PILOT OF FOOD LOSS AND WASTE VALUE CHAIN SELECTION GUIDE IN KENYA

Julia Shuck, Diana Nduku and Rashmi Ekka
Agribusiness Associates Inc. and Fresh Produce Consortium Kenya
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Any remaining errors and omissions are the responsibility of the contributors of the report.
1. Executive Summary

The Fresh Produce Consortium (FPC) of Kenya was the first organization to pilot the ‘Food Loss and Waste Value Chain Selection Guide’ for two weeks in January 2022, with technical support from Agribusiness Associates Inc. The guide was developed in 2020 with technical support from USDA and funding from USAID. The guide is intended to help various agriculture stakeholders select value chains to work in based on the greatest potential to reduce food loss and waste (FLW). This investment decision making tool was produced to be highly adaptable to reflect the current work and approach of the organizations and/or group(s) using it.

FPC Kenya is a business membership organization representing a diverse range of value chain actors involved in the production and supply of fresh produce. Of its 360+ members, engaging 300 of Kenya’s 800 small, medium, and large-scale exporters make FPC one of the largest export associations in the country, linking businesses with international, domestic high-end grocery stores and local open-air markets. This multi-faceted approach helps FPC facilitate value chain specific dialogue for an integrated industry approach to tackle the most pressing issues that increase efficiency and economic productivity. FPC’s rich network of partners share the common goal of reducing FLW of high-value horticultural export goods, motivating participation in piloting the FLW Value Chain Selection Guide to grow Kenya’s GDP while improving agricultural livelihoods and the food nutrition and security index of the region.

FPC members produce for export and high-end domestic value chains. This influenced the types of value chain actors that were interviewed for this selection exercise as well as the final value chains selected for further FLW investments.

The in-country pilot focused on leveraging FPC’s capacity to be a FLW champion for Kenyan agriculture by equipping them with various methods and approaches. Eight value chains were selected for the prioritization exercise. The top four value chains were: avocado, mango, tomato and green beans. An in-depth investigation of avocados was not possible as it was out of season during the pilot period (January 2022). As FPC seeks to support its members, which consists of producers linked to formal supply chains, few losses for mangoes were observed while surveying a packhouse, whereas green bean losses were evident. FPC’s goal was to investigate one domestic and one export value chain so tomato and green beans were selected and are the focus of this report.

Key Tomato Value Chain and Loss Findings

Tomatoes are a popular food in the Kenyan diet and comprise 15% of horticultural production for domestic use. Tomatoes are primarily produced in open fields by smallholder producers, with a growing number of large-scale greenhouses producing for high-end supermarkets. Because of their local popularity, tomatoes have a range of options for produce rejected at the highest levels to still reach local markets. This study found:

- The high-end supermarket value chain for tomatoes experiences an estimated loss and waste of 56%. These estimates are similar to the postharvest losses recorded in Rwanda for tomatoes, which was 55% in 2018.1

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● Because of the high demand for tomatoes, produce rejected at the packhouse (approximately 18.75%) can often be taken to the local markets and sold at a lower rate, especially during the dry season when production cannot meet consumer demands.

● Tomatoes are susceptible to FLW due to lack of contracts leading farms to sometimes leave produce in the field unharvested.

● Tomatoes often accumulate damage along the value chain because of numerous touch points and lack of temperature control. Consumer tendency to check for ripeness by squeezing produce leads to damage that causes tomatoes to spoil even more quickly.

● Kenya’s growing middle-class is driving imports of processed foods, indicating an opportunity for locally processing tomatoes into sauces and paste.

Key Green Bean Value Chain and Loss Findings
Green beans are an important export product, contributing to almost 23% of income generated from the horticulture crop sector, according to Kenya’s Horticultural Crops Directorate. Green beans are typically grown by more sophisticated farms that understand the investment required to meet stringent international standards, specifically those of the European Union. Produce rejected for human consumption is frequently repurposed into animal feed, which as an income generating activity is not considered food waste or loss, or applied as a green manure, which is considered a loss as per the definitions from Food and Agriculture Organization’s 2019 State of Food and Agriculture Report.3

● Field research found a conservative estimate of 40% loss for green beans export value chain until the point of export. Of that, 30% is rejected for quality at the farm and packhouse levels. Other studies have found 59% losses in the green bean value chain.4 The relatively lower levels of loss can be attributed to strong relationships and contracts between the producer and packhouse, with the packhouse providing extension services and transportation of produce. Based on FAO data, the US experiences approximately 7% green bean losses throughout the whole value chain.5

● Key contributors of green bean losses are pest and disease (russetting), wind damage, and dehydration caused by lack of irrigation the day before harvesting.

● Most consumers of wet market produce purchase green beans that have been cut up and added to cut potatoes and carrots as a value-added package. Consumers that buy fresh green beans to improve the nutritional status of their diets see high levels of food waste as they experiment with new recipes as green beans are not common in Kenyan cuisine.

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3 This report uses FLW definitions provided by FAO in: FAO. 2019. The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction. Rome. Licence: CC BY-NC-SA 3.0 IGO. “Empirically it considers food losses as occurring along the food supply chain from harvest/slaughter/catch up to, but not including, the retail level. Food waste, on the other hand, occurs at the retail and consumption level. This definition also aligns with the distinction implicit in SDG Target 12.3. This report also asserts that, although there may be an economic loss, food diverted to other economic uses, such as animal feed, is not considered as quantitative food loss or waste. Similarly, inedible parts are not considered as food loss or waste.” (pp xii – xiii).


Food Waste

Open market vendors try to manage their purchases so they only buy wholesale what they estimate can be sold at retail. For the vendors surveyed, they see little food waste if supply is well managed and there is space to store unsold produce overnight. During data collection, one vendor became aware of the damage caused by consumers squeezing tomatoes too tightly to check for freshness and immediately adopted a model of selecting produce for consumers.

A survey of consumers at local open markets found a higher demand for tomatoes, with a few going bad before preparing due to menu change or only partially using produce before going bad. Little data exists on green bean waste as this is primarily grown for European consumers.
I. Background on Kenya’s Horticulture Sector

The total global food loss and waste (FLW) in 2017 was about 1.9 Gt of food, which is 29% of the total primary food production. The FLW-associated Greenhouse Gas (GHG) emissions are estimated to be more than 2.5 Gt. Looking at the various agriculture value chains, fruits and vegetables contribute almost half of the total FLW, followed by roots and tubers. Similarly, analysis of the 5 value chain stages - production, storage and handling, processing, distribution, and consumption, shows that in general, production and consumption stages yield higher FLW.6

From 1970 to 2011, Kenya’s population grew from 11 million to 39.5 million, reaching 50.9 million in 2018 and an anticipated 81 million by 2040. Kenya is the third-largest economy in sub-Saharan Africa. Although the country’s GDP per capita is consistently improving, the number of undernourished people has increased to 13 million (2018-2020, 3-year average) from 9.8 million during 2013-2015 (3-year average). Almost half of the population lives on less than US$1/day, with one-third of adults food insecure and one-third of children under five chronically malnourished. This growing population requires more land and natural resources, with traditionally rain-fed farms being pushed to more arid areas, increasing susceptibility to climate vulnerability. Reducing FLW in Kenya has significant potential to reduce poverty and food insecurity for many of the country’s most vulnerable.7

Of the country’s total population, 73% live in rural areas. In 2017, agriculture made up 29.3% of Kenya’s GDP, providing livelihoods to 80% of the population.8 According to FAO, agriculture consists of 65% of export earnings. Smallholder farmers produce about 90% of the nation’s agricultural products.9

Existing data estimates food loss in Kenya to be 20 - 30% of all harvested crops.10 An IFPRI study found mango production experiences 25 - 44% losses, up to 60% in some instance. Tomatoes and green beans were found to have comparable levels of loss, 55% and 59%, respectively.11,12

The total value of horticulture production in 2018 increased 19.7% from 2017. In 2018, 92.25% of the total domestic value of horticultural production came from three categories: cut flowers (45.54%), fruits (25.68%), and exotic vegetables (21.02%), which all the vegetables in this study fall under. At the same time, 74% of horticultural exports came from flowers, 18% from vegetables, and 8% from fruit. From 2017 to 2018, Kenya saw a total value increase of 33.3% for horticultural products. A 15% increase in vegetable exports was attributed to improved compliance with market requirements, especially for the European Union. Fruit exports saw an increase of 42.4% as a result of higher prices, proper harvesting timing, and lifting a self-imposed 8-year ban on mangoes until pest damage could be controlled.13 See Annex 5 for more data.

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9 SokоЅhristFresh: First mile cold storage as a service | BASE
13 AFA-Horticultural Crops Directorate
II. FLW Value Chain Selection Process

The five stages of the FLW Value Chain Selection Process include:

1. Framing a food loss and waste objective to specify the organization’s approach and goal,
2. Identifying promising value chains based on the organization’s existing work and the possibility of addressing key FLW priorities,
3. Choosing prioritization criteria based on the organization’s mission to ensure the value chain selected is aligned with existing goals and strengths,
4. Collecting qualitative and quantitative data to address gaps in existing knowledge and develop the foundation for FLW data management and advocacy
5. Validation workshop with key stakeholders, including export growers and government officials, to validate the findings and facilitate multi-stakeholder collaborations

Figure 1. FLW Value Chain Selection Process Stages

Stage 1. FLW objective developed

In a four-hour session, the FPC Kenya FLW Pilot Team engaged in a series of activities to develop a FLW objective.

