



Post-Harvest Losses in Marketed fruits and vegetables:

Evidence from selected markets in Dar es Salaam

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Contents

1. Introduction	4
2. Background	6
2.1 Production and marketing of fruits and vegetables in Tanzania	8
3. Methodology	12
3.1 Sampling	12
3.2 Data collection methods.....	13
3.3 Limitation.....	13
3.4 Ethical consideration.....	13
4. Findings	15
4.1 Demographic characteristics	15
4.2 Business Profile	15
4.3 Loss in marketed fruits and vegetables	17
4.3.1 Self-reported cumulative losses	17
4.3.2 Losses experienced during transportation.	20
4.3.3 Loss experienced in the marketplace.	22
4.3.4 Actions recommended by traders.	24
5. Conclusion and recommendations	27

List of Tables

Table 1. Production of fruits and vegetables in Tanzania, by number of farm households engaged, planted area, and quantity harvested.	9
Table 2. Tanzania vegetable export values (million USD), by major market destinations	10
Table 3. Tanzania fruit and nuts export values (million USD)	10
Table 4. Dar es Salaam markets selected for the study.....	12
Table 5. Sample distribution by municipality and selected crops	13
Table 6. Social Characteristics of the Interviewed Traders	15
Table 7. Basic Descriptive Statistics of the Businesses	16
Table 8. Self-reported cumulative loss (% of stock volume), by type of crop	19

List of Figures

Figure 1. Production of fruits and vegetables ('000 tons) in Tanzania.	8
Figure 2. Source of product and Mode of Payment	16
Figure 3. Percent of traders reporting different levels of cumulative losses	17
Figure 4. Percent of traders reporting cumulative quantity loss, by type of commodity	16
Figure 5. Percent of traders reporting cumulative financial loss (TZS), by type of business operation	19
Figure 6. Self-reported quantity loss (% of stock volume) experienced during transportation, by type of business operation.	20
Figure 7. Self-reported quantity lost (% of stock volume) in the marketplace, by type of business operation.	21
Figure 8. Self-reported quantity lost (% of stock volume) in the marketplace, by type of commodity.....	22

1. Introduction

Reducing post-harvest losses (PHLs) and food waste is an effective and complementary approach to improving food and nutrition security. Recent disruptions in global supply chains have heightened concerns over the worsening status of world food and nutrition security. Estimates indicate that 9.2 percent of the world population faced chronic hunger in 2022 compared to 7.9 percent in 2019. In other words, about 122 million more people faced hunger in 2022 than in 2019, before the outbreak of COVID-19 pandemic. Africa bears the largest burden as almost 20% of its population faced hunger in 2022 compared to 8.5 percent in Asia, 6.5 percent in Latin America and the Caribbean, and 7 percent in Oceania. Against the global target of ending world hunger, it is projected that 600 million people will still face hunger in 2030. In the absence of the COVID-19 pandemic and the war in Ukraine scenario, the projected number would drop by 119 million and by around 23 million in a scenario that the war had not happened. (FAO, IFAD, UNICEF, WFP and WHO, 2023.).

Since early 2020, global commodity prices have steadily risen to an all-time high since the 2007/08 food crisis. Progress towards ending world hunger and all forms of malnutrition has been seriously undermined by the effects of COVID-19, geo-political conflicts, climate change and population growth. In Tanzania, despite national food self-sufficiency, food poverty is high (at 8%) and still widespread amongst Tanzania's rural communities—9.7% (URT, 2020)—and one third (32%) of children under the age of 5 are malnourished (URT, 2018)

Raising agriculture production and productivity alone is no longer sufficient to achieve desired food and nutrition outcomes. There is consensus that reducing post-harvest losses and food waste, parallel to raising agriculture productivity, leads to increased food availability and household income, and reduced poverty. In addition, lowering levels of post-harvest losses and food waste minimizes the need to expand agricultural land, thus mitigating negative environmental impact from agriculture.

The world is determined to halve per capita global food waste at the retail and consumer level and reduce food losses along production and supply chains including post-harvest losses by 2030 (Sustainable Development Goal 12.3). It is estimated that one third of the food produced globally for human consumption is lost or wasted annually. This is equivalent to approximately USD 310 billion of food lost or wasted in developing countries (FAO, 2019)¹.

The extent of post-harvest losses varies by crops, regions and across different stages along the value chain from the time of harvest through processing, marketing, preparation and finally at consumption. In developing countries, most PHLs occur at farm level during harvesting, handling and storage. However, off-farm PHL-experienced during transportation and marketing-account for around a quarter of the total loss.

¹ [FAO - Success stories: Reducing post-harvest losses](#)

In addition, PHL is especially acute for cereal and horticulture crops, where the latter experience losses of up to 46%.

There is a limited but growing body of literature dedicated to studying PHLs in fruits and vegetables. There is even lesser attention, especially in developing economies, paid to losses incurred during the marketing process. This study attempts to bridge the existing knowledge gap by focusing on post-harvest losses in marketed fruits and vegetables in Dar es Salaam.

A purposive and convenient sampling approach was employed to select and interview 532 traders. The survey results show that there is a high prevalence of PHL in marketed fruits and vegetables. The extent of loss however varies by type of traded commodity, type of business operation, and stages along the marketing process. In general, retailers and vegetable traders report relatively lower losses than middlemen, wholesalers, and fruit traders.

Poor transport and market infrastructures, improper handling of food produce, and inadequate use of modern technology and safety measures are commonly cited factors leading to high losses of traded fruits and vegetables. This paper recommends that the government, in coordination with other stakeholders, continue to improve the road and market infrastructures, provide capacity building to improve crop handling, use of appropriate technologies, and encourage creative packaging to add value and reduce loss.

The paper has also illustrated that halving losses in traded fruits and vegetables can recover foregone income enough to feed an average household for almost half a month. This emphasises the great potential that lowering PHL has on improving household income, food and nutrition security, and welfare.

2. Background

Large quantities of post-harvest food losses are experienced in extensive parts of developing countries, including Africa. In 2011 FAO estimated that one third of the food produced, globally, for human consumption is lost or wasted (FAO, 2011)². Also, estimates at the time suggested that post-harvest grain loss in Sub-Saharan Africa alone was worth USD 4 billion a year, enough to feed 48 million people (World Bank, 2011)³. Recent statistics for Tanzania indicate that overall post-harvest crop losses in maize-based systems are equivalent to 25–40%, with up to 47% losses for maize specifically (Mutungi, et al. 2022).

Post-harvest losses refer to losses of crops, produced for human consumption, which occur at any stage along the supply chain from the time of harvesting up until the marketing stage. Food loss can be in the form of physical loss (that is, volume shrinkage or deterioration of condition), loss of nutritional value (from crop deterioration or contamination), and economic loss (loss in monetary value). The levels of post-harvest loss vary across regions- due to differences in climatic conditions, infrastructure, and technology-and by type of crops. Post-harvest losses can reach up to 20% for cereals, 30% for dairy and fish, and 40% for fruit and vegetables (FAO, 2019)⁴.

In 2015, nations around the world agreed to halve global food loss and waste by 2030 (SDG 12.3). Likewise, African nations, under the 2014 Malabo declaration, committed to halve post-harvest food losses in the continent by 2025. Through the partnership of YieldWise and SAVE FOOD initiatives by Rockefeller Foundation and the Food and Agriculture Organization (FAO), respectively, Tanzania developed the 2019-2029 national post-harvest management strategy. The strategy identifies the following areas for intervention: creating awareness on post-harvest management to reduce food loss, improving market access for agriculture products, generating knowledge through research and development (R&D) to promote adoption of tested modern technologies, strengthening institutional capacity and stakeholder coordination to facilitate implementation of strategic interventions, and collecting data on post-harvest loss to monitor progress (URT, 2019)⁵.

