

A Service of

ZBW

Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Rezaei, Maryam; Opiyo, Paul Otieno

Research Report Understanding food loss in African leafy vegetables: Insights from Kisumu's urban and peri-urban context

ODI Global Report

Provided in Cooperation with: Overseas Development Institute (ODI), London

Suggested Citation: Rezaei, Maryam; Opiyo, Paul Otieno (2025) : Understanding food loss in African leafy vegetables: Insights from Kisumu's urban and peri-urban context, ODI Global Report, ODI Global, London

This Version is available at: https://hdl.handle.net/10419/319289

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



ND https://creativecommons.org/licenses/by-nc-nd/4.0/





Report Understanding Food Loss in African Leafy Vegetables:

Insights from Kisumu's Urban and Peri-Urban Context

Maryam Rezaei, Paul Otieno Opiyo ODI Global | April 2025







Understanding Food Loss in African Leafy Vegetables: Insights from Kisumu's Urban and Peri-Urban Context

Maryam Rezaei, Paul Otieno Opiyo





ODI Global 203 Blackfriars Road London SE1 8NJ United Kingdom

© ODI Global 2025

Online ISSN: 2052-7209

This work is licensed under CC BY-NC-ND 4.0.

Readers are encouraged to reproduce material for their own publications, as long as they are not being sold commercially. ODI Global requests due acknowledgement and a copy of the publication. For online use, we ask readers to link to the original resource on the ODI Global website.

Views and opinions expressed in this publication are the responsibility of the author(s) and should in no way be attributed to the institutions to which they are affiliated or to ODI Global.

How to cite: Rezaei, M., Otieno, P.O. (2025) Understanding Food Loss in African Leafy Vegetables: Insights from Kisumu's Urban and Peri-Urban Context. London: ODI Global (https://odi.org/en/publications/understanding-food-loss-in-africanleafy-vegetables/)

Acknowledgements

The authors extend their gratitude to the reviewers for their valuable comments on final draft – Steve Wiggins (Principal Research Fellow, Climate and Sustainability, ODI Global) and Robert Van Otterdijk (Expert in sustainable development in the agri-food sector and food loss and waste).

About this publication

This report is a product of ODI Global's partnership with the World Vegetable Centre, as part of the Veggies 4 People and Planet (V4P&P) project, supported by the IKEA Foundation.

About the authors

Maryam Rezaei is a research fellow in the Climate and Sustainability team at ODI. She leads the work on food systems.

Paul Otieno Opiyo is an independent consultant and city researcher working on urban food systems in Kisumu County.

Contents

Acknowledgements / i

Display items / iii

Acronyms/Glossary / iv

1 Introduction / 1

- 1.1 Food loss and waste: definition and impact / 1
- 1.2. Understanding food loss in the Kenyan horticulture sector /3
- 1.3. Priority value chain: African leafy vegetables in the Kenyan food sector / 4
- 1.4. Research scope and objectives / 6

2 Methods / 7

- 2.1. Study area / 7
- 2.2. Research method / 8
- 2.3. Selection criteria and rationale for market study / 9
- 2.4. Selection criteria and rationale for value chain study / 12
- 2.5. Consensus on solutions / 13

3 Findings and discussion / 14

- 3.1. Value chain of ALVs in Kisumu's urban and peri-urban areas / 15
- 3.2. Food-loss hot spots along the selected ALV value chains / 21

4 Solutions for the prevention and reduction of food loss along the ALV supply chain /30

- 4.1. Production and harvest / 30
- 4.2. Aggregation and transportation / 32
- 4.3. Market / 33
- **5 Policy recommendations** / 36

6 Conclusion / 39

References / 41

Appendix 1 Questionnaire / 44

Display items

Tables

Table 1 Performance of ALVs in Kenya by area, volume and value – 2019–2020 / 4
Table 2 Importance of ALVs for healthy diet / 5
Table 3 Markets selected for the study / 10
Table 4 Estimated losses of selected ALVs along the supply chain / 23

Figures

Figure 1 Conceptual definition of food loss and waste / 2
Figure 2 Methodology steps / 7
Figure 3 Map of Kenya showing the location of Kisumu City / 7
Figure 4 Location of markets selected for the study / 10
Figure 5 Number and categories of traders interviewed per market / 11
Figure 6 Geographic areas of focus for ALVs / 12
Figure 7 Number of KIIs per market type and actors / 12
Figure 8 Value chain of ALV in Kenya / 13
Figure 9 Value chain of ALVs in Kisumu's urban and peri-urban areas / 15
Figure 10 Gender structures in ALV supply chain / 21

Acronyms/Glossary

ALVs	African leafy vegetables			
FAO	Food and Agriculture Organization of the United Nations			
FGD	focus group discussion			
GDP	gross domestic product			
ІСТ	information and communication technology			
KII	key informant interview			
NGO	non-governmental organisation			
V4P&P	Veggies for People and Planet			

1 Introduction

1.1 Food loss and waste: definition and impact

The definition of food loss and waste has long been subject to debate. The fundamental questions such as what is considered food, what constitute loss and waste, and how it should be calculated, have sparked disagreement among research and development communities. The issues became prominent after the global consensus around dedicating an indicator to food loss and waste as part of the Sustainable Development Goal on responsible production and consumption (SDG 12). To facilitate measuring and monitoring progress towards reduction of food loss and waste, the following definition was adopted and is used for the purpose of this document: food loss and waste is decrease in quantity or quality of food along the food supply chain (FAO, 2019). Food, in turn, means 'any substance, whether processed, semi-processed or raw, which is intended for human consumption' (FAO and WHO, 2025). Empirically, the definition considers food loss 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 levels, including in hotels, restaurants and catering. Food loss and waste can be measured in terms of reduced quantity (e.g. in weight) or reduced quality (e.g. nutrition, economic value). The United Nations Food and Agriculture Organization (FAO) report also considers food diverted to other

economic uses, such as animal feed or bioenergy, as food loss, as they are produced for human consumption but ultimately not directly used by people to meet their dietary needs.

Although evidence does not support the hypothesis that food-loss reduction can directly increase availability and affordability of food for vulnerable people, the indirect impact of food loss on farmers' incomes and the livelihoods of value chain actors is well established. Beyond economic and social effects, food loss and waste represent a critical inefficiency in the use of natural resources, including water, energy and land. Over 25% of the world's fresh water and 20% of farmland are used to produce food that is not ultimately consumed (FAO, 2019). Furthermore, the production and distribution of food that nobody eats contributes 8-10% of global greenhouse gas emissions, highlighting their significant role in fuelling climate change and environmental degradation.

In 2023, between 713 and 757 million people were estimated to be undernourished, and nearly 3 billion people were unable to afford a healthy diet. By 2030, 53% of the global population facing hunger will be concentrated in Africa (FAO et al., 2024). At the same time, 14% of food is lost (FAO, 2019) and further 19% of food wasted globally (UNEP, 2024). In Africa, food loss in fruits and vegetables is up to 50% (GCF, 2023), varying across countries and subregions. This issue is particularly





pronounced in countries where inadequate storage, post-harvest capacity, cold chain, transportation infrastructure and fragmented supply chains exacerbate the problem. Identifying the stage(s) along the supply chain where food loss occurs, addressing its root causes, and designing sustainable solutions to prevent and reduce food loss present opportunities to improve food systems across Africa.

1.2 Understanding food loss in the Kenyan horticulture sector

The agriculture sector plays a crucial role in the economy of Kenya, accounting for more than 20% of GDP in 2022. It employs more than 40% of the country's 54 million people and more than 70% of the rural population (Central Bank of Kenya, 2022). Nearly half (48.5%) of total land in Kenya is agricultural, but it is under pressure from growing population and urbanisation (World Bank, 2021). Smallholder agriculture reportedly contributes to nearly 51% of the country's agriculture (Mibei et al., 2021). Horticulture is a vital sector, ranking as the second-largest foreign exchange earner in agriculture after tea: it contributes 36% of agriculture's share of GDP (Matui et al., 2016) and 8% of total GDP (Geoffrey et al., 2014). The industry provides direct and indirect employment to over six million Kenyans. While approximately 95% of horticultural production is consumed or utilised domestically, the remaining 5% is exported, generating substantial

foreign exchange revenue for the country (Research Solutions Africa, 2015). The key subsectors are vegetables (exotic, Asian, ALVs) – 36%; fruit – 30%; flowers – 26%; nuts – 5%; medicinal and aromatic plants – 2% (Matui et al., 2016; RSA, 2015).

Despite the economic prominence of agriculture in Kenya, the Global Hunger Index 2024 classified Kenya's hunger levels as 'serious', with an estimated 34.5% of the population undernourished and 17.6% of children under five stunted (Global Hunger Index, 2024). Levels of food insecurity in Kenya are reportedly increasing nationally, along with high regional disparity in terms of food and nutrition security outcomes. The number of undernourished (threeyear average 2020–2022) was 13.5 million people, while those who were moderately or severely food insecure numbered 38.3 million (FAOSTAT, 2024). At the same time, 12–20% of total national production of food in Kenya is lost, and the country imports 17.3% of its supply of crops from other countries. Losses are particularly high for fruits and vegetables, estimated in the range of 20-40% (De Jong et al., 2024). Some estimates are even higher, putting horticultural losses as high as 50%, mainly due to poor storage and handling practices (Kitinoja and Kader, 2015). The difference could be the result of methodological approaches, seasonality and definitions. Mwaniki and Nyamu (2022) argue that nearly half of harvested fruits and vegetables never make it to market. Food loss in the agriculture sector in Kenya equals 72

billion Kenyan shillings annually (Omulo, 2024). Recognising the magnitude of the food-loss problem, African Union Heads of State and Governments including Kenya called to reduce postharvest losses in Africa by 50 percent by year 2025 (African Union, 2014). To achieve this target, Kenya has endorsed a national post-harvest management strategy for food loss and waste reduction, to be implemented by 2028 (Kenya Ministry of Agriculture, 2024)

1.3 Priority value chain: African leafy vegetables

Commonly consumed African indigenous vegetables in Kenya include amaranth (Amaranthus cruentus), African nightshade (Solanum scabrum), African eggplant (Solanum aethiopicum), jute mallow (Corchorus olitorius), and okra (Abelmoschus callei). While consumption of these indigenous vegetables in Kenya varies due to regional, ethnic and gendered practices of food production and preparation, their contribution to dietary needs was found to be 10% higher in rural areas compared to urban and

Сгор	2019			2020			
	Area (ha)	Volume (MT)	Value (KES)	Area (ha)	Volume (MT)	Value (KES)	% of total value
Cowpea (leaves and beans)	79,535	159,386	3,512,308,830	36,018	113,666	3,348,701,203	37.4
African nightshade	6,950	69,254	2,397,810,725	5,917	58,909	1,831,009,726	20.5
Spider plant	4,280	35,295	1,229,098,895	3,949	36,445	1,315,530,681	14.7
Leaf amarantha	3,996	54,813	1,322,286,150	3,237	38,172	831,076,886	9.3
Pumpkin	1,487	31,022	722,892,977	1,755	35,829	813,596,889	9.1
Sleder	355	7,107	350,836,860	541	5,605	260,730,596	2.9
Pumpkin leaves	903	6,650	147,623,496	900	6,172	158,159,801	1.8
Jute mallow	672	5,894	309,079,967	657	3,373	155,029,483	1.7
Grain amarantha	453	3,020	178,728,617	511	2,459	127,453,939	1.4
Russian confrey	75	644	19,460,000	163	1,354	50,321,660	0.6
Vine spinach	193	811	33,530,230	217	1,030	29,476,001	0.3
Malabor	41	593	27,780,000	70	652	23,344,245	0.3
Total	98,940	374,489	10,251,436,747	54,235	303,666	8,944,431,110	100.0

 Table 1
 Performance of ALVs in Kenya by area, volume and value – 2019–2020

Note: ha = hectares, MT = metric tonnes, KES = Kenyan shillings.

Source: Agriculture and Food Authority, Horticultural Directorate (www.afa.go.ke/home-horticultural-crops-directorate)

peri-urban areas (Abukutsa-Onyango, 2015). These crops are primarily cultivated by smallholder women farmers in rural and peri-urban areas, within a value chain that is marked by underdeveloped marketing systems (Elolu et al., 2023). This underdevelopment is evident in limited market access, inadequate storage and transportation infrastructure, and a lack of institutional support, all of which hinder farmers' ability to secure fair prices.