FPC identified the following key FLW-related impacts they are interested in addressing:

- Increase food and nutrition security in Kenya by increasing consumers access to high quality food supply
- Reduce income lost from produce being rejected (loss) and/or thrown away (waste)
- Enable farmers to produce food sustainably (social, economic, environmental)
- Enables farmers to have a secure market access for their produce

FPC’s FLW objective is to:
Halve FLW from farm to fork by 2030 in the targeted value chains for FPC Kenya members
Leveraging their organizational priorities and strengths, FPC can achieve this objective by conducting the following activities:

- Creating awareness of the impacts of FLW for all value chain actors, to influence their knowledge, attitudes and practices through trainings and awareness campaigns
- Facilitating partnerships among various value chain actors for technical solutions in transportation, packaging, pest and disease management, and processing to put solutions in place that can be adopted by various actors, reducing FLW
- Engaging in market analysis to better predict market demand and trends that support farmers in proper production planning so their produce sells for better prices
- Lobbying for inclusion of FLW issues in Kenyan policies to create a better production environment and increase international trade competitiveness

This work would further establish FPC as a champion for FLW reduction and a hub for reliable and accessible FLW data in Kenya.

Figure 2. FPC FLW Theory of Change
Stage 2. Value Chain Identification

The FPC FLW Pilot Team Lead created an initial list of value chains based on their experience. They then conducted a key informant interview with a large-scale exporter. The exporter highlighted other major export crops with high levels of loss that could benefit from identifying entry points to train farmers. Thyme and basil were added to the list, as Kenya is the main supplier of fresh herbs to Europe, particularly during Europe’s off season. Granted, thyme and basil are not prevalent in local Kenyan diets. While export value chains are a priority for FPC Kenya, they also wanted to assess domestic value chains with high consumption, economic and assumed waste value - based on this tomato and cabbage value chains were chosen.

Table 1. 2018 Production Statistics for Promising Value Chains Identified by FPC

<table>
<thead>
<tr>
<th>Crop</th>
<th>Production Area (Ha)</th>
<th>Volume (MT) Domestic Consumer Demand (L/M/H)</th>
<th>Production Value (KES)</th>
<th>Export Volume (MT)</th>
<th>Export Value (KES)</th>
<th>Reason for Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado</td>
<td>16,501</td>
<td>318,087 H</td>
<td>5,972,104,428</td>
<td>64,477,082</td>
<td>10,839,367,033</td>
<td>Government priority deemed as “green gold,” anticipate seasonal glut in 3-4 years, low quality varieties limit value addition (e.g. oil)</td>
</tr>
<tr>
<td>Mango</td>
<td>48,541</td>
<td>746,377 H</td>
<td>12,846,113,214</td>
<td>9,659,925</td>
<td>1,612,454,056</td>
<td>Government priority to manage fruit fly pest driving growth of mango orchards and return to EU market (after 8 year self-ban)</td>
</tr>
<tr>
<td>Tomato</td>
<td>28,263</td>
<td>574,458 H</td>
<td>19,903,552,256</td>
<td>-</td>
<td>Not exported</td>
<td>Members move large volumes in domestic market; seasonal glut</td>
</tr>
<tr>
<td>Cabbage</td>
<td>22,892</td>
<td>620,523 H</td>
<td>7,646,157,500</td>
<td>-</td>
<td>Not exported</td>
<td>Seasonal glut in market</td>
</tr>
<tr>
<td>Fine Beans</td>
<td>7,942</td>
<td>66,765 L</td>
<td>3,309,256,570</td>
<td>22,098,505</td>
<td>6,328,868,135</td>
<td>Members move large volumes in international markets</td>
</tr>
<tr>
<td>Peas in Pod</td>
<td>22,840</td>
<td>88,685 L</td>
<td>2,992,671,573</td>
<td>22,938</td>
<td>116,892,976</td>
<td>Members move large volumes in international markets</td>
</tr>
<tr>
<td>Basil</td>
<td>-</td>
<td>-</td>
<td>987,924</td>
<td>1,735,367,721</td>
<td>Recommended by large scale export member</td>
<td></td>
</tr>
<tr>
<td>Thyme</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Recommended by large scale export member</td>
</tr>
</tbody>
</table>

Stage 3: Prioritizing Promising Value Chains

The core FPC Kenya FLW Team was joined by their CEO and a value chain expert from their membership in a food loss and waste discussion. This was followed by choosing selection criteria based on FPC Kenya’s organizational interests and goals, described in Table 2. In this 6-hour session, two members of the FLW Core Group identified 6 key criteria and rated the identified value chains for each metric based on a combination of secondary research and familiarity with the Kenyan agricultural context (see Table 2). Annex 2 details the criteria and indicators selected for the prioritization exercise.

Table 2. FPC Kenya’s FLW Value Chain Prioritization Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Price/Kg (KES)</th>
<th>National Scale of Crop</th>
<th>Food Loss %</th>
<th>Economic Outcomes</th>
<th>Food Security &amp; Nutrition</th>
<th>FLW Investment Opportunities</th>
<th>Gender/Women</th>
<th>Youth (18 - 35)</th>
<th>GHG emissions CO2/T produced</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Domestic Export</td>
<td>Production T/year**</td>
<td>Export (Tonnes)**</td>
<td>Export (KES)</td>
<td>Lit Review</td>
<td>Value of FLW/kg</td>
<td>% Diet + Nutrition Level</td>
<td>FPC members willingness to invest</td>
<td>Employment &amp; Entrepreneurship Opportunities</td>
<td>Opportunities for technology</td>
</tr>
<tr>
<td>RANK</td>
<td>Weightage (%)</td>
<td>2018</td>
<td>10.8 BN</td>
<td>43</td>
<td>27</td>
<td>20</td>
<td>18</td>
<td>9</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>Avocado</td>
<td>90</td>
<td>318,087</td>
<td>64,477,082</td>
<td>64,477,082</td>
<td>1.6 BN</td>
<td>10.8 BN</td>
<td>43</td>
<td>27</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Mango</td>
<td>90</td>
<td>746,377</td>
<td>9,659,925</td>
<td>9,659,925</td>
<td>1.6 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Tomatoes</td>
<td>101</td>
<td>574,458</td>
<td>1.4 BN</td>
<td>1.4 BN</td>
<td>10.8 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>Fine Beans</td>
<td>60</td>
<td>205</td>
<td>22,098,505</td>
<td>22,098,505</td>
<td>1.6 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Snap Peas</td>
<td>80</td>
<td>128</td>
<td>22,938</td>
<td>22,938</td>
<td>1.6 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>Cabbage</td>
<td>50</td>
<td>620,523</td>
<td>Not Exported</td>
<td>96,477,082</td>
<td>1.6 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>Thyme</td>
<td>80</td>
<td>128</td>
<td>22,938</td>
<td>22,938</td>
<td>1.6 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>Basil</td>
<td>370</td>
<td>475</td>
<td>987,924</td>
<td>987,924</td>
<td>1.7 BN</td>
<td>44</td>
<td>27</td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Numbers highlighted in green are from recent studies the FPC FLW Team found to be relevant and reflective of the current situation. Non-highlighted numbers are rough estimates that come from older reports or other areas. Annex 2 and Annex 3 shows how the value chains were scored against the prioritization criteria. Source for 2021 export data: https://horticulture.agricultureauthority.go.ke/index.php/statistics/statistics
Stage 4: Data Collection

Value chains selected for data collection

The top 4 value chains that emerged from the prioritization process are avocado, mango, tomatoes and green beans. FPC was particularly interested in assessing one domestic and one export value chain. The top ranked value chain, avocados, was not researched as it was not in season. During the first data collection site visit to a large-scale mango exporter, the FLW Team observed that fruits that didn’t meet EU quality standards could be sent to the United Arab Emirates, then sold to local vendors, indicating minimal losses for the export-specific value chain.

The lack of domestic production and sales data for basil and thyme indicate these herbs are not currently among the country’s top horticultural crops and that their primary use is for export and not domestic markets, like coriander and rosemary.

**Tomatoes were selected as a domestic value chain and green beans were chosen as the export value chain** for in-depth investigation.

Methodology

This pilot used the case study method, consisting of key informant interviews and observations at a large-scale export packhouse for green beans and a large-scale domestic packhouse for tomatoes. The packhouses connected the study team to two green bean farms and two tomato farms they contract with to interview and/or observe. In total, two open field green bean farms, one tomato greenhouse and one open field tomato farm were observed and interviewed, with an additional large scale open field tomato farmer being interviewed. This approach allowed for a more focused study on the postharvest losses experienced by packhouses for export or high-end domestic markets, acknowledging that this is not representative of smallholder farmers. Additionally, three open air market vendors and three consumers were interviewed to understand food waste for green beans and tomatoes.

Geographic Overview

Green Bean Production in Isinya District, Kajiado County

The Isinya District is located in the southeastern part of Kajiado county of Kenya, about 40 minutes south of Nairobi by car. Classified as a typical rangeland, the area receives an average annual rainfall of about 450 - 550 mm with tropical high day time temperature and high surface evaporation. Shallow soils on top of basement rocks make establishing trees difficult, but support a savannah environment naturally suited for livestock.\(^{14}\) The soils include well drained, shallow to moderately deep, brown to dark brown, stony to gravelly clay loam.\(^{15}\)

A bi-modal rainfall pattern has long rains (March to May) and short rains (October to December). Temperatures vary both with altitude and season. The coolest period is between July and August,

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while the hottest months are from November to April. This landscape is most vulnerable to moisture stress/less intense rains, increased temperatures, intense rainfall/flooding.  