Tanzania's commitment to reduce on-farm and off-farm post-harvest crop losses goes back decades. Since the 1980s the government has worked with various organizations such as FAO, the United Nation Development Programme (UNDP), the World Food Programme (WFP), the Swiss Agency for Development and Cooperation (SDC), and the Alliance for a Green Revolution in Africa (AGRA) to name a few. Targeted interventions implemented over the years include capacity building within the government; developing relevant policy and monitoring instruments; construction and rehabilitation of storage facilities for crops; farmers' training on post-harvest management, including handling and storage hygiene, and adoption of improved storage technologies (such as the use of hermetic bags and metallic silos).

² FAO, 2011. Global Food Losses and Food Waste – Extent, Causes and Prevention, Rome: FAO

³ World Bank, 2011. MISSING FOOD: The Case of Postharvest Grain Losses in Sub-Saharan Africa

⁴ FAO, 2019. [FAO - Success stories: Reducing post-harvest losses](#)

⁵ URT, 2019. National Post-harvest Management Strategy (NPHMS) 2019-2029

Earlier agriculture research and policy interventions, on food value chains, focused mainly on traditional staple crops due to their strong contribution to food and nutrition security. Recently, there have been targeted efforts to improve nutritional health aimed at promoting improved consumption and post-harvest management of non-traditional staples such as fruits and vegetables. This is partly in response to societies becoming more conscious of healthier diets and lifestyle choices. A growing urban population has also been a source of increasing demand for diversified food products including fruits and vegetables influenced by higher prevalence of non-communicable diseases, rising incomes and improved public health awareness.

Despite the growing demand, fruits and vegetables are susceptible to high levels of post-harvest losses. There is a relatively limited but growing number of studies on post-harvest losses in fruits and vegetables. There are even fewer studies that examine losses incurred during the marketing process. Some studies from Tanzania have shown that retail traders experience higher levels of vegetable loss compared to farmers and wholesalers (Dome & Prusty, 2017) (Mtui, 2017).

To bridge the existing knowledge gap, this study attempts to contribute to this growing body of literature. This study examines the extent and magnitude of post-harvest loss experienced in marketed fruits and vegetables in Dar es Salaam. The sample covers three types of fruits (mango, watermelon, and pineapple) and two types of vegetables (tomato, and round potato). The selection was based on account of the crop's economic importance in terms of production and marketing. A study by Benson et al. (2018), for instance, established that expanding potato and vegetable production in Tanzania has a strong effect on poverty reduction, especially rural poverty. Moreover, the study established that fruits and vegetables are strongly linked to dietary diversity in Tanzania (Benson et al., 2018)⁶.

Objective

The main objective of this study is to examine the quantitative and financial post-harvest losses experienced by Dar es Salaam fruit and vegetable traders.

Specific Objectives

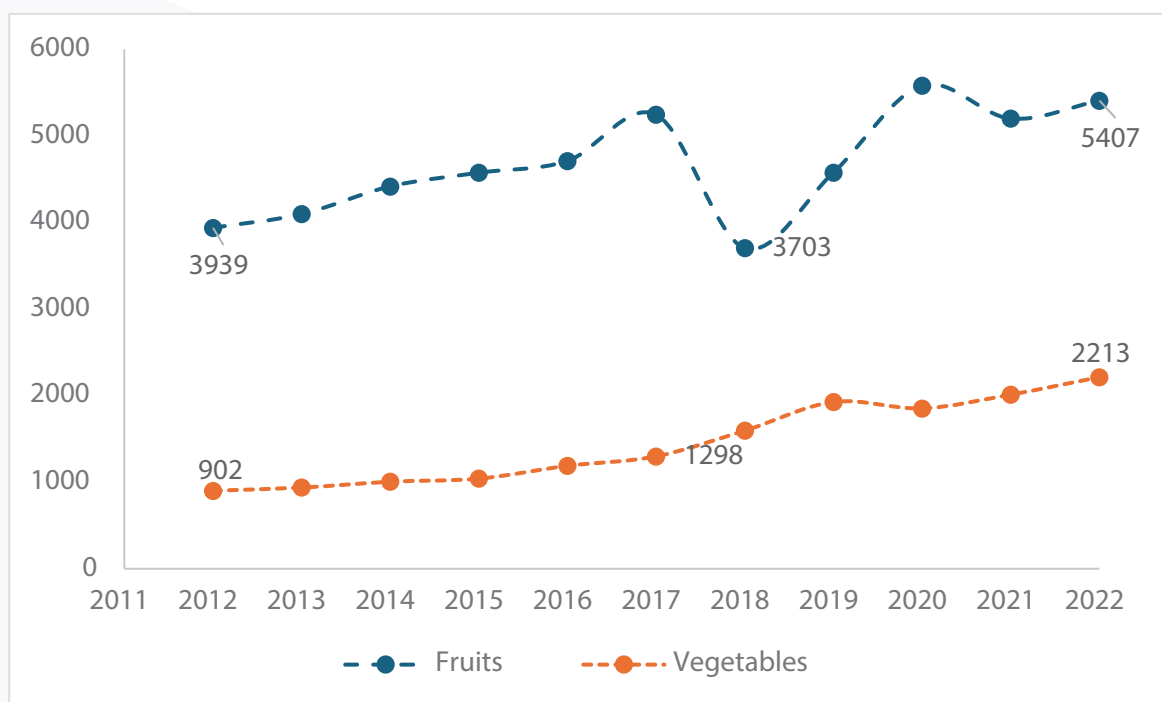
- i. To estimate the quantitative loss of fruits and vegetables in the selected Dar es Salaam markets.
- ii. To establish the estimated financial value of the lost fruits and vegetables.
- iii. To find out factors contributing to the losses of fruits and vegetables in the selected markets.
- iv. To suggest mechanisms to reduce the rate of losses of selected fruits and vegetables.

⁶Thurlow, J., Randriamamonjy, J., and Benson, T. 2018, Identifying priority value chains in Tanzania

2.1 Production and marketing of fruits and vegetables in Tanzania

During the past decade, Tanzania has witnessed a gradual increase in the production and marketing of fruits and vegetables. For instance, between 2012 and 2022, fruit production in the country increased from 3.9 to 5.4 million metric tons. Likewise, over the same period vegetable production has more than doubled from 0.9 to 2.2 million metric tons (see figure 1) (URT, 2018⁷; URT, 2023⁸). Similarly, the number of households engaged in the production and marketing of fruits and vegetables in Tanzania has grown over the years to 2.9 million from 407,827 between 2007 and 2019 (NBS, 2012, 2021). This growth in production is likely responding to an increase in consumer spending and consumption of healthier foods such as fruits and vegetables. Production is dominated by small-scale farmers, with less than 2 hectares, who constitute about 70% of vegetable producers.

Figure 1. Production of fruits and vegetables ('000 tons) in Tanzania.



Source: Economic survey 2017; Hali ya Uchumi wa Taifa katika mwaka 2023

⁷ Economic survey 2017

⁸ Hali ya Uchumi wa Taifa katika mwaka 2023

Production of the studied crops has also expanded in terms of the number of engaged households, area under cultivation, and output volume (Table 1). For instance, the number of farm households engaged in production of tomatoes-the most cultivated vegetable in the country-has doubled between 2007/8 and 2019/20. Similarly, over the same period, the number of those cultivating watermelon has grown fourfold. In addition, while production of pineapples may have been limited back in 2007/08 (URT 2012)⁹, it currently involves over 50 thousand farm households and occupies half the land size used for tomato production.