As a subsection of African indigenous vegetables, African Leafy Vegetables (ALVs) have been integral to traditional Kenyan diets. They are often seen as affordable sources of nutrition for lowincome households, making them a key ingredient of household cooking in the country. Once seen as a 'poor man's crop', the consumption of ALVs has grown substantially in both urban and rural areas. Consumption intensity of ALVs is higher in rural Kenyan dwellers, with a mean of four times a week compared to twice a week among urban dwellers (Gido et al., 2017). ALVs are highly nutritious, providing a source of protein and micronutrients, and due to their low capital requirements, they serve as an important income source for small-scale producers (farming on less than 0.5 acre), particularly women. The Agriculture and Food Authority 2019/2020 report highlights that Kenya produced 303,666 metric tonnes of ALVs in 2020, valued at 8.9 billion shillings. The top four ALVs by value were the leaves of cowpea (37.4%), African nightshade (20.5%), spider plant (14.7%), and leaf amaranth (9.3%).

ALVs have also been gaining their place in both formal and informal markets in Western Kenya. The most popular varieties consumed include African nightshade (Solanum spp.), spider plant (Cleome gynandra), cowpea leaves (Vigna unguiculata), jute mallow, amaranth (Amaranthus spp.), slender leaf (Crotalaria spp.) and pumpkin leaves (Cucurbita spp.). Other vegetables that are consumed are the vine spinach (Basella alba) and Ethiopian kale (Brassica carinata) (Ndinya, 2019). While various estimates suggest significant losses along the supply chain

ALV name	Nutritional value
Amaranth, Kiwicha	Lysine and bioactive compounds, Qualitatively and quantitatively superior protein composition than cereals and legumes. Ranked as one of the top five vegetables in antioxidant properties
Green amaranth	Most of the essential nutrients, with notable amounts of Mg, Ca and dietary fibre.
Spider plant, African cabbage	Dietary polyphenolic phytochemicals such as flavonoids, essential ions, polyphenols and terpenoids. Ascorbic acid, violaxanthin, and β -carotene, α , β , and γ -tocopherol, β -cryptoxanthin and luteolin, polyunsaturated fatty acids. Rich source of vitamins A and C, protein (%23.4), fibre (%8.3) and Zn. Higher concentrations of Ca, Fe, P, K and vitamin C than commercial vegetables like cabbage and Swiss chard.
Cowpea leaves	Source of essential nutrients and minerals.

Table 2 Importance of ALVs for healthy diet

of ALVs in Kenya, lack of reliable data has limited the ability of public and private actors to effectively tackle the issue.

Consultations with experts and local stakeholders, alongside a review of existing literature, identified three key ALVs – African nightshade (managu in Swahili), cowpea leaves (majani ya), and amaranth (mchicha) – as priority crops due to their perceived high losses, significant contributions to household nutrition, healthy diets, and income generation for small-scale producers.

1.4 Research scope and objectives

Most estimates of food loss in Kenya have been conducted for staple crops at national level and the issue has rarely been investigated in urban and peri-urban areas, where a part of vegetable production, marketing and consumption takes place. In addition, food loss reports focus predominantly on technical causes of loss at farm level. As a result, solutions to reducing food loss have often overlooked social and environmental drivers of losses and interventions fall short of targeting specific stages and actors along the value chain. To address these gaps, this study adapted a spatial approach to understanding the extent of food loss along the value chains of selected crops in urban and peri-urban context of Kisumu. Kisumu County Food System Strategy 2023-2027 (County Government of Kisumu, 2023) identifies reducing post-harvest loss as a key pathway to achieving a sustainable food system for the county. The strategy outlines several solutions, including promoting innovation and technology, increasing value addition and improving post-harvest handling and infrastructure. However, it falls short of providing the socio-economic and environmental costs and benefits associated with implementing these solutions, which could hinder their uptake by various stakeholders.1

Specifically, the study aimed to respond to three research questions:

- What quantity of African nightshade, cowpea leaves, and amaranth are lost in Kisumu's urban and peri-urban areas from production to retail, including at local informal and wet markets, and at what stage of the value chain?
- 2. What are the causes of food loss in ALVs?
- 3. What are the priority solutions for foodloss reduction in these supply chains?

¹ This study is conducted as part of the Veggie for People and Planet (V4P&P) project, which seeks to strengthen and making the vegetable sub-sector more competitive through a mix of supply- and demand-driven strategies. The results of this study will link to

2 Methods

The research method is based on qualitative data collection, specifically from reviewing the literature, conducting semi-structured interviews with experts and value chain actors, and observational analysis. Its multidisciplinary is reflected in the composition of the research team, which included an economist, a gender expert and food technologists.

Emphasising stakeholder engagement throughout the process to ensure comprehensive data collection, consensus-building and ownership of the findings, the process of conducting the study was designed to employ a participatory approach to foster collaboration among food systems actors and municipality. The methodological steps are illustrated in Figure 2.

2.1 Study area

Located in Western Kenya, and the administrative and commercial capital of Nyanza Region, Kisumu is the third-largest city in Kenya after the capital Nairobi and the coastal city of Mombasa. It is located on the north-eastern shores of Lake Victoria in Kisumu County, which is one of the forty-seven units of devolved government in Kenya (Figure 3). **Figure 3** Map of Kenya showing the location of Kisumu City



Source: Openstreetmap.org, RCMRD

Figure 2 Methogology steps

Literature review, Expert interview (mapping actors, activities, potential causes of FL)

Source: Inspired by FAO (2018)

Semi-structured questionnaire, interview with VC actors (main causes, FL hot spots, potential solutions)

Data analysis and stakeholders' validation (rough scale, solutions)

Priority solutions, recommendations

Kisumu grew from a small town of 32,000 residents in 1969 to over 500,000 residents in 2019 (Opiyo and Ogindo, 2018. The city has expanded organically, with the informal settlements of Bandani, Obunga, Manyatta, Nyamasaria and Nyalenda forming a ring around the originally planned city. Over 65% of the population live in informal settlements (Opiyo et al., 2018) characterised by inadequate urban infrastructure and suboptimal services. The municipal boundary extension in 1972 brought large areas of land that are basically rural in nature inside the city boundary. More than 60% of households in Kisumu County rely on crop farming as a primary source of income. Most agricultural activities conducted on small land parcels of around one acre in size, cultivating traditional leafy vegetables, with relatively short value chains (Chen et al., 2021). Women are engaged in on-farm activities and trading, while men primarily handle transportation (Elolu et al., 2023). African indigenous vegetables sustain many small-scale farms, with women playing a key role all along the value chain in both urban and peri-urban regions of Kenya.

Around 61% of Kisumu County's population is classified as food insecure, and only 44% of young children meet the minimum acceptable diet requirements as per World Health Organization/ UNICEF guidelines. Over 80% of children in the county consume diets lacking in iron-rich foods. Despite the progress in tackling malnutrition in the country, 18% of children under five in Kisumu are stunted, 6.6% are underweight, and less than 1% are wasted (Gewa et al., 2021).

2.2 Research method

This study adopted a mixed-methods approach, combining a literature review, key informant interviews (KIIs), semi-structured interviews, and observational analysis to assess food loss in ALV value chains in Kisumu. The literature review, drawing from peer-reviewed articles, grey literature, and official reports, facilitated the identification of target vegetable value chains, mapping the flow of products, key actors, and preliminary hotspots for food loss. This review also provided insight into the underlying causes of food loss, informing the scope of the study.

To validate and refine the findings from the literature, KIIs were conducted with key stakeholders, including government officials from agriculture, environment, and public health sectors, farmer group leaders, market trader association representatives, and local NGOs. These interviews helped identify data gaps, verify the targeted value chains, and provide local context for the assessment.

A qualitative methodology was employed, integrating semi-structured interviews and direct observations. Tailored questionnaires were administered to traders, producers, aggregators, and transporters, focusing on the social, technological, climatic, and institutional factors contributing to food loss. Stratified sampling ensured a balanced representation of gender and age groups, capturing diverse perspectives across the supply chain.

The preliminary findings were shared with a select group of stakeholders, including those from Kisumu County, the Veggies for People and Planet (V4P&P) network, and local researchers, for feedback on relevance and accuracy. Based on these insights, a multi-stakeholder validation

workshop was organized to refine potential solutions for reducing food loss. This workshop facilitated discussions on trade-offs and synergies among proposed strategies, fostering consensus on the most impactful and feasible interventions.

These solutions were designed not only to mitigate food loss but also to enhance the sustainability of the value chain by addressing social equity, economic viability, and environmental sustainability. Furthermore, the recommended interventions were aligned with broader health and environmental goals, ensuring their relevance and potential for long-term impact.

2.3 Selection criteria and rationale for market study

Recognising the crucial role of urban and periurban markets in providing consumers with access to fresh vegetables and supporting the livelihoods of traders and producers, Kisumu's markets were chosen as the main point for the food loss assessment. This focus allowed for a comprehensive analysis of market dynamics and their relation to food loss in an urban context, providing a foundation for identifying key points along the value chain where products are sourced, handled, and transported to market. To ensure the study's findings were representative, a diverse range of Kisumu's markets was selected. The markets were prioritized based on the following criteria:

- Location: urban and peri-urban to provide insight into varying supply chain dynamics.
- **Size**: large, medium and small markets to capture diverse operations and trade volumes.
- Level of informality:² the mix of formal and informal set ups to understand challenges and opportunities within market systems.
- Infrastructure: the presence or absence of facilities like cold storage, water and sanitation directly influencing market efficiency and food-loss rates.

Municipal markets: Kibuye and Jubilee markets were selected to represent urban core markets due to their significant roles as the largest and second-largest wholesale and retail markets, respectively. They serve as the primary suppliers of vegetables to smaller markets across the city. Furthermore, both markets cater to a diverse range of city residents across various socioeconomic classes, providing a broad perspective on the dynamics of vegetable trade.

Medium-sized urban markets: Manyata and Kowino markets were selected as the only food markets in this segment. Migosi market was excluded as it primarily caters to non-perishable goods, which are outside the scope of this study.

Suburban markets: Three markets—Kiboswa Market (North), Otonglo Market (West), and Chiga Market (East)—were selected for their strategic geographical distribution, prominence within Kisumu's periphery, and status as the largest market centres in their respective suburban areas.

Informal is defined as: 'all economic activities by workers or economic units that are – in law or practice – not covered or sufficiently covered by formal arrangements', includes legitimately-produced goods and services that do not necessarily follow formal processes such as standards regulations, business registration or operational licences (FAO, 2017).

Figure 4 Location of markets selected for the study.



Table 3 Markets selected for the study

Category	Name of market	Geo-coordinates
Municipal Markets	 Kibuye Market Jubilee Market 	-0.0942,34.7685615 -0.1014205,34.7608153
Urban Daily Markets	3 Manyata Market4 Nyalenda /Kowino Market	-0.0978373,34.7775996 -0.1136796,34.7685713
Sub-Urban Daily Markets	 5 Kiboswa Market (North) 6 Otonglo Market (West) 7 Chiga Market (East) 	-0.0263862,34.7464681 -0.0759177,34.7076593 -34.846522 ,0.099347
Beach Markets	8 Dunga Market (South)	-0.144651,34.7343463

Beach markets along Lake Victoria: Dunga Market was selected as the representative beach market due to its central location in the southern part of Kisumu's urbanised area. Other beach markets were excluded as their character and trading patterns are primarily rural, falling outside the focus of this urban and peri-urban assessment.

Three key considerations guided the identification of traders for interviews:

Product type: During pilot testing at Riat and Mamboleo markets, it became clear that most traders sell a mix of African Leafy Vegetables (ALVs) and other vegetables. Focusing solely on ALV traders would risk introducing sampling bias. Therefore, a stratified sampling approach was employed to ensure balanced representation across key product categories.

Age and gender of traders: Acknowledging that traders' experiences and perceptions differ by age and gender, the sample was designed to include a diverse range of age groups and equal representation of women and men. This included young (18–35 years), middle-aged (36–55), and elderly (56 and above) traders, enabling a comprehensive understanding of generational perspectives on market dynamics. **Trading space**: Kisumu markets comprise both formal and informal trading spaces. Formal spaces are designated market stalls, while informal spaces consist of makeshift structures or open areas. To capture a broad range of market environments, traders from both types of spaces were included in the sample.

Sampling methodology

The number of traders interviewed per market was determined proportionally based on the market's size and the number of traders dealing in African Leafy Vegetables (ALVs). This approach ensured representation from both larger and smaller markets while considering the specific populations of ALV traders. Dunga Market presented a unique challenge, as it predominantly functions as a fish market with only a limited number of ALV traders. To address this, the sample from Dunga Market was supplemented by additional interviews in the nearby Nyalenda informal settlement, which had a high concentration of traders operating in informal spaces. A smaller number of traders from the formal Kowino Market were also included in the sample.

Figure 5 Number and categories of traders interviewed per market



Number of traders per market



Number of traders per market category



2.4 Selection criteria and rationale for value chain study

The study sites were selected to cover both wholesale and retail wet markets, as well as production areas for ALVs sold in Kisumu city.

