

# Sectoral Value Chain Mapping in Kakamega County, Kenya

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## Research Article

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# Abstract

The Kenyan agricultural sector will play a pivot role in achieving its national development roadmap, Vision 2030. This report explores the agricultural value chains within Kakamega County, Kenya, focusing on sweet potatoes, bananas, soya beans, vegetables, palm oil, honey, and avocados. Data collection for the study primarily involved direct engagement with stakeholders across the various sub-counties. The study revealed the unique characteristics and challenges faced in each value chain, laying the foundation for understanding the local agricultural dynamics. These challenges included equipment shortage, lack of technical skills, and poor marketing strategies. Recommendations are put forward to address the specific hurdles and optimize opportunities within each value chain. Fostering cooperative formations, exploring value addition and enhancement of technical skills are the common themes across the recommendations for the value chains. Further, training, certification acquisition, research and development and process optimization have been suggested to bolster productivity, quality and market competitiveness. The proposed interventions require collaborative effort from the stakeholders including government agencies, non-governmental organizations and the local communities. By creating an enabling environment and implementing the recommended strategies, sustainable agricultural-based growth and economic development, aligning with the national Vision 2030, can be fostered in Kakamega County, Kenya.

## 1. Introduction

Agricultural sector growth and development is crucial to Kenya's overall economic and social development. Kenya's Vision 2030, the country's development roadmap, recognizes the pivotal role of the agricultural sector in achieving its targets. The Agricultural Sector Transformation and Growth Strategy (2019-2029) within this vision aims to elevate the income of 3.3 million small-scale households. This strategy places a strong emphasis on enhancing land productivity and agro processing to not only increase the sector's contribution to the national GDP but also improve agricultural outputs and add significant value. Additionally, the strategy seeks to enhance household food resilience against environmental and economic shocks. This will be achieved through the cost reduction of nutritious foods and targeted support, including subsidies and social protection measures.

As part of its Bottom-up Economic Transformation Agenda, the government has designated value chain development as a key strategy to bolster growth and competitiveness. The approach involves sectoral value chain mapping, with the goal of fortifying local value chains led by Kenyan Micro, Small, and Medium Enterprises (MSMEs). The objective is to elevate these value chains, assessing strengths, weaknesses, commercial viability, constraints, as well as environmental and social sustainability characteristics. This initiative ultimately seeks to transform these local value chains into larger industries and companies.

This report focuses on agro-processing value chains within Kakamega County shown in Figure 1 zeroing on sweet potatoes, bananas, soya bean, vegetables, palm oil and emerging value chains of honey and avocado.

# 1.1 Methodology

Data collection of the value chain was conducted through primary data collection where the researchers directly engaged with individuals and stakeholders involved in the value chain to gather firsthand information about various aspects, such as processes, actors, strengths, weaknesses, constraints, and opportunities. The value chain mapping was conducted in Butere, Mumias, Matungu, Khwisero, Lurambi and Ikolomani sub counties.

## 2. Value chain mapping

### 2.1 Palm oil

Palm trees were introduced to Kakamega County by Mumias Sugar Company in collaboration with KALRO in 2004. The palm trees are grown in Matungu, Mumias East, Mumias West and Butere sub counties. The oil is extracted from fresh fruits batches (FFB) and processing is extremely time-sensitive since the quality of the batches decreases quickly after harvest. As a result, mass palm oil production for industrial purposes requires complex and costly infrastructures and geographical proximity between production and processing facilities. Due to the infrastructure required and time sensitivity of harvesting and processing, the value addition of palm fruit is limited to individuals who are processing the fruits using traditional equipment and without a proper processing facility. The lack of processing infrastructure has also led to farmers cutting down the trees as the plantations do not have a direct economic value opting to plant subsistence crops like maize. The Figure 2 below show the current palm oil value chain in Butere for a farmer with 250 trees in a 5-acre farm.

Actors within the value chain include.

- Primary actors: Farmers, processors, retailers
- Supporters: ATDC Bukura (Basic training), KALRO (sells seedlings to farmers), Mumias company (Supported farmers in purchase of seedlings at initial stages of palm introduction to the county)

The value chain in Figure 2 is as follows.

Raw Material Supply:

- Medium-scale farmers manage more than 50 but fewer than 500 trees (1 farmer), while small-scale farmers handle 1 to 50 trees (with more than 10 farmers). Trees are sourced from KALRO Kakamega.

