Fighting Post-Harvest Food Loss in Kenya

Analysis of the fruit & vegetable value chain working towards business opportunities

enviu & RVO

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   Issue: Food Losses in Kenya
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2 A picture of food losses in Kenya
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Our Vision is to Reduce Food Loss by 80% in 2030

Managu (Local healthy leaves), Nairobi, Kenya
To feed the growing global population, food volume will need to increase enormously.

- Population is estimated to increase from 7.5 billion (2017) up to 9.7 billion by 2050.

- To feed a growing population, food production will need to increase by 60% by 2050 compared to 2005 (UN 2009).

- FAO estimates that each year, approx. 1/3 of all food produced for human consumption in the world is lost or wasted.

- Fruits and vegetables, plus roots and tubers have the highest wastage rates.

40-50% of vegetables and fruits are lost globally.

»By reducing food waste, we can advance critical conservation efforts and help fight for food security worldwide.«.

UNDP Goodwill Ambassadors

<table>
<thead>
<tr>
<th>Year</th>
<th>Billion People</th>
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<td>2017</td>
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<td>2050</td>
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Food loss is a significant limitation to food security and farmers income in Kenya

- **Food loss (aka post-harvest loss)** is a significant limitation to food security in sub-Saharan Africa. More than 1.3 billion dollars is spent on importing food into Kenya.

- **36.5% are food insecure** and 35% of children under five are stunted (chronically malnourished) in Kenya (FAO).

- **Population** is projected to double until 2050.

- As a result of this rapid increase, **land parcels** in the areas of high agricultural potential are decreasing in size, affecting food production (FAO).

- Food loss **reduces income** by almost 15% of approx. 470 million farmers and other value chain actors.
Enviu aims to build social ventures to improve the fruit & vegetable value chains

Why?
To increase (nutritious) food security and smallholder farmers’ (economic) resilience

How?
By improving the efficiency in Kenya’s fruit & vegetable value chains

What?
We will build 3-5 social ventures in 3 years, creating interventions to prevent food loss
This program focuses on preventing post-harvest food loss in the fruit & vegetable chains to benefit the domestic market

- The focus of this program for now is on the fruit and vegetable chain in Kenya, as these chains show the greatest potential and urgency to fight food loss. Fruits and vegetables are the most perishable crops and moreover provide a high nutritional value (i.e. micronutrients) that is much needed in the diet of many Kenyans.

- The focus will be on the domestic market, as this represents 95% of the total market and suffers the highest losses due to smaller and less professional farming practices and value chains.

For now, focus will not be on:

- Staple foods like maize and potatoes are in the focus of different NGO’s already.

- The export market is acknowledged in this research to be in correlation with the challenge of food loss in Kenya, but it will not be further investigated in this small size report.

- Dairy, we have done some research and talked to stakeholders in this value chain. However, there are big differences between this value chain and that of vegetables & fruit, e.g. because of the processing of milk. The waste problem is also different, because farmers and brokers do no throw away bad milk (waste), but sell it anyway with a very bad quality and food safety (dilution, use of chemicals, lack of cold chain). Therefore, the issue analysis focuses on the fruit and vegetables chain first.
A Picture of Food Losses in Kenya

Market Mombasa, Kenya
The majority of food is lost post-harvest

» The majority of losses are at production or during handling and storage: such losses disproportionately affect the incomes of farmers in rural areas, where poverty rates are highest.

Efforts to reduce Post-Harvest Loss have the potential to improve producers’ income and build more resilient value chains, able to withstand the effects of climate-related shocks and stressors.« (Ridolfi et al., 2018)
Bananas and Mangoes are produced on a great scale, but due to their fragility during transport, they are also prone to be lost along the value chain. Therefore their particularities are examined further in this report.

Cabbages (including African Indigenous Leaves) and Tomatoes are the main vegetables in the field of horticulture in Kenya and are further investigated in the following as losses are highest with Cabbages, followed by Tomatoes, Kales and lastly Indigenous Vegetables. (Ndirangu et al. 2017)

FAOSTAT: Kenya 2016

Please note: fruits & vegetables that are mostly exported are faded out.
Where do highest food losses occur?