Identification of geographical production areas for ALVs

The production areas for ALVs supplied to Kisumu markets were identified through a combination of literature reviews and key informant interviews with market actors. Kisumu's peri-urban regions contribute significantly to the vegetable supply in the city's markets. For each identified geographical area, one farmer group comprising 10–20 small-scale farmers were selected for in-depth interviews. Key informants were chosen based on criteria such as gender, age, and type of agriculture (irrigated versus rainfed). These individual interviews were complemented by a focus group discussion (FGD) involving 10–15 members from each farmer group. The key production areas for ALVs are illustrated in Figure 6

Figure 6 Geographic areas of focus for ALVs





Figure 7 Number of KIIs per market type and actors

Identification and engagement of key informant transporters and aggregators

To gain a better understanding of the logistics and transportation dynamics within the ALV value chains, interviews were conducted with 18 transporters and aggregators responsible for delivering produce to Kisumu's markets. They represented a diverse cross-section of logistical operators including:

- **Aggregators**: these individuals typically hire vehicles to transport ALVs from production areas to markets.
- **Truck operators**: responsible for longdistance haulage of bulk produce.
- Tricycle taxis (Auto rickshaws): commonly used for short-distance deliveries within urban and peri-urban areas.
- Motorcycle taxis (boda-bodas): often employed for quick and flexible last-mile deliveries to markets.

• Passenger service vehicle operators, although known to transport some produce, were not available for interviews as they typically drop off luggage at Kibuye Market before continuing to other destinations.

2.5 Consensus on solutions

Several solutions and recommendations were grouped and shared with four diverse stakeholder groups, including the public sector (both national and county levels), the private sector, market actors, women's cooperatives, farmers' organisations, youth groups, and research institutes. These groups assessed the solutions based on their feasibility for implementation and their potential negative impact on the social, economic, and environmental sustainability of Kisumu's food systems. This process aimed to gather stakeholders' perspectives on sustainability and stimulate discussions around the practicality and viability of proposed actions.

3 Findings and discussion

The findings of this study identify foodloss hotspots and their underlying causes. However, they provide only a rough estimate of the actual scale of food loss along the value chains of the three selected ALVs. Nevertheless, the information and data gathered are sufficient to raise stakeholder awareness of the issue's magnitude and offer a reliable foundation for future statistical surveys, developing solutions and designing actionable recommendations.



Figure 8 Value chain of ALV in Kenya

Source: Abel (2019)

3.1 Value chain of ALVs in Kisumu's urban and periurban areas

The value chain of ALVs is categorised into rural and per-urban, based on the production and markets channels (Abel, 2019). It is characterised by information asymmetry, a lack of trust and transparency within transactions, and very weak linkages between upstream actors and downstream partners (Agnew et al., 2021). This general value chain map captures the complexity of ALVs in Kisumu County. However, for the purposes of this study, a simplified illustration is provided, focusing on the movement of products, the network of small-scale producers, aggregation, transportation, and the wholesale and retail markets in Kisumu. The produce is sold fresh or minimally processed, with little transformation or value addition occurring along the value chain.



Figure 9 Value chain of ALVs in Kisumu's urban and peri-urban areas

Households, Restaurants & Institutions

Production: The primary sources of ALVs sold in Kisumu are peri-urban farms in areas such as Kajulu, Kolwa, Nyahera, Ahero, and Sondu, as well as rural farmlands within Kisumu County, including the Kano Plains. However, local production from these areas may not fully meet the growing demand for ALVs in the city. To supplement this supply, additional produce is sourced from neighbouring counties like Vihiga, Kakamega, Nyamira, and Kisii. Small-scale farmers typically cultivate ALVs on plots of less than one acre, growing a variety of leafy vegetables, including African nightshade, cowpea leaves, and amaranth. Key activities at this stage include land preparation, sowing, weeding, irrigation, fertilisation, harvesting, and selling to middlemen. While rural producers generally lack productivityenhancing practices (Agnew et al., 2021), peri-urban farmers may utilise improved seeds, fertilisers, or pesticides to boost yields. When such inputs are used, they are typically sourced from agrovet dealers, neighbours, or occasionally produced by the farmers themselves. The high value segments of traditional markets are dominated by opportunistic brokers and middlemen, whose exclusionary tendencies drive smallholders out of participating in the market (Abel, 2019).

When the demand is high, but supply is low the middlemen take all my vegetables – but when there is an oversupply, they get to be very picky on the freshness, size of leaves and usually dictate the price.

(Male farmer, Koluwa East)

Aggregation and transportation: After harvesting, farmers remove foreign matter, clean, and sort the ALVs by quality into bundles, which are then packed into woven plastic or sisal bags. These bags are collected by middlemen, who aggregate the produce before coordinating its transportation to Kisumu's central wholesale and retail hubs, such as Kibuye and Jubilee markets. Transporters, using trucks, motorcycles, and other vehicles, deliver the bags to the markets for further distribution.

Motorbikes can easily access my farm even after it rains – it is fast and cost effective. But I prefer Auto rickshaw, because my produce is protected from direct sunlight, dust and motor fumes – plus Auto rickshaw can carry a large volume of produce in one trip.

(Male farmer, Kochogo North)

Markets and distribution

In Kisumu, formal traders operate within designated market spaces, while informal traders often occupy open areas within the markets or along nearby roads. Critical infrastructure, such as shade, raised stalls, reliable energy, clean water, sanitation, and waste management facilities, remains inadequate or dysfunctional in both formal and informal settings. While some traders are based in formal spaces, others trade in open or spillover zones along roads. I use the canopy provided by a large tree just outside the market which protects the produce from direct sunlight. But during the rainy period, I must seek shelter elsewhere.

(Female trader, Kibuye market)

Apart from Jubilee and Dunga fish markets, Kisumu lacks specialised food markets. Fresh produce markets are typically sections of larger markets that also sell other goods, such as clothing and housewares. ALVs are predominantly sold by small-scale traders in the fresh produce sections, often in informal spaces, and their volume is lower compared to the more popular leafy vegetables like cabbages and kales. Accessibility is a major factor in determining the significance of these markets for both producers and consumers. Hence, the growth of Kisumu's transportation systems has led to the expansion of informal markets around major transport hubs and intersections, with most key markets located along or near main highways.

a. Municipal urban daily markets

Kibuye and Jubilee are the primary wholesale and retail markets in Kisumu, serving as the main supply sources of fruits and vegetables for smaller city markets and informal traders, as well as suburban markets (Opiyo and Ogindo, 2018; Otieno et al., 2022). Kibuye, the largest market in Kisumu, accommodates approximately 7,000 traders who operate from early morning until late evening (Onyango et al., 2013), catering to urban residents from all socio-economic backgrounds. It also supplies ALVs to daily urban markets, including Manyata, Nyalenda, Otonglo, Chiga, and Kiboswa, as well as informal roadside markets and supermarkets. Both markets face significant infrastructure challenges, including poor road conditions and a lack of adequate storage and preservation facilities. This deficiency contributes to high levels of food loss, particularly in vegetables that remain unsold at the end of the day (George and Oloko, 2018; Opiyo, 2020). Interviews and observations revealed that the shelf life of African nightshade is 1-2 days, cowpeas 2-3 days, and amaranth approximately 4 days. Furthermore, the markets suffer from disorganisation and poor quality and safety standards.

I lose 20% of my produce because there is no storage and cooling facilities in this market. This is loss of my income.

(Female trader, Jubilee market)

Traders in Kibuye and Jubilee markets are organised in sections and rows based on merchandise type, facilitating navigation and transactions. However, both markets have expanded in an unregulated manner, leading to inefficiencies in product handling and storage. In response, Uhuru Market was opened in 2022 to accommodate traders displaced during the port upgrade and informal traders from Kisumu's Central Business District. Despite being a modern, well-structured space, its operationalisation has been delayed due to unresolved conflicts between traders and city authorities over space allocation and relocation.

Consequently, many traders continue operating in informal settings where vegetables and other perishables are exposed to harsh weather conditions, exacerbating food loss.

Acknowledging the challenge of cold storage in Kibuye Market, a storage facility was constructed with support from international agencies to provide traders and distributors with a space for preserving perishable products, including vegetables. However, the study found that the facility remains unused due to high operating costs, trust issues, and management challenges. This exemplifies a common pitfall in development interventions, where externally driven solutions fail due to inadequate consideration of local economic and operational contexts.

b. Urban daily markets

Urban daily markets in Kisumu, including Manyata Peace Market in Manyata A, Kowino Market in Nyalenda A, and Migosi Market, resemble larger municipal markets but operate on a smaller scale with fewer traders and customers. Located in lowerincome residential areas and informal neighbourhoods, these markets serve as critical access points for fresh produce. However, they face severe infrastructure challenges, including unreliable water supply, inadequate sanitation, and a lack of functional cold storage facilities, limiting their efficiency and increasing the risk of food loss.

Refrigeration could be quite effective in improving longevity of my ALVs. I spray water on my produce to keep them cool and show an appearance of freshness. However, some ALVs spoil at a faster rate after exposure to water.

(Female trader, Manyata Peace Market)

Despite these limitations, traders in these markets sustain a steady supply by sourcing fresh produce daily from larger wholesale hubs such as Kibuye Market. Interviewees suggested that food losses in these markets are lower than in larger wholesale markets, though further quantification is required to validate this claim. The frequent replenishment of stock ensures that residents in informal settlements have consistent access to fresh vegetables, minimising reliance on cold storage and preservation.

c. Weekly markets

Weekly markets in Kisumu operate once or twice a week, primarily serving local residents. Located in the city's extended suburban areas, markets such as Mamboleo, Wath-Orego, Riat, Kiboswa, Dago, Chiga, Otonglo, and Ojola source fresh produce from Kibuye and Jubilee markets, as well as from small-scale peri-urban and rural producers. Some also function as aggregation points where middlemen collect produce from local farmers for redistribution across the city. Initially open-air markets, these hubs have seen infrastructure improvements, with the county government providing basic amenities such as market shades and

sanitation facilities. However, many of these facilities remain inadequate or dysfunctional, forcing traders to operate from makeshift structures in open spaces and along roadsides.

There is a shortage of clean water and nowhere to store to product overnight. I take my produce home at the end of the day to spread out on a flat raised surface to stay cool. (Female trader, Otonglo market)

d. Informal daily open-air beach markets

Located along the shores of Lake Victoria, these markets are primarily centred around fishing and are situated near fish landing sites. They are most active in the mornings, when fishermen bring in their catch, and in the evenings, when traders transport produce from the hinterland. Vegetable traders operate informally alongside fish sellers, supplying fresh produce to fishing communities and nearby villages. They source their vegetables from Kibuye wholesale market or small-scale rural producers. Within Kisumu city's administrative boundaries, examples include Dunga, Obambo, Rari, Ogal, Paga, Rota, Usoma, and Usare. Unlike formal markets, these hubs lack organised infrastructure and rely heavily on informal trade setups. While this informality enhances accessibility to fresh produce, it also presents challenges related to sanitation, storage, and exposure to weather conditions, contributing to inefficiencies and food loss.

3.1.1 Gender and social structures in the ALV value chain

Women constitute approximately 60% of ALV producers in Kenya (Kebede et al., 2018), and the value chain in Western Kenya and Kisumu follows a similar pattern (see Figure 8). This study confirms that, despite limited ownership of land and productive assets, women play a dominant role in the production and sale of African nightshade, cowpea leaves, and amaranth in peri-urban and rural Kisumu. Their involvement is largely shaped by entrenched gender roles and the compatibility of ALV cultivation with their existing workloads and responsibilities (Kiptot and Franzel, 2011). However, gender-based discrimination affects women's participation in farming and may contribute to higher losses on their farms.

Women are not allowed to farm during their menstrual periods. If they do, your entire farm can get spoiled.'

(FGD with farmers, Kajulu ward)

In contrast, men are more actively involved in transport and play a key role in decisionmaking on transactions and pricing at the distribution and wholesale stages. As ALVs gain market value, men increasingly enter the trade, potentially displacing women from more profitable segments (Shiundu and Oniango, 2007). Men are majorly involved in the leadership roles, security and transportation of ALV. Traditionally women are to take care of the daily house activities hence limits them if they want to venture into transport sector due to the long trips associated with it.

(Female trader, Jubilee market)

This shift in participation underscores the unequal distribution of power and resources within ALV value chains, often marginalising women as market commercialisation increases. Women farmers frequently encounter barriers to accessing credit—partly due to a lack of collateral and financial literacy—alongside restricted land ownership and limited access to improved technologies. These constraints reduce their incentives for investment and negatively impact their income and overall participation in the value chain.

Women do not own farms. This discourages the women from farming. The old men don't want to give the youths and women share of the farmland and its expensive to rent a land which can end up not producing the desired produce and income.

