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Indigenous Leafy Greens Value Chain Deep-Dive

May 2023

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Executive summary

Background and overview of Kenya's ILG* sector

Country Production

- In 2020, **Kenya produced 300k MT of ILG**, primarily by smallholder farmers for the domestic fresh produce market
- Production volumes grew 4% at a 4% CAGR from 2017 – 2020, with **demand driven by rising consumption in urban areas** due to increased consumer awareness of ILG's health benefits
- Of the more than 200 species of indigenous vegetables grown in Kenya, **the most commonly consumed are cowpea, African nightshade, amaranthus, and spider plant**
- While production happens across the country, **nearly half occurs in Western Kenya**

Critical Loss Points

- **34% of production volume is lost** along the supply chain, equating to ~101k MT of waste annually
  - Production (15%): Driven by lack of buyers and value addition opportunities
  - Aggregation level (3%): Driven by improper handling during transport and storage
  - Offtake level (16%): Driven by multiple intermediaries and improper storage
- **Losses are highly influenced by seasonality** with most losses occurring during the rainy seasons** due to an oversupply of ILG and other fresh produce

Other Insights

- **Kenyans consume ILG three times per week on average**, cooking them alone or mixed together with other ILG, tomatoes, and onions
- **Leafy greens are high in key micronutrients** including iron, folate, vitamin A, and vitamin C
- **Women are highly involved in horticultural supply chains**, particularly at the production, wholesale, and informal retail levels
- Due to its income generation opportunities for SHFs, nutrition, and agro-climatic adaptability, **ILG have been prioritized as a key crop by the Kenyan government and NGOs**

*Indigenous leafy greens

**Rainy seasons in Kenya are April-June and November – December, Tomato supply gluts trail rains by ~1 month, which is the growing period of ILG

Note: Loss and waste defined as produce unsold between farm-gate and retailer level

Source: : Kenya Horticulture Crop Directorate, FAOSTAT, Bokelmann et al. (2022), Gido et al. (2017)

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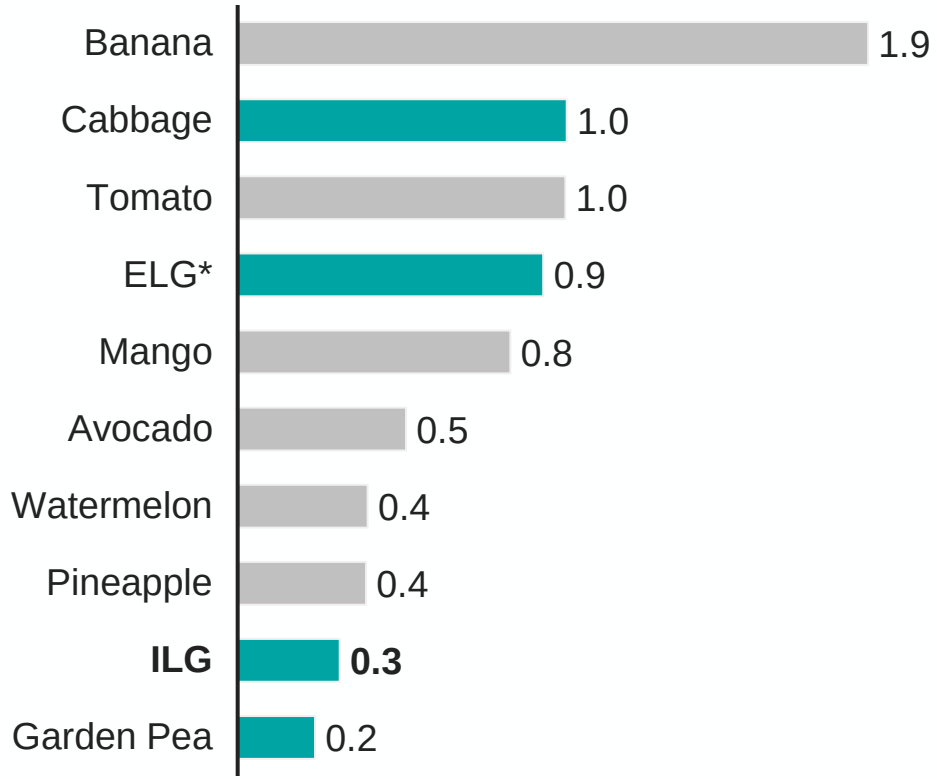
Driven by strong domestic demand, indigenous leafy greens are the third largest vegetable in Kenya by production volume