Processing of Raw Materials:

- A privately-owned processing facility has a capacity of 100 litres of palm oil per week. Approximately 25kg of palm fruit yields 7 litres of palm oil. The type of oil produced (cooking or cosmetic grade)

depends on the quality of the palm fruit. The resulting products include cooking oil and cosmetic oil.

#### Marketing:

- Cooking oil is retailed to local consumers for culinary purposes. The owner produces soap using the cosmetic oil, and some is sold to other soap manufacturers within the Kakamega County and in Nairobi County.

#### Waste Disposal:

- Fibrous waste from palm oil processing is dried and converted into briquettes for use in the process. Process water is directed to the farm for irrigating the trees.

#### Staffing:

- The company employs a total of 3 staff, which increases to 8 to 10 people during processing. The workforce is predominantly male, given the labour-intensive nature of the current process.

## Challenges

The main challenges faced are:

1. Lack of harvesting and processing equipment. This makes the process labor intensive as they use traditional mortar and pestle as shown in appendix Figure 9.
2. Labor challenge: Due to the manual processing many people shun away thus getting labor is difficult.
3. No cooperatives to bring the palm farmers together causing the smaller farmers not to benefit from the palm trees in their homesteads.
4. Access to finance is limited due to the stringent measures put by the lending institutions.
5. Lack of technical skills in processing the palm oil
6. Poor labelling and packaging
7. Lack of processing facility
8. Lack of costing know how of the process as they only have a value of oil and soap based on current market price of the items.

## Opportunities

1. Training
  - a. Plant layout
  - b. Processing

- c. Business costing
  - d. Standardization; Quality of product & process, Safety
2. Fabrication of processing equipment
  3. Textile: The fibrous branches of the palm trees can be used as source of fiber strands
  4. Branding and marketing
  5. Digitization: Process documentations, marketing
  6. Formation of cooperatives to aggregate all small-scale palm farmers.
  7. Build collection and aggregation centers for the other farmers to sale their fruits.

## Emerging value chains from palm oil value chain.

Honey value chain: Due to the availability of palm fruits and vastness of area the entrepreneur has begun bee keeping at the edge of the plantation with 5 beehives. The bees feed on the palm fruits and is yet to harvest the honey and beeswax.

## 2.2 Sweet potato Value chain

Kakamega County is members are in involved in sweet potatoes with an approximated coverage of 4277.5ha(<https://www.foodbusinessafrica.com/kenya-commences-value-addition-of-sweethttps://www.foodbusinessafrica.com/kenya-commences-value-addition-of-sweet-potatoes-with-establishment-of-processing-plant/potatoes-with-establishment-of-processing-plant/>). There have been tremendous efforts of supporting cooperatives with an aim of increasing value to the sweet potatoes farmers through value addition and fetching better markets. Two corporative were identified: KEBUK and Western organization of people living with AIDS and HIV (WOPLAH).

**KEBUK corporative** Operates in 4 sub counties namely: Khwisero, Emuaya, Butere, Kakamega where it derives its name. The cooperative was formed in 2016 by amalgamation of groups in the sub-counties and has 120 members as shown in table below.

*Table 1: Disaggregation of KEBUK cooperatives members*

Total Number of Members	120 (70 being most active)
Males	40%
Females	60%
Youth	20%
PWDs	4%

The staff of the cooperative is as shown below with a team of 7 people.

*Table 2: Disaggregation of Cooperative staff*

Total Number of Members	7
Males	1
Females	6
Youth	3
PWDs	0

## Water and Electricity

KEBUK center relies fully on grid from national grid to power their process equipment and other machines. On water, the center mainly uses rain harvested water. Occasionally, and when needed, piped water is also used.

## Environment

- Waste wasters are released into drainage.
- Potatoes peels dried and used for animal feeds.

## ICT

Minimal use of ICT – Computers stolen during the last regime.

## Western organization of people living with AIDS and HIV

Western organization of people living with AIDS and HIV (WOPLAH) started in 2003 but was formally registered as non-profit making organization in 2008 by eleven community leaders in Mumias known as ambassadors of hope with the need for equitable access to HIV/AIDS counseling and testing, health education and economic empowerment. The group's founder is Madam Phasilia Shijinga and they work to reduce stigma for people living positively with HIV/AIDs through support groups, community dialogues and income generation. The current membership comprises 300 members and includes women and men, the youth and people living with disability. Their main objectives are to:

- Ensure a healthy community through nutrition intervention.
- Ensure access to basic education for OVC.
- Advocate for human rights for PLWHIV and key population ● Ensure a sustainable community.