(Farmers FGD)

Women traders in Kisumu's major markets have formed savings and loan groups to raise capital and provide social support, playing a crucial role in organising market spaces and advocating for traders' welfare. These structures not only enhance women's economic empowerment but also contribute to more efficient ALV value chain operations. However, social and safety barriers increase food losses for women traders. Market interviews revealed that safety concerns prevent some women from transporting and displaying their products in the early morning hours when temperatures are cooler, unlike their male counterparts. This delay exposes highly perishable ALVs to prolonged heat. At Kisumu's Kibuye wholesale market, small-scale women traders purchase fresh stock daily from wholesalers, reducing their reliance on storage infrastructure. In the absence of formal market information systems, retailers estimate daily sales based on their knowledge of local demand.

These challenges highlight the need for gender-sensitive—and where possible, gender-transformative—food loss interventions that address the specific barriers women face along the value chain.

Cultural norms further shape ALV value chain dynamics in Kisumu's neighbouring county, Vihiga, where some of the city's supply originates. ALVs are often viewed as 'traditional' or subsistence crops, limiting their appeal among urban consumers from higher socio-economic backgrounds. Their association with alternative medicine, ancestral spirits, or religious beliefs may also influence demand.

Additionally, our study found that in some households, cultural hierarchy dictates that parents must plant their crops before their children, delaying planting schedules and potentially affecting ALV yields and market supply.

Figure 10 Gender structures in ALV supply chain



There are times you should not plant the vegetables. We always wait for the elders to plant first.

(FGD)

3.2 Food-loss hot spots along the selected ALV value chains

The study identified markets and production stages as the primary food-loss hotspots for the selected ALVs. Estimates of loss at each stage were derived from reports by farmers, traders, and aggregators, as well as KIIs, FGDs, direct observations, and a literature review. These figures serve as indicative estimates rather than precise measurements of ALV losses along the value chain. Despite this limitation, the study effectively highlights key food-loss hotspots and their underlying drivers, provides an approximate scale of loss, and underscores the significance of the issue in Kisumu's ALV supply chain. The findings serve as a foundation for developing targeted interventions to reduce losses and mobilise stakeholder action. To enhance the reliability of these insights, the study

underwent multiple validation rounds, incorporating stakeholder consultations to refine trends and patterns.

3.2.1 Scale and causes of food loss in selected ALVs

The extent of food loss along the ALV value chain in Kisumu is not well documented. Interviews with farmers in Kisumu indicated that on-farm losses are about 20%. This figure only refers to crop from the moment it is was mature (ready for harvest) in the field, and not to crops that spoilt during growth. However, this loss could still stem from pre-harvest factors, including the lack of improved seed varieties, inadequate technical advice, pests, diseases, and a lack of resources to ensure proper on-farm storage (Gogo et al., 2018).

Most farmers prefer to harvest and weigh their produce before selling it directly to aggregators or transporters, either at the farm gate or upon delivery to a nearby collection point. In this system, the burden of post-harvest losses often shifts to downstream actors, particularly market traders. Aggregators, in turn, absorb the risks and costs associated with transportation and potential spoilage at the market. Large-scale farmers, benefiting from higher yields and consistent customer demand, favour farm-gate sales for efficiency. In contrast, small-scale farmers are more likely to transport their produce to markets themselves, aiming for better prices and direct engagement with vendors to maximise earnings.

Driver will not bear any liability that comes with transportation – because they say they carry passengers. so, you send your luggage of ALV at own peril.

(Male aggregator, Kibuye Market)

Only around 5% of food loss occurs during transportation and aggregation, primarily due to inadequate packaging and rough handling. This relatively low figure can be attributed to the lack of accountability among transporters for the losses that occur at this stage.

Very minimal losses occur during the transportation – because the distance is very short. The losses we witness, happen because of mishandling in matatus. I would say (losses) stand at 5%.

(Female transporter, Kibuye market)

This study highlights the critical link between the root causes of food loss upstream and its symptoms downstream, particularly the decline in vegetable quality by the time they reach markets in Kisumu, where ALV losses can reach 20-30%. The scale of food loss varies by crop among the three ALVs studied. For example, many farmers and traders reported that African nightshade, a highly perishable crop, could experience up to 50% loss during transportation and market handling. This was confirmed during interviews and observations with value chain actors. While such spoiled produce may still have residual value as animal feed, sold at a lower price, it is classified as food loss since it is no longer consumed by humans.

The study also reveals a significant data and knowledge gap regarding qualitative losses, including nutritional value, along the supply chain. Although this research does not quantify nutritional losses, existing literature indicates that some ALVs experience substantial declines in nutritional quality as they progress through the value chain. For instance, from harvest onwards, African nightshade loses significant nutritional value, with dry matter content reduced by 32.8-45.5%, and mineral elements, vitamins, and proteins reduced by up to 29.4% (Gogo et al., 2017). Additionally, water loss through transpiration leads to degradation of nutrients like vitamin C, chlorophyll, and carotenoids (Kirigia, 2018). An overview of the estimated losses along the value chains of the three selected ALVs, along with the potential causes, is presented in Table 4. Respondents assigned equal weight to these causes, and assessing the impact of each cause on the extent of loss was beyond the scope of this study.

a. Technical factors

At the production stage, farmers often lack access to high-quality inputs due

Table 4 Estimated losses of selected ALVs along the supply chain

Stage of supply chain	Type of loss: quantitative or qualitative	Estimated % loss	Potential causes of loss
Production and harvest	Quant	20%	 Inadequate knowledge and skills on optimal harvesting practices, time, tools and techniques. Plant pests and diseases which manifest in higher loss downstream. Prolonged exposure to high temperatures during harvest – delayed collection and improper handling in high-temperature conditions. Limited capacity and knowledge of post-harvest management – farmers often lack training on proper post-harvest handling, including sorting, cleaning, and storage, leading to higher losses. Insufficient access to protective storage infrastructure – lack of access to shade, cold storage, or immediate transportation after harvest. Overproduction without market linkage – inconsistent market demand leading to surplus production.
Aggregation/ transportation	Quant	5%	 Improper handling and packaging – Rough loading/unloading, unsuitable packaging, and lack of training cause physical damage and accelerate spoilage. Lack of standardised grading and sorting – mixing damaged or lower-quality produce with fresh crops, accelerate deterioration and reduces overall marketability. Prolonged delays and poor supply chain coordination – inefficient aggregation, waiting times for transport, and poor scheduling. Overcrowding and overloading – excessive stacking in transport vehicles crushes and damages vegetables, shortening shelf life. Exposure to weather elements – lack of protective covering during aggregation and transport results in damage from rain, direct sunlight and dust. Limited aggregation facilities and infrastructure – inadequate collection points, cool storage, and sorting facilities lead to disorganised handling and spoilage. Poor roads and long transit times – bad roads, congestion, road accidents and breakdowns prolong exposure to unfavourable conditions. Lack of specialised transport vehicles – absence of refrigerated or ventilated trucks accelerates spoilage due to high temperatures and humidity. High transportation costs and limited resources – cost-cutting measures lead to compromised quality preservation, such as using inappropriate vehicles.
Market stage	Quant/Qual	20%/ 30%*	 Poor market infrastructure – inadequate facilities such as insufficient or damaged stalls, draining, lack of roofing, and poor ventilation. Poor market governance – presence of 'cartels' controlling the wholesale markets. Unhygienic market conditions – poor sanitation in marketplaces attracts pests, rodents, increasing spoilage risks. Lack of proper storage facilities – absence of cold storage or cooling systems in markets results in accelerated wilting, rotting, or loss of freshness in vegetables. Oversupply during peak production seasons – excess produce during the rainy season leads to gluts in the market, overwhelming demand and causing a significant portion of unsold produce to spoil. Price volatility – rapid fluctuations in vegetable prices during oversupply periods. Congested market spaces – overcrowding limits the proper display and handling of produce. Limited demand for substandard produce – consumers' preference for fresh, high-quality vegetables means damaged or wilted produce often goes unsold and is discarded. Inefficient inventory turnover – poor planning by traders in managing stock rotation can result in older stock being unsold and spoiled. Lack of capacity and knowledge on post-harvest loss prevention – traders and market vendors may lack training or awareness of practices that reduce spoilage and extend shelf life such as proper display techniques and sorting
 Lower quality ALVs sold at a price 30% lower than standard price, indicating qualitative loss. 			methods. Lack of access to value addition or processing options – without facilities or partnerships for turning unsold produce into processed goods (e.g., drying, freezing), surplus vegetables are wasted.

to financial constraints or insufficient knowledge of best agricultural practices. This not only affects the immediate productivity of ALVs but also reduces their shelf life, as poor application of pesticides or harvesting techniques contribute to premature spoilage.

At the aggregation and transportation stages, maintaining the physical condition of ALVs requires specialised transport and packaging solutions, which are often unavailable to resourceconstrained small-scale producers, particularly women. ALVs are frequently transported using public transport vehicles, such as matatus (passenger service vehicles) and motorcycle taxis. While these modes are affordable, they are ill-suited for handling crops, with drivers not being held accountable for any losses or damages. The vehicles lack basic features such as protective storage compartments or proper ventilation. As a result, the vegetables are subjected to rough handling, contamination, and exposure to dust, dirt, and exhaust fumes during transit. Bags of ALVs are often loaded onto vehicle roofs or open boots, fastened with ropes, and left exposed to heat, rain, and wind, which causes physical damage, such as bruising and crushing, and accelerates spoilage. Motorcycle taxis, though popular for their affordability and accessibility, often drag produce along the ground, further damaging and contaminating the vegetables.

In the market, the absence of cooling facilities exacerbates the situation, especially during peak production seasons when ALVs must be sold over several days. Without adequate storage, spoilage increases significantly. Moreover, the lack of affordable packaging solutions and limited value-added market channels further contribute to food loss. Manual handling during loading and offloading also worsens the problem, as vegetables are frequently bruised or crushed in the process.

b. Knowledge and capacity factors

Knowledge and capacity gaps across the ALV supply chain, including lack of technical know-how, training and awareness among key actors – farmers, aggregators, transporters and market traders – limits their application of best practices for producing, handling and preserving ALVs. These deficiencies result in poor quality, increased spoilage, and ultimately food loss, as well as diminished market value.

At the production stage, there is limited knowledge among farmers about proper agronomic practices and the effective use of inputs, such as fertilisers and pest control measures. This, coupled with low-quality seeds, often result in pest infestations that compromise the quality of ALVs. Such infestations sometimes manifest only after harvest, further exacerbating post-harvest losses. Many producers fail to harvest at optimal times, such as early in the morning when temperatures are cooler. This practice leads to wilting and spoilage, particularly for the more perishable ALVs that are highly sensitive to heat and rough handling. Farmers interviewed

frequently emphasised the need for better education and training on harvesting methods to minimise these losses.

The knowledge gaps extend to aggregators, who often lack training in sorting and grading vegetables to separate damaged or lower-quality produce from high-quality produce, which diminishes overall marketability. The absence of appropriate packaging materials and lack of knowledge about packing perishables exacerbates this issue. Transporters also exhibit limited understanding of best practices for handling perishable goods, frequently ignoring the risks of mishandling, as they lack accountability for any losses incurred.

In markets, many traders and vendors are unaware of optimal display techniques and inefficient inventory turnover often leads to unsold stock spoiling before it can be sold. Moreover, improper handling of ALVs during transactions – such as piling vegetables without care or dropping them – causes additional physical damage.

Most traders are not connected to alternative marketing channels, such as schools and hospitals which restricts their ability to reduce waste and create additional revenue streams. A market study in Kenya shows that over 88% of consumers are willing to pay more for cleaned, sorted and graded fresh cowpea leaves, while 35% and 25% of consumers, respectively, prefer destalked and chopped vegetables over unprocessed vegetables (How We Made it in Africa, 2022). Most farmers and traders interviewed emphasised the need for training on simple, costeffective methods to preserve and add value to ALVs, particularly during peak production seasons when oversupply leads to gluts in the market.

With the availability of the solar driers, losses at the harvest level have been greatly reduced because the low-quality vegetables are sorted, cut into small pieces, dipped in salty boiling water for 5–6 minutes, then spread out to dry in the direct sun inside the solar drier. But before that we would have at the farm level up to 20–25% loss.

(FGD with 10 farmers - Vihiga County)

It is estimated that 2.1% of Kenyan farmers and 14.5% of intermediaries process ALVs, into dried or frozen products (How We Made it in Africa, 2022). Substantiated by market and feasibility analysis for the processed products, the public sector could mobilise the food processing industry to explore value addition to ALVs.

c. Climate and natural environment

Natural and climatic shocks, such as droughts, floods, and hailstorms, significantly undermine the resilience of ALV production systems. Interviews with farmers in the Nyando Basin, for example, highlighted the frequent destruction of harvest-ready ALVs due to recurring flooding. These floods not only damage standing crops but also delay subsequent planting cycles, reducing overall productivity and increasing the risk of food loss. ALV farming in Western Kenya and around Kisumu is heavily reliant on rain-fed agriculture, making it particularly vulnerable to fluctuations in weather patterns.