The Isinya rangelands, historically a nomadic pastoral landscape managed for livestock and animal production, is evolving to an agropastoral-ecological production system with fragments of cultivated lands mixed with traditional pastoralism. Peri-urbanization is contributing to a patchwork of land ownership where livestock herding is less and less viable and wildlife once roamed freely, although semi-nomadic pastoral practice remains the predominant lifestyle.

Other socio-ecological changes circumventing environmental limitations to improve yields include access to specialized seed varieties that respond better to fertilizers and cheaper irrigation systems, allowing exploitation of abundant groundwater for crop production throughout the year. Recent droughts further make irrigation more enticing to manage weather unpredictability.

French beans are grown mainly for the export market where they are sold as fresh or canned. The leading counties in terms of value in 2017 were Machakos, Kirinyaga, Kajiado, Murang’a and Nakuru that accounted for 33.1, 23.4, 9.8, 5.9 and 5.4 percent respectively. Despite growing output, production and marketing of French beans in Kenya has continually faced the challenges of pests and diseases, increasing the cost of production. Additionally, excess pesticide use leaves residues that have resulted in high rejection rates in the export market. The main pests affecting green bean production are white flies, mites and aphids, with the main diseases including bean rust and bean spot.

Kenya’s Horticultural Crops Directorate Authority reported in the first half of 2021 (January - July), that Kenya exported 8,488 T of green beans, valued at KSh 2.6 billion (US$22.8 million). Green beans sell domestically for KSH60/kg (US$0.52) and for export at KSh205/kg (US$1.79).

Tomato production at Lake Naivasha, Nakuru County

Lake Naivasha, in the semi-arid Eastern Rift Valley, is the second largest freshwater lake in Kenya (after Lake Victoria) and has no surface outlet. Formerly an open savannah, the landscape at Lake Naivasha has shifted to ranch land and settlements outside of Hell’s Gate National Park, south of the lake.

South central Nakuru County receives approximately 750 mm of precipitation annually with a temperature range of 17-21 °C. On average, the first wet season of the year (January-June) tends to be about 1°C warmer and about 30% wetter than the second wet season; however, seasonal

18 Ibid
19 HCDA, Fresh Exports January - July 2021, volume in kgs
20 HCDA, Fresh Exports January - July 2021, value KSh
21 https://www.xe.com/currencyconverter/convert/?Amount=101&From=KES&To=USD (3 March 2022)
22 https://aquadocs.org/bitstream/handle/1834/2127/WLCK-30-34.pdf;jsessionid=3109C7BC28CO39C6B3BD50CEF2262C22?sequence=1
precipitation varies substantially from year to year. This area faces dry spells/droughts, intense precipitation/flooding and heat stress from high temperatures. Dry spells are on average longer during the second wet season. Extreme precipitation and flood risks are moderate in both seasons with most years receiving between 20 and 30 mm of precipitation on the wettest day.23

A successful horticultural industry began blooming near Lake Naivasha in the early 1980s, reaching 5,000 hectares by 2006.24 Most of the produce goes to Europe, with the area being Kenya’s top foreign-exchange earner. The increased employment opportunities in power generation and horticulture led to a 20-fold increase in the local population.25 Lake levels are a third of its predicted level due to substantial water extraction from the lake and rivers in the catchment for industries of national importance (geothermal power exploration; irrigated horticulture), agriculture, and domestic uses.26 Treated as a common good, the lake’s ability to sustain an increasing demand for irrigation water is becoming more uncertain.27

Production is steadily increasing in the non-traditional counties of Kajiado, Machakos and Narok, while the leading county, Kirinyaga, is showing a downward trend in area, production and value. This decrease in production is attributed to a buildup of pests and diseases as well as diversification to other enterprises. From 2017 to 2018, the tomato production area increased 4.5%, from 27,053 ha to 28,263 ha, while output increased 13.2%, from 507,275 MT to 574,458 MT. The increase in the area of production, volume and value was attributed to enhanced irrigation and growing high yielding hybrid varieties tolerant to pests and diseases. Pests and diseases remain major challenges in tomato production especially in the central Kenya counties.

FAO agriculture statistics shows a significant increase in tomato production from 2019 to 2020. This mirrors an increase in area harvested. This trend shows both an eager market to fill domestic demand, and greater potential for FLW. Multiple farmers surveyed noted that during the rainy season when tomato production is high, produce will be left in the field unharvested due to lack of market.

Kenya’s Horticultural Crops Directorate Authority reported in the first half of 2021 (January - July), Kenya exported .33 T of tomatoes, valued at KSh 34 million (US$298,000) further reinforcing most of the tomato production is for domestic consumption. Tomatoes sell for KSh101/kg (US$0.88).28


27 https://aquadocs.org/bitstream/handle/1834/2127/WLCK-30-34.pdf;jsessionid=3109C7BC2BC039C6B3BD50CEF2262C22?sequence=1

28 https://www.xe.com/currencyconverter/convert/?Amount=101&From=KES&To=USD (3 March 2022)
III. Findings from Green Bean for Exports and High-End Domestic Tomato Value Chains

Green Bean Export Value Chain

Green Bean Photostory: Journey from Farm to Market

1) Planted green beans

2) Harvesting is done by women because they are perceived as more efficient and gentle while picking the beans
3) The harvesters sort the green beans according to packhouse requirements

4) Green beans are put in crates for the packhouse truck to pick up

5) The truck transports the green beans to the packhouse overnight

6) Within hours of arriving at the packhouse, the green beans are graded by quality control. The entire delivery is either accepted or rejected. Rejects are returned to the farm where they are used as cattle feed or green manure.
7) Green beans are labeled with the farm’s information for traceability and stored in a cold room.

8) The green beans are sorted and processed (e.g. top and tails cut off) according to the customer requirements.

9) The green beans are weighed, packaged, and taken to another cold room.

10A) The green beans are loaded into a refrigerated truck for movement to the port of exit (air).
10B) Export packhouses can also supply green beans to domestic high-end grocery stores.

11) Consumers purchase and consume green beans.
**Key Findings**

- Field research found a conservative estimate of 40% loss for the green bean export market value chain. Of that, 30% is rejected for quality at the farm and packhouse levels. Key contributors of green bean losses are pest and disease - russetting, wind damage, and dehydration caused by lack of irrigation the day before harvesting.

- Green beans grown to market fresh are highly perishable with a shelf life of 7 days after harvesting. This biological factor necessitates an efficient postharvest system to reach foreign customers in a timely manner.

**Farm.** As illustrated in figure 3, the large-scale green bean farm surveyed yielded 5 T/acre. Unpicked produce was roughly estimated by marking three spots in the field and counting remaining beans left in 1 m², factoring in 25% of the field suffering from dry conditions as saline groundwater had clogged the irrigation tape. This indicated 7% of produce being left on the field unharvested. Harvesting occurs in the morning, finishing early afternoon, to collect produce before it is too hot and increases dehydration quality issues. Wind damage is common in the area, leading the farm to grow corn around the perimeter of fields to serve as a natural barrier. After harvesting, the all female harvesters carry the produce to a sorting facility on-site. At this point, about 10% of the harvested crop is rejected for not meeting market standards. Harvesters are paid based on the weight of what they picked that goes to the packhouse. Because of the easily observed direct link between on-farm harvesting and sorting with rate of packhouse rejections, large-scale farms prioritize training new and regular harvesters on best practices to reduce instances of delivering produce to the packhouse that is likely to get rejected. When a shipment of produce is rejected, the farm is still financially responsible for production and harvesting costs. From the rejected produce, the harvesters can freely take however much produce they want for household consumption, which helps alleviate their unpaid harvesting efforts for produce that does not meet market standards. That said, rejected produce may be more of a factor of production than harvesting technique, and green beans are not a staple in the Kenyan diet reducing their appeal to local harvesters. Within agricultural systems, farms typically take on the greatest level of risk compared to other value chain actors, and in this example,
some of those risks are being passed on to the harvesters. Remaining rejected produce is either bartered with nomadic herders as cattle feed in exchange for the cattle manure as an organic fertilizer, or applied to the land as a green manure. Green beans repurposed for cattle feed, an income generating activity, is not considered a loss or waste, although green manure is, as per FAO classification.²⁹

A quality assessment was conducted by randomly selecting 20 green beans and having the supervisor walk the FLW team through an assessment. Interestingly, 6 of the 20 green beans (30%) did not meet quality standards, but this only accounted for a 10% reduction in weight as many green beans did not meet requirements for being small or showing signs of dehydration.

**Packhouse.** The farm has a contract with the packhouse, who provide crates for transporting sorted produce, and use their own trucks to pick up harvested beans in the afternoon. The trucks travel in the evening to take advantage of naturally cooler temperatures, reducing stress on produce. Once produce arrives at the packhouse, it stays in the delivery hall until a quality assessment can be conducted. A sample, proportional to the amount received, is rapidly assessed and a quality assessment sheet is completed that indicates what percent of produce should be rejected and for what reasons. The load is given an overall rating, from very good to poor quality, and given to the farm manager. The packhouse will accept a load with more than 60% acceptable product, except for issues like russetting, which

continue to spread throughout the load and will likely be rejected by importers as the issue spreads during transportation. Rejected produce is transported by the exporter to the originating farm. This produce is no longer viable for human or livestock consumption due to pest and disease damage, especially when russetting continues spreading throughout the entire shipment, and quality losses during the additional transportation and handling. While some green beans may still technically be safe to eat, they remain a lesser consumed food in the Keyan diet and lack local consumer demand. Once returned to the farm, the produce is used as a green manure.