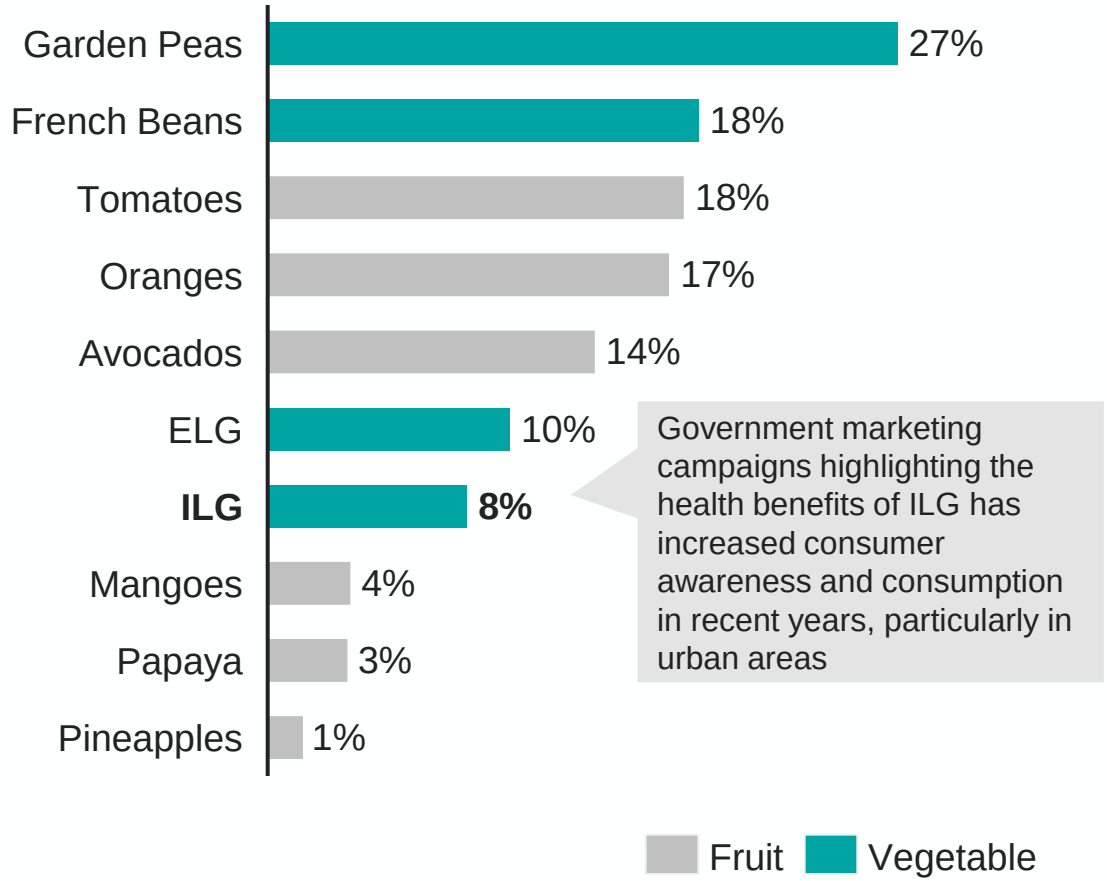
Production volumes (2020)

Millions MT



Production volumes CAGR (2017 - 2020)

Percentage



Government marketing campaigns highlighting the health benefits of ILG has increased consumer awareness and consumption in recent years, particularly in urban areas

*Exotic leafy greens (includes kale and spinach)

Note: Fruits and vegetables defined using FAO guidelines, which exclude roots and tubers, pulses