In terms of quantity produced, watermelon has grown by sixfold while harvested mangoes have more than doubled. Adoption of modern technologies such as irrigation and improved seed varieties guarantee production and supply of fresh fruits and vegetables throughout the year. In Mainland Tanzania, one third (32.7%) of the total area irrigated during short rainy season (135,716 ha) is dedicated to fruits and vegetable production. Tomato occupies the largest area under irrigation (32.9%), followed by onion (16.0%), and watermelon (15.9%) (URT, 2021)¹⁰.

Table 1. Production of fruits and vegetables in Tanzania, by number of farm households engaged, planted area, and quantity harvested.

	Number of farm households engaged		Planted area (ha)		Quantity harvested (tons)	
	2007/8	2019/20	2007/8	2019/20	2007/8	2019/20
Irish potatoes		78,838		64,429		319,314
Tomato	49,972	102,160	17,837	51,658	209,983	329,907
Watermelon	4,164	17,990	1,865	18,496	10,585	68,687
Mango		658,965	64,332	96,560	190,402	526,518
Pineapple		53,939		24,601		114,263

Source: Author's own calculation using National sample census of agriculture 2007/8, and 2019/20.

In their totality, households cultivating any of the sampled crops (round potato, tomato, watermelon, mango, and pineapple) represent 12% of all agriculture households in Tanzania. A large proportion (61%) of fruits and vegetables produced in the country is marketed (URT, 2021)¹¹. This implies that, in addition to farmers, many households in the country derive their incomes and employment from fruit and vegetable value chains.

⁹ URT, 2012. National sample census of agriculture 2007/08.

¹⁰ URT, 2021. National sample census of agriculture 2019/20.

¹¹ URT, 2021. National Sample Census of Agriculture 2019/20

Statistics indicate that Tanzania's export of fruits and vegetable has steadily increased in recent years. Foreign income from vegetable exports reached USD 310 million in 2021 compared to USD 119 million recorded in 2018 (ITC, 2021)¹². In other words, foreign earnings from marketed vegetables went up by a factor of 2.5 in just three years. However, in 2022 export earnings from vegetables declined by 31.4% to USD 213 million (see table 2). This is mainly due to a drop in the value of exports to India which was to some extent offset by increased exports to other countries. Major market destinations for Tanzania's vegetable exports include countries in Asia (India, the United Arab Emirates, Pakistan, Bangladesh), Africa (Uganda, Kenya, South Africa), and Europe (Netherlands, UK). Earnings from these markets constitute at least 90% of total vegetable export earnings.

Table 2. Tanzania vegetable¹ export values (million USD), by major market destinations

	Exported value in 2018	Exported value in 2019	Exported value in 2020	Exported value in 2021	Exported value in 2022
World	119.1	141.4	221.1	310.8	213.2
India	52.1	107	153.7	248.6	100.3
United Arab Emirates, Pakistan, Bangladesh	48.3	10.8	38.2	33	65.9
Uganda, Kenya, South Africa	7.4	16.5	16.3	14.6	29.7
Netherlands, United Kingdom	4.1	4.4	2.6	2.3	3
Earnings from major markets as % of total vegetable exports	94%	98%	95%	96%	93%

Source: 1. Edible vegetables and certain roots and tubers. Author's own calculation based in TRADE MAP data. Trade Map - List of importing markets for a product exported by Tanzania, United Republic of

Compared to vegetables, Tanzania earns much less from export of fruits. In 2021, for instance, Tanzania earned USD 179 million from exports of edible fruit and nuts (ITC, 2021)¹³. It is worth noting that a large share of this amount constitutes earnings from exports of cashew nuts (USD 159 million) (URT, 2022)¹⁴. This implies that the remaining USD 20 million will comprise of income from exported fruits and other nuts.

Table 3. Tanzania fruit and nuts export values (million USD)

Export commodity	Exported value in 2018	Exported value in 2019	Exported value in 2020	Exported value in 2021
Edible fruit and nuts; peel of citrus fruit or melons ¹	138.0	368.4	376.8	179.4
Cashew nut ²	110.8	353.1	359.6	159
Edible fruit and nuts (excluding cashew nuts)	27.2	15.3	17.2	20.4

Source: Author's own calculation based on 1. TRADE MAP data and 2. Hali ya Uchumi wa Taifa katika mwaka 2021

¹² ITC, 2021 [Trade statistics | ITC \(intracen.org\)](https://www.intracen.org/)

¹³ ITC, 2021 [Trade statistics | ITC \(intracen.org\)](https://www.intracen.org/)

¹⁴ Hali ya Uchumi wa Taifa katika mwaka 2021

Tanzania has a relatively small share in the global export market of fruits and vegetables. For instance, lead exporters of vegetables (edible vegetables and certain roots and tubers) include China, Mexico, Netherlands and Spain. In 2022, exports from each of these countries contributed 10-12% of the total export value. On the contrary, Tanzania's export share was 0.3% compared to Kenya (0.3%), Ethiopia (1%), Morocco (2%) and Egypt (2%) in the African region (ITC,2021). Tanzania's position in the global market may be attributed to several reasons including: first, the country's exporting companies operate mainly as subsidiaries of large companies often based in Kenya (Match Maker Associates, 2017). This type of business arrangement may put Tanzania at a disadvantage especially if it undermines identification of the commodity's country of origin. Second, it is possible that a large proportion of the produced fruits and vegetables are consumed in the domestic market leaving little room for export. Over the last two decades, the composition of Tanzania's export structure has shifted away from agriculture commodities towards extractives. Over half of Tanzania's merchandize exports, which was once made up of agriculture commodities back in 2000, is now dominated by extractives (mainly gold). In the period between 2000 and 2021, the share of agriculture exports to international markets has dropped from 24.5% to 16.8% in Asia and from 26.8% to 5.3% in the European Union and Americas. However, by 2021 over half of these exports were extractives (Onder, H., Mungunasi, E. A., & Prasad, A., 2023). Third, some of the fruits and vegetables are probably traded informally across Tanzanian borders, therefore go unrecorded in official statistics. Informal cross border trade is a common practice across different agriculture commodities in Africa.

In summary, the growing global demand for healthier foods mean there is potential for growth of fruit and vegetable markets. This creates employment and income earning opportunities for farm and non-farm households in Tanzania. While fruits and vegetables are said to be prone to high levels of post-harvest losses, the magnitude of the problem in the country is insufficiently explored. Therefore, this study aims at providing evidence to inform policy processes.

3. Methodology

This study was executed using a quantitative approach. Data collection was carried out in November 2021 with the aid of a semi-structured questionnaire.

3.1 Sampling

The sample for this study comprised of fruits and vegetable wholesalers, middlemen, and retailers from selected markets in Dar es Salaam region. This region was purposively sampled because it is the major trading centre for marketed fruits and vegetables in Tanzania. In addition, extension of the sample beyond the studied region was limited by the available budget.

Nine popular wholesale and retail markets were purposely chosen (see table 4) as they account for largest proportion of fruits and vegetables traded in the region. Kariakoo, which was initially one the targeted markets, was replaced by Kisutu market because during fieldwork it was under reconstruction following a fire incident.

Table 4. Dar es Salaam markets selected for the study.

Municipality	Market
Ilala	Kisutu
	Ilala
	Buguruni
Kinondoni	Tandale
	Mwananyamala
	Tegeta Nyuki
Temeke	Temeke Sterio
	Vetenari
Ubungo	Mabibo

The study focused on three types of fruits (mango, watermelon, and pineapple) and two types of vegetables (tomato, and round potato). These crops are supplied in large quantities almost throughout the year and are highly perishable.