After green beans are admitted to the packhouse, they go into humidified cold storage for 24 hours to reduce the temperature of the green beans without further dehydrating them. When moving from the cooler to packing area, the produce is assessed for quality again to ensure russetting or other issues not observed before have become more prominent. It is estimated this rejects an additional 3.5% of produce. In the pack room, women prepare the green beans for packaging, trimming tips if requested by the importer, and putting in trays before going to a male employee who operates the plastic wrap machine. While gender and salaries were observed and not discussed at the packhouse, this is in-line with broader social structures in Kenya where women often work in lower skilled and lower paid positions than men.

Between whole pieces and trimmings, 25% of produce at this stage is rejected and goes to a landfill. Once packaged, produce is kept in another cold storage room before being loaded onto a refrigerated truck that delivers the product to the airport where it primarily goes to European markets. The import rejection rate and subsequent consumer waste for green beans is unknown.

While a majority of food loss occurs at the packhouse, understanding the key reasons are due to damage from wind, pests and disease, and dehydration, speak to the production practices of farms. Some green bean varieties are more tolerant to local pest and disease, but most were bred for other climates so are more susceptible to losses caused by environmental factors.

*Image 3. Green Bean with quality issues*

Quality issues with the above green bean include: the brown russetting spots, mechanical damage at top of green bean from how it was picked, and curling caused by dehydration. Russetting prevents this product from being safe for consumption. If a green bean had mechanical damage and curling, it would still be safe for human consumption, although it would likely have a shorter shelf life.

**End Markets.** The import rejection rate and subsequent consumer waste for green beans is unknown.
High-End Domestic Tomato Value Chain

FPC's members supply produce for export and high-end supermarkets, which tend to be engaged in the formal economy, compared to the typical smallholder farmer who also tends to have less access to inputs and services. As FPC is focused on reducing FLW for their members, the high-end supermarket value chain was selected for this case study.

High-End Tomato Value Chain Photostory: Journey from Farm to Market

1) While some tomato production occurs in greenhouses, a majority of Kenyan farmers grow this produce in an open-field setting.

2) Once harvested, tomatoes are sorted at the farm, packed into crates and transported to the packhouse in vans and trucks by the farmer.

3) Contracted large scale farms deliver their tomatoes to the packhouse where they are immediately sorted. Produce not meeting the quality standards for domestic high-end grocery stores are returned to the farmer.

4) Accepted tomatoes are packed into crates, and along with other produce are transported in refrigerated trucks to grocery stores.
5) At the grocery store, tomatoes are rotated to put the freshest produce at the bottom and check for bruised or lightly damaged fruits that do not meet customer expectations. About 10% of delivered tomatoes are returned to the packhouse, where they are then thrown away, going to the municipal landfill.

6) Tomatoes returned to the farmer and then transported directly to a local market. Vendors typically experience waste at the market, primarily from bruises left by customers testing tomatoes for ripeness before purchase.

7) After purchase, consumers prepare tomatoes for consumption, acknowledging tomatoes sometimes go bad before they are used. Rotten tomatoes are thrown away in the trash to go to a municipal landfill.
Tomatoes grown for the fresh market have a medium level of perishability with a shelf life of 10 - 14 days after harvesting.

**Farm.** A tomato producer in Naivasha was interviewed to assess on-farm losses. The farm harvests tomatoes three times per planting cycle. As shown in figure #5 farms harvest tomatoes, expecting 10% losses during on-farm sorting and grading, while greenhouses experience less losses as they are better able to control pests, disease, and other environmental factors, such as excessive heat. Rejected produce in open fields is left on the side of the field, while rejected but still edible produce at the greenhouse is sent to the facility canteen to feed harvesters. Rejected greenhouse produce that is not edible is composted. Farms are contracted with a high-end domestic packhouse that supplies grocery stores, which are patronized by middle- and upper-income families.

**Packhouse.** The farm transports produce to the packhouse using their own vehicles - in trucks and the back of vans. Tomatoes are sorted upon arrival. Rejected produce is returned to the farmer at that time. The produce rejected for high end markets is then taken to local open markets. After sorting, tomatoes are put in cold storage until they can be delivered to the supermarkets.

**Supermarket.** At the supermarket, produce is rotated for a ‘first in, first out’ approach. Approximately 10% of produce goes bad at the supermarket, including bruising from consumers testing the ripeness of produce and in some instances, any pieces that have been exposed to open and leaking produce. This produce is returned to the packhouse, which follows Nairobi waste management plans. Due to their perishable nature, returned tomatoes are sent to the landfill. These high-quality produce standards extend to donations where local orphanages have requested rejected
produce but the packhouse has decided to instead provide them the same quality of tomatoes that go to the supermarket a few times each week.

A rapid field loss assessment of tomatoes remaining in the field after the last main harvest counted the number of tomatoes left on or under each plant. Four samplings found an average loss of 51.5 small tomatoes per plant. Accounting for the typical 10% rejection rate, 46 tomatoes per plant valued at KSh5/2 tomatoes indicated an economic loss of KSh115.88 per plant (US$1.01). While the harvest and sale of these tomatoes were not factored in by the farm manager, opportunities that allow the locals who typically harvest the field to collect the remaining produce can help address food security, even if at a small scale.

Multiple farmers interviewed reported leaving tomato fields unharvested each year because they cannot find a market for their produce.
IV. FOOD WASTE

To assess waste, a semi-structured survey asking about food purchases and what goes unused was conducted on a sample of three open air market vendors and three consumers. Note, this is a divergence from the formal export and high-end supermarket value chains, although food rejected at the packhouse level for these high-end markets often goes to local open-air markets.

Due to the small sample size, results are not representative of the population and should not be extrapolated as such. Data is presented in terms of averages to 1) give a general idea of food waste, 2) test the data analysis aspect of the toolkit, and 3) provide a template to analyze future waste survey data. A more representative data sample requires 20 - 30+ surveys from a greater range of consumer categories (i.e. restaurants, hotels, etc.).

Vendor Food Waste Survey

Two vendors from the Kangemi market and one vendor from the Machakos vendor were interviewed. The average age of vendors was 36, ranging from 27 - 42. The vendors had been selling produce for 1, 3 and 10 years. Future research can analyze waste experienced by vendors based on years of vending experience, location - particularly for food that must be transported greater distances from the farm, vendor business size (quantity vendor per week), and/or ability to store unsold produce.

When purchasing produce, vendors select based on ripeness - based on color, size, and damage from improper handling. Green beans are also selected for firmness. Produce is further sorted as tomatoes are sold by size and ripeness, mangoes are sold by size and variety, and avocados are sold by size. Larger produce typically has a higher price.

Green beans and avocados are purchased from brokers. Mangoes are purchased from the farmer or a broker, and tomatoes are purchased from farmers, brokers or other market vendors in the morning. Mangoes traveled approximately 80 km from the farm to the market. Vendors did not know how far the other produce traveled to get to market. When vendors purchase wholesale produce, someone either carries the stock on their back or on a cart, depending on the quantity purchased.

Two of the vendors can store unsold produce overnight, buy avocados, mangoes, and green beans weekly and tomatoes three times per week. These vendors store produce in a kiosk, either on a raised shelf or on a plastic carpet to avoid contact with water/moisture. The room they store produce in is cool. The vendor lacking a place to store unsold produce only purchases what they are confident can be sold each day.

Tomatoes, mangoes and avocados are sold fresh and unprocessed, with green beans being cut and packaged with potatoes and carrots.
Table 3. Local open-air vendor food purchase and waste

<table>
<thead>
<tr>
<th>Produce</th>
<th>Shelf Life @ Market (days)</th>
<th>Wholesale KSh/kg</th>
<th>Retail KSh/kg</th>
<th>% thrown away</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>2.5</td>
<td>45 (35 - 50, 60 low season)</td>
<td>105 (90 - 120)</td>
<td>7% (5 - 10.7)</td>
</tr>
<tr>
<td>Mangoes</td>
<td>8.5</td>
<td>15 10-20/fruit</td>
<td>25 25-30/fruit</td>
<td>0</td>
</tr>
<tr>
<td>Avocados</td>
<td>3</td>
<td>55 - 60 (Low season) 10-30 (peak season)</td>
<td>60-90 (Low season) 50-60 (Peak season)</td>
<td>5.35%</td>
</tr>
<tr>
<td>Green Beans</td>
<td>3.5</td>
<td>50</td>
<td>80 (60 - 100)</td>
<td>7%</td>
</tr>
</tbody>
</table>

Of the produce surveyed, tomatoes have the highest volume of product moving through the market and the highest rate of waste, which can be attributed to a short shelf life at the market level (2.5 days) and damage caused by customers pressing produce to check for ripeness. The survey created awareness of customer damage for one vendor, who immediately began selecting tomatoes for customers, like other vendors with less waste, to reduce damage. This indicates creating awareness among vendors can help lower food waste. During a key informant interview, a large scale packhouse purchasing both greenhouse and open field tomatoes from farmers under a contract experienced about 10% loss at the grocery store level. This greater percent of waste occurs in part to a higher quality standard of what produce will remain on shelves.

Mangoes experience little to no waste at the vendor and consumer levels due to a longer shelf life (8.5 days) and high consumption demand.

Avocados have a lower level of loss at 5.35%, which can be attributed in part to the low quantities sold relative to tomatoes and mangoes.

Green beans are not a major part of the typical Kenyan diet. Two of the three vendors sell green beans with the vendor who cannot store unsold produce and who buys to sell daily opting out of this product. Both vendors selling green beans add value by cutting them up and selling them in a bundle with potatoes and carrots. This incorporates the product into local diets and explains the low volumes of produce going through the market. One vendor sells their 15% of remaining green beans to a farmer for livestock feed, which is not considered food waste. The other vendor uses the remaining green beans as compost for the kitchen garden, which is classified as waste. The main reason green beans go unsold is because they go bad, in large part due to dehydration. While hydration issues can occur along the value chain, if green beans are not irrigated the day before being harvested, they lose their crispness quicker and do not meet consumer standards.