Source: Kenya Horticulture Crop Directorate, FAOSTAT

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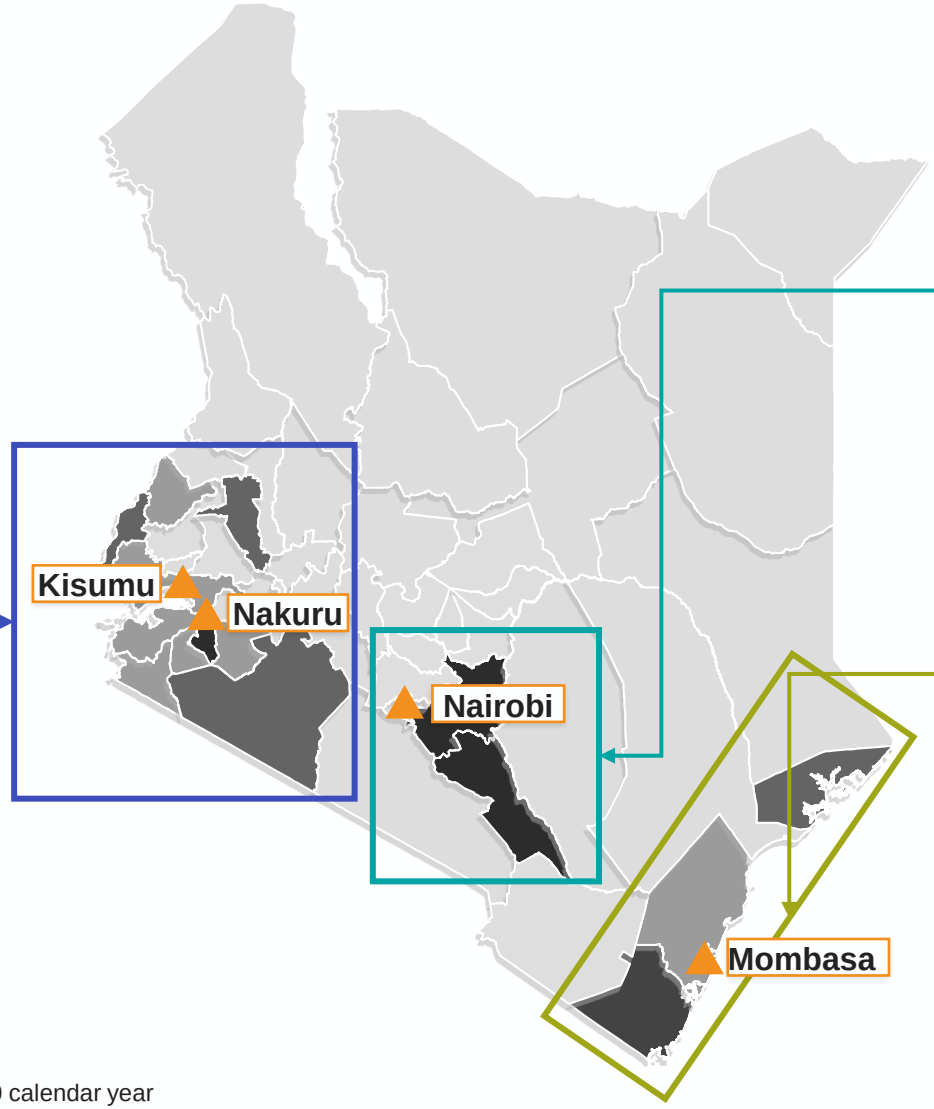
Of the 200+ ILG native to Kenya, the most commonly consumed are cowpea leaf, African nightshade, amaranthus, and spider plant

				
Common names	Cowpea leaf Kunde	African nightshade Managu	Amaranthus Terere	Spider plant Saga
Production volumes	114K MT	59K MT	38K MT	36K MT
Top producing counties	1. Makueni 2. Machakos 3. Kwale	1. Nyamira 2. Uasin Gishu 3. Bomet	1. Lamu 2. Narok 3. Mombasa	1. Nyamira 2. Kisii 3. Uasin Gishu
Consumption patterns	• Kenyan households consume ILG 3x per week on average • Individual varieties may be cooked alone or combined with other ILG, tomatoes, and/or onions • Common preparation techniques include steaming, boiling, and frying • One barrier to consumption is the perception that ILG are time-consuming to prepare			

Note: Data based on 2020 calendar year
Source: Kenya Horticulture Crop Directorate, Bokelmann et al. (2022), Gido et al. (2017)

Nearly half of ILG is grown in Western Kenya, although there is significant production in the central and coastal regions as well

Western region
- **Production volumes:** 115K MT
- **Area harvested:** 12.9K Ha
- **Production value**: 4.0Bn KES*



Central region
- **Production volumes:** 53K MT
- **Area harvested:** 24.2K Ha
- **Production value**: 1.0Bn KES**

Coastal region
- **Production volumes:** 32.2K MT
- **Area harvested:** 4K Ha
- **Production value**: 0.8Bn KES***

*Equal to $30M USD as of April 23, 2023
**Equal to $7.5 USD as of April 23, 2023
**Equal to $5.7M USD as of April 23, 2023
Note: Data is for the top four ILG species as of the 2020 calendar year
Source: Kenya Horticulture Crop Directorate

