenhouse gases that later affected the ozone layer, leading to global warming. The local government staff bemoaned a lack of adequate disposal areas for waste.

Mitigating Strategies to Post-Harvest Strategies

After carefully analyzing and observing the causes of PHL in tomato, the researcher suggested strategies that can be used to mitigate the effects of PHL in tomato on the various stakeholders in the distribution chain.

Processing of Excess Tomato: Tomato processing was also identified as one strategy that can play a significant role in mitigating post-harvest losses of tomatoes. Excess tomato, which is suitable for tomato processing, can be processed into various processed products such as tomato juice, puree, tomato paste, and ketchup. These products have a much longer shelf life and can be sold as export products, which can ultimately earn the country foreign exchange.

Enhanced feedback and communication between farmers and traders, facilitated by ZNFU: While a few traders and distributors would communicate with each other on which farms they would order from and where they would sell, the communication was not much and this contributed to the colliding of supplies causing abundance which ultimately led to price drops and losses at the market.

Improving ways of packaging: Technocrats called for improved means of packaging tomatoes when taking them to market. They stressed the need for improved packaging, which they believed contributed to increased shelf life when properly packaged.

Provision of communal cold storage facilities: There were calls by technocrats and traders alike for the Lusaka City Council, which is in charge of the market, to put up communal cold storage facilities at the market. The traders showed a willingness to pay to have their commodities kept at a controlled temperature once the cold room was in place.

Supplying to Chain Stores: Chain store managers called for a consistent supply of quality tomatoes from the farmers all year round. They said they are willing to sign long-term contracts with farmers or farmer cooperatives to supply them with fresh tomatoes. One of the managers at one chain store said:

Supply to various markets within Lusaka: Tomato traders and distributors should not limit themselves to doing business at Soweto Market, which is the central market but is often overcrowded. They should also consider

selling their products to other markets like Mandevu Market, Chelstone Market, Bauleni Market, and Chawama Market. These markets are populous and thus offer a good market for fresh tomatoes. This would help overcome the clashing of many traders at Soweto Market.

6. Summary, Conclusions and Recommendations

6.1. Conclusions

This study analyzed the causes of PHL in fresh tomatoes at Soweto Market in Lusaka District of Zambia, the effects of PHL on traders, and the pitfalls in the strategies used in the distribution of fresh tomatoes. The results indicated that direct exposure to sunlight and excess heat was a major negative contributor to the PHL of fresh tomatoes at Soweto Market. Other contributors to PHL were poor handling, a poor road network, and the dumping strategy, where large-scale farmers offloaded too much produce to the Soweto market, leaving other markets within Lusaka. It was also established that PHL had several effects on the stakeholders in the tomato distribution chain, including economic impacts on the traders, environmental impacts, compromised business relationships, and dissatisfied customers. It was found that processing excess tomato into tomato juice, puree, tomato paste, or tomato sauce would greatly add value to the excess tomato, which otherwise could be wasted. Another strategy was to reduce overreliance on the Soweto market for tomato sales, which

could be achieved by encouraging distributors to also explore trading at other markets in and outside Lusaka. Another strategy would be to develop an integrated communication system between traders and sellers at the market that advises traders where the demand for tomato is.

6.2. Recommendations

Based on the conclusions of this study and insights from stakeholders, the following recommendations have been proposed:

- More investment into tomato processing plants is needed to consume the excess tomato produce on the markets.
- ZNFU to develop a well-coordinated communication system, in part using ICT, showing how much tomato has been supplied to each of the markets within Lusaka, its current selling price, and where it is needed.
- The local government, in collaboration with ZNFU and the traders, should invest or encourage investment in communal cold storage facilities and the provision of shaded areas that can be used by all tomato traders in markets in Lusaka.
- Distributors should consider delivering tomatoes to other markets within and outside Lusaka.

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