Green beans and tomatoes both experience about 7% food waste at the vendor level. Tomatoes go to the landfill, while unsold green beans are applied to vendors’ kitchen gardens as a green manure.

**Consumer Food Waste Survey**

Of the three consumers surveyed, two were the primary food preparers. Due to a small sample size, the responses of these two groups were not compared. The average respondent age was 33, ranging from 26 - 45.
When asked which foods most often get thrown away at home, vegetables were the most common response. As shown in Table 3, one respondent mentioned leafy greens (lettuce), two mentioned crucifers (cabbage, cauliflower, kale), one mentioned legumes (green beans), two mentioned an herb (rosemary, coriander), and all three mentioned the nightshade tomato and one mentioned the nightshade capsicum. Two respondents mentioned starchy prepared foods (bread, ugali). When asked why food is thrown away, two mentioned it goes bad and one noted food preferences (e.g. children do not like vegetables prepared). All food thrown away goes to municipal waste.

Table 4. Foods most often thrown away at home

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Food Items</th>
<th>Respondents Mentioning Food Category (Count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy greens</td>
<td>lettuce</td>
<td>1</td>
</tr>
<tr>
<td>Crucifer</td>
<td>cabbage, cauliflower, kale</td>
<td>2</td>
</tr>
<tr>
<td>Legume</td>
<td>green beans</td>
<td>1</td>
</tr>
<tr>
<td>Nightshade</td>
<td>capsicum, tomato</td>
<td>3</td>
</tr>
<tr>
<td>Herb</td>
<td>rosemary, coriander</td>
<td>2</td>
</tr>
<tr>
<td>Prepared Foods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starches</td>
<td>bread, ugali</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5. Nairobi consumer food purchase and waste

<table>
<thead>
<tr>
<th>Produce</th>
<th>Shelf Life (days)</th>
<th>Purchase frequency (days/week)</th>
<th>Weekly purchase quantity</th>
<th>% Breakdown of Food Waste</th>
<th>Total % wasted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>6</td>
<td>3</td>
<td>1.25 kg</td>
<td>17.7  8.3  0 0</td>
<td>26</td>
</tr>
<tr>
<td>Mangos</td>
<td>7</td>
<td>3</td>
<td>9 fruits</td>
<td>0  0  0 0</td>
<td>0</td>
</tr>
<tr>
<td>Avocados</td>
<td>3.5</td>
<td>1</td>
<td>4 fruits</td>
<td>0  0  0 0</td>
<td>0</td>
</tr>
<tr>
<td>Green Beans</td>
<td>4</td>
<td>1.5</td>
<td>.7 kg</td>
<td>0  0  50 50</td>
<td>50</td>
</tr>
</tbody>
</table>

On average, 26% of tomatoes are thrown away, with two-thirds going bad before they can be used and one-third thrown away after being partially used. Green beans have a higher rate of food waste, 50%, at the consumer level. This can be attributed to consumer preferences and green beans not being part of the traditional diet. Between market vendors and consumers, the latter contribute the most to food waste.
When asked why the respondent thinks of food waste, all three mentioned money (economic outcomes), with one respondent including wasted food could go to feeding poor people and street children (food and nutrition security outcomes). When asked how respondents try to reduce food waste in the home, two mentioned focusing on buying what they can finish, one mentioned properly storing in the refrigerator, and a house manager noted buying what the family likes in higher quantities and reducing the quantity of items they do not like, while using different green bean recipes that appeal to the children (e.g. frying, baking spicy chips).

Consumers contributed food waste to home storage issues, especially when electricity goes out for extended periods of time, food preferences that influence consumption patterns, preparing food in a way that is not appealing to the consumer, preparing more food than can be consumed, and changing the menu after purchasing foods based on a different meal plan.
V. Findings by Prioritization Criteria

Economic Outcomes

A case study approach was taken by profiling one or two farms, precluding the ability to scale estimates to the national level. Given that FPC’s partner organizations are high-end and export oriented, the study surveyed large farmers and sophisticated packhouses. Hence, the farms surveyed on average have more advanced systems and close contact with packhouse and high-quality standards and hence tend to experience lower levels of losses than smallholder producers whose produce goes to local wet markets, and who produce the majority of tomatoes grown in Kenya.

Green beans. Green beans are required to meet stringent European Union market standards. Upon arrival at the packhouse, produce is inspected for quality assurance. A sample proportional to the amount of produce received is checked for quality issues. Up to 40% of the load can have quality issues and still be accepted, unless an issue like russetting is present, in which the entire shipment is rejected as this physiological disease typically continues spreading throughout an entire container. Quality issues commonly experienced in green beans were observed to come from: wind damage, rust disease, russetting, and dehydration after picking.

Green beans lack domestic demand so while some export produce may be rerouted to local markets, most is used as cattle feed, which fetches a lower rate, or green manure.

There is little to no value-added processing for green beans apart from packaging.

Tomatoes. Tomatoes have high domestic demand, hence there are often alternative markets that will resell the produce at a lower rate. Production planning among rain-fed and irrigated tomato farmers has the potential to improve FLW from having a glut produce during the rainy season and high prices for consumers in the dry season. A domestic market for value added tomato products could also help with balancing seasonal oversupply issues, with local value-added opportunities, such as processing of tomato puree and paste, which can be done on a smaller scale with limited capital investments.

FLW Investment Opportunities

FPC has members of both the tomato and green bean value chains interested in investing in improvements. The Kenyan government has a great incentive to invest in tomatoes, which have high local demand and can address food security, while green beans provide an opportunity for improving GDP through increased export profits. Kenya has adopted horticulture standard KS1758, which meets Codex Alimentarius and SPS (Sanitary and Phyto-Sanitary) measures, for the production of domestic and export fresh produce markets. Implementing these standards can increase the country’s reputation for producing high quality produce, making it more attractive to other importing countries. Granted, these standards can create a high barrier of entry for smallholder farmers who will need to invest more heavily upfront to achieve profits and may not have the same access to resources.

There is demand for green beans rejected for human consumption to be sold at a discounted rate as livestock feed. While this is a considerable decrease in value, the contributions to another income generating activity of cattle production, prevent a lot of green bean rejections from being classified
as a loss or waste. Awareness campaigns with recipes that appeal to the Kenyan palate for green beans, can help promote this value chain and increase local consumption.

The green bean value chain is more contract-oriented than tomatoes and has fewer farms overall, which makes targeted investing easier, but not scalable. In terms of technologies to reduce FLW, many green bean varieties grown in Kenya were bred for different climatic conditions, leading to greater losses and overall resiliency issues.

Both Value chains present opportunities for value addition, simple cost-effective storage methods and processing options that would improve the product shelf-life. Local innovation hubs set in different centers across Kenya have the capacity to nurture the options for small scale farmers who tend to incur most losses. Large-scale farmers and prospective investors can upscale the innovations at a minimal cost to consume most of the food that would be wasted.

Both value chains can benefit from better harvesting and handling practices and improving cold chains.

**Gender/Women**

At the farm level, women typically harvest tomatoes and green beans, while men work more in land preparation. Women are hired seasonally as needed; being paid for the produce they pick that goes to the packhouse. For green beans, women can take rejected produce home. Men are provided work year-round to manage various aspects of the farm. At the packhouse, women do the sorting, grading, and trimming to meet packaging requirements, while men move the product through the various stages of the packhouse.

Value addition offers the greatest opportunities for women to work in the tomato value chain. For example, women can take up tomato processing activities such as making ketchup, paste, sauce, dried tomatoes etc.

Due to a more closed system and less local demand for green beans, this value chain has less opportunities for entrepreneurship.

**Youth (18 - 35)**

Green beans are viewed as being more appealing to youth because of their high value as an export crop. Although, the barrier to entry would be less for the tomato value chain because of its domestic opportunities and local production experience. Like women, youth can leverage value addition activities as a FLW intervention for entrepreneurial opportunities.

**Carbon Footprint**

The FReSH FLW Value Calculator was used to estimate the impacts per acre. This calculator is currently in beta version 1.2, and uses US EPA WARM results typical of USA landfills and assumed to be representative globally. “The results in this tool are generic, are not peer-reviewed, and should be interpreted as a screening-level assessment based on expert knowledge of the impacts of food loss and waste (FLW) on nutrition security and environmental indicators.” The carbon footprint component of this tool indicates greenhouse gas emissions (kg CO₂ eq) resulting from FLW. “Impact assessment methods are aligned with methodology from the European Union, Product
Environmental Footprint. The FReSH Calculator includes greenhouse gas emission estimates for tomato and lettuce (used here as a proxy for cabbage). Estimates of GHG emissions for the remaining crops were collected through an online search. The same data source was used for snap peas and fine beans, or green beans, (6.5tCO₂e/T produced) as limited emissions data is available and the crops are similar.

In this study, tomatoes yielded 24 tonnes/acre and experienced 8.9 T/acre food loss and waste. Green beans yielded 5 tonnes/acre and experienced 2 tonnes of loss/acre. Due to the nature of these yields, we expect tomatoes to have a greater negative impact on multiple indicators, exacerbated by not having waste data for green beans. The calculator included tomatoes as a specific category and the generic fruits and vegetables category was used for green beans.