We usually lose around 20% of our produce. But weather events like hailstorm can cause up to 100% loss of ALVs, when they are ready to harvest.

(farmers FGD, Kajulu)

The impacts of climate also extend beyond production. Farmers interviewed in Kisumu highlighted how pre-harvest pest infestations often continue to manifest at the postharvest stage, leading to spoilage during storage and transportation. Flooded, poorly maintained roads and prolonged delays caused by impassable routes expose vegetables to heat and humidity, accelerating spoilage. Additionally, vegetables transported in open vehicles are further exposed to rain and wind, compounding the damage. When it abruptly begins to rain, the rider will speed off to look for shelter which might be far – meaning the produce will be exposed to water. In this situation, a crop like cowpeas leaves deteriorates very fast. The rider will either return the low-quality crop to the farmer to deal with it or deliver a very low-quality produce to the market.

(Farmers FGD, Vihiga County)

At the market stage, unpredictable heat or rain exacerbate challenges such as poor drainage and overcrowded spaces. Traders are unable to adjust their operations according to seasonal weather patterns. Unsold vegetables, stored in unhygienic conditions and exposed to excessive moisture, deteriorate rapidly, further contributing to losses. Traders in Kisumu highlighted that the absence of covered stalls and elevated platforms worsens spoilage, particularly during periods of heavy rainfall.

d.Behavioural factors

Behavioural factors, driven by decision-making patterns, cost-saving measures, and market practices, lead to inefficiencies and significant food losses along the ALV value chains.

At the production stage, overproduction due to unreliable market linkages is a key issue. FGDs with farmers revealed risk-averse decision-making, where farmers prioritise maximising yields to mitigate risks such as low prices or poor crop performance. This results in surplus ALVs that cannot be absorbed, particularly during peak harvest periods. Additionally, farmers often normalise losses as an inherent part of agriculture, which discourages the adoption of improved practices to address this issue.

During aggregation and transport, high transportation costs and resource constraints influence decisions. Farmers attempt to reduce the number of trips or rely on any available vehicles, such as public transport or motorcycle taxis. Informal aggregation practices further hinder handling, with produce often being roughly handled, stuffed into large bags, and carelessly loaded and unloaded.

At the market stage, traders frequently sprinkle water on vegetables to preserve their appearance under the hot sun. However, this practice accelerates decay, particularly when contaminated water is used, rendering the vegetables unsafe and unmarketable. Additionally, vegetables with high moisture content decay more rapidly if not sold immediately.

Consumer preferences and market dynamics also drive losses. Buyers prioritise fresh, high-quality vegetables and often reject slightly wilted or damaged produce, leaving traders with unsold stock that must be heavily discounted or discarded. Our research shows that wilted ALVs are often sold at 30% lower than standard prices or discarded altogether.

e. Infrastructural factors

In Kisumu's hot and humid climate, infrastructural inadequacies significantly contribute to food loss in ALVs. Farmers and vendors frequently lack access to protective on-farm storage, such as shaded areas or cold storage, leaving fresh produce exposed to environmental conditions that reduce quality and shelf life. Some farmers mitigate this by planting trees for shade and minimising the time between harvest and sale to aggregators. Furthermore, the absence of nearby collection points or aggregation centres forces farmers to delay transportation or rely on informal aggregation methods, which exacerbates losses.

We do not have a storage facility and keep our product under the trees in shade, waiting for the transport. During the favourable seasons, when the production of ALV is higher, we have to sell our crop at a lower price to aggregators to minimise loss.'

(Female farmer, Chavakali)

The transportation of produce is hindered by poor roads, particularly in rural areas like Kajulu and Kano. During the rainy season, rough and impassable roads lead to extended transit times and frequent physical damage to produce due to vibrations and mishandling. Delays caused by traffic congestion, road accidents, and vehicle breakdowns further reduce the freshness and marketability of ALVs. Inadequate market shades, stalls, water supply, and sanitation facilities force many traders to display their produce in open spaces, exposing vegetables to direct sunlight and heat. Furthermore, limited market space creates congestion and unsanitary conditions, further degrading the quality of ALVs. For example, in Kiboswa Market, vegetable traders were relegated to roadside vending, while in Jubilee Market, ALV traders lacked designated stalls and had to operate in less organised, less protected areas.

f. Institutional and governance factors At the production stage, low access to credit prevents farmers from investing in better seeds, fertilisers, or postharvest tools. As a result, the quality of produce deteriorates before it even leaves the farm. The absence of quality standards and enforcement mechanisms further complicates the situation. Farmers and aggregators often lack the training or incentives to adhere to good practice in harvesting, handling, packaging and grading, leading to inconsistent product quality.

When middlemen arrive at the farm, they instruct the farmer to start harvesting without specifying the quantity they require. Only after the vegetables have been plucked do they begin negotiating prices and the measurement standards, often pressuring the farmer to accept lower rates than they would get at the market. As a result, a middleman might purchase produce worth 1,000 shillings for 600 shillings or less, knowing that the farmer is reluctant to waste the harvested vegetables or face market uncertainties. In many cases, farmers are left with little choice but to sell at a loss, repurpose unsold stock as animal feed or organic manure, or risk financial setbacks. Another challenge with middlemen is their influence in the marketplace. If a farmer refuses to sell to them at the farm, they may still encounter them at the market, where middlemen use proxies posing as customers to drive prices down. Over time, the lack of direct buyers forces farmers to accept lower offers rather than returning home with unsold produce.'

(FGD with farmers, Vihiga County)

Inadequate enforcement of existing food safety regulations along the value chain and particularly in markets reflects deeper systemic issues. Public health authorities in Kisumu lack the staffing and resources needed to monitor and enforce food safety standards effectively. Although food safety guidelines exist, high levels of informality and lack of business registration make strict control and enforcement nearly impossible.

Informality of food retail operations in Kisumu creates a host of governance challenges. Weak market governance structures have allowed the rise of powerful cartels in city markets such as Kibuye. They regulate the entry of vegetables, demand payments from suppliers, and dictate prices, creating barriers for small-scale traders. Suppliers who fail to meet cartel demands face delays in offloading their vegetables, leading to extended storage time and higher spoilage rates. In the absence of reliable and regulated market information system, market price and demand for different types of ALVs in Kisumu fluctuates based on consumers' preferences. Although this is to a certain extent a predictable factor, rapid fluctuation occurs during the rainy season, due to oversupply of certain types of ALVs. As a result, the market price does not justify the cost of logistics and farmers leave mature produce on farm to decay.

g. Gender and social factors

Kenya's male-dominated inheritance laws allocate family land exclusively to sons, leaving women dependent on male relatives for access. Despite Kenya's Matrimonial Property Act and National Land Policy, patriarchal systems dominate land governance. Only 14% of women in rural Western Kenya have secondary education, limiting their ability to navigate legal frameworks (Konrad-Adenauer-Stiftung, 2021). Where women are prevented from owning land or securing long-term land tenure, their willingness and capability to invest in irrigation systems, improved storage facilities, and post-harvest processing technologies, reduces. Additionally, many lending institutions require collateral, such as land or other assets, which women often do not possess.

As a woman, I am just given a small place to plant my ALVs – my husband uses the larger section of the farm to plant maize – women can be empowered to own and inherit lands – in order to stop being at the mercy of their husbands.'

(Female farmer, Vihiga County)

4 Solutions for the prevention and reduction of food loss along the ALV supply chain

Addressing food loss in Kisumu's ALV sector requires a combination of training, technology adoption, infrastructure investment, and market reforms. Expanding knowledge-sharing networks for farmers and traders, documenting and scaling up low-cost post-harvest innovations, strengthening public-private partnerships, addressing informality, and improving roads, storage and transportation could drastically reduce food loss in Kisumu.

There are several innovative initiatives at Kisumu County level to promote more sustainable and efficient practices in the vegetable sector, even if not all of them specifically recognise and prioritise ALVs. Notably, the Kisumu Food System Lab (Alliance of Bioversity International and CIAT, n.d.) is introducing innovative urban gardening methods for ALV production, including vertical, hanging, tin, and sack gardens. The lab is supporting product development by helping stakeholders develop innovative solutions to diversify the ways ALVs can be consumed and marketed. The Kisumu County government's nutrition education initiative is developing education materials to improve dietary quality for urban poor consumers, which indirectly supports the

ALV value chain by increasing demand and awareness. The lab is piloting innovative approaches to strengthen connections between ALV value chain actors from producers to consumers by organising multi-stakeholder workshops and training to build trust while empowering women and youths. While not specific to ALVs, the information and communication technology (ICT)-driven solutions (County Government of Kisumu, 2023) is exploring the use of ICT to provide platforms for educating value chain actors and potentially improving market linkages.³

4.1 Production and harvest

Training and capacity building for farmers

An effective approach to training and building the capacity of farmers could be through farmer field schools that provide hands-on training in best agriculture practices. This includes educating farmers on optimal time of harvest, appropriate use of chemicals, and the right maturity stage to ensure maximum nutritional value and extended shelf life. Recognising that gender disparities exist in agricultural training and extension services, it is essential to ensure that women farmers

³ In designing the solutions, the study aims to ensure alignment with interventions of the Veggies for People and Planet (V4P&P) project and, to extent possible, leverage the network and knowledge built through multiple components of V4PP, to deliver the co-benefit of food loss reduction in ALVs.

are not left behind. Cultural barriers that may hinder women's access to information and training must also be addressed through community sensitisation and awareness campaigns. Beyond improving harvesting skills, farmers should be trained on the use of simple ICT tools and be supported with market information channels that help them understand price and demand. They can then align their harvests with markets and diversify to more popular crops in any given season.

Promote effective management of plant pest and disease

Integrated pest management strategies, which encourage farmers to adopt environmentally friendly and cost-effective pest control methods, are key in reducing food loss in ALVs. These include biological control measures, as well as cultural practices like crop rotation to break pest and disease cycles. However, for these practices to be widely adopted, farmers must have the knowledge and access to affordable inputs and high-quality, disease-resistant seeds. By supporting the distribution of organic pesticides and encouraging the development of improved seed varieties that naturally resist common pests and diseases, stakeholders including government agencies, NGOs and private sector players - can significantly enhance farmers' ability to protect their crops. Simple digital tools, such as SMS alerts, can provide timely information on potential pest infestations, emerging crop diseases, and climate-related threats like droughts or hailstorms. These enable farmers to take preventative action, such as applying natural pesticides in advance or adjusting planting schedules to avoid adverse weather conditions.

Investment in protective harvesting and storage infrastructure

Low-cost mobile shade nets or harvesting shelters that provide immediate protection from direct sunlight, reducing heat stress on freshly harvested vegetables, are an effective way to prevent losses in ALVs. Beyond immediate protection on farm, simple cooling solutions such as evaporative cooling and the charcoal cooling blanket (Defraeye, 2024) can extend the shelf life of perishable vegetables. These are cheap, reliable options to preserve excess produce during peak harvest periods, preventing unnecessary spoilage. Solar powered units are particularly beneficial in peri-urban areas where access to electricity is limited, ensuring an environmentally friendly and cost-effective approach to post-harvest storage. To further streamline postharvest management, cooperative-based collection points can be established or scaled up to facilitate timely transportation and reduce losses.

Strengthening market linkages

Creating stronger and more reliable market connections for ALVs is essential to reducing food loss and improving farmers' incomes. One solution is to develop contract farming models, where farmers cultivate ALVs based on pre-arranged agreements with traders, supermarkets or institutional buyers such as school feeding programmes and hospitals. Some contracts, however informal and limited in scope, are already in place, through which farmers can sell their products directly to local hospitals or churches. Additionally, expanding farmer cooperatives could help smallholder farmers in negotiating better prices, pooling resources for improved postharvest handling, and reducing reliance on informal markets. Leveraging technology further strengthens market linkages, with digital marketing platforms such as mobile apps promoting e-commerce, and SMS-based price alerts offering real-time connections between farmers and buyers. These platforms enable farmers to make informed decisions about when and where to sell their produce, reducing instances of surplus accumulation. Digital tools also facilitate better supply chain coordination, helping traders and transporters optimise logistics, leading to faster and more efficient distribution.

4.2 Aggregation and transportation

Improved post-harvest handling practices

Simple measures, such as handling with care during aggregation and transport, avoiding over-stuffing of ALV in gunny bags, and using clean surfaces for sorting, can extend the shelf life of ALVs and improve their marketability.