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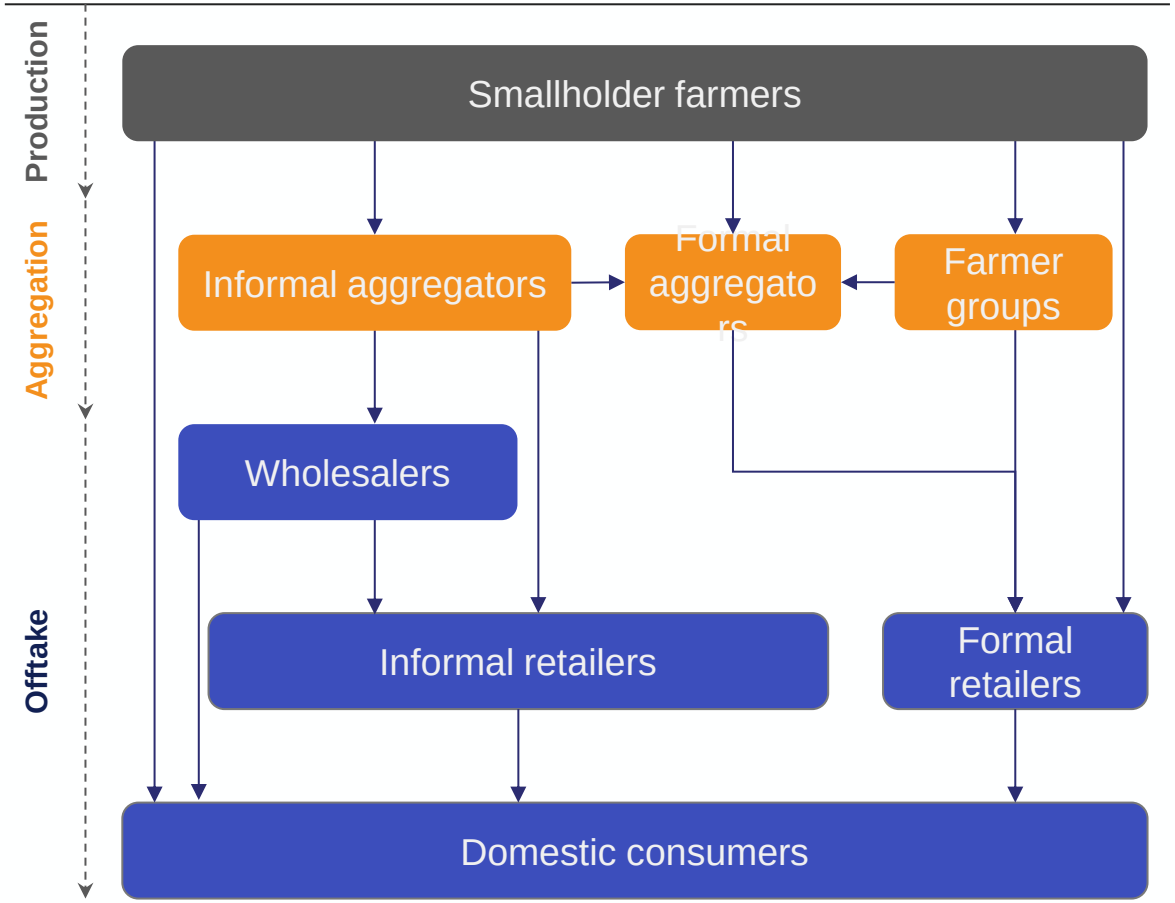
Most ILG are produced by smallholder farmers and sold domestically at informal retailers as fresh produce

Domestic fresh value chain visualization



Description

Production
- ILG are produced primarily by SHFs in rural and peri-urban areas
- The crops are attractive for SHF production due to their short growing cycle*, agroclimatic adaptability, and low inputs required
- Most SHFs sell to brokers at farm-gate, although some supply to formal aggregators, farmer groups, and formal retailers

Aggregation
- Informal aggregators source directly from farmers and are responsible for harvesting and transporting produce to market
- Formal retail aggregators are contracted by formal retailers and may source from multiple actors including individual SHFs, farmer groups, and / or brokers
- Organized farmer groups, most prevalent in peri-urban areas, may also sell directly to formal retailers

Offtake
- Wholesalers purchase from informal aggregators and sell smaller bundles of greens to informal retailers or directly to consumers
- Almost all ILG are sold domestically as fresh produce
- Most consumers purchase ILG at informal, open-air markets, with a small but growing portion opting for formal retailers
- Dried ILG is a niche but growing product category that is sold both domestically at formal retailers and internationally** via exporters

*Typically 4 – 8 weeks from sowing to harvest
*International demand driven by Kenyan diaspora
Note: Commercial farms, processors, and exports were excluded from visualization as they represent a small percent of production
Source: Godo et. al (2016), Kenya Horticulture Crop Directorate, FAOSTAT, Abel et al. (2019,) Expert interviews

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34% of production volumes is lost along the supply chain, equating to ~101K MT of waste annually

Key takeaways

Smallholder farmers

Farmers struggle to find buyers during rainy season due to a market-wide oversupply of ILG and other rain-fed produce

Limited knowledge and offtake opportunities for value addition leads to further levels of on-farm losses

Informal aggregators

Improper handling practices, lack of cold storage, and poor road infrastructure result in transportation losses from farm to market

Formal aggregators

Formal aggregators are more likely to implement proper transportation and storage practices, leading to low rejection rates at formal retailers