»Seasonality is a big thing, sometimes we don’t have enough and at the other moment we have excess.«

Interview during fieldwork

- **50-60% are lost**
  - Bananas

- **40-60% are lost**
  - Mangoes

- **50-60% are lost**
  - Leafy Greens

- **40-60% are lost**
  - Cabbage

- **30-40% are lost**
  - Tomatoes

Please kindly note that estimations on post-harvest losses are often lacking, and/or based on different methodologies and therefore should be used with great care.
System Structure

Zooming in on: Bananas

Insights revealed through a FAO report in 2014

Challenges
- Banana supply chain in the country is complex and inefficient and it is estimated that 95% of the bananas sold are grade two bananas, handled by street vendors and retailers in residential areas with 5% sold to supermarkets and other institutions (Kinyua, 2008).
- 70% of the bananas on bunches at the bulking center have bruises due to poor transport particularly from the farm; rough handling when loading and offloading; loaders are paid by item, so incentive is on quantity and not quality.
- Loss in value at the farm gate of 33% due to poor appearance.

Opportunities
- Bananas can be processed into several products like flour, powder, canned slices, chips (crisps), jam and jelly. This presents a great market opportunity for banana value chain stakeholder in Kenya (Ndaka, 2012).
- Apart from being a source of nutrients, banana is a reliable and regular source of cash income to 380,000 rural families (Ndaka, 2012).
- Banana wine and Banana beer (aka "urwaga") are also common products. Often consumed as an everyday beverage during festivals, ceremonies and cultural events. Despite the huge local and export potential of banana beer, there is just very little commercial production of this product going on (Smallstarter, 2014).

System Structure

Zooming in on: Mangoes

- Particularities in Kenya revealed through field work

Challenges

- During bumper season, 50-60% of mangoes never leave the farm = high post-harvest loss.
- In some regions, mangoes contribute to 40% of the household income.
- High seasonality (October – February).
- Almost no access to storage or cooling technologies to hinder overripping.
- 39-52% lost due to diseases, inadequate handling & lack of linkages to market.

Opportunities

- High value crop with high profit margins: between 50 – 90 % for farmers.
- For fresh mangoes, demand is high both locally and for export. For processed products (such as dried fruit, purees, and juices), local demand is low.
- USAID report predicts that local demand for mangoes will double between 2013 and 2022 and export demand to increase by five-fold from 2011 to 2022, in agreement with Kenya’s National Mango Business Plan (Ridolfi et al., 2018).
Zooming in on: African Indigenous leafy Vegetables (AIV)

- Particularities in Kenya revealed through desk research (Gogo et al. 2017)

**Challenges**

- Research shows that indigenous vegetables now account for some 30% of all the vegetables marketed in Kenya, with the percentage growing.
- High seasonality.
- Crop is highly perishable and more than half of it is lost before it reaches consumers, especially market loss (around 40% loss): poor handling, unhygienic market conditions, inappropriate packaging, lack of cold storage facilities, and season gluts.
- Immense loss of nutritional value along the value chain.
- Main producing counties in Kenya: Nakuru, Kisii and Kakamega.

**Opportunities**

- Increasing demand (higher than available produce) in both formal and informal markets in the peri-urban and urban centers of Africa (increasing awareness of high nutritive and medical value).
  - High economical value.
  - High in vitamins, proteins, antioxidants and dietary fibers.

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50–60%

E.g. African Nightshade (Solanum scabrum Mill)
System Structure

Zooming in on: Cabbage

Mainly based on Ndaka (2012)

Challenges

- No reliable quantitative data, according to Ndirangu et al. (2017): with cabbages experiencing higher losses than tomatoes, and indigenous vegetables experiencing the lowest losses.
- Harvesting takes place any time after the heads mature. Losses can occur as a result of untimely harvesting or when head maturity coincides with rain season as heads tend to crack or split wide open. The exposed internal tissue soon becomes unusable.
- Cabbage is often marketed immediately after harvest through brokers.
- Transport: stalk is very firm and might break the head of another cabbage.
- Market/Retail: outer layers removed for cosmetic reasons to increase sell.

Opportunities

- In the local farming systems, cabbage is cultivated as part of a diversified cropping pattern, and is mostly grown as a cash crop for the local market.
- Cabbage waste is very appreciated by pig breeders as feed.
System Structure

Zooming in on: Tomatoes

Mainly based on Sibomana et al. (2016)

Challenges

- Second highest vegetable in terms of production and value (accounts for 14% of total vegetable produce in Kenya).
- Tomatoes show some of the highest post-harvest losses (estimated at USD 20M lost per year).
- Tomatoes produced in Kenya are primarily for local consumption, with minimal export to neighboring East African countries.
- Highly perishable nature of the produce.
- Tomatoes are often in non-refrigerated trucks to markets and baskets that carry a high quantity of tomatoes (those at the bottom are under pressure and tend to degrade faster).
- Rough handling, poor sanitation and warm storage temperatures lead to losses.
- Price competitions in respect to processing: production costs of tomatoes in Kenya are high in comparison to imported cheap puree from India and Egypt.