Based on calculations in the FReSH tool, tomato contributes 5,224 kg CO₂ eq/acre FLW (587 kg CO₂ eq/T produced), while green bean production contributes 1,256 kg CO₂ eq/acre FLW (628 kg CO₂ eq/T produced). Tomatoes experienced the greatest level of loss and waste at the consumer level, the destination with the highest GHG emissions because this includes emissions released during the distribution, transportation and marketing phases. Most green bean loss and waste occurs at the packhouse during sorting, grading and inspecting. GHG emissions for green beans could be reduced by doing better sorting on the farm to reduce the instance of transporting produce that will be rejected. As a fresh export produce, any green bean loss or waste after export will have a significantly higher rate of GHG emissions due to the nature of air transportation.

**Nutrition Security**

Tomatoes are a key part of the typical Kenyan diet, while green beans are still primarily produced for export, although it is available in local markets in limited quantities. Because of these food preferences, FLW reduction interventions for tomatoes have a greater potential to increase food and nutrition security to both urban and rural poor than green beans.

Storing and/or processing for consumption in the low season is not currently a common value-added activity for the green beans or tomato value chains. Green beans are produced for the fresh export market and storing would require canning or freezing product, which is a limited industry in Kenya.

While there are slightly more processing opportunities for tomatoes for juices and sauces, this value chain has the greatest potential for value added activities to meet the demand of the growing middle class for products like pasta sauces and condiments. At the consumer level, some households save tomatoes, for example by preserving in vinegar.

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32 https://www.trade.gov/country-commercial-guides/kenya-agribusiness
Table 6. Impact of FLW on Nutritional Outcomes, nutritional losses in person days per acre

<table>
<thead>
<tr>
<th></th>
<th>Tomato</th>
<th>Green Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macronutrients</strong> - person/day - equivalents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>801</td>
<td>317</td>
</tr>
<tr>
<td>Protein</td>
<td>1,566</td>
<td>643</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>1,154</td>
<td>427</td>
</tr>
<tr>
<td><strong>Micronutrients</strong> - person/day - equivalents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td>4,272</td>
<td>2,356</td>
</tr>
<tr>
<td>Calcium</td>
<td>890</td>
<td>385</td>
</tr>
<tr>
<td>Food folate</td>
<td>3,338</td>
<td>1,087</td>
</tr>
<tr>
<td>Iron</td>
<td>1,335</td>
<td>1,510</td>
</tr>
<tr>
<td>Vit A</td>
<td>14,827</td>
<td>109</td>
</tr>
<tr>
<td>Zinc</td>
<td>1,009</td>
<td>362</td>
</tr>
</tbody>
</table>

The 2011 Kenya National Micronutrient Survey found significant zinc deficiencies throughout the population, followed by iron and iodine, with folates being an important nutrient for pregnant women. In this study, tomato loss is 8.9 T/acre, while green beans saw 2 T/acre loss, excluding export and consumer waste. Tomato losses from one acre could provide enough daily dietary recommended micronutrients for 1,173 people and micronutrients for 4,278 people. For green beans, this loss could enough macronutrients for 462 people and micronutrients for 968 people. When scaled per tonne of loss, green beans have a greater potential for providing macronutrients, indicating their promise as a tool to address food and nutrition security if consumed more by the population.

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VI. Strategy and Conclusion

FPC is a very dedicated player in reducing FLW in Kenya. The potential for long term impact of their FLW work includes increasing food security by having more nutritious, quality, safe, accessible and available food. It will lead to more job creation and improved agricultural incomes leading to improved standards of living. Producers will have a greater access to market. Kenyan agriculture’s environmental sustainability will increase, and the carbon footprint of agricultural products will decrease. Kenya will contribute to increasing Sustainable Development Goals 12.3, which seeks to achieve responsible consumption and production. Finally, Kenya’s reputation of producing high quality food through an efficient and sustainable food system that fetches higher market prices, improving the country’s GDP.

The following strategy and conclusion were developed during the validation workshop, where the above findings were shared and vetted by participants - primarily FPC members and partners. Food loss data for tomatoes and green beans were presented to participants, as well as highlights from the waste survey. Key takeaways of the validation workshop are bulleted below. A detailed workshop summary can be found in Annex 4.

Next Steps

- Identify existing government FLW reduction-related strategies
- Incorporate existing work done (FAO)
- Clear roadmap, monitoring aspect to see impact having
- Fill in gaps of crops don’t have data for

Strategy 1: Trainings

The following suggestions both leverage FPC’s current training skillset, including postharvest loss trainings, and require additional skill building (i.e. FLW reduction technologies, monetizing information, etc.)

- Make strategy wider - update theory of change language to go beyond “training”
- Couple capacity building of actors with investments in technologies
- Walk through each step for the process carefully to identify training opportunities; including train export inspectors
- Training of trainers for local lead farmers who then train smaller farmers
- Sensitize market/food handlers on produce quality How reduce waste at market? Consumer education in store; Labels to educate consumer on storing and handling; in open market separate open vs greenhouse tomatoes so know when can eat each
- Monetize information - how much could farmers/different VCAs profit from reduced losses?

Strategy 2: Value Chain Actor Partnerships

- Define the roles of different stakeholders (Govt & VCAs) in reducing FLW
- Gather a group of businesses/SMEs to better identify gaps/entry points for impact
- Starting point for solutions: value addition, preservation techniques, access to cold storage facilities, infrastructure for transportation, highlight best varieties

Strategy 3: Market Analysis

- Look at seasonality - track production and price fluctuations over 12 months
- Clearly identify who determines prices and how
• Opportunities for entrepreneurs in addressing FLW issues, how help support them and keep afloat until achieve a return on investment
• Determine acceptable losses

**Strategy 4: Advocacy of FLW for Government**
• Strong national or county level strategies for different actors to carry out their goals
Annex 1: Fresh Produce Consortium of Kenya

Organizational Overview

FPC Kenya is the first organization to pilot the use of the 'Food Loss and Waste Value Chain Selection Guide.' It is a business membership organization representing a diverse range of value chain actors involved in the production and supply of fresh produce in the domestic, regional and international markets. Of its 360+ members, 300 of Kenya’s 800 small, medium and large-scale exporters make FPC one of the largest export associations in the country, linking businesses with international, domestic high-end grocery stores and local open-air markets. The remaining 60 members represent a range of value chain actors, including input suppliers and financial organizations. This rich network of like-minded partners share the common goal of reducing food loss to improve Kenya’s GDP and the food nutrition and security index of the region, providing FPC Kenya with the motivation to pilot the FLW Value Chain Selection Guide.

FPC Kenya supports its members’ businesses to remain successful and grow by facilitating domestic and international market development through advocacy and lobbying, improving market access, and building members’ capacity to sustainably produce a supply of high-quality fresh produce. FPC Kenya leverages its secretariat’s technical, food safety, nutrition and food security, and business advisory expertise to build capacity through awareness campaigns and training, partnering with complementary organizations to adequately meet its members’ needs. FPC Kenya facilitates working relationships among its network’s members to create partnerships between private sector companies and government organizations, supporting an enabling environment for producers, suppliers and exporters to conduct business in the fresh produce sector. FPC Kenya focuses on value chains of interest to both its members and the country’s horticulture sector.

Food Loss and Waste Experience

FPC Kenya participated in a week-long postharvest losses training offered by the University of Nairobi under the Capacity-building in food security for Africa (CabFoodS-Africa project) under the African Universities Research Alliance (ARUA) Center of Excellence in Sustainable Food Systems (ARUA-SFS), hosted by the University of Pretoria and supported by the Innovation in Post-Harvest Loss and Food Waste Reduction Consortium, led by Iowa State University.34,35 This training equipped the FPC Kenya Food Safety team with the expertise to identify the different stages along the value chain where losses and wastes occur. The team explored simple, affordable interventions to address FLW for small scale producers and at the household level to improve food nutrition and security. Following this training, the team has been involved in drafting and validating the proposed National Post-Harvest Loss Strategy and the FPC Kenya Food Loss and Waste RoadMap.

The FLW Value Chain Selection Guide pilot assisted FPC Kenya in understanding how to prioritize value chains to intervene in. Being a key industry player gives FPC an advantage in mobilizing and championing the reduction of food loss and waste in the country, with intentions to expand throughout the East African Region.

Market Systems Development

Domestic Advocacy and Lobbying: Kenyan exporters depend on a few export points for their produce, primarily Nairobi (air) and Mombasa (sea). Exporters far from these ports face a myriad of

35https://sites.google.com/iastate.edu/phlfwreduction/home/about?authuser=0
challenges. For example, long transport times reduce produce quality, which increases rejection rates, leading to food waste and increased cost of production. FPC Kenya collaborated with other sector players to successfully advocate for the expansion and adoption of the Kisumu International Airport for export of fresh produce, beginning January 2022.

**International Communication to Create Market Linkages:** In 2013, Kenya implemented an 8-year self-ban to contain the damage and spread of the fruit fly pest. Having successfully managed this issue at the national level, FPC Kenya has been involved in a mango marketing mission to Brussels, Belgium, as exports to the EU resumed in 2021. The opening of the EU market means more exporters are able to sell their produce at more favorable rates compared to other international markets. This further reduces mango FLW caused by seasonal fluctuations of output as markets are available.

**Trainings on Good Agricultural Practices:** After training more than 10,000 producers and exporters on good agricultural practices, voluntary and mandatory standards among other training, FPC Kenya has observed an increase in fresh produce production and exports stemming from improved compliance with the establishment of efficient quality management systems that ensure produce is safe and traceable to its origin. Greater market acceptability contributes to reducing losses and waste.