Wholesalers

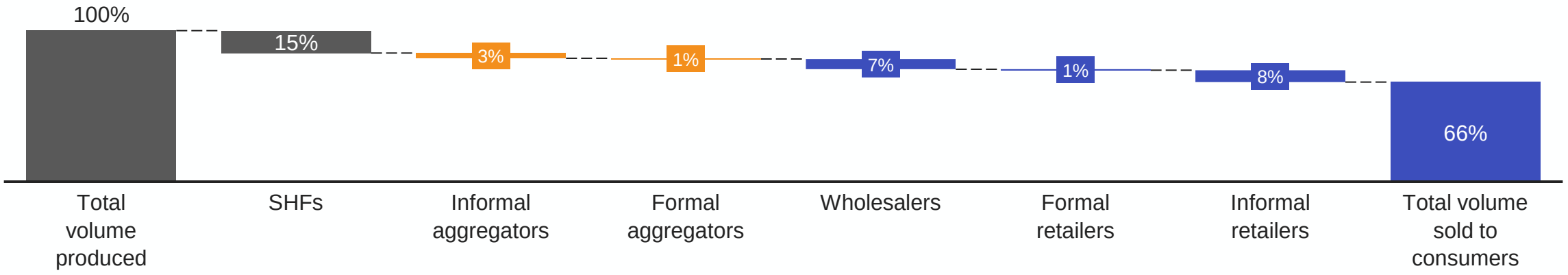
Information asymmetry allows informal aggregators to pass quality losses on to wholesalers

Formal retailers

Formal retailers lack commercial incentives to reduce in-store losses due to favorable contracts with suppliers

Informal retailers

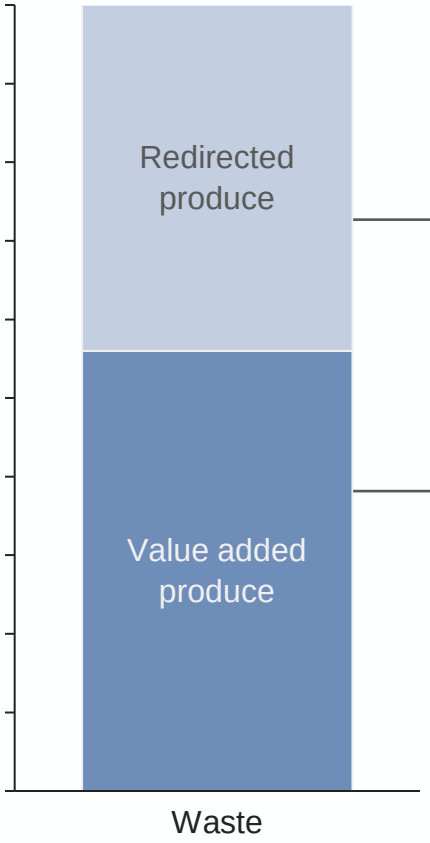
Multiple intermediaries involved between farm and offtake markets is time consuming, leading to high levels of quality loss by the time retailers market produce



Source: Gogo et al. (2016), Expert interviews, TechnoServe analysis

45% of ILG volumes wasted could be redirected to consumers as fresh produce, while the remainder is more suitable for value addition

Waste volumes by rescue solution category



	Description	Volume (K MT)	Primary Sources
Redirected produce	Produce desirable to consumers in its current state (e.g., surplus or blemished produce)	45	• Farms • Formal aggregators
Value addition	Produce that needs to be processed from its current state in order to be desirable to consumers (e.g., produce crushed in transport, overripe produce)	56	• Informal aggregators • Wholesalers • Formal and informal retailers

Total MT 101K

Note: Analysis only applicable to rescue solutions. Reduction solutions may change the breakdown of waste quality
Source: Expert interviews, TechnoServe analysis

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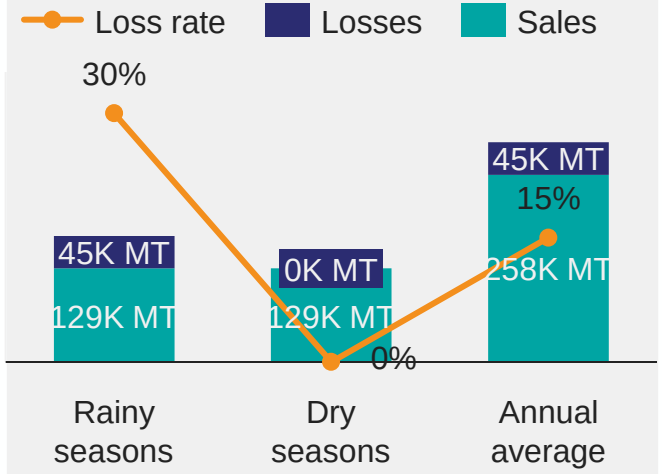
Farm-gate losses almost exclusively occur during the rainy seasons, when markets are unable to absorb the influx of supply

SHFs → Informal aggregators → Formal aggregators → Wholesalers → Formal retailers → Informal retailers

Loss volumes and rates



- Unsold produce typically **used as animal feed** for livestock **or sold to informal markets** at heavily discounted prices
- Lack of offtake opportunities in the rainy season results in **economic losses for farmers**