30-40 %

Opportunities

- Increasing demand for processed tomatoes potentially resulting from growing population and a growing middle-class.
Challenges in the Value Chain Causing Food Loss
Smallholder farmers are key for Kenyan food production but are confronted with disadvantages.

Diversified income: crop and livestock production; off-farm agricultural labour; labour in the non-farm sector; and, transfers and remittances.

When it comes to selling their produce, farmers have a low negotiation power position, because:

1. They are dependent on brokers to come to their farm.
2. They often all harvest at the same time causing over supply.
3. Market prices are unknown to them.

Based on information by FAO 2015
Key Stakeholders

There are multiple brokers ruling the production stream and bringing produce to the market

Farm Broker

- Brokers **pick up produce, sell to traders** at the market who then sell to retailers.

- Farm brokers often take the produce on consignment and only pay farmers once it is sold after deducting their commission.

- **Margins up to 40%**: A kg of melons at the farm can go for Sh15 and at the retail market KSh25.

- The **lack of cold storage** for perishable produce lets the brokers hold the farmer at ransom, because they know there is no place to keep the produce.

- Research supported by IDRC has found that these intermediaries, on average, **extract one-quarter of the wholesale value of smallholder** farmer produce as it is transported and marketed between the farmgate and the wholesale buyer.

- »These brokers are a mini-government. They dictate the cost of every commodity, when to sell, who to buy from and most importantly, they ‘own’ the customers.«
  
  Supplier on Wakulima (marikiti) market

Market Broker

- »In Nairobi, the county government officials have learned to co-exist with them,« said the supplier. 
  »It is a brokers’ paradise here.«

- »In Marigiti, the brokers are in charge and control the market operations. Once our Lorries arrive, they immediately take charge. They pay the city council levies and taxes and sell our potatoes or cabbage. Since most traders arrive in the wee hours of the morning at 3 am, the brokers count the number of lorries that arrive in the market. If there are many lorries in a particular day, they strategize to buy the produce slowly in order to create an artificial oversupply. That lowers market prices. We lose.«
Key Stakeholders

Nearly all fresh produce is (still) sold in kiosks of Mama M bogas

Mama M boga

- In Nairobi nearly all fresh produce is sold in kiosks run by women vendors known as Mama M bogas. There are over 80,000 of them in Nairobi alone.

- Mama M bogas buy at wholesale markets with mobile money credit, up to a max. of Sh 5,000 from M-Shwari. Most loans are taken between 3-5 am and repaid by evening.

- They buy produce at the market and let a mkokoteni (handcart) guy bring it to their stall. Margin price of tomatoes at Mama M boga about Sh36. To get a better margin, they have to arrive at a market very early to purchase higher quality produce.

- Some Mama M bogas provide credit service to their clients.

- There is a lobby for licensing and relocation of Mama M bogas / Dukas to places designated by national or county governments.

Competition from supermarkets is rapidly increasing, which threatens the business of Mama M bogas.

Trend / Pattern in the Food System

Consumer

- For low-income households income is around Sh12,000, of which over Sh4,000 goes into buying such things as potatoes, sukumawiki, cabbages and tomatoes.

- Kenyans spend 30–55% of their money on food; hereby 93% is purchased in local stalls, street kiosks – not supermarkets.

- Food prices are rising correlative to strong export market (Rockefeller Foundation 2015).

- The price of potatoes, sukuma wiki, cabbages and tomatoes has dramatically risen, according to the latest figures from the national statistician: A kilogram of cabbages, for example, has increased by 56% from Sh48 in February, 2016 to Sh75 in (February, 2017).
We believe these are the key challenges to overcome to realize our ambition to reduce food loss by 80% in 2030.
The main challenges causing post-harvest food losses

**Seasonality**

1. Long trading chain which is dominated by brokers.
2. No cold storage along the chain.
3. No financial products available to stakeholders in the chain.