Transitioning to more protective packaging materials is another critical intervention. Instead of using woven plastic bags (i.e. gunny bags), which offer little protection and contribute to environmental pollution, aggregators and transporters should adopt crates and reusable containers. These allow for better airflow, reducing moisture buildup that accelerates spoilage. Encouraging the use of appropriate packaging solutions would improve the preservation of vegetables, but a prerequisite is addressing the high cost of the crates as well as the risk of theft, which could make this simple solution unaffordable for small-scale actors.

Establishing low-cost cooling solutions, such as low-cost evaporative coolers or solar-powered refrigeration in aggregation points can help maintain the freshness of ALVs while awaiting transport or sale.

Standardised grading and sorting practices

Establishing clear grading guidelines that help farmers and aggregators distinguish between premium-quality produce and lower-grade vegetables is a key step in food-loss reduction in ALVs. By setting standardised criteria - such as colour, freshness, and absence of infestation and defects, coupled with higher price for better quality, farmers are incentivised to invest their time and resources in improving quality. Providing grading kits at aggregation points ensures that sorting is done efficiently and uniformly. These kits, which can include measuring tools, weighing scales and quality checklists, help farmers and traders adhere to agreedupon standards, reducing inconsistencies, protecting farmers, and raising consumer confidence. When farmers have access to grading tools, they can categorise produce more accurately, making it easier to sell at fair prices based on quality rather than volume alone.

Investment in roads and affordable transport solutions

Poor roads increase transit times, expose produce to excessive heat, and contribute to mechanical damage. However, in the absence of improved infrastructure, more affordable solutions such as investing in community-based transport could ensure quick and efficient vegetable delivery, reducing spoilage caused by prolonged exposure and rough handling.

We purchased as a group a motorbike that we use to transport our produce easily and in a faster way. Our motorbike rider has been trained in proper handling of leafy vegetables while on transit. This has significantly reduced our loss.

(Female farmers FGD, Vihiga County)

By equipping vehicles such as auto rickshaws with simple modifications such as breathable storage compartments and cushioned crates without affecting the space they need for passengers, transporters can maintain the freshness of ALVs while keeping costs low. Organising market aggregation schedules can prevent unnecessary delays and congestion at collection points. Additionally, coordinating collection and delivery times through farmer cooperatives, business networks or digital scheduling platforms can ensure a smoother flow of produce, reducing waiting times and losses.

Farmers struggle with unreliable transport, forcing them to sell quickly at lower prices

or risk losing produce. Cooperative-owned transport services can also solve the issue by pooling resources that could be invested in shared transport solutions.

4.3 Market

Upgrading marketing infrastructure

Lack of cold storage facilities in Kisumu's Kibuye and Jubilee markets push traders to rely on overnight storage in makeshift wooden stalls. Establishing communal cold storage units, co-designed and comanaged by the municipality and traders' associations, would allow vendors to extend the shelf life of ALVs, particularly during peak seasons when oversupply leads to excessive waste. Upgrading market stalls with low-cost measures that are developed together with traders, such as shaded canopies, ventilated storage areas and raised display tables, would protect vegetables from contamination and deterioration. Additionally, improving market drainage systems is essential, as poor drainage often results in waterlogging, leading to vegetables getting soaked, rotting faster, and becoming unsellable.

Improving handling practices and display of ALVs

Training market vendors on display methods—such as spreading out vegetables on raised, clean surfaces – explaining the benefits, and providing them with means to follow the training can significantly improve quality and shelf life. Similarly, the common practice of overstuffing vegetables in 90kg gunny plastic bags to reduce number of trips to the market and maximise sales leads to bruising and accelerated decay. Use of weighing scales would help minimise waste while ensuring fair trade for both vendors and buyers.

Managing oversupply, promote and build capacity in value addition

During peak production seasons, many traders struggle to sell all their produce before it spoils, especially when consumer demand is low. Supporting community-based processing units, where surplus vegetables can be solardried or frozen, could extend shelf life and create alternative products for sale. In Manyatta and Kibuye markets, some traders have started sun-drying ALVs, but access to drying facilities remains a challenge. Expanding such initiatives with support from cooperatives and local authorities could reduce waste and create new income opportunities. Strengthening direct linkages between farmers and institutional buyers, including through public procurement to schools, hospitals and restaurants, could also provide an alternative market for traders. These institutions require a consistent supply of vegetables, yet many smallscale farmers struggle to connect with them due to fragmented supply chains. Establishing structured trading platforms - either through digital marketplaces or coordinated supply agreements - would allow farmers to match their production with real-time demand.

Improving hygiene and food safety measures

Many market areas in Kisumu lack waste disposal systems, leading to the accumulation of rotting vegetables, which attracts pests and rodents. Providing waste disposal bins and enforcing segregation and waste management practices would help maintain cleaner market environments, reducing contamination and losses.

Access to clean water is another critical issue. Dedicated water points for washing and handling vegetables would improve hygiene and extend produce freshness. Finally, building an economic case for food safety through premium price and training vendors on safe storage techniques – such as using clean containers, avoiding exposure to pests, and preventing crosscontamination – would further enhance food safety and reduce losses.

Mainstreaming gender transformative approaches and culturally relevant food-loss solutions

The double burden of lack of land ownership and access to credit prevents women from investing in better farming and post-harvest practices. A key solution is to expand financial inclusion for women through savings and credit cooperatives and microfinance initiatives. Women traders in Kisumu have already formed self-organised savings groups, which help them pool resources for business expansion. Strengthening such groups by providing financial literacy training and linking them to low-interest loan facilities would allow more women to invest in better storage solutions, cooling units and improved packaging.

Additionally, subsidised leasing programmes for improved post-harvest technologies such as ventilated crates, shade nets and mobile cooling storage could help women producers and traders preserve ALVs for longer periods, ensuring they reach consumers in good condition.

Restricted market access due to household cares and safety concerns was flagged as a factor leading to higher losses among women traders in Kisumu. Establishing storage and aggregation points closer to women farmers – where they can easily and safely drop off their produce for early morning distribution – would ensure their vegetables reach the market in fresher condition.

Women frequently lack bargaining power, forcing them to accept lower prices. Training and supporting women entrepreneurs, strengthening their capacity and their leadership in market associations and representation in decision-making entities that regulate market space allocation and pricing could address this challenge.

Empowering women to speak freely in public forums about the challenges they are facing. Training and encouraging them to take up more leadership positions.

(Female trader, Otonglo market)

Supporting women-led marketing cooperatives can also help small-scale female traders collectively negotiate fair prices with wholesalers and bulk buyers. Use of the mobile phone-based money transfer service M-PESA has improved the safety of transaction and protecting women traders from theft. Building on the success of this experience, introducing digital platforms where women can access real-time market prices through mobile apps or SMS alerts would enhance their ability to make informed selling decisions.

5 Policy recommendations

Addressing structural weaknesses in governance, financing and data accessibility can enhance market efficiency, farmer resilience and sustainability, ultimately reducing post-harvest losses and boosting the profitability of ALVs in Kisumu. The following policy recommendations could improve the enabling environment and prepare the ground for implementation of the solutions:

Establish a multi-stakeholder platform for coordination

A multi-stakeholder platform involving government agencies, private sector players, farmer cooperatives, research institutions, and development organisations should be established to coordinate food-loss reduction initiatives. This platform would align policies, facilitate knowledge-sharing, and drive the implementation of innovative post-harvest management solutions for ALVs. Additionally, partnerships between research institutions, universities, and the private sector should focus on developing and scaling affordable post-harvest technologies, such as efficient drying, cooling, and packaging solutions.

Establish a regular data collection and monitoring system for food loss in ALVs

To enhance targeted interventions and assess the impact of food loss on income and nutrition, the county government and research institutions should systematically collect and analyse both qualitative and quantitative data on ALV losses along the supply chain. This system should include an analysis of seasonality to track fluctuations in food loss and identify patterns, as well as accurate measurement of losses at each stage of the value chain to inform targeted interventions. Complementary supply chain studies incorporating household and hospitality sector food waste research could further provide a more holistic picture of inefficiencies from farm to fork.

Integrate food-loss reduction in ALVs in the main agri-food systems related policies

As part of a broader Kisumu food loss and waste reduction strategy, a countylevel food-loss reduction action plan specifically for ALVs would be essential for aligning efforts with existing policies. This could promote long-term sustainability, coordination across different sectors, and the allocation of the resources needed to improve the quality of ALVs and realise the potential of these highly nutritious crops to generate more income for farmers and healthier diets for consumers.

Strengthen post-harvest infrastructure and market linkages

The county authority needs to continue efforts in implement minimum infrastructure standards for ALV storage and transport, including investing in collective community facilities such as cooling and storage, shaded aggregation points and ventilated transport. Expanding cooperatives, in particular targeting women groups, enhancing protection and legal systems to promote contract farming, and using public procurement policies to link producers and cooperatives to institutional buyers such as schools and hospitals would help small-scale producers and traders gain better access to structured markets and fair price. Developing market-based incentives and partnerships could generate a triple win of food-loss reduction, income growth and better household nutrition.

Facilitate access to finance for small-scale farmers and traders

Kenya has taken major steps to address access to finance for actors along the value chain of small producers through savings and credit cooperatives and M-PESA. Financial institutions need to scale these best practices and develop tailored credit products that consider the realities of ALV farmers. These might include low-cost, collateral-free loans for purchasing storage and paying for specialised transport and processing equipment. Stronger partnerships between county government, microfinance institutions and commercial banks is needed, as well as financing models that combine low-interest loans, grants and loan guarantees to de-risk investments in post-harvest management. Financing mechanisms should encourage cooperative-based funding models, where farmer and trader groups collectively access loans for investments in improved transport and market infrastructure. Specifically targeting ALV producers would allow for community-driven financial inclusion, ensuring that women and smallscale traders benefit from available credit opportunities.

Encourage Public-Private Partnerships and donor support

Strengthen partnerships between the public and private sectors to drive localised, scalable interventions. Donor funding should be strategically channelled into innovative solutions that align with local infrastructure capacity and stakeholder needs.

Enforce best hygiene practices and food safety regulations in markets

County authorities must work with market committees to ensure compliance with food safety and handling regulations standards, supported by a monitoring and enforcement framework that incentivises best practice. Government incentives – such as tax breaks for businesses investing in improving hygiene and food safety – could drive private-sector participation.

Consumer awareness campaign on the nutritional value of ALVs

Public awareness campaigns through radio, social media and community outreach could educate consumers on the health benefits of ALVs, leading to increased demand and consumption. Developing and distributing recipe booklets and cooking demonstrations and engaging local influencers, chefs and food bloggers to popularise ALV-based meals among young people could showcase easy ways to prepare ALVs. Additionally, organising nutrition education sessions in markets and community centres and schools would support the promotion of ALV consumption, emphasising affordability and health benefits and encouraging dietary diversification.

6 Conclusion

Reducing food loss in ALVs in Kisumu is not merely a logistical or technical challenge—it is a complex issue shaped by a web of interrelated factors, including onfarm practices, market dynamics, climate conditions, infrastructure limitations, and socio-economic inequalities. This study has highlighted these challenges across three ALV value chains and emphasised the need for targeted, multi-faceted interventions.

Empowering farmers through capacitybuilding initiatives, such as farmer field schools, is critical to equipping them with the skills and knowledge necessary for adopting best practices that improve productivity and sustainability. Investing in infrastructure, including protective harvesting and storage facilities, as well as upgraded market spaces, is essential to minimising post-harvest losses and preserving crop quality. Strengthening market linkages through contract farming and digital platforms would create more transparent and reliable supply chains, offering fairer trade opportunities for small-scale producers.

Given that a significant proportion of ALV losses occur at the market stage (20–30%), there is an urgent need for improved infrastructure, enhanced market governance, better hygiene practices, and solutions to repurpose unsold vegetables. Furthermore, women, who play a central role in the ALV value chain, continue to face socio-cultural and economic barriers that limit their participation in more lucrative segments of the trade. Any interventions must address these genderspecific challenges, ensuring that women are empowered as key agents of change rather than passive recipients of support.

Policy and governance reforms are equally crucial in fostering an enabling environment for more sustainable value chains. Financial inclusion initiatives can provide small-scale farmers and traders—especially women—with the resources and capital needed to invest in improved technologies and post-harvest management practices. Additionally, a structured system for consistent data collection and monitoring is vital for informing evidence-based decisionmaking, enabling targeted interventions, and tracking progress toward food-loss reduction.

Despite the challenges, farmers and traders in Kisumu are already finding ways to reduce losses, protect their crops, and improve their incomes. Initiatives such as the Kisumu Food System Lab and the V4P&P project demonstrate the potential for innovative, locally driven solutions. By building on these efforts and fostering collaboration among stakeholders, Kisumu can lead the way in reducing food loss in ALVs and serve as a model for best practices across the country.

This study, while limited in scope and reliant on qualitative and secondary data, provides a valuable foundation for further research and action. Future studies should focus on accurately quantifying food losses at each stage of the value chain and assessing the long-term sustainability of proposed solutions. Consumer-level behaviours that contribute to food waste also warrant deeper exploration.