Key challenges	Existing solutions	Adoption*
Market access		
• Lack of buyers during rainy seasons due to oversupply of produce from rainfed systems	• Processors purchase surplus ILG from farmers during rainy seasons for drying and freezing	○
	• Farmers solar dry ILG on-farm, although this technique is less effective during the rainy seasons when temperatures and sunlight are lower	○
	• Digital marketplace platforms (e.g., Kwik Basket, Taimba) connect farmers directly to offtake markets	○
Knowledge		
• Lack of knowledge on value addition techniques to prolong shelf life (e.g., solar drying)	• NGOs (e.g., World Vegetable Center, USAID) train farmers on GAP and value addition techniques	◑
• Improper cleaning practices (e.g., neglecting to dry leaves after cleaning them with water) can lead to diseases such as mold		
Equipment		
• Lack of cold storage results in accelerated quality deterioration and spoilage	• Solar cold storage and other alternative cold storage products (e.g., Solar Freeze, Tanager) offer practical, lower cost storage solutions for SHFs with limited financing and unreliable access to electricity	○

*Est. proportion of actors currently using solution in Kenya

Source: Gogo et al. (2016), Muchoki et al. (2020), Expert interviews, TechnoServe analysis

High ● Medium ◑ Low ○

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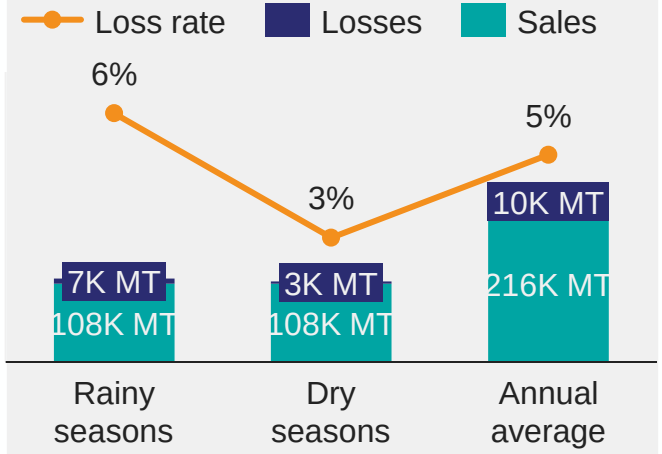
Informal aggregators' improper packaging and transportation practices cause quality deterioration from farm to market

SHFs → **Informal aggregators** → Formal aggregators → Wholesalers → Formal retailers → Informal retailers

Loss volumes and rates



- **Many aggregators selling to Nairobi source from peri-urban farms** as transporting from Western Kenya is expensive and increases chance of quality deterioration due to longer transport times
- **Aggregators may "window dress" product***, filling top layer of sacks with high quality greens to cover lower quality greens below

Key challenges	Existing solutions	Adoption
Market access		
• Lack of buyers during rainy season due to oversupply of produce from rainfed systems	• *Did not identify existing solutions in Kenya*	
Knowledge		
• Improper handling practices (e.g., use of burlap sacks and non-perforate ethylene bags) limits air circulation and crushes tender leaves during transport to market	• Plastic crates improve circulation and prevent crushing but are perceived by transporters as bulky and expensive	○
	• Alternative packaging technologies, such as Xtend polyethylene films, extend shelf life by controlling the gas exchange of oxygen, CO2, and ethylene	○
Equipment		
• Lack of temperature-controlled transportation and market storage accelerates spoiling process of heat-sensitive greens, particularly during warmer months	• While formal aggregators typically use cold trucks for transportation, adoption in the informal sector is low due to the high cost of investment	○
Infrastructure		
• Poor road conditions increase total transportation time from farm to market and cause leaves to shake	• *Did not identify existing solutions in Kenya*	

*Occurs primarily in dry season when demand is high and supply is low

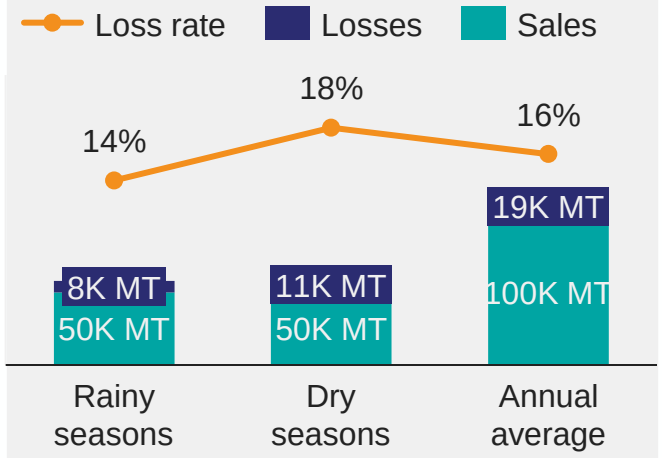
Source: Gogo et al. (2017), Gogo et al. (2016), Expert interviews, TechnoServe analysis