The selection of the respondents was done with the help of market officials and traders' leadership. Initial consultation with market officials revealed a lack of or inadequate listing of traders, posing a challenge of obtaining a sampling frame. Due to this challenge, the original sample size (585 traders) was distributed equally across markets and selected crops. However, in some markets there was a discrepancy between the intended and actual sample size due to lack of middlemen. In such cases an attempt was made to compensate the gap with additional wholesalers and retailers. Gender was also taken into consideration during selection process.

Thereafter, purposive and convenient techniques were applied to obtain respondents. This largely depended on researchers' strategic assessment, and respondent's availability and consent.

Table 5. Sample distribution by municipality and selected crops

Crop	Municipality				Total
	Ilala	Kinondoni	Temeke	Ubungo	
Watermelon	13	17	37	26	93
Pineapple	17	33	38	27	115
Mango	23	39	35	28	125
Tomato	25	25	28	23	101
Potato	20	25	24	29	98
Total	98	139	162	133	532

3.2 Data collection methods

Semi-structured questionnaires were administered by trained enumerators using computer-assisted personal interviews in November 2021. A pre-test of the questionnaires was done at Kawe market in Kinondoni municipality. The survey instruments captured key information such as demographic characteristics, business details, quantitative and financial losses, and factors attributed to losses.

3.3 Limitation

The initial plan was to develop a representative random sample from the selected study areas. However, a different sampling strategy had to be adopted due to lack and difficulty of establishing a sampling frame. The employed sampling strategy was therefore not meant to produce a representative sample, rather to simply provide a snap short of the prevailing situation in relation to the research objectives. To that end, the results may not be representative of the intended study population nor generalized for the whole country. While efforts were made to take gender into account, field experienced revealed that few women trade in the selected crops.

3.4 Ethical consideration

All the required research permits were obtained from the Tanzania Commission for Science and Technology (COSTECH) and the President's Office, Regional Administration and Local Government (PO-RALG). Informed consents were obtained from respondents, and data confidentiality was assured to them.

4. Findings

4.1 Demographic characteristics

A Majority (86%) of the interviewed traders were men whose average age (40) is four years older than their women counterparts. Men constitute a large proportion of our sample for two main reasons. One, our sample is largely made up of fruit traders-most of whom are men. Second, nearly half of our sample comprise of male dominated middlemen and wholesalers. Women on the other hand are more engaged in the sale of leafy vegetables, which was not part of our sample. In addition, four out of five (82%) traders are married, 14% are single and 4% are Separated/Divorced/widowed. Most traders (62%) in our sample have a primary level education, while one in ten (10%) have some secondary education and about one fifth (18%) have ordinary level secondary education (See Table 6).

Table 6. Social Characteristics of the Interviewed Traders

	Observations	Percent
Men	458	86%
Women	74	14%
Average age: all	532	39
Average age: men	458	40
Average age: women	74	36
Level of education		
No formal/ some primary education	31	6%
Primary education	331	62%
Some secondary education	54	10%
Secondary education	96	18%
Post - secondary	15	3%
Marital status		
Single	72	14%
Married	438	82%
Separated/Divorced/widowed	22	4%

4.2 Business Profile

Fruit traders make up a larger proportion (63%) of our sample, while the other 37% comprise of vegetable-tomato and round potato traders. Nearly half (48%) the traders are in retail, whereas wholesale traders and middlemen constitute the other 32% and 17% of the sample respectively. A small proportion (3%) of the businesses operate in both wholesale and retail trade. Almost all businesses (92%) are operated under sole ownership, and capital is mostly raised from own savings (82.5%). Other sources of capital include grants and informal loans from relatives or friends (10%), and formal loans from financial institutions (3.8%).

Typically, retailers operate with smaller capital compared to middlemen and wholesalers. One third (35%) of retailers operate businesses with a capital of less than TZS 100,000, and a majority (90%) of them with a capital not exceeding TZS 500,000. On the contrary, more than three quarters (77%) of wholesalers and nearly all (96%) middlemen manage businesses worth at least TZS 500,000. In addition, half (52%) of the wholesale traders and 69% of middlemen operate with a capital of not less than one million shillings.

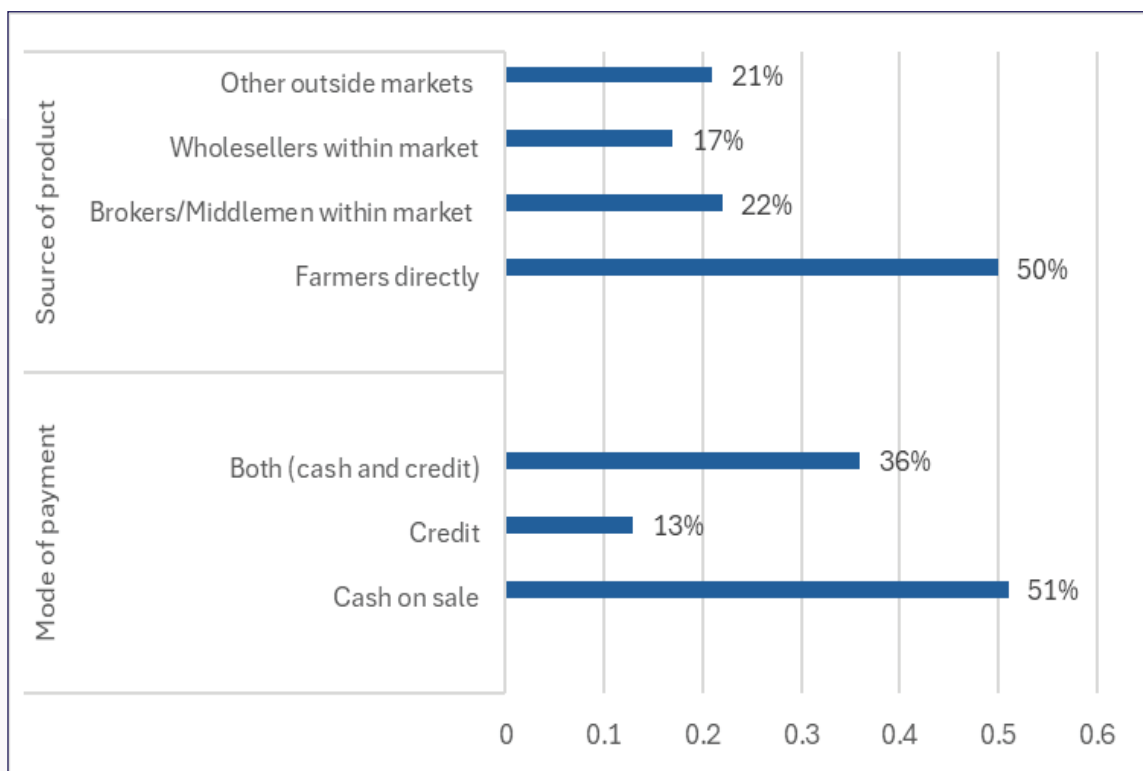
Most traders (88%) are engaged full-time in running their business, although 3 out of 10 traders also have other sources of income. 45% of traders run their daily business operations on their own, while some engage assistance from family members (16%) or casual labour (39%). Furthermore, a third (32%) of the traders have no more than 5 years of experience in their respective businesses, while over a quarter (27%) have been in business for 6-10 years and the remaining 41% for over 10 years.