Addressing food loss in the ALV sector in Kisumu requires a fundamental shift in mindset. Rather than accepting food loss as an unavoidable aspect of agriculture, stakeholders must view it as an opportunity to embrace holistic, multidimensional solutions. A combination of technological innovation, capacity building, infrastructure investment, and policy reform will be key to transforming Kisumu's ALV sector into a more efficient, inclusive, and resilient food system.

References

- **Abel, B.** (2019) <African Indigenous vegetables value chain governance in Kenya> Studies in Agricultural Economics 121 (https://doi.org/10.7896/j.1818).
- Abukutsa-Onyango, M.B., Brückner, M. and Gülay, C. (2015) Food habits matter: investigating the consumption of African indigenous vegetables in Kenya. Paper presented at Tropentag, 16-18 September, Berlin.
- African Union Commission (2018) Post harvest loss management strategy. Addis Ababa (https://au.int/en/documents/20180821/post-harvest-loss-management-strategy-august-2018).
- **Agnew, J., Mwangi, J., Hall, R.P., et al.** (2021) Transaction and information pain points in African indigenous vegetable value chains in Western Kenya. Blacksburg: Virginia Tech.
- Alliance of Bioversity International and CIAT (n.d.) 'Food System Lab in Kisumu, Kenya'. Webpage. Alliance of Bioversity International and the International Center for Tropical Agriculture (https://alliancebioversityciat.org/projects/food-systemlab-kisumu-kenya).
- **Central Bank of Kenya** (2022) MPC Agriculture Survey, July 2022 (www.centralbank. go.ke/2022/07/29/mpc-agriculture-survey-july-2022).
- **Chen, Q., Knickel, K., Tesfai, M., et al.** (2021) <A framework for assessing food system governance in six urban and Peri-urban regions in sub-Saharan Africa>. Frontiers in Sustainable Food Systems 5: 763352.
- **County Government of Kisumu** (2023) Kisumu county food system strategy 2023-2027 (www.kisumu.go.ke/wp-content/uploads/KISUMU-COUNTY-FOOD-SYSTEM-STRATEGY-2023-2027.pdf).
- **de Jong, M.V., Selten, M.P., Gitata-Kiriga, W., et al.** (2024) An overview of the Kenyan food system: outcomes, drivers and activities. Foresight4Food. Oxford.
- **Gogo, E. et al.** (2017) <Nutritional and economic postharvest loss analysis of African indigenous leafy vegetables along the supply chain in Kenya> Postharvest Biology and Technology 130: 39–47 (https://doi.org/10.1016/J.POSTHARVBIO.2017.04.007).
- Gogo, E., Opiyo, A.M., Ulrichs, C. and Huyskens-Keil, S. (2018) <Loss of African indigenous leafy vegetables along the supply chain. International Journal of Vegetable Science 24, 361–382 (https://doi.org/10.1080/19315260.2017.1421595).
- **Elolu, S., Byarugaba, R., Opiyo, A M., et al.** (2023)> Improving nutrition-sensitive value chains of African indigenous vegetables: current trends in postharvest management and processing> Frontiers in Sustainable Food Systems 7 (https://doi. org/10.3389/fsufs.2023.1118021).

- **FAO** (2017) Formalization of informal trade in Africa: trends, experiences and socioeconomic impacts. Accra: FAO Regional Office for Africa (https://globalinitiative. net/wp-content/uploads/2018/01/FAO-Formalization-of-informal-trade-in-Africa. pdf).
- **FAO** (2018) Food loss analysis case study methodology (https://elearning.fao.org/ course/view.php?id=374).
- **FAO** (2019) The state of food and agriculture 2019: moving forward on food loss and waste reduction. Rome: FAO.
- **FAO, IFAD, UNICEF, WFP and WHO** (2024). The state of food security and nutrition in the world 2024 Financing to end hunger, food insecurity and malnutrition in all its forms. Rome: FAO (https://doi:https://doi.org/10.4060/cd1254en).

FAO and WHO (2025. Codex Alimentarius: International Food Standards. Rome.

- **FAOSTAT** (2024) Hunger and food insecurity indicators (www.fao.org/faostat/ en/#country/114).
- **GCF Green Climate Fund** (2023) Scaling solutions for food loss in Africa. Green Climate Fund. (www.greenclimate.fund/document/re-gain-scaling-solutions-food-loss-africa-0).
- Geoffrey, S.K., Hillary, N.K., Antony, K.M., et al. (2014) <Challenges and strategies to improve tomato competitiveness along the tomato value chain in Kenya> International Journal of Business and Management 9 (https://doi.org/10.5539/ijbm. v9n9p205).
- **George K. and Oloko, M.** (2018) <Flow of materials in a market system: food security and environmental sustainability perspective> International Journal of Markets and Business Systems 3 (4) (https://doi.org/10.1504/IJMABS.2018.10019178).
- Gewa, C. A., Stabile, B., Thomas, P., et al. (2021) < Agricultural production, traditional foods and household food insecurity in rural Kenya: practice, perception and predictors> Journal of Hunger & Environmental Nutrition 18 (4): 540–563 (https://doi.org/10.1080/19320248.2021.1994083).
- Gido, E., Ayuya, O., Owuor, G., and Bokelmann, W. (2017) <Consumption intensity of leafy African indigenous vegetables: towards enhancing nutritional security in rural and urban dwellers in Kenya> Agricultural and Food Economics 5: 1–16.
- Global Hunger Index (2024) <Kenya> (www.globalhungerindex.org/kenya.html).
- Gogo, E., Opiyo, A., Ulrichs, C., & Huyskens-Keil, S. (2018). Loss of African Indigenous Leafy Vegetables along the Supply Chain. nternational Journal of Vegetable Science, 24, 361 – 382. doi:https://doi.org/10.1080/19315260.2017.142159 5.
- How We Made it in Africa (2022) 'Profit-making idea: Traditional African vegetables in Kenya and Tanzania'. 30 Octover (www.howwemadeitinafrica.com/profit-making-idea-traditional-african-vegetables-in-kenya-and-tanzania/148371).
 7Kebede, S.K., Krause, H., Ngenoh, E., et al. (2018) Hortinlea Baseline Survey Report 2014. Hannover Economic Papers (HEP), No. 641. Leibniz Universität Hannover (www.econstor.eu/bitstream/10419/200653/1/dp-641.pdf).

- **Kiptot, E. and Franzel, S.** (2011) <Gender and agroforestry in Africa: a review of women>s participation> Springer Science+Business Media (https://doi.org/10.1007/s10457-011-9419-y).
- **Kirigia, D., Kasili, R. and Mibus, H.** (2018) <African leafy vegetables pre-harvest and post-harvest constrains and technologies for losses reduction along the field to consumer chain> Journal of Horticultural Science 12: 51–60.
- Kitinoja, L. and Kader, A.A. (2015) Measuring postharvest losses of fresh fruits and vegetables in developing countries. Postharvest Education Campaign white paper 15-02 (https://postharvest.org/wp-content/uploads/2023/12/PEF-White-Paper-15-02-PHL-FV-measurement.pdf).
- Konrad-Adenauer-Stiftung (2021) Women access to land rights for food security: a case of Baringo and Samburu Counties (www.kas.de/en/web/kenia/single-title/-/ content/women-access-to-landrights-for-food-securitya-case-of-baringo-andsamburu-counties).
- Marcus, R., Samuels, F., Jalal, S. and Belachew, H. (2021) Gender-transformative programming. Background Paper Series UNICEF Gender Policy and Action Plan 2022-2025 (www.unicef.org/lac/en/media/43146/file).
- Marija Knez, K.M. (2024) <Revealing the power of green leafy vegetables: Cultivating diversity for health, environmental benefits, and sustainability> Global food security 43.
- Matui, M.S., Gonzalez, Y.S., Gema, J. and Koomen, I. (2016) From aid to sustainable trade: driving competitive horticulture sector development: a quick scan of the horticulture sector. Tech. rep., Wageningen Centre for Development Innovation.
- Mibei, S.B., Macharia, I.N. and Mwenjeri, G.W. (2021) < Technical and allocative efficiencies among smallholder Tomato farmers in Kajiado County, Kenya> East African Agricultural and Forestry Journal 85: 271–278.
- Mwaniki, F.N. and Nyamu, F.K. (2022) <Reducing food loss in Kenya for a sustainable food future> in Filho, W.L., Kovaleva, M. and Popkova, E. (eds) Sustainable Agriculture and Food Security: pp. 311–326. Springer.
- Ndinya, C.A. (2019) < The genetic diversity of popular African leafy vegetables in western Kenya>. Genetic diversity in horticultural plants: 127–159.
- **Onyango, G.M., Wagah, G.G., Omondi, L.A. and Obera, B.O.** (2013) Market places: experiences from Kisumu City. Mistra Urban Futures (www.mistraurbanfutures. org/en/publication/market-places-experiences-kisumu-city).
- **Opiyo, P.A., Agong, S.G., Awuor, F.O and Gilani, M.** (2021) <Urban dynamics of food loss and waste: challenges and opportunities for improving food security in Kisumu, Kenya> Journal of Food Security 9(1): 1–7 (https://doi.org/10.12691/jfs-9-1-1).
- **Opiyo, P.O. and Ogindo, H.O.** (2018) <The characteristics of the urban food system in Kisumu, Kenya>, in Battersby, J. and Watson, V. (eds) Urban food systems governance and poverty in African cities: 182–194. London: Routledge.

- **Opiyo, P., Obange, N., Ogindo, H. and Wagah, G.** (2018) The characteristics, extent and drivers of urban food poverty in Kisumu, Kenya. Consuming Urban Poverty Project Working Paper No 4, African Centre for Cities, University of Cape Town (https://repository.maseno.ac.ke/handle/123456789/2375).
- **Otieno, A., Obange, N. and Onyango, G.M.** (2022) Rapid urban food system appraisal, Kisumu Kenya 2021–2022. FAO and County Government of Kisumu.
- **Research Solutions Africa** (2015) Report of a study on fresh vegetables market in Kenya: Desk review. Nairobi.
- Shiundu, K.M. and Oniango, R. (2007) <Marketing African leafy vegetables: challenges and opportunities in the Kenyan context> African Scholarly Science Communications Trust (https://doi.org/10.18697/ajfand.15.ipgri2-8).
- **Defraeye, T., Schudel, S., Shrivastava, C., et al.** (2024) <The charcoal cooling blanket: a scalable, simple, self-supporting evaporative cooling device for preserving fresh foods> Biosystems Engineering 238: 128–142 (https://doi.org/10.1016/j.biosystemseng.2023.12.001).
- **UNEP United Nations Environment Programme** (2024). Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste. United Nations Environment Programme.
- **UN DESA** (n.d.) 'Gender terms explained' (www.un.org/esa/sustdev/csd/csd15/lc/ gender_terms.pdf).
- **World Bank** (2021) < Agricultural land (% of land area)>. Webpage (https://data. worldbank.org/indicator/AG.LND.AGRI.ZS?locations=KE).

Appendix 2 Questionnaire

Production stage

RESEARCH TOPIC: Understanding the scale, causes, and solutions to food loss in three African leafy vegetables in Kisumu City

Introduction and informed consent

My name is ______ – A Research Assistant for the ODI _ World Vegetable Center (WorldVeg) Healthy Urban Diets Project, that aims to understand the demand for vegetables and support the role of vegetables in healthy urban diets. Kisumu is one of the cities participating in the project. This research is being conducted on three value chains of African leafy vegetables and tomatoes based on the scale of production and consumption. The three African indigenous leafy vegetables selected for the study are African nightshade -managu; Cowpeas – kunde and Amaranth – mchicha). Please note that you will not be identified, and the responses you give will be treated with strict confidentiality and will be used only for the purpose of this study. If you consent, we will proceed with the interview. You are free to decline to answer any questions or terminate the interview at any time.

Do you consent to proceed with the interview?

Name of RA/ Interviewer

Date:

Time:

Section A: Questions for producers / farmers

Demographic information (This information will be captured in a participant list of the FGD)

Respondent No:

Gender: M F

Age category: 18-35 36-55 56 and above

Level of formal education:

No formal education Primary Secondary Tertiary

Location of farm/ production site:

Size of the farm under ALVs /tomatoes

Volume of production (per month???) Or per season?

How many seasons per year?

Use of technology (irrigation, greenhouse, etc)

Which vegetables do you produce in your farm? (The groups targeted will be those that produce the vegetables of focus, this will be a confirmation question)

African nightshade - managu Cowpeas - kunde Amaranth - mchicha Tomatoes Any others? (Specify) Where do you sell the vegetables from your farm? – order by volume – (Farmgate, nearby local market centre, markets in Kisumu, other towns, etc).