High ● Medium ◑ Low ○

Information asymmetry allows informal aggregators to pass on losses to wholesalers, who lack complete information about supply quality

SHFs | Informal aggregators | Formal aggregators | **Wholesalers** | Formal retailers | Informal retailers

Loss volumes and rates



- Unsold produce in urban areas more likely to be **sent to landfills** due to limited presence of livestock compared to rural areas
- Despite lower demand, some wholesalers reported lower losses in the rainy season as **lower temperatures prolonged shelf life**

Key challenges	Existing solutions	Adoption
Market access		
• Lack of buyers during rainy seasons due to oversupply of produce from rainfed systems	• *Did not identify existing solutions in Kenya*	
Knowledge		
• Wholesalers unable to discern quality of produce in sacks supplied by aggregators prior to purchase • Underuse of protective packaging exposes produce to contamination due to poor sanitation of open-air markets and frequent handling by consumer	• Alternative packaging technologies, such as Xtend polyethylene films, extend shelf life by controlling the gas exchange of oxygen, CO2, and ethylene	○
Equipment		
• ILG exposed to heat and other weather due to lack of cold storage in open-air markets	• Subscription-based cold-storage (e.g., Fresh Box) and other refrigeration services provide more affordable storage options for retailers	○

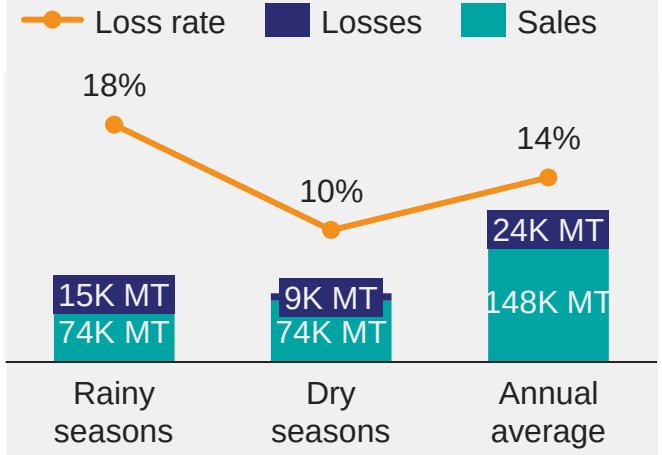
Source: Expert interviews, TechnoServe analysis

High ● Medium ◑ Low ○

By the time produce reaches informal markets, retailers have a short window of time to sell ILGs before spoiling

SHFs → Informal aggregators → Formal aggregators → Wholesalers → Formal retailers → **Informal retailers**

Loss volumes and rates



- Retailers periodically **apply water to leaves to preserve freshness**, which may lead to contamination and accelerate losses
- Urban retailers interviewed are interested in learning to dry leaves but feel they **don't have the space required for processing**

Key challenges	Existing solutions	Adoption
Market access		
• Lack of buyers during rainy seasons due to oversupply of produce from rainfed systems	• Digital platforms connecting mama mbogas to consumers (e.g., Soko Kijiji) provide additional offtake opportunity for retailers	○
Knowledge		
• Improper storage practices (e.g., storing ILG alongside ethylene-producing produce) accelerates deterioration process • Underuse of protective packaging exposes produce to contamination due to poor sanitation of open-air markets and frequent handling by consumers	• Alternative packaging technologies, such as Xtend polyethylene films, extend shelf life by controlling the gas exchange of oxygen, CO2, and ethylene	○
Equipment		
• ILG exposed to heat and other weather due to lack of cold storage in open-air markets	• Subscription-based cold-storage (e.g., Fresh Box) and other refrigeration services provide more affordable storage options for retailers	○
Infrastructure		
• Multiple intermediaries in supply chain is time consuming, leading to high levels of quality loss by the time retailers market produce	• Digital platforms connecting farmers directly to offtake markets reduce the number of handoffs required	○

Source: Gogo et al. (2017), Gogo et al. (2016), Expert interviews, TechnoServe analysis