**Partnerships:** Through its work, FPC Kenya commonly partners with government institutions and authorities, including the Ministry of Agriculture, Livestock, Fisheries and Co-operatives (Horticultural Unit); Kenya Plant Health and Inspectorate Services (KEPHIS); Horticulture Directorate (HCD); and Kenya Agricultural and Livestock Organization (KALRO); as well as businesses and other membership organizations, such as financial solutions providers.

**FPC Kenya FLW Pilot Team**

The FPC Kenya FLW Value Chain Selection Guide Pilot project team included: Diana Nduku, Food Safety Manager; Patience Katana, Food Safety Manager; Purity Mueni, Business Development Manager; and Julia Shuck, Pilot Lead from Agribusiness Associates.

Additional contributors to the FLW Value Chain Selection process include Raphael Wafula, FPC Kenya Agronomist; Okisegere Ojepat, FPC Kenya Chief Executive Officer; and Josiah Syanda, African Representative to IPCC e-Phyto Steering Group at International Plant Protection Convention.

**Annex 2: FPC Kenya’s Priority Criterion and Indicators for Selecting Value Chains**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Weightage (%)</th>
<th>Definition of Criteria</th>
<th>Why Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Outcomes</td>
<td>Value of FLW/kg</td>
<td>30</td>
<td>Monetary value of product loss along value chain, from the farm to national GDP</td>
<td>- Key focus on FPC’s mandate - Monetizing FLW sensitizes value chain actors Economic terms are more persuasive when</td>
</tr>
</tbody>
</table>
| **Food Security & Nutrition** | % Diet + Nutrition Level | 20 | Discussing value chain interventions (sensitize farmers through value of loss, government through GDP growth, etc.)
- Priority focus for FPC Kenya
- Contributes to National Agenda’s Big 4 (2017 - 2022, food security, affordable housing, manufacturing and affordable healthcare for all) and Vision 2030 |

| **FLW Investment Opportunities** | FPC members willingness to invest | 18 | The value chain FPC Kenya members are willing to invest in to address FLW
Ability to leverage funding for interventions that are:
- Responsive to the priorities of FPC members for a more collective approach of tackling FLW reduction
- VCs development partners are willing to invest in |

| **Gender/ Women** | Employment & Entrepreneurship Opportunities | 10 | The lucrative opportunities for women employment and entrepreneurship in the formal value chain and for value addition
- Promote equitable development among Kenyans
- Identify value addition job opportunities, emphasizing women’s engagement; women tend to work in local value addition (i.e. juicing, drying, etc.) filling the informal market more than men |

| **Youth (18 - 35)** | Opportunities for technology | 12 | Evaluating opportunities for youth to diversify technological advancements and solutions.
- Promote equitable development among Kenyans
- Identify opportunities for technology that youth are most willing |
to leverage in production  
- Leverage experience of those willing to develop/innovate technology to manage mango orchards

<table>
<thead>
<tr>
<th>Carbon Footprint</th>
<th>GHG emissions CO2/T produced</th>
<th>10</th>
<th>The value chain with highest carbon emissions score least while those with the lowest to no emissions score highest.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Climate Vulnerability affects quantity and quality of produce - too dry, not meet market standards so thrown away</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Carbon Footprint identify major GHG emitters to identify interventions, especially if thrown in landfill</td>
</tr>
</tbody>
</table>
Annex 3: Scoring Value Chains Against Prioritization Criteria

Economic values were calculated for the value of kg of FLW based on the domestic value of the product and weighted accordingly.

Food security and nutrition followed a more subjective scoring, based primarily on occurrence in the typical Kenyan diet (i.e. daily, weekly, rarely), then how much nutrition that product was known to provide. Avocados ranked high for their healthy fat content, cabbage was given an 18/20 since it’s eaten by most Kenyans daily, and products produced primarily for export with little domestic consumption received a 6 (for its potential to provide nutrition) to 3.

FLW investment opportunities were assessed based on FPC members’ willingness to invest in a particular value chain as FPC has found that a greater diversity of interest increases the likelihood of collective interventions taking place. This criteria was scored based on a) the number of FPC members engaged in the value chain, with membership serving as a proxy indicator for willingness to invest, and b) the profitability of the crop, which is assumed to indicate ability to invest. Based on this approach, avocado, mango and green beans rose to the top, while cabbage and tomatoes scored lower. Through this pilot exercise, FPC has expanded its knowledge of FLW and gained a heightened awareness of a lack of understanding of FLW among members, who often only consider on-farm losses. Future endeavors to educate members on loss and waste at different points along the value chain can help foster a more robust understanding of willingness to invest.

The following two criteria, gender and youth, were assessed simultaneously to take into consideration the differences among these groups, specifically their unique preferences.

The selected gender criterion was viewed as primarily targeting women, who are not as frequently involved in value chains and when they are, receive a low rate of pay compared with other positions men may hold. Value chains were ranked based on their appeal to women, who are often concerned with providing basic nutrition for their families and emphasized key domestic value chains over primarily export value chains.

Youth, categorized as being ages 18 - 35, were scored based on opportunities for leveraging technology, which commonly entices youth engagement, as well as overall attractiveness to this age range. For example, high value export crops with short growing periods, such as thyme and basil, were viewed as being more enticing than the common and unexciting crops like cabbage and export crops that take more time and inputs to produce. That said, tree crops like mango and avocado were seen as being favorable because of their promotion by the national government.

Lastly, climate vulnerability was originally selected as a component to capture which value chains were most susceptible to losses. During the scoring exercise, all crops were viewed as being equally vulnerable to climate changes. Since equal scores did not provide an opportunity to distinguish between value chains, this criterion was changed to Carbon Footprint, with data coming from the FReSH FLW Value Calculator.
Annex 4: Validation Workshop Notes

WELCOMING REMARKS
USDA Ryan Scott, Counselor USDA

Hello everyone, and welcome to this Validation Workshop for the Food Loss and Waste Value Chain Selection Guide. My name is Ryan Scott and I am a Counselor with the U.S. Department of Agriculture’s Foreign Agricultural Service based in Nairobi, Kenya. We are very excited to have your participation today. Food loss and waste is a global issue, with one third of all food produced being lost or wasted, contributing up to one third of global greenhouse gas emissions from food systems. Food production is resource intensive and when food is lost or wasted, it also entails the economic loss of resources that have been invested, including land, water, labor, and energy.

The Food Loss and Waste Value Chain Selection Guide is a resource developed by Agribusiness Associates in partnership with USDA and USAID in 2020. The goal of the guide is to help stakeholders understand how to better integrate food loss and waste reduction strategies into agricultural value chains. In 2022, we had the opportunity to pilot the guide’s usage for the first time, and our team was very excited to be able to collaborate with Agribusiness Associates and the Fresh Produce Consortium of Kenya to pilot the guide here in Kenya. The goal of this year’s program is to ensure the guide’s efficacy in a real-world trial, and to assist key Kenyan organizations in identifying priority areas for greater FLW reduction investment resulting in the greatest social, economic and environmental impacts.

This Validation Workshop represents the 5th and final step of the guide’s implementation and will be an opportunity to share findings from field data collection conducted in the last two weeks, and to identify any gaps in data or in understanding of the guide’s usage, and to foster group discussion. We would like to thank you all for participating either virtually or in-person today. We are looking forward to the discussion.

Okisegere Ojepat, CEO FPC Kenya

- FLW important discussion we should have had many years before
- Regulator & Ministry attendees to have this conversation seriously
- Pilot in Kenya w an association & Costa Rica w government
- In country have both excess and availability issues, how much deal w environmental - carbon gasses, nutrition, export and domestic markets (bean value chain: retailers want top and tailed beans; curved bean is a waste - does a bent bean means it’s less nutritious or that top and tail are not food?)
- 40% of food being wasted, how many people go hungry? Policy makers, regulators and ministry, what need to do here to shift conversation and have a reality check among us?
- Conversation with Dr. Edewa what done w FAO on studies and how validate what we’re doing here
- Separate out food and find side uses so even if waste, has gone through many options
- In Germany, weigh food don’t finish at buffet and charge customer

INTRODUCTIONS

Participants introduced themselves, including their title and favorite food they feel experiences a lot of food loss and/or waste. Several participants took this opportunity to explain why those losses occur and added other key FLW aspects to the conversation.