Table 7. Basic Descriptive Statistics of the Businesses

	Observations	Percent
Type of trade		
Retail	254	48%
Wholesale	172	32%
Wholesale and Retail	17	3%
Middlemen	89	17%
Type of commodity		
1. Fruits	333	63%
Watermelon	93	18%
Pineapple	115	22%
Mangoes	125	24%
2. Vegetables	199	37%
Tomatoes	101	19%
Potatoes	98	18%
Sole ownership	489	92%
Source of capital		
own savings	439	83%
informal loan (individuals/friends)	28	5%
formal loan(banks/ SACCOS)	20	4%
grant(friends/relatives)	25	5%
Other	20	4%
Is business fulltime?		
Yes	468	88%
Have other income generating activity?		
Yes	153	29%

One in ten (10%) traders buy their agriculture commodities from multiple sources. Half the traders, mostly middlemen and to some extent wholesalers, buy their supplies directly from farmers. In addition, 22% of the traders buy their stock from brokers/middlemen and 17% from wholesalers located within their marketplace, while the other 21% buy from other outside markets. Half (51%) the traders pay cash upfront for their products, 13% buy on credit, while 36% use both cash in advance and credit (See Figure 2.)

Figure 2. Source of product and Mode of Payment



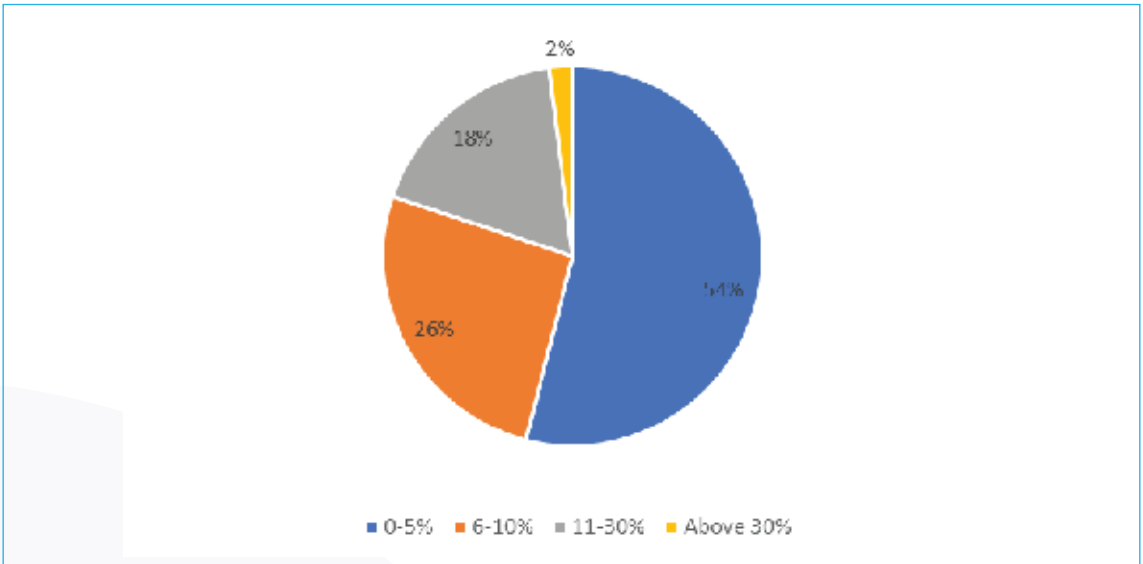
4.3 Loss in marketed fruits and vegetables

4.3.1 Self-reported cumulative losses in a single stock cycle

Two out of ten traders reported a cumulative loss¹⁵ of more than 10% of their initial stock volume, around one quarter suffered a 6-10% loss, and over half (54%) experienced losses not exceeding 5%.

¹⁵ Cumulative loss refers to total estimated loss incurred throughout the marketing process, from the time of stock acquisition to making the final sale of fruits and vegetables.

Figure 3. Percent of traders reporting different levels of cumulative losses



Note: ranges of cumulative losses experienced by traders are captured in the legend

Fruits, particularly watermelon and mangoes, were reported to experience higher average losses than vegetables. For instance, there are twice as many fruits as vegetable traders who reported losses which exceed 10% of their initial stock volume (Figure 4).

Figure 4. Percent of traders reporting cumulative quantity loss, by type of commodity

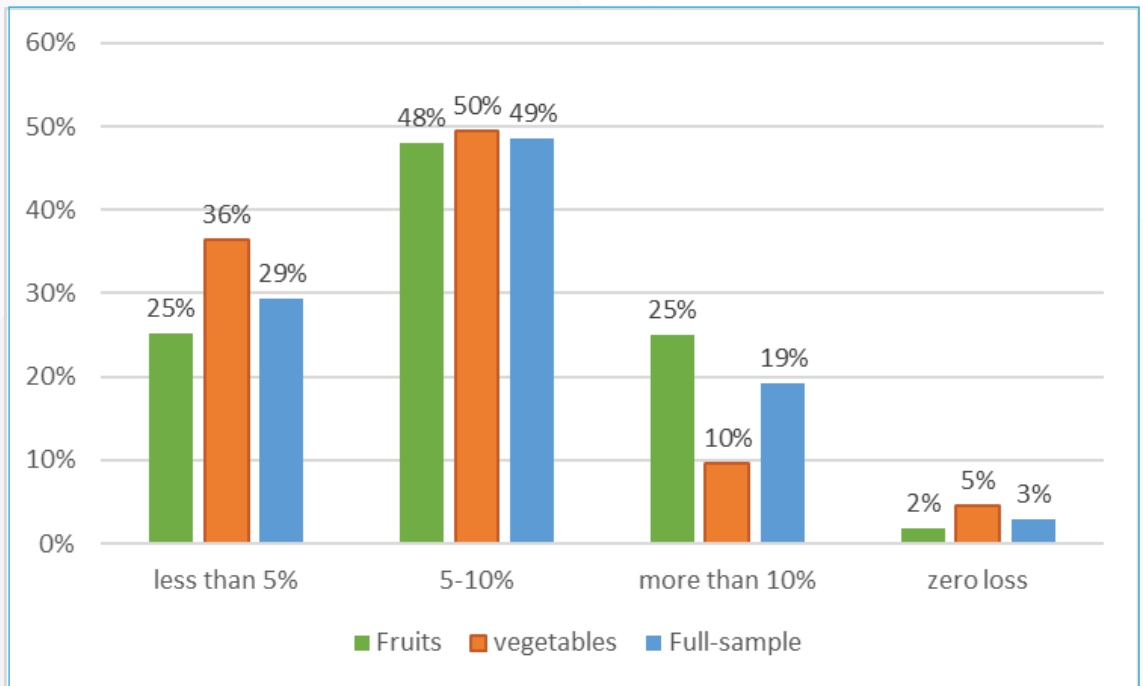


Table 8 below provides more details on between and within variation of self-reported quantity loss. It is evident that tomato traders report relatively lower losses, with the least within crop variation (IQR), than other crops under investigation.

For instance, three quarters of tomato traders (75th percentile) report losses which do not exceed 8% of their stock volume, while losses in other crops are said to be in the range of 10-15%. Quantity losses reported by potato and pineapple traders display similar patterns to each other.