High ● Medium ◑ Low ○

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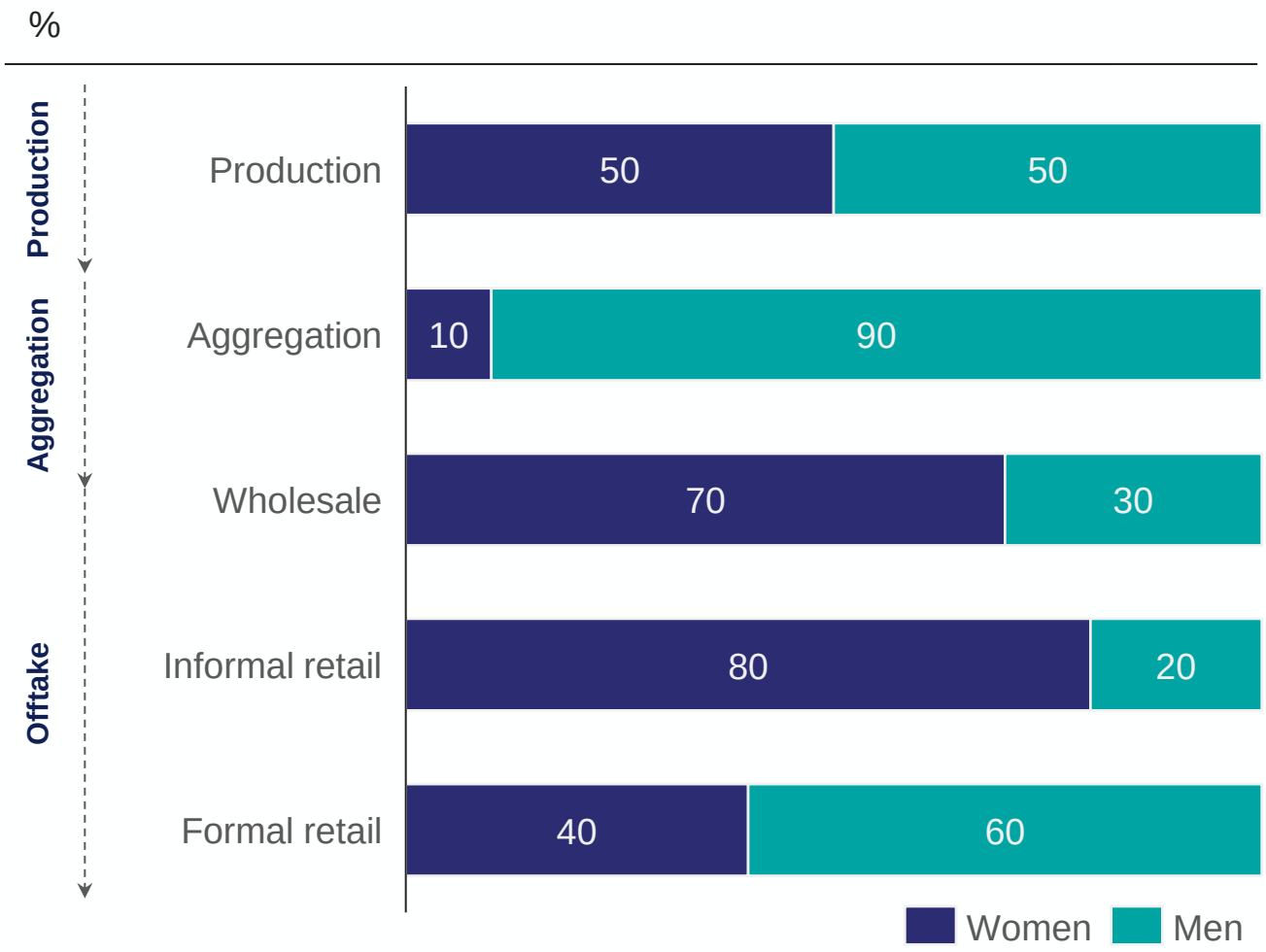
Activities related to production, wholesale, and informal retail present the largest opportunity for female engagement

Gender breakdown by activity in horticulture sector



> *"Women would not survive the transportation business due to the long hours and manual labor required. Men are hard-wired to endure hardship."*
>
> - Male Director, industry association

> *"Cultural barriers make it difficult for women to take on leadership positions. Women are often forced to choose between their family or their job."*
>
> - Female CEO, solution provider

> *"Women are more patient and detail-oriented, which makes them well suited for aggregation and retail activities."*
>
> *- Male CEO, exporter*

Note: Data should be interpreted as directionally representative of Kenya's horticulture sector
Source: Expert interviews, TechnoServe analysis

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We aligned on three value chain archetypes for preliminary solution design

Value chain archetype	• **Leafy greens**	• **Affordable and accessible fruits**	• **Less affordable seasonal fruits**
Scalable chains	• **Indigenous leafy greens** (e.g., spider plant, cow pea leaves, nightshade) • Exotic leafy greens (e.g., spinach, kale)	• **Tomato** • Banana	• **Mango** • Pineapple • Avocado
Shared characteristics	• Lower seasonality • High perishability (< 48 hours) • Tender leaves susceptible to handling injuries during transportation • Limited processing sector	• High production volumes • Low seasonality • Medium / high perishability • Highly affordable • Limited processing sector	• High seasonality • Significant export market • Established processing sector

Sankey diagram: ILG