- Julia Shuck - ABA FLW Expert Consultant (spinach)
● Gurbinder Gill - ABA Managing Associate (spinach)
● Diana Nduku - FPC, Food Safety Officer & FLW Lead on project (mangoes)
● Patience Katana - FPC, Food Safety Officer (green beans)
● Okisegere Ojepat - FPC, CEO (nuts)
● ___ - (tomatoes) separate open vs greenhouse tomatoes so know when can eat each
● ___ - (___ dish of peas and beans)
● Corrine - ___ Africa work Kenya import and export (potatoes) KFC importing frozen chips vs potatoes, which can grow in Kenya, but **variety impacts** storability, handling too
● ___ - Kenya Agriculture food scientist (banana) - postharvest handling, don’t properly harvest or sort, **little value addition**
● Theresa ___ - Kenyan Ministry of Agriculture ____ (mango) pest and disease losses, loss at farm level management, don’t harvest at prime ripeness; a lot of hunger and could save a lot of money, saw documentary on **how much farmers could profit if losses reduced**
● ___ - ___ (avocado) not consumed on time
● Robert - (banana) color changes so think it is not good so wasted, no options to maintain color
● ___ - (avocado) over ripes while waiting for it to ripen, premature harvesting and handling
● - Agriculture Food Authority, Agriculture Crops Directorate, Assistant Director (cowpeas leaves) produced in kitchen gardens, need to invest in **preservation techniques**, leaves dried for future use; would like intervention ideas
● Grace ___ - (french beans)
● Eric - (fine beans)
● ____ - Agriculture Authority ____ mix of beans and rice) prepare a lot that isn’t finished

**Workshop Comments**

● SHF don’t yield 5 tons/acre - need to fill in gaps of crops don’t have data for
● If person who delivers produce doesn’t get along with receiver, will see more damages
● Grace - loss starts at farm level, ⅓ of what harvest is lost w no guarantee will go to market, even when take not sure what will be accepted so don’t get full amount expect as a farmer; see value chain addition, especially in tomato, cold storage; knowledge of quality handling and aggregating produce for everyone; at household level boil tomatoes, add a bit of vinegar and store it - the chain starts with all of us
● Corrine - 1) **looking at seasonality** and market trends - overflow of produce but others when prices really go up; 2) loss at supermarket and consumer level because don’t know how to store well; Europe put on **label to educate consumer** on how to store (what temperature, wash before use); pick own where not pre-packed could grocery store indicate somehow?
● (RTI) Everyone pressing in store, **education in store** - if tomatoes hit shelves when good but push throughout the day, will be soggy by end of the night; people realize the entire impact of loss? Who bears the cost of the loss? It’s always pushed to farmer. Who determines the quality?
● Theresa - losses come from somewhere, issue of **transportation** that may not have been incurred
● Grace Summer Fresh limited - Storability in the market is the same for all vegetables; China markets are developed where they do pre-packaging at farm level. Reengineering traditional approaches at farm level - farmer at mercy of 1 public agency for how things are run - tomorrow’s prices are unknown - **who determines prices?**
- Before being an inspector was a flower grower; the grower has certain markets that are already set and it always comes back to them. No control over handling - for roses when picked beyond acceptable, get higher losses. Encourage netted when transported, between packhouse and grading take shortest route possible because of temperature differences; a lot of efforts need to be at production and consumer levels - if consumer doesn’t store well, goes bad quicker; **put a lot of effort on training and walked through each step of the process carefully**, how much lost to insects, how much lost at packhouse - train graders; don’t always have control over transport.
- Theresa - drivers have to be management of behavior and requires accurate training. **Make strategy wider** than training to get to heart of topic
- Edewa - **incorporate existing work done**; public education on how quantitative and qualitative losses occur - 40-100% losses if qualitative in nature. Quantitative losses occurring at different stages along value chain. Gains can be made on education of value chain actors on how to become efficient. Significant issues occurring in value chains - strong national or county level strategies for different actors to carry out their goals - recognize loss happens but should be minimized to make value chains sustainable over time. Some county investment plans include these aspects. Nairobi has a food waste reduction strategy and a postharvest loss strategy drafted by FAO that is still to be taken up and adopted to avoid losses in the future.
- Where collaborate w ministry so aligned and not running parallel but building towards a national strategy
- Theresa - **have several different strategies**, maize from 12 - 6% loss; ministry actively collaborates; guide is targeted (strength); Avocado FL is an objective
- AFA (HCD) : consolidate minds to be substantive; avocado high because mature harvesting and transportation -> what can work on?
- Theresa - government looks at whole value chain from seed to market, so this guide is very specific towards FLW but the other strategy is to look at all production issues, disease, other stakeholders coming in, which is the generals strategy
- (From Carmen?) - have been training on postharvest losses; 4 counties on 18 value chains, now training on 13 value chains. **Training of trainers for local lead farmers who then train smaller farmers**
- **How reduce losses at market** - interested in approaches plan to use. Working with the traders to build their capacity to handle while reducing bruising and at packhouses - so support throughout supply chain
- (Grace?) Aggregator - wanting to compete with drivers of FLW. Have a cold storage facility that helps w quality produce and helps farmer to be sustainable - training at farm level so produce that comes out can deal w labor and acceptable level of loss. Local markets can be a bruising experience so **opportunities for entrepreneurs in addressing FLW issues, how help support them and keep afloat until achieve a return on investment**

**Where would you invest your KSh10,000 to address FLW?**
- **KEPHIS** - training, we do a lot of audits of production sites; **train inspectors, especially for export** so maintains quality by time reaches end market
- In 2 value chains, what are those **businesses/SMEs to better identify gaps**. Not alone so can identify 25 others and together decide where there are **entry points for impact**. Look for a business person so that after 5 months they are continuing the work and being more profitable
- Production - planting material, selecting best certified varieties and postharvest training
- Grace: Information access - ** monetize information ** so people see the value
- Theresa: ** Sensitization ** issues of quality that has other causes; train those at ** market/food handlers on produce quality ** because will have impact later
- KSh10,000 is very little because need ** infrastructure for transportation **
- Grace: add ** access to cold storage facilities ** and trained personal from point of harvest to fork
- Technologies to reduce damage and increase shelf life

Other Comments
- Corrine: Which other partners are you working with? Loss happens from farm level onwards and those losses are still consumable. For value addition, there is purity and ATCs to find out what value addition can be done - doing in potato, could be interesting to explore for horticultural crops. In potatoes, have crop that isn’t moving because market is not buying/over supplied. If need to dispose and still fit for human consumption, can go to humans or animals and they pay something small to cover the cost. Some manure companies collect large volumes of waste - BASF feeds black flies that process leftovers into manure and are a source of high protein - others can contribute their expertise
- Gather a scenario for the informal system - you took on a streamlined system with an exporter and large-scale farmer delivering directly. Go to a smallholder farmer and get a clearer picture on the ground. For tomatoes, a lot of waste is from crates being overpacked so see greater losses. Provide a scenario of the Kenyan context
- ** Acceptable losses ** - varies but for roses it’s 0 - 3%; so come up with acceptable losses for other value chains
- Theresa - ** clear roadmap, monitoring aspect to see impact having **

Chat Comments
Dr. Andrew Edewa:
- Please add losses due to (1) delayed harvesting leading to overspecs; (2) Transportation losses due to poor loading or dehydration/soiling; (3) unsold produce due to lack of market off season; (4) poor storage leading to moulds, etc
- Important to clearly separate quantitative and qualitative losses, including economic losses. i.e value lost due to alternative use with low prices
- While looking at quantitative and qualitative losses along the value chain, it would be good to separate the unrecoverable % (waste) at retail and consumer level.
- Is the study also considering the socio-economic and environmental outcomes and impacts? the FLWs makes certain value chains less attractive where seasonality is involved. the producers/suppliers scale down on their businesses; but may also offer greater opportunities for agro-processing and value added
- ** As a way forward following the study, the role of different stakeholders (Govt & VCAs) should be defined as part of the broader FLW reduction/ prevention strategy. Capacity building of actors, coupled with investments in technologies to reduce these losses/wastes should be considered **

<table>
<thead>
<tr>
<th>Crops</th>
<th>2016 Area (Ha)</th>
<th>2016 Volume (MT)</th>
<th>2016 Value (KES)</th>
<th>2017 Area (Ha)</th>
<th>2017 Volume (MT)</th>
<th>2017 Value (KES)</th>
<th>2018 Area (Ha)</th>
<th>2018 Volume (MT)</th>
<th>2018 Value (KES)</th>
<th>% Of Total</th>
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<tbody>
<tr>
<td>Cut Flowers</td>
<td>13,265</td>
<td>333,658</td>
<td>70,829,466,905</td>
<td>13,280</td>
<td>159,961</td>
<td>82,248,862,888</td>
<td>13,310</td>
<td>161,227</td>
<td>113,165,186,323</td>
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<td>Exotic Veg</td>
<td>117,541</td>
<td>1,887,880</td>
<td>37,908,435,144</td>
<td>134,466</td>
<td>2,250,298</td>
<td>47,071,728,379</td>
<td>141,427</td>
<td>2,412,682</td>
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<td>Indigenous Veg</td>
<td>63,287</td>
<td>229,491</td>
<td>6,842,976,899</td>
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<td>219,458</td>
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<td>54,740</td>
<td>292,096</td>
<td>8,151,716,317</td>
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<td>Aromatic</td>
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<td>124,642</td>
<td>5,791,117,070</td>
<td>12,542</td>
<td>160,448</td>
<td>7,395,277,047</td>
<td>14,734</td>
<td>180,841</td>
<td>7,163,976,384</td>
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<td>Summer flowers</td>
<td>8,257</td>
<td>194,284</td>
<td>3,453,496,751</td>
<td>7,260</td>
<td>184,310</td>
<td>3,473,496,000</td>
<td>5,185</td>
<td>260,517</td>
<td>3,237,546,671</td>
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<td>Asian Veg</td>
<td>5,150</td>
<td>16,311</td>
<td>738,234,406</td>
<td>3,673</td>
<td>12,853</td>
<td>629,643,613</td>
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<td>14,040</td>
<td>650,301,293</td>
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<td>Medicinal</td>
<td>460</td>
<td>3,492</td>
<td>128,233,500</td>
<td>739</td>
<td>3,563</td>
<td>81,782,241</td>
<td>727</td>
<td>3,483</td>
<td>81,795,991</td>
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<td><strong>Total</strong></td>
<td><strong>387,310</strong></td>
<td><strong>5,778,936</strong></td>
<td><strong>181,379,326,955</strong></td>
<td><strong>402,796</strong></td>
<td><strong>6,217,285</strong></td>
<td><strong>207,529,071,425</strong></td>
<td><strong>412,867</strong></td>
<td><strong>6,696,384</strong></td>
<td><strong>248,479,319,993</strong></td>
<td><strong>100.00</strong></td>
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*Source: AFA-Horticulture Crops Directorate*