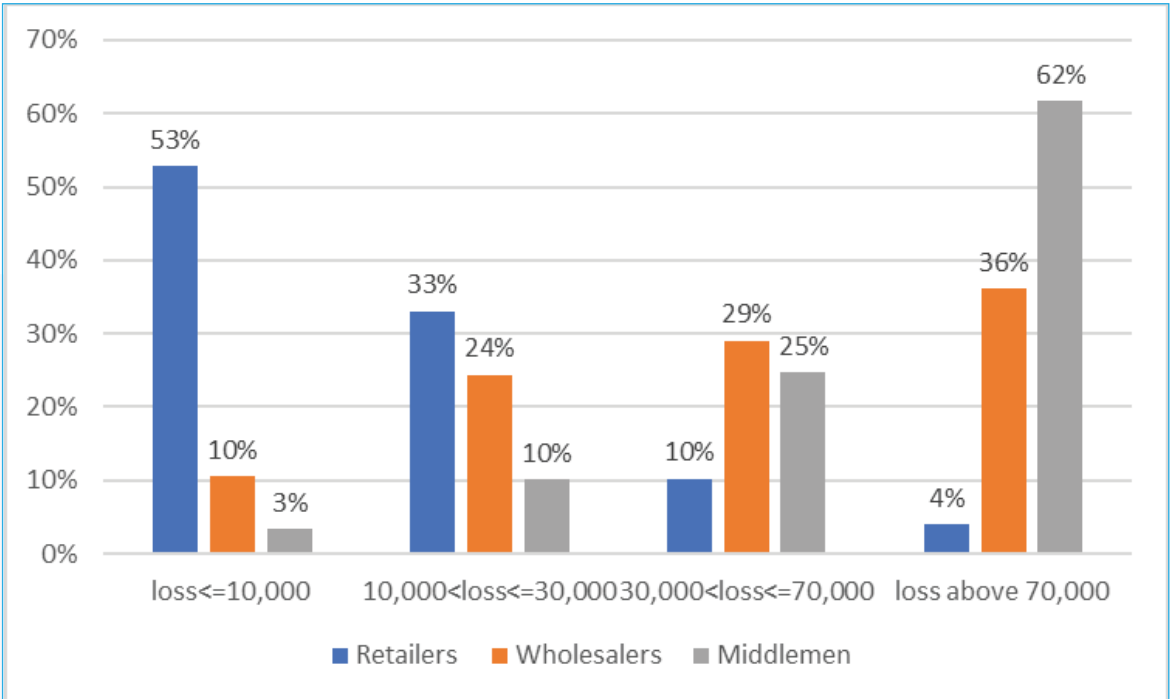
Table 8. Self-reported cumulative loss (% of stock volume), by type of crop

	25 th tile	percen- Median	75 th percentile	Interquartile range (IQR)
Watermelon	5%	10%	10%	5%
Pineapple	4%	5%	10%	6%
Mango	3%	8%	15%	12%
Tomato	2%	5%	8%	6%
Potato	3%	5%	10%	7%

In terms of the associated financial loss, nearly one third (30%) of traders estimate their current loss at TZS 10,000 or less. Furthermore, at least a quarter of them value their loss between 10,001 and TZS 30,000, and another quarter experienced a loss of more than TZS 70,000. Similar to estimates of quantity loss, most vegetable traders report relatively lower financial losses compared to fruit traders. For instance, the percent of vegetable traders who estimate their financial loss at TZS 10,000 or below (43%) is twice as much as fruit traders (22%). See Table A1 in appendix.

Estimated financial losses also vary by type of business operation-be it wholesale, retail, or brokerage. One can easily note from figure 6 that retailers are likely to fall within the lower spectrum of reported financial losses compared to middlemen and wholesalers. For example, over half (53%) of retailers estimate their losses to be TZS 10,000 or below, compared to 10% of wholesalers and 3% of middlemen. On the other hand, middlemen and to some degree wholesalers are more concentrated on the upper end of reported financial losses. This observed pattern may be associated with, among other things, the volume of traded commodity. From section 4.2 above we note that middlemen and wholesalers generally operate businesses on a relatively larger scale than retailers. Therefore, exposing large quantities of delicate products, such as fruits and vegetables, to unfavourable marketing conditions will likely result in large post-harvest losses.

Figure 5. Percent of traders reporting cumulative financial loss (TZS), by type of business operation

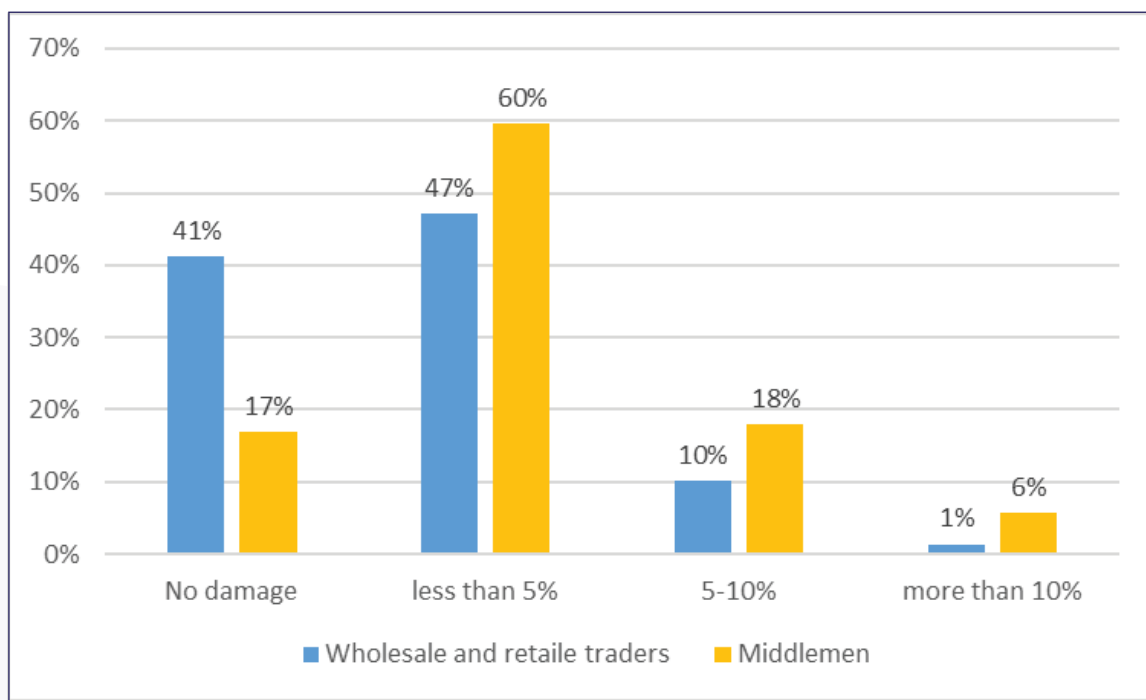


Extreme humidity and heat, poor road infrastructure and inappropriate packaging, poor storage, and limited market access are the most cited factors associated with fruits and vegetable losses experienced during the marketing process. Other mentioned factors include type of seed variety used in farm production, rats and theft, and poor handling of produce by traders and customers. The evidence presented so far indicates that almost all fruit and vegetable traders experience varying levels of post-harvest losses depending on the type of crop and business operation (wholesale, retail, brokerage). Literature also reveals that post-harvest losses tend to vary across different stages along the value chain. The next section explores the extent of experienced losses at different stages within the marketing process and associated factors.

4.3.2 Losses experienced during transportation.

Results from the survey indicate that, both, the prevalence and magnitude of loss incurred during transportation is higher amongst middlemen compared to wholesalers and retailers. For instance, 83% of middlemen compared to around 60% of wholesalers and retailers report varying levels of losses incurred during transportation (see Figure 6). In terms of magnitude, middlemen report relatively higher losses than wholesalers and retailers. In addition, those trading in fruits and tomatoes report higher losses during transportation than potato traders.

Figure 6. Self-reported quantity loss (% of stock volume) experienced during transportation, by type of business operation.



The extent of crop loss at this stage is most likely associated with the degree of crop delicacy, the time and distance travelled from the product source to the market, the quality of transport infrastructure, the mode of transportation and or type of containers/packaging used when transporting the crops.

For instance, in addition to other sources, all middlemen purchase directly from farmers compared to only 40% of wholesalers and retailers who also, on some occasions, do the same. This means that middlemen are more likely to travel longer distances to collect and transport their products from farms to markets. In contrast, wholesale and retail traders buy their commodities mainly from middlemen located near to or in their own respective markets. Considering that most farming in the country takes place in rural areas, it is important for farmers and traders to have access to good road infrastructure. Transportation through rough roads subjects crops to vibrations and longer time on the road which increases the risk of damage.