**Inefficient Value Chain**

4. Lack of professional farming practices.
5. No regional market information.
6. Transport damages.

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**Farmer**

- Farmer agent

**Rural**

**Peri-urban**

**Urban**

- Broker
- Market broker
- Wholesale market
- Mama Mboga (small shop)
- Street vendors
- Consumers
Challenges in the value chain

The challenges explained

Key findings

Lack of professional farming practices and market access: Smallholder farmers often have poor (post-)harvest handling practices, due to lacking tools and skills. Furthermore, access to the market is hindered by the small size of their harvest and lack of market information.

Transport damages (unsuitable vehicles and poor road conditions): Poor quality roads as well as inadequate transport packaging and vehicles affect not only the shelf-life and quality of produce, but also the time it takes to get produce to the market.

Long trading chain which is dominated by brokers: The Kenyan marketing system is complex and fragmented, with brokers taking commissions on transactions along the whole supply chain. This results in lower returns for farmers, and higher consumer prices.

No cold chain / storage along the chain: After harvest, perishable food deteriorates and spoils quickly. One way to slow this process down is by lowering the temperature of produce. However, the cold chain for perishable crops is almost non-existent in Kenya.

No financial products available to smallholder farmers to improve business: Traditional financing institutions, like banks, require credit scores before loaning money. However, farmers often neither have business records nor collateral assets, and are therefore not eligible for such financial products. This prevents them from de-risking and professionalizing their business.
Deep Dives into Three Potential Markets
Deep dives into three potential markets

We have identified five key challenges in the current food production system of smallholder farmers. As problems are interlinked and connected, we propose three ways to approach these.

Therefore, we dive deeper into these topics to determine why these solutions/markets are non-existent for the domestic market yet.

**Asset Based Financing**
To become less dependent on the weather and prevent bumper seasons we need innovative financial solutions to make innovation in farming practices possible.

**Transport & Storage**
Horticultural products have the challenge of high seasonality and perishability. Extending shelflife and re-designing transport is a possibility to preserve higher quality and quantity.

**Food Processing**
The challenge of high seasonality and bumper season can also be absorbed (up to 100%) through processing of horticultural produce.
Deep Dive

Financial Products in the value chain

Micro-Loans, Kenya
Smallholder farmers are in a cash flow trap

- Incidental expenses like school fees or medical costs force farmers to harvest early and settle for a lower quality and income than they could have had.

- Difficulties in accessing credit, as banks are often reluctant to lend to them due to poor collateral and lack of information.

- 33% of smallholders receive credit: the amount they borrow – $195, or approximately 8% of their annual income.

Reinforcing Feedback Loop / Virtuous Cycle

- Farmers have no savings
- Lower prices for lower quality
- Lower prices due to oversupply
- Harvest early / Pressure to sell
- Farmers all harvest at the same time
- Dependent on weather
- Cannot invest in irrigation and greenhouses
- Farmer have to pay expenses (e.g. school fees)

Intervention opportunity: To reduce the gain of a reinforcing loop, one leverage point for innovation is to slow the growth (e.g. enable farmers to create savings).
Traditional finance institutions shy away from investing in agriculture

Smallholder farmers in Kenya account for 70% agricultural production and livelihoods to 80%, yet agricultural finance is only 5% of total credit provided at a national level. This lack of financing causes low-productivity and impedes efforts for the country to become food secure and provide a means for these farmers to emerge from the poverty cycle.

Traditional finance institutions shy away from investing in agriculture, despite most major banks boasting of having established agribusiness units. Banks consider agriculture as high-risk and focus their activities on corporate clients within the formal banking sector versus the informal sector, which comprises the population segment that includes virtually all smallholder farmers.

Independent of a financing source, smallholder farmers do not have robust data that would support lending decisions (e.g. farm performance), do not have collateral to secure any loans, tend to be distributed increasing costs of servicing any loans and arguably are higher risk given less developed infrastructure to guarantee production and delivery.

Even within agriculture, segments that service the export market, or local high-end market receive the bulk of agricultural finance leaving the investment and input financing needs of producers for the local market unmet.
Asset Based Financing

Impact potential of financing farming activities is massive

The average smallholder farmer in Kenya, of which there are 3 million earns approximately $2 a day. Since 70% of the population derive some level of income from farming, the impact potential of financing these activities is massive.

Direct Impact

1. A lift of up to 40% in income to farmers
2. A reduction in food costs to consumers

Indirect Impact

1. Increase in financial literacy and financial inclusion objectives
2. Reduction in physical labour requirements on smallholder farms resulting in an increase in school attendance
Asset Based Financing

There are some interesting opportunities for financial products in the value chain

3 key opportunities we see around asset based financing in Kenya

1. Providing asset-based financing for **income-generating assets**: financing assets such as solar irrigation systems and greenhouses have been shown to increase production by upwards of 33%.