*Table 3: Member disaggregation within the WOPLAH group*

Women	Men	PWD
80%	20%	3%

Under nutrition intervention they have encouraged members to grow orange- and purple fleshed sweet potatoes alongside African leafy vegetables and mushrooms. WOPLAH sources planting materials from KALRO Kakamega and previously through support from a GIZ sponsored program. The group occasionally produces sweet potato flour through natural solar drying and juice using domestic tools since they have not acquired processing equipment and space. The organization relies on the local market at Ekero center with occasional sales at exhibitions and farmer field schools. The main market segment comprises walk in visitors at the farm although the bulk of what is produced is consumed by members to address their nutritional needs. They have no distribution channels or marketing strategies. Their consumers are walk-in visitors and group members.

## Challenges faced by WOPLAH

1. Group has no processing area and currently use makeshift kiosk.
2. The group has no equipment for value addition.
3. The group is mostly composed of women who lack farming land as the men control the utilization of land.
4. Safety and hygiene of products as they used natural solar drying.
5. No KEBS mark for their products

## Value Addition at KEBUK

1. Cleaning
2. Peeling
3. Slicing
4. Frying
5. Packaging
6. Branding – Stickers
7. Sold at the processing center to individuals and resellers or transported to nearby shops within the sub-county.

## Value along the Chain

Raw sweet potatoes are sold by the farmers at an average cost of Ksh. 35 per kg. A kg of raw sweet potatoes yields 5 packets of crips which sells at Ksh. 50 each. This results to Ksh. 250 per kg for the value-added products.

# Equipment and Machines

WOPLAH has no equipment however, KEBUK center has the following machines.

- Ovens (2) – One working (not optimum) and the other not working.
- Milling machine – working
- Mixer – One working, one not working.
- Deep-fryers
- Proofer
- Slicers
- Tables
- Solar drier – Not working, needs to be repaired.
- Weighing scales – Some vandalized.

## Challenges at KEBUK

1. Business costing – The center has not been able to fully conduct a cost analysis of the whole value chain to establish true profitability.
2. Energy – The center fully depends on the national grid which has proved to be costly and sometimes unreliable.
3. Equipment – mismatch between consecutive process equipment. For example, oven can hold 36 pcs at a time while proofer holds 80 pcs at a time. Some of the equipment have broken down and are yet to be repaired.
4. Technical skills – The center members have no technical skills to maintain the equipment. Thus, the center must outsource maintenance services.
5. Management wrangles – Being a cooperative, there are frequent power wrangles which sometimes affects the running of the cooperative.
6. Interference from the political class – Sometimes, there is interference from the political class.
7. Corruption – There is frequent corruption among the management of the cooperative.
8. Financial – Lack of sufficient finances to repair the run-down equipment and other machinery after a period of cooperative mismanagement.
9. Certification – The products are yet to be certified by KEBS. However, the management is keen to obtain such certifications.
10. Seasonality – Sometimes there is issues of supplies due to change of seasons.
11. Involvement of youth is low – This is due to the perception that this is a dirty business.
12. There is no separation between the management between the business and the cooperative.



13. Technology – irrigation to avoid seasonality, value addition composite flour, seedlings that can adopt to various seasons, etc.

## Opportunities

1. Training
  - a. Basic repairs and maintenance.
  - b. Cost analysis
  - c. Hazard Analysis Critical Control Point (HACCP)
  - d. Documentation
2. Repairs and maintenance of the existing equipment
3. Redesign/optimization of the value addition process.
4. New sources of energy such as solar power, biomass, etc.
5. Re-use/recycle of process water.
6. Implementation of ICT in management, marketing, record keeping, communication, costing, etc.
7. Develop a new value chain peels animal feed.
8. Linkages between the players need to be improved/established.
9. Export opportunities.

## 2.3 Soya Value chain

Annual domestic soybean production in Kenya between 2000 and 2010 was on average 2 425 MT (FAO, 2011). Estimations of annual consumption of all soybean products (grain, cake, oil) in Kenya are in the range of 100 000 MT (Tinsley, 2009) to 150 000 M (Jagwe and Owuor, 2004). In Kakamega County most farmer is in CBO that helps to aggregate the small-scale farmers. In Matungu Sub County there is Matungu CBO comprising of 14 farmers group that grow soya bean. The CBO has a total number of 180 people 70 men, 110 women 3 youth and 1PWD. They add value to soya beans to produce milk, yoghurt, crackles, crunchies, cakes, cookies, and Okaro given to members as chicken feed. (Okara is chaff that is obtained after sieving soy pulp). The CBO is coordinated by Anglican Development Service (ADS) who are sponsored by 2scale.