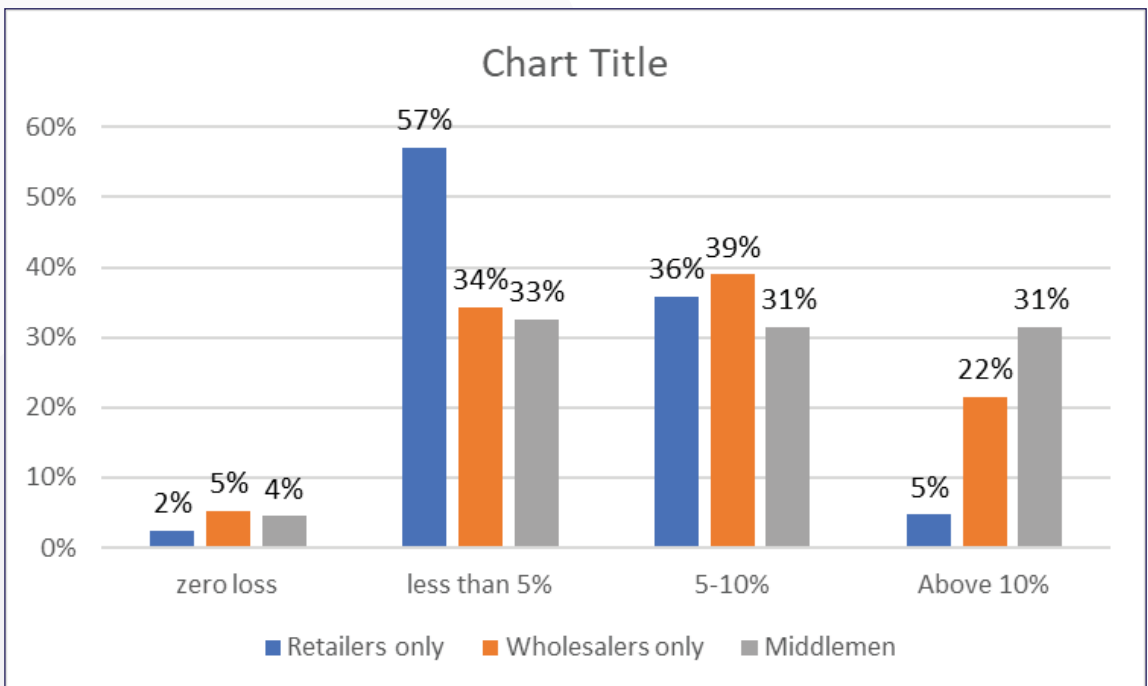
The means of transportation and containers used varies with the size of consignment and type of product in question. Middlemen often use trucks, while wholesale and retail traders use a combination of different means of transportation including large and medium sized trucks (33%), smaller cargo trucks- famously known as 'Toyo' or 'kirikuu' (24%), physical man-labour (31%), and carts (4%). Furthermore, timber crates and sacks are commonly used to pack tomatoes and potatoes respectively. Watermelons, mangoes, and pineapples are simply stalked in different modes of transportation. The use of such methods, whilst accounting for the delicate nature of fruits and vegetables in question, can pose greater risk of damage and crop loss at this stage along the value chain.

4.3.3 Loss experienced in the marketplace.

Upon arrival at the market, it is customary for traders to sort through their products for the purpose of grading and price setting. Ideally, a trader would prefer selling off all their product stock whilst still fresh to avoid losses. Traders reported spending an average of 2-4 days within which a fresh stock of purchased fruits and vegetables is completely sold out. This falls within reported time range of 3-7 days for which the products are said to still maintain their freshness. Tomatoes are usually sold out faster than fruits and potatoes, possibly due to a higher demand. However, even within this time frame most traders are still compelled to sell their commodities at a discount price. For instance, fruit traders admitted to sometimes discounting their selling price for up to approximately 15%. This is most common during the main harvest season as there is a more frequent supply of fresh produce entering the market.

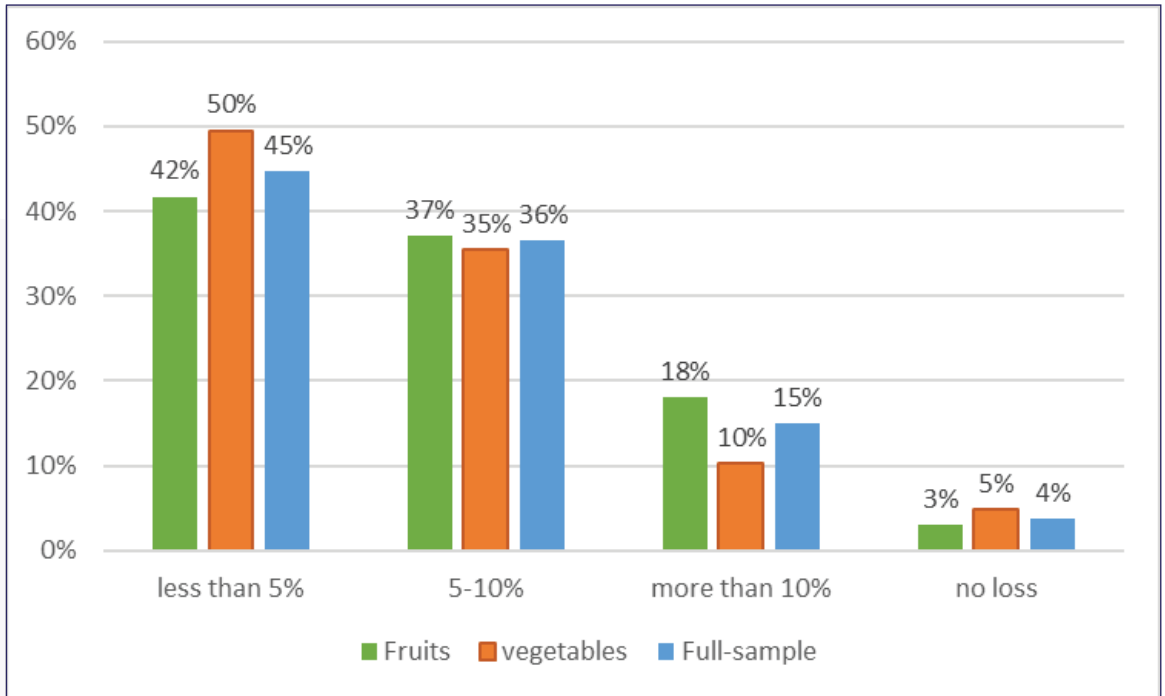
Nearly all traders (96%) claim to experience some level of losses in the marketplace. Over half the retailers and one third of, both, wholesalers and middlemen report losses of less than 5% of their stock volume. A much lower proportion of retailers (5%) than wholesalers (22%) and middlemen (31%) reported losses which exceed 10% of their stock volume. Retailers usually buy and sell goods in relatively smaller quantities, which may explain why they also report lower losses than their trading counterparts. In addition, even these small losses could still constitute a significant portion of retailers' lost earnings.

Figure 7. Self-reported quantity lost (% of stock volume) in the marketplace, by type of business operation.



Like the experience observed during transportation, fruits appear to suffer higher losses than vegetables in the marketplace. Almost twice as many fruits as vegetable traders estimate their losses to be more than 10% of their stock volumes.

Figure 8. Self-reported quantity lost (% of stock volume) in the marketplace, by type of commodity.



Unfavourable weather conditions (especially humidity and heat), animals such as rats, and theft are cited as main causes of loss in the marketplace. This may be partly associated with how traders store their commodities in the market. With only a small number using storage rooms, half the traders (53%) simply cover their produce on tables or on the ground, and close to two out of ten (18%) leave their products out in the open.