   Current solutions are focused on consumer products (M-Kopa) or require steady income and a track record (car loans, etc.). As of yet, in Kenya there are no solutions that provide loans of €1500+ to smallholder farmers based on the asset they acquire with the loan.

2. Building a commodities market-place that provides a guaranteed market and thus a consistent and **predictable revenue-stream** to farmers. This revenue stream can be then used to provide financing similar to invoice financing or warehouse receipting.

   Current start-ups working on this are e.g. Twiga Foods and Taimba. They’re not focused yet though on leveraging gathered data for financial products for smallholder farmers, providing an opportunity here.

3. Building **better more comprehensive digital profiles of the farmers** and exploring how mobile banking solutions can be leveraged to enable the use of these data to enhance lending decisions but also to deploy and collect loan funds.

   There are a number of MFI’s and start-ups working on this opportunity, like Tala (using social data for credit profile) and FarmDrive (alternative credit scoring). Enviu’s Three Wheels United has been successful in India with previously unbankable rickshaw drivers, obtaining high repayment rates through gamification, social aspects and digital financial education through a software platform.
Most important question is which financial product could truly scale?

- **Which product can truly scale and have the most impact on smallholder farmers?**
  Numerous examples of credit products exist in the market with varying levels of success – however none have broken through akin to M-Pesa transforming the market.

- **What is the right partnership model?**
  Between banks, MFIs, mobile money providers, community groups and the emerging mobile only services, the number and breadth of partners is wide and fragmented. Given the wide distribution of the target farmers, to reach the necessary scale the right partners with aligned incentives are necessary.

- **How might we create solutions that solve problems people care about?**
  In order for financial markets to truly work for the poor, they need to help people solve the problems they care about. Headway has been made with examples in this report, however none have truly reached scale.
A lack of adequate storage & transport cause nearly half of the losses

KSh350billion ($35 billion) worth of perishable foods are wasted annually, with nearly half of those losses due to temperature changes experienced in transit between the grower and the grocer. The longer it takes to transport the produce to the market the higher the traders’ losses.

More than 80% of the local food market in Kenya is informal, and these products suffer from a fundamental lack of understanding or consumer demand for best practices in handling (grading, sorting, value addition), adequate packaging and transportation.

In developed countries cold storage capacity in urban areas is about 200 litres per capita, while in developing countries it is about 19 litres per capita.

Cleantech refrigeration options are capital-intensive, but have low operational costs thereafter. The upfront capital investment requirements make it difficult to access for smallholder farmers and other low-income stakeholders in the agricultural value chain.

Based on reports by GiZ (2016) and The Post-Harvest Foundation (2013)
Lack of electricity poses the main challenge for cold storage facilities

Cold chains need to be uninterrupted to deliver post-harvest loss reduction benefits. Point solutions exist but it is actually holistic system solutions that are crucial. Such a system change needs the involvement and coordination of the many stakeholders along the supply chain, from harvest to processing/packing/distribution, transport, and retail.

Approximately only 18% of households in Kenya are connected to a power grid, and the lack of access to electricity makes building a cold storage facility outside of the main metropolitan zones very difficult as a high quality energy supply is crucial for any cooling or refrigeration application. Energy demand for cold storages tends to vary considerably over daily and seasonal periods. The resulting deviations in energy demand render accurate demand prediction difficult and provide a potential barrier towards developing sustainable business models for supplying cooling applications with energy from decentralized, renewable sources. (Winkworth-Smith et al. 2014, Yahia 2010)
The impact of cold storage is less waste, better quality, and better prices

Cold storage solution providers base the business model on:

1. Less waste because of longer shelf-life, so more produce to sell
2. More time to sell turns into better pricing
3. Better quality to sell turns into better pricing

Payback periods mentioned differ greatly. E.g. a report stated there is a payback period of 8 years. InspiraFarm claims 24 to 36 month payback period. India’s Ecozen claims a 40% income increase for the farmer after a 2 year break even point. There seems to be a business model, with many solution providers coming up and apparently doing well, but nowhere the income upside of cold storage is calculated / proven in a clear study or business case.

To be researched: how much less waste and extra income can actually be achieved for the major crops like tomatoes, while the extra shelf time is still limited to e.g. 2 weeks extra. How much levelling out of seasonality is really achieved through such extensions of shelf life?
There are some interesting opportunities for transport & storage

Increasing the quality and access to adequate means of transport and storage could have a high impact on increasing the quality of food and decreasing food losses in Kenya.

1. Make (cold) **storage available** through rental systems.

2. **Shortening the value chain** and the various changes of transportation by linking smallholder farmers and mama mbogas at the market.

3. **Third party logistics companies** (3PLs) are virtually non-existent in Kenya. This forces most cold chains in Kenya to be vertically integrated and designed to meet the specific needs of individual businesses.
Transport & Storage

Most important question is which storage concept could have the highest added value?

Outstanding questions that need further field research are:

1. What is the added value of better preservation versus added costs for better technology of different storage solutions?

2. What is the upside potential of different costs with regards to achievable extension of lifetime and improvement of quality?
Deep Dive

Processing of Food

Mango slices in a solar dryer
Processing of Food

Processing would be a solution for food loss, but domestic market still has to be built

Processing increases earnings, product shelf-life, reduces post-harvest losses and enhances food security. Processing techniques include Juicing, drying, canning and freezing.

Entry barriers for food processors to supermarkets are quite high, because of their standards and long pre-financing terms. Local food processors are not very professional yet.

In bumper season, prices drop enormously. The price differences below show the margin/room to add value (and increase price) by processing the food.

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<th>Food</th>
<th>Current Price</th>
<th>Processed Price</th>
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<tr>
<td>Maize (kg)</td>
<td>3,600 Sh</td>
<td>2,800 Sh</td>
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<tr>
<td>Tomatoes (kg)</td>
<td>120 Sh</td>
<td>20 Sh</td>
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<tr>
<td>Potatoes (bag)</td>
<td>3,400 Sh</td>
<td>1,800 Sh</td>
</tr>
<tr>
<td>Cabbages (bag)</td>
<td>1,800 Sh</td>
<td>1,200 Sh</td>
</tr>
<tr>
<td>Kales</td>
<td>1,300 Sh</td>
<td>800 Sh</td>
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The Kenyan agro-food industry is dominated by oil making, fruit processing, soft drinks and beer industry, dairy and meat processing industries, cereals and snacks. Most are foreign-owned multinational companies that produce for export.

The middle class, that buys (processed) food in supermarkets, floats around 30% in Nairobi. The mass market (low income) is not accustomed to buying processed foods.

On average, people in Kenya spend 45% of their income on food, of which 21% on vegetables and fruit.
Processing of Food

The largest channel by far in Kenya are the shops of Mama Mbogas

Instead of processing for export, the biggest system change would be to build a market for processed food in Kenya. This would directly serve as a solution to food insecurity and farmer income in Kenya.

In Kenya there are three target segments one could serve:

1. Mama mbogas retailer shops (low income & middle class)
2. Supermarkets (middle class)
3. Larger institutions (schools, companies, restaurants)

There are some processors selling in the domestic market; these all sell to supermarkets (of all sizes). Entry barriers for food processors to sell to supermarkets are quite high, because of their standards and long pre-financing terms. Especially, in combination with the local food processors that are not very professional yet.

Large majority of the people in Kenya buys their fruits and vegetables at mama mbogas. In Nairobi alone there are over 80,000 mama mboga kiosks.
Processing of Food

There are a couple of interesting opportunities for local processing

Food processing could be the fastest growing sector in Kenyan industry if the right incentives are made available (infrastructure, regulation, training) (Onyang, Agro-processing in Kenya).

1. **Dry-freezing African Indiginous Vegetables (AlVs).** There is a revitalised interest in indigenous foods, which are perceived to be healthy. They have long held a significant role as important components in African diets; they are indispensable ingredients in soups or sauces that accompany carbohydrates or staples (Smith & Eyzaguirre, 2007).

2. Food processing can provide opportunities for single consumptions at low prices. For example by bundling of different types of vegetables in small portion bags (e.g. all vegetables as a bundle to make a stew) that keep the vegetables fresh or by complementary products such as small packages with herbs and other food components or recipes.

3. Sell **dried tomatoes** as ingredient for stews or sauces to **hotels, schools, large institutions**.

4. **Find products suitable to sell to mama mbogas** instead of to supermarkets (which are in their existing diets and are affordable).
Most important question is what processed foods can we provide for the masses?

Conclusion is that local processing is a very large untapped market.

Outstanding questions that need further field research are:
1. What are ingredients/products that fit in the regular diet of the average Kenyan?
2. Can we keep processing costs low enough to provide the products to the masses?
Opportunities to innovate the Kenyan food system
For inspirational purposes: some interesting international cases we found

Pick ‘n Serve – pre-cooling and packhouse model [www.picknserve.com]
In India, Pick ‘N Serve is demonstrating the financial viability of a pre-cooling and packhouse model targeted at bananas. Traveling in a band of 4 trucks, Pick’N Serve unloads a small cooling facility on-site, which altogether takes about 1 ½ hours. Once the bananas are cool they are transferred to a reefer storage container nearby, where they are held until being transported to local markets, large retailers, or ports for export.

Coldhubs – off-grid cold storage [www.coldhubs.com]
Coldhubs is a Nigeria-based company that utilizes solar panels to provide off-grid cold storage to farmers using a pay-as-you-store business model. The farmers are provided with reusable plastic crates into which they can transfer their produce, and are charged a flat daily rate per crate.

LEAF – cold chain as a service + market linkage [www.lawrencedale.com]
In South India, LEAF provides integrated and customized cold chain solutions by combining cold chain as a service with an aggregation business model. They integrate logistics, storage, and processing services to bring goods from farm to market, uniquely utilizing a combination of GPS and logistics software to optimize truck routes for efficiency.

Apeel Sciences – spray to prolong shelf life [www.apeelsciences.com]
Apeel Sciences (USA) creates products from plant-derived materials that help fresh food suppliers and retailers increase produce quality and fight food waste. Every plant on earth has a peel or skin that protects it. Made of these same materials, Apeel adds a little extra “peel” to the surface of fresh produce that naturally reinforces the plant’s own peel and slows the rate of water loss and oxidation — the primary causes of spoilage.

Doodhwala – household delivery [www.doodhwala.net]
Bangalore-based Doodhwala buys small batches of milk each day directly from farms near India’s sprawling cities and makes household deliveries itself. The arrangement offers farmers the security of a reliable and fair buyer and bypasses the chain of middlemen charging for transport and other services. Doodhwala makes 400,000 deliveries per month in Bangalore and Pune.
For inspirational purposes: some interesting Kenyan start-ups we found

Twiga Foods – mobile B2B supply for Africa’s vendors | [www.twigafoods.com](http://www.twigafoods.com)
Twiga enables mobile-based, cashless, business-to-business (B2B) supply. A vendor orders stock from Twiga, and they reliably show up the next day at their shop with a low-cost, better quality, product than informal markets can provide.

Taimba – simplifying food chains for accessible quality food | [www.taimba.co.ke](http://www.taimba.co.ke)
Taimba is a business to business mobile-based cashless platform that connects farmers to retailers. We cut waste and make farmer products affordable without undercutting the farmer.

InspiraFarms – turn-key refrigerated storage solutions | [www.inspirafarms.com](http://www.inspirafarms.com)
InspiraFarms provides turn-key refrigerated storage solutions, client-centered technical support and affordable leases that enable small and growing agribusinesses to access energy-efficient food processing technology, reduce produce losses, cut energy costs, access new markets and grow sustainably – on or off-grid.

SunCulture – agro-solar irrigation system | [www.sunculture.com](http://www.sunculture.com)
Combining the energy efficiency of solar power with the effectiveness of drip irrigation results in the best solution for farmers, at a cost they can afford. SunCulture’s AgroSolar Irrigation system makes it cheaper and easier for farmers to grow higher quality crops and increase their yields by 300% or more.

Sweetunda (Burton & Bamber) – dried fruit sweets | [www.sweetunda.com](http://www.sweetunda.com)
Burton and Bamber is an agro-processing company with a vision to create income for farmers and reduce food loss. They take fruit, process (by dehydration) and sell it under the brandname Sweetunda – Kenyan dried mango (and other fruits) created from food that was previously wasted. They’re building a sustainable supply chain and offering premium prices for good quality fruit.

FreshBox – cold storage as a service on market level | [www.freshbox.co.ke](http://www.freshbox.co.ke)
FreshBox’s developed a large commercial cooling unit that can hold over two tons of fruits and vegetables and fits conveniently in a vendor space at fruit and vegetable markets across Kenya. They’re pay-as-you-go model allows them to reach customers that previously have not had access to refrigeration services and allows us to help prevent the spoilage of fruits and vegetables.
Based on the challenges and gaps present in the value chain, what is happening in Kenya already and inspired by best practices worldwide, we have come to the following list of business opportunities.