*Table 4: Matunga CBO members' disaggregation*

Women	Men	Youth	PWD
61%	39%	1.67%	0.5%

## Challenges

1. Poor layout and lacks process flow.
2. Lack of trained personnel to operate equipment.
3. Lack of equipment.
4. Breakdown and maintenance of few available equipment.
5. Poor packaging and labelling
6. Lack of marketing strategies
7. Reliance on donor fund

## Opportunities

1. Development of process flow and layout of the process
2. Training:
  - a. Process
  - b. Equipment maintenance
  - c. Good manufacturing practices
3. Digitization and ICT: branding, marketing, documentation
4. Increasing the value-added products to produce:
  - a. Animal feeds: defatted soya meal
  - b. Soya oil
  - c. Drinking soya
5. Update process equipment to utilize modern technology.

## 2.4 Banana Value chain

Banana production is at 2500 hectares across the county. Some farmers have formed cooperatives like KEBUK to aggregate the bananas and conduct some value addition, increasing the value to farmers. KEBUK society operates a value adding process producing buns and mandazi. The value addition is limited due to lack of equipment like dryer thus the bananas are incorporated in the dough making process to produce confectionaries. Figure 5 below shows the current value chain.

### Processing of bananas: Value addition process

The process includes sorting, weighing, cleaning, ripening (of required ripe), peeling, slicing, drying, milling, baking, labeling, and packaging.

## Value of product along the chain

In the value chain cycle, the Society buys banana fruits at Ksh 20 per kilogram. The ripe bananas are mixed with wheat flour while kneading. 1 Kg of bananas is mixed with 2 kg of wheat flour which yields 45 packets of buns with a production cost of Ksh 700. Each packet is sold at Ksh 50 generating Ksh 2250. Owing to their lack of solar dryers to make banana flour, they are limited to buying bananas to 10 kg per day.

Middlemen buy a stalk of bananas at Ksh 300 to Ksh 600/pc and sells it in the local market at Ksh 700 to Ksh 1200/pc.

## Technologies and Equipment

The plant has acquired the following equipment and technologies for their operations.

- Slicer
- Millers
- Weighing scales
- Ovens
- Prover
- Stainless Tables

## Source of Energy and Water

Currently the processing company use national power grid to run equipment and other machinery and their main source of water is harvested rainwater coupled with municipal water.

## Waste

Banana peels are the only significant waste product in the plant. Currently they give them away to local farmers as an animal feed without further value addition.

## Challenges

1. Faulty and broken-down equipment. The solar dryer is not working and requires a lot of repair work. The facilities have two ovens, but one is not working. In addition, one of the two millers also require maintenance.
2. Human resources. There are no qualified and skilled staff to operate and maintain the equipment at the plant. In case of any issue, the society must hire external services which results to extra costs and lack of consistency in production.

3. There is no costing analysis to determine the plant profitability.
4. There is a mismatch in the production process where the ovens can hold 36 pieces of 400 grams bread while the consecutive prover has a capacity of 280 such breads at once.

Additionally, the flour mixer capacity is also low.

5. The products have not yet been certified by KEBS
6. There is no separation between the society managing team and the plant management and staff who should be running the business. This makes it difficult to differentiate between cooperative and business desire.
7. The banana crop is a seasonal crop as they depend on rain, where January to April is the low season.
8. Inadequate funds which make it difficult to run the business.
9. The packaging and sealing are done manually using the foot sealer.

## Opportunities

1. Repairing the damaged equipment to achieve optimum production. There is need to improve equipment across all the production lines.
2. Training the staff in:
  - Business management
  - Marketing and branding
  - Basic repair and routine maintenance of equipment
  - Good manufacturing practices
3. Separation of cooperative running and value addition business
4. Adoption of irrigation by the farmers to avoid fluctuations due to low seasons hence maintaining consistent quality and quantity production throughout.
5. Recycle the water at the site and minimize spillage within the plant by ensuring proper piping is done.
6. Use the banana stems as a source of fiber instead of disposing them in the farms to rot.
7. Use the banana stem core to produce the herbal juice.
8. Digitalize and apply the ICT in running of the business operations, branding, and marketing within and outside its locality.
9. Improving transportation of the bananas by setting up picking points for the farmers who are widely spread across the county.
10. Increasing products in the value addition chain; composite flour, cookies, candy

## 2.5 Vegetable value chain

Vegetable farming Kakamega County is practiced at small scale level although there are few groups that have come up to unite the farmers and aggregate the vegetables. Various groups and CBOs have been formed to encourage vegetable farming like Shibuye Community Health Workers' community-based organization (CBO) that is 100% female with over a membership of 2000 women, KEBUK corporative with members as shown in Table 1 .Overall, women are predominantly responsible for the farming activities.