Implications of reducing losses in marketed fruits and vegetables.

So far, the results from our study have reveal the following. First, almost all fruit and vegetable traders experience varying levels of post-harvest losses. Second, fruits generally endure higher post-harvest losses compared to tomatoes and potatoes. Third, retailers operate on relatively small-scale and report lower levels of losses compared to middlemen and wholesalers. The global commitment, through Sustainable Development Goals (SDGs), aims to halve PHL and waste by 2030. What would be the implication of reducing losses within the context of our study?

Throughout the marketing process, traders report a median loss of TZS 30,000 for each stock volume they sell over a period of three days. This means that for two stock volumes sold per week, they record an estimated loss of TZS 240,000 per month. Now suppose traders were able to halve these losses, that is by TZS 120,000 per month. How would this compare to the average household food expenditure? The 2017/18 national household budget survey estimated that the median household monthly food expenditure in Dar es Salaam was TZS 241,745. Adjusting for inflation this amount is equivalent to about TZS 268,000 in 2021 when the survey was conducted.

This implies that if traders were to save half the value of their post-harvest losses, they could potentially feed an average household for a period of 13 days. In other words, post-harvest losses amount to almost a month worth of food consumption in any given household.

This simple example shows that lowering losses in marketed fruits and vegetables can produce significant benefits in terms of enhancing individual and household incomes, food security and livelihoods. This is an important message for traders, in general, and retailers in particular. Despite reporting relatively lower losses, retailers constitute the largest portion of our sample and that of the fruit and vegetable traders in the country. Therefore, small losses incurred by individual retailers could collectively make up a significant fraction of the total loss experienced by fruit sales and vegetable traders. In addition, losses no matter how small erodes traders' profits, limits their potential for business growth and perpetuates an unending poverty cycle.

4.3.4 Actions recommended by traders.

Traders proposed several measures that could be adopted to minimize losses during marketing of fruits and vegetables. The suggestions can be broadly grouped into improving market infrastructure/facilities and services; improving transport infrastructure (especially rural roads); capacity building for farmers and traders; boosting domestic consumption; and strengthening stakeholders' coordination and commitment.

Improving market infrastructure and services can significantly reduce fruit and vegetable losses by addressing various inefficiencies and challenges within the supply chain. Traders' testimonies support a well-known fact that extreme temperatures and poor ventilation can lead to high losses in fruits and vegetables. Exposure to heat, for example, not only causes shrinkage and wilting of the products, but also accelerates the deterioration process. Traders advise that markets be built with enough space to allow for sufficient airflow and reduce commodity congestion.

Furthermore, well-designed and regularly maintained storage facilities that allow for proper ventilation, temperature control, and humidity management can substantially extend the shelf life of fruits and vegetables and minimize spoilage. The storage facilities should be regularly cleaned and disinfected to avoid the spread of diseases and pests.

Strengthening security services in marketplaces is also crucial to ensure the safety of products and overall well-being of consumers, vendors, and the neighbouring community. Well-trained security personnel can be used to carry out regular patrols and respond quickly to any security concerns. Security can also be strengthened by ensuring that marketplaces are equipped with adequate lighting, especially at night.

The upgrading of market structures in the country should include installation of closed-circuit television (CCTV) cameras. For all this to work efficiently, a sense of community responsibility is needed bringing together vendors and nearby residents in security initiatives such as neighbourhood watch programs.

Improving transport (rural road) infrastructure. The distance and time it takes to transport fruits and vegetables from the source to customers, among other things, can greatly determine the level of experienced PHL. Fruit and vegetable production largely take place in rural areas, or on the outskirts of major markets/urban centres. It is important therefore that road infrastructures from production areas leading into destined markets are accessible and in good condition throughout the year. This will help shorten the transportation time and limit physical damage of crops. Well maintained roads also mean lower cost of transportation, which may encourage those buying directly from farmers to use more appropriate means of transportation which they would otherwise not use due to cost implication.

Capacity building for farmers and traders

Capacity building for farmers and traders is vital in reducing post-harvest losses of fruits and vegetables. Farmers need the necessary knowledge, skills, and resources to improve their practices and efficiency in production, handling, packaging, storage, and transportation of crops. Extension services can be used to promote farmers' adoption of better production technologies including improved seed varieties, proper harvesting, use of insecticides and handling techniques.

In addition, farmers and traders need to have adequate knowledge of their market requirements such as quality of demanded fruits and vegetables. Post-harvest management techniques such as temperature control, humidity management, the use of appropriate storage materials, and sorting to avoid contamination of unspoiled produce is necessary.

In addition, training should cover basic business principles including trustworthiness, and adherence to quality and safety standards. Capacity building for farmers and traders is a long-term investment that can significantly reduce post-harvest losses, increase income, and improve food security. This requires input from state and non-state actors.

Boosting domestic consumption. Sustained broad economic development is strongly linked to high demand for consumer goods. Boosting domestic consumption of fruits and vegetables can be achieved through increased household income and or education. Wealthier households tend to diversify their consumption pattern to include nutritious foods including fruits and vegetables. Therefore, increasing household incomes will likely generate an income effect which will drive up demand for fruits and vegetables especially in urban areas.

On the other hand, regular promotional campaigns and school programs can be used educate and sensitise communities on the importance of fruits and vegetables in improving nutrition and health outcomes-especially among rural women and youth.

Traders also alluded to how sufficient market space, including availability of car parks, can help attract certain clientele. Wealthier customers, for instance, often prioritize convenience, comfort, and safety when shopping. Therefore, providing adequate infrastructure can cater to their preferences.

5. Conclusion and recommendations

This study set out to examine the extent and possible causes of crop loss experienced by fruits and vegetable traders in selected Dar es Salaam markets. The results suggest that almost all fruit and vegetable traders experience varying levels of post-harvest losses. The extent of loss varies by type of crop and business operation (wholesale, retail, brokerage), and stage along the value chain. In our case, fruits were reported to suffer more from post-harvest losses compared to tomatoes and potatoes. In general, retailers seem to experience lower levels of losses compared to middlemen and wholesalers. Throughout the marketing process, middlemen incur higher losses during transportation, and to some extent at the marketplace.

Unfavourable weather and transport conditions, inappropriate packaging, poor storage, and limited market access are some of the common factors associated with fruits and vegetable losses. Other factors include type of seed variety used in farm production, rats and theft, and poor handling of produce by traders and customers.

This paper has illustrated that reducing post-harvest losses in marketed fruits and vegetables can have a significant effect on improving food security and livelihood. Therefore, the study recommends that the Government in partnership with other stakeholders needs to:



Improve access to good transport infrastructure to reduce time spent on the road and product collision

- Continue to improve road infrastructure especially in rural areas. Further, encourage traders to use specialised transport containers including refrigerated ones to protect the quality of different crop products



Improve market infrastructure to create more space that allows for better ventilation and reduce congestion.

- This will also create a better and cleaner environment which protects against destructive insects and animals.
- This should be accompanied by adequate security services such as community watch programs, proper lighting, installation of CCTV cameras



Encourage creative packaging of products to add value and increase access to different market segments

- Traders should also be trained on proper post-harvest handling practices including storing their products in dry areas.



Increase investment in R&D, through TARI and other relevant research institutions.

- This will develop seed varieties which are more tolerant towards extreme weather and post-harvest handling conditions.

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Appendix

Table A1 . Percent of traders reporting estimated financial loss, by type of crop.

Estimated financial loss (TZS)	Fruits	Vegetables	Total
loss≤10,000	22%	43%	30%
10,000<loss≤30,000	29%	23%	26%
30,000<loss≤70,000	24%	12%	19%
Loss above 70,000	26%	22%	25%
Total	100%	100%	100%



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