Most opportunities tackle the pressing issues in the fruit & vegetable chains, however as promised we’ve identified interesting opportunities surrounding these chains. All these opportunities are worthwhile developing and validating to solve the issue of post-harvest food loss. From this list we will make a selection to start with.
Opportunities

Longlist of Business Opportunities (1/3)

**Financial Solutions**

#1 Asset based financing for irrigation & greenhouses  
**Issue** No financial products available to invest in increasing farmers’ harvest.  
**Solution** A financial product that is tailored made for smallholder farmers to invest in irrigation systems and greenhouses (to keep out heavy rains).

#2 Financial products for cooperatives/SACCOs  
**Issue** Farmers are often not united or not professional enough to use their combined needs & offering.  
**Solution** Digitalization of cooperatives + financial products like bridge loans and asset based financing for irrigation, green houses or storage facility.

**Cold Storage**

#3 Cold storage of fruit and vegetables & linking farmers to the market  
**Issue** Farmers cannot sell 100% of their produce in bumper season and are dependent on brokers for offtake and price.  
**Solution** Arranging transport to get produce from farmer to a cold storage facility in his region. Including a bridge loan for the farmer and linking him to several off-takers.

#4 Refrigerators in small retailer shops (mama mbogas)  
**Issue** Retailers that sell to end consumers don’t have cold storage  
**Solution** Small refrigerators (on lease) for retailers, which will save them losses and daily trips to the market.
Longlist of Business Opportunities (2/3)

**Food Processing / Designing a New Value Chain**

**#5 Process tomatoes and build a local ketchup brand**

*Stepping into an existing startup*

**Issue** A lot of tomatoes get wasted, because farmers harvest all at the same time

**Solution** Build a new value chain in which farmers can sell their tomatoes throughout the year to the processor against a stable price. Work with farmers on their farming practices to increase output and process the tomatoes into a ketchup sold on the Kenyan market.

**#6 Process food (e.g. into soup or dried ingredients)**

**Issue** Due to bumper season many fresh produce get wasted. Processed food is not a part of the Kenyan diet (of the masses) yet.

**Solution** A part of the produce can be preserved by processing it so shelf life is prolonged.

**#7 Janta Meals**

*Replicating a company from India*

**Issue** Unsafe food and limited affordability of nutritious foods

**Solution** Healthy and safe street food in slums
Opportunities

**Longlist of Business Opportunities (3/3)**

**Transport**

**#8 Set up a third party transport company for stakeholders in the chain**

**Issue** Farmers don’t have transport, brokers use open & old trucks that accelerate food loss. Also packaging is a reason for big losses on the road.

**Solution** A logistic company that provides suitable transport & packaging for farmers, cooperatives, processing companies.

**Market Access**

**#9 Grocery Delivery Service to End Consumer**

**Issue** The value chain of horticultural produce is long and inefficient

**Solution** A grocery delivery service to serve end consumers directly with fresh farm produce. Streamline value chain (digitally) and increase transparency on pricing, trading, timing of selling etc. Farmers are often at a very disadvantaged position as they have no idea of current pricing on markets, and sell too low to brokers
Our goal is to build 3-5 social ventures targeting the issue of food loss. As a start we will select 4 business concepts to start developing and validating from the list of opportunities above. To increase the chances of success and to increase the impact of the opportunities we will pursue, the following principle will be used in selecting the business concepts.

a. **Interventions on several points throughout the chain** that enhance one another. As we are convinced that solving one problem does not solve the whole issue.

b. **Developing businesses in different stages**, from new ideas to replicating companies. This way best practices are captured and new solutions for remaining gaps are created.

c. **Include both Vertical (solutions for multiple chains) & horizontal (new chain) solutions**. To create scalable solutions that work for multiple chains and to create an entire very efficient value chain as a best practice for the industry.
We will start validating 4 business concepts

**Innovation #1** Asset based financing for irrigation systems & greenhouses

**Innovation #2** Cold Storage as a Service
Setting up cold storage facilities, with a Warehouse Receipt System and market linkage

**Replicating #3** Janta Meals: healthy and safe street food in slums

**Transport damages** (unsuitable vehicles & poor road conditions)

**Long trading chain** which is dominant

**No cold chain / storage**

**No financial products**

**Scaling #5 Local Ketchup**
to set up a new value chain for a local Ketchup brand
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And many others!
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“You never change things by fighting against the existing reality. To change something, build a new model that makes the old model obsolete.”

Buckminster Fuller