Value addition process:

1. Cleaning
2. Slicing
3. Blanching
4. Drying
5. Sales

### Value along the Chain

The value of vegetables increases with value addition. At farm level kales are sold at Ksh. 10 per kg. while dried vegetables are sold at ¼ kg at Ksh 60. 1 kg of green vegetables yield approximately ¼ kg of dried vegetables.

### Equipment required.

- Washing tables
- Slicers
- Solar drier

### Challenges

1. Drying – The solar drier has broken down and needs to be repaired.
2. Perception – Comparison between the fresh and dried vegetables as most people prefer fresh produce.
3. Seasonal as farmers depend on rainfall for planting.

### Opportunities

1. Targeted marketing e.g., dry areas – Kakuma
2. Technology:

- a. Adopt irrigation,
  - b. Solar drying/oven
3. Explore export opportunities.
  4. Digitization: marketing and branding

### **3. Conclusion and Recommendations**

In conclusion, the value chain mapping conducted for key agricultural products in Kakamega County has provided valuable insights into the existing processes and challenges faced by local farmers and processors. Each value chain, including palm oil, sweet potatoes, soya, banana, and vegetables, exhibits unique characteristics and opportunities. The identification of key actors and the delineation of various stages in each value chain have laid the foundation for understanding the dynamics of agricultural production and processing in the region.

### **Recommendations:**

#### **1. Palm Oil Value Chain:**

- Address the lack of processing equipment by exploring collaborative efforts or seeking support from relevant institutions.
- Facilitate the formation of cooperatives to unite palm farmers, enabling them to collectively address challenges and benefit from economies of scale.
- Provide financial support and technical training to enhance processing capabilities, ensuring efficiency and product quality.
- Explore opportunities for branding and marketing to increase visibility and demand for palm oil products.

#### **2. Sweet Potato Value Chain:**

- Offer training programs to enhance technical skills for processing and equipment maintenance.
- Encourage the formation of cooperatives to strengthen the collective bargaining power of farmers and processors.
- Explore the possibility of securing certifications such as KEBS to enhance product credibility in the market.
- Invest in research and development for new sweet potato-based products to diversify the value chain.

#### **3. Soya Value Chain:**

- Develop a comprehensive process flow and layout to optimize production efficiency.
- Provide training on equipment operation, maintenance, and good manufacturing practices.
- Integrate digitization and ICT for branding, marketing, and documentation purposes.
- Explore opportunities to increase the range of value-added soya products, such as animal feeds and soya oil.

## 4. Banana Value Chain:

- Prioritize repairing and maintaining existing equipment to optimize production.
- Provide training in business management, marketing, and equipment maintenance.
- Explore opportunities for value addition, such as producing banana flour or herbal juice from banana stem core.
- Facilitate the adoption of irrigation among farmers to overcome seasonality challenges.

## 5. Vegetable Value Chain:

- Repair and upgrade the solar dryer to ensure consistent and efficient drying of vegetables.
- Promote targeted marketing efforts, especially in dry areas like Kakuma, to tap into new markets.
- Investigate the potential of technology adoption, such as solar drying or ovens, to improve the drying process.
- Explore export opportunities for dried vegetables, leveraging technology and digitization for efficient market access.

These recommendations aim to address the identified challenges and capitalize on the opportunities within each value chain, fostering sustainable growth and economic development in Kakamega County. Implementation of these suggestions requires collaboration among stakeholders, including government bodies, NGOs, and local communities, to create an enabling environment for agricultural value chain development.

## Declarations

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### **Conflicts of Interest:**

The authors declare that no conflict of/ competing interest exist.

### **Author Declarations:**

All authors have read and agreed to the publication of the manuscript.

### **Ethics approval/declarations:**

It is not applicable

### **Authors' contributions:**

Conceptualization - A. Onyuka, I. Wekesa and M, Murimi; Methodology - M. Cheloti and I. Wekesa; Formal analysis - M. Murimi and A. Onyuka; Investigation - M. Murimi; Resources - A. Onyuka; Writing-original draft preparation - M. Cheloti, M. Murimi. and I. Wekesa; Writing-review and editing - M. Cheloti and M. Murimi; Visualization - I. Wekesa; Supervision - A. Onyuka.

### **Data availability statement**

The authors declare that the data supporting the findings of this study are available within the paper and its Supplementary Information files. Should any raw data files be needed in another format they are available from the corresponding author upon reasonable request

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## **Figures**



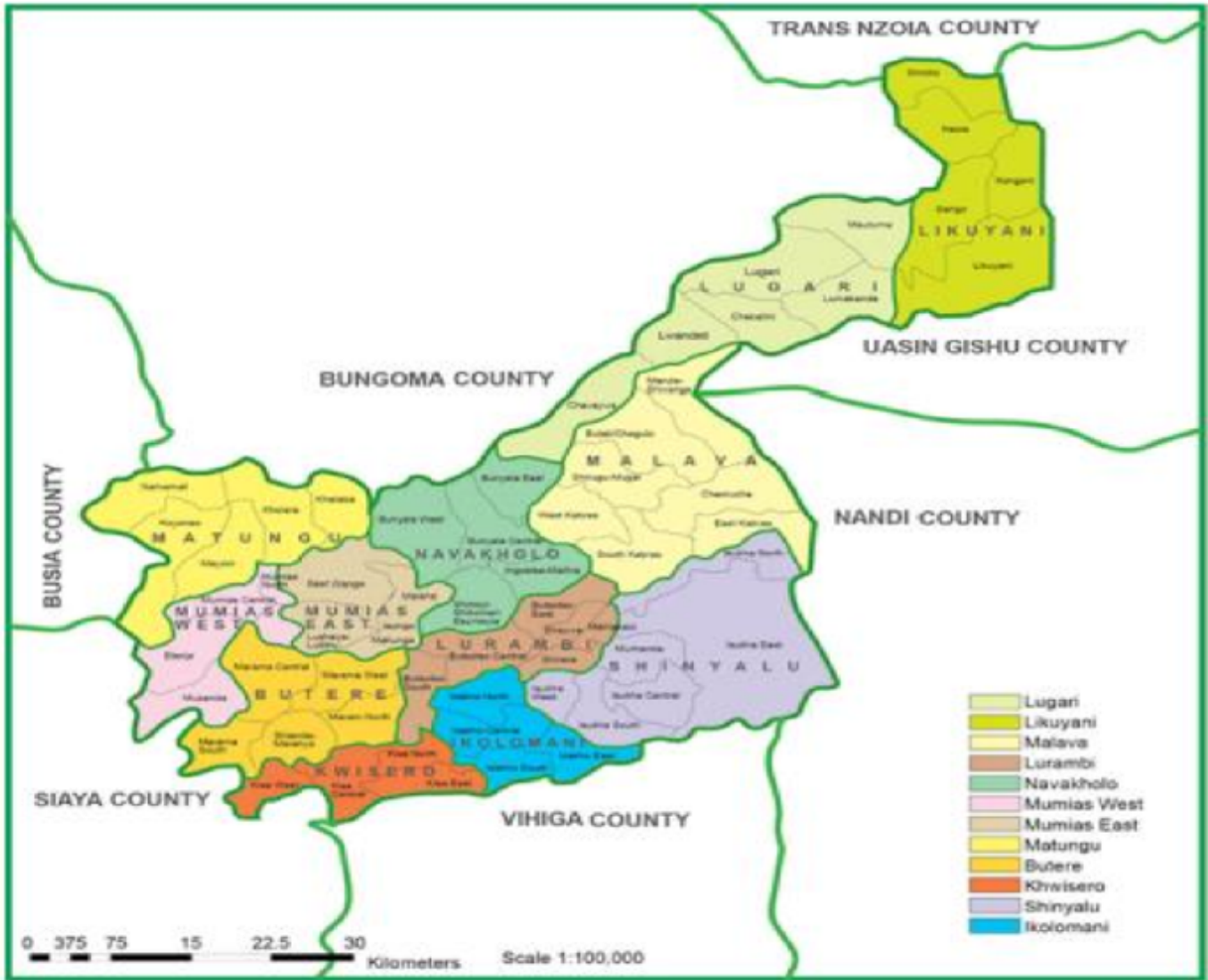


Figure 1

Position and size of Kakamega County