To whom do you sell your vegetables? – order by volume? (local consumers, middlemen/ aggregators, wholesalers / retailers in Kisumu) OR selfconsumption

What standards do buyers expect? Freshness, cleaned, colour, etc.?

What means of transport is used to transport the vegetables to the market – by yourself or buyers? (lorry or truck; hand cart; Auto rickshaw, PSV matatu, motorcycle, bicycle, carry by self)

Why do you choose to use the means of transport specified in (6) above? (Price, convenience (readily available), time (e.g. speed))

What do you perceive as losses (spoilage, reduced quality/freshness, discarded etc)

What has been the trend / changes in losses in the last 5-10 years?

If relevant - who bears the cost of losses? Farmers, aggregator or vendor?

Are there any quantitative losses of your vegetables at the harvest stage?

What percentage of total produce?

Do you sell products at lower price because of lower quality at the harvest stage? What percentage?

If you transport your vegetables to the market, do you lose any of the produce at this stage? What percentage? (QN loss)

If you transport your vegetables to the market, do you sell any of your produce at lower price because of lower quality? What percentage? (QL loss)

What are the reasons for losses/damage to your vegetables at the harvest/ post-harvest stage at the farm? (NOTE: if interviewing a female farmer, ask if balancing household care with farm work affects the level of loss)

Improper use of chemical inputs (lack of access, availability, cost, low knowledge of dose and timing of application) Lack of access to technology Damage due to poor or rough harvest and handling practices Rotting due to exposure to weather elements (rain, humidity, heat, etc) and flooding Lack of proper storage capacity and facility Wilting due to exposure to high temperatures Time of the day (what time of the day do you normally harvest your vegetables? Why?) Attacks by pests, diseases, and rodents (specify which ones) Others (specify)

If you transport your vegetables to the market. What are the reasons for losses/ damage to your vegetables during transportation?

Damage due to rough or poor handling practices Damage due to poor packaging practices (poor packaging materials, over packing and pressure on the crop, etc.) Damage due to vibration on rough roads Wilting due to exposure to high temperatures Exposure to dirt and motor vehicle fumes Spoilage due to long distances travelled to the market Others (specify)

Do the losses/spoilage have implications on your income? Can you provide estimates of the percentage of income lost?

What do you currently do to minimise or reduce loss or spoilage of your vegetables?

In the last few years, have you been involved in any project, programme, trainings, or initiative to reduce losses or spoilage of your vegetables?

Section B: Questions for observations on the ground (Ask ONLY if necessary)

Other than ALVs or tomatoes, what are the other food products produced?

Are there any quality standards applied in production of vegetables?

How are harvested food products protected from the sun and rain?

How are the vegetables packaged and stored at the farm? Why?

How are the vegetables packaged for transportation? Why?

What are the measurement and packaging units used, and how are they measured?

Do you they any specialised equipment or facilities for harvesting, storage or transportation of vegetables? Which ones?

Section C: Social/gender issues in food loss reduction:

Which activities are women mainly involved in?

Are there any social norms and traditions that limit women, youth or men participation?

What should be done to increase opportunities for men, women and youth to participate in the supply chain?

Section D: Environmental issues

Are there waste management measures in place (organic waste separation, animal feed, composting)

Do you have access to any cold storage facilities? What is the source of energy for storage, cold chain etc? Is access to energy an issue that contributes to FL?

Is the weather variability contributing to increased food losses? How? How is the situation during the rainy seasons or dry seasons?

Section E: Any other issues or observations

Do you have any other issues or suggestions regarding the subject we have just discussed that you would like to share with us?

Transport and aggregation

RESEARCH TOPIC: Understanding the scale, causes, and solutions to food loss in three African Leafy Vegetables in Kisumu City

Introduction and informed consent

My name is ______ – A Research Assistant for the ODI _ World Vegetable Center (WorldVeg) Healthy Urban Diets Project, that aims to understand the demand for vegetables and support the role of vegetables in healthy urban diets. Kisumu is one of the cities participating in the project. This research is being conducted on three value chains of African leafy vegetables and tomatoes based on the scale of production and consumption. The three African indigenous leafy vegetables selected for the study are African nightshade – managu; Cowpeas – kunde and Amaranth – mchicha). Please note that you will not be identified, and the responses you give will be treated with strict confidentiality and will be used only for the purpose of this study. If you consent, we will proceed with the interview. You are free to decline to answer any questions or terminate the interview at any time.

Do you consent to proceed with the interview?

Name of RA/ Interviewer

Date:

Time:

Section A: Questions for transporters/ distributors? Demographic information

Respondent No:

Gender: M F

Age category: 18-35 36-55 56 and above

Level of formal education:

No formal education Primary Secondary Tertiary

Are you familiar with the basics/ public health standards of transporting vegetables?

Location / Area of operation:

To which market(s) in Kisumu do you deliver vegetables? How long does it take you to reach the market? Why?

What mode of transport do you use to deliver vegetables to the market? Why?

Bicycle Motorcycle Three-wheeler taxi (Auto rickshaw) Pick-up truck Passenger Service Vehicle (matatu) Large truck Hand cart Others (specify) Is your mode of transport specifically designed/ modified to carry food / vegetables? How?

Which vegetables do you transport / distribute/ deal in?

African nightshade – manage Cowpeas – kunde Amaranth – mchicha Tomatoes Any others? (Specify)

What is the source(s) of the vegetables you transport to or distribute in Kisumu?

How are the vegetables delivered to you from the farms /markets?

What do you perceive as losses (spoilage, reduced quality/freshness, discarded etc)

What has been the trend / changes in losses in the last 5-10 years?

Are there any losses or spoilage or damages that occur during transportation of the vegetables? What percentage is lost?

Who bears the cost of any losses or damages during transportation? (Transport operator, owner of consignment). Why?

What are the reasons for the losses or damages of vegetables during transportation?

Damage due to rough or poor handling practices Improper packaging practices (material, over packing) Rotting due to exposure to weather elements during transportation (rain, humidity, heat, etc) Wilting due to exposure to heat / high temperatures Exposure to dirt and motor-vehicle fumes Spoilage due to long distances and time taken to the market. Rough or bumpy roads to the markets. Others (specify) Do the losses/ spoilage have implications on your income? Can you provide estimates of the percentage of income lost?

Do you take measures to minimize or reduce loss or spoilage of the vegetables you transport?

In the last few years, have you been involved in any project, programme, trainings, or initiative to reduce losses or spoilage of vegetables?

Section B: Questions for observations on the ground (Ask ONLY if necessary)

Other than ALVs or tomatoes, what are the other goods do you transport?

How are the vegetables you transport protected from the sun and rain?

Do you have access to and use any cooling facilities? Which ones? How are the vegetables packaged for transportation? Why? Follow up on why tomatoes are packaged in smaller wooden boxes with others covered outside the box). Why ALVs packaged in gunny bags and not crates?

Do you have any specialised equipment for transportation of vegetables? (Which ones? If not Why?)

Section C: Social/gender issues in food loss reduction:

Which activities are women mainly involved in?

Are there any social norms and traditions that limit women, youth or men participation.

What should be done to increase opportunities for men, women and youth to participate in the supply chain?

Section D: Environmental issues

Are there waste management measures in place (organic waste separation, animal feed, composting)

Do you have access to any cold storage facilities? What is the source of energy for storage, cold chain etc.? Is access to energy an issue that contributes to FL? Is the weather variability contributing to increased food losses? How? How is the situation during the rainy seasons or dry seasons?

Section E: Any other issues or observations

Do you have any other issues or suggestions regarding the subject we have just discussed that you would like to share with us?

Market stage:

RESEARCH TOPIC: Understanding the scale, causes, and solutions to food loss in three African Leafy Vegetables in Kisumu City

Introduction and informed consent

My name is _____ – A Research Assistant for the ODI _ World Vegetable Center (WorldVeg) Healthy Urban Diets Project, that aims to understand the demand for vegetables and support the role of vegetables in healthy urban diets. Kisumu is one of the cities participating in the project. This research is being conducted on three value chains of African leafy vegetables and tomatoes based on the scale of production and consumption. The three African indigenous leafy vegetables selected for the study are African nightshade -managu; Cowpeas – kunde and Amaranth – mchicha). Please note that you will not be identified, and the responses you give will be treated with strict confidentiality and will be used only for the purpose of this study. If you consent, we will proceed with the interview. You are free to decline to answer any questions or terminate the interview at any time.

Do you consent to proceed with the interview?

Name of RA/ Interviewer

Date:

Time:

Market venue:

Section A: Questions for market traders

Demographic information

Market:

Respondent No: 1

Gender:

Μ

F

Age category: 18–35 36–55 56 and above

Level of formal education:

No formal education Primary Secondary Tertiary

In which section of the market do you trade?

Formal market space Informal space within the market Informal space outside the market

Which vegetables do you deal in?

African nightshade – manage Cowpeas – kunde Amaranth – mchicha Tomatoes Any others? (Specify)

What is the source(s) of the vegetables you sell? (Where do you buy the vegetables?) Can you provide contacts? (Note: they should name the production sources – where the vegetables come from).

How are the vegetables delivered to you in the market? (Note: Time and frequency of delivery, mode of transport & packaging, etc)

What is the quality grade when you receive it? (On a scale of 1-4) Where Grade 1 is wilted, damaged or observable quality issue, and Grade 4 is fresh, visible high quality, packaged etc.)

Who are your main customers? (households, restaurants, institutions) From which residential areas?

What proportion / percentage of vegetables in a batch do you throw away / discard? (Out of 10 units – i.e. on a scale of 0–10)

What do you do with the lower quality vegetables? (Sell at lower price, minimal processing, discarding)

In your view, are there losses (by vegetable) along the value chains? At what stage are these losses more likely to happen? (Harvest, transportation, or market)

Do you consider food loss (vegetables getting spoilt) as an integral part of the operation? Why?

What are the reasons for food losses in your vegetable business?

lack of knowledge on best handling and post-harvest practices, Inadequate infrastructure and logistics Lack of storage and cold chain Lack of information systems on supply and demand, Poor condition of marketplace including space, hygiene, availability of clean water Consumers purchasing behaviour (preferences, price, food safety, etc.) Pests, rodents, and diseases Natural disasters – flood, heat, humidity Others

Do the losses have implications on your income? Can you provide estimates of the proportion of income lost? (on a scale of o-10; or percentage) Is there any waste management mechanism in the market? How is waste managed?

Who bears the cost of waste management? (Traders, Municipality, Market Association)

What solutions do you think can address the problem of food loss?

What solutions for prevention/reduction/ management of food loss have worked before? What has not worked before? And why?

What is needed for the proposed solutions to happen?

Section B: Questions coupled with observations on the ground?

Observe the difference in practices between male and female vendors.

Other than vegetables, what are the different types of food products sold by the trader?

Are food products protected from weather elements – the sun and rain, and how?

Are food products cooled or pre-cooled, adequately, or not? (Observe and ask – any availability of cooling facilities?

Are food products packaged and stored adequately? How and where are they stored?

Are food products handled carefully to avoid damage?

Is potable water used to wash food products or equipment? (Observe and ask about water availability and use)

What are the measurement and packaging units used, and how are they measured?

How are food products transported and does this cause any damage or other loss?

What coping strategies are being used at the site to prevent, reduce and manage food losses? (e.g. cutting, minimal processing, animal feeds) How effective or ineffective are the loss reduction measures? (Rating on a scale of effective – neutral – Ineffective).

To what extent is the local infrastructure in place and adequate? (Observe the infrastructure and facilities in the market – stalls, shade, water, electricity, etc) Section C: Social/gender issues in food loss reduction:

Highlight the points of the market where women are mainly involved.

Identify and show women's and men activities in the VCs, even if not visible and/or not remunerated; identify social norms and traditions that limit women's participation.

Identify men's roles that might increase women's opportunities.

Identify training opportunities, equipment and infrastructure gaps, services and inputs to which women should gain access to reduce food losses. Identify possibilities to empower women to benefit from services and facilities and increase their involvement in decision making in the market.

Section D: Environmental issues

Are there waste management measures in place (organic waste separation, animal feed, composting)

Do you have access to any cold storage facilities? What is the source of energy for storage, cold chain etc? Is access to energy an issue that contributes to FL?

Is the weather variability contributing to increased food losses? How? How is the situation during the rainy seasons or dry seasons?

Section E: Any other issues or observations

Do you have any other issues or suggestions regarding the subject we have just discussed that you would like to share with us?

Additional notes by the RA/Enumerator:



ODI Global advises leaders on driving positive change. We turn bold ideas, evidence, and broad expertise into actionable strategies for a more resilient, just and equitable future.

ODI Global

203 Blackfriars Road London SE1 8NJ, UK +44 (0)20 7922 0300 info@odi.org

odi.org odi.org/facebook odi.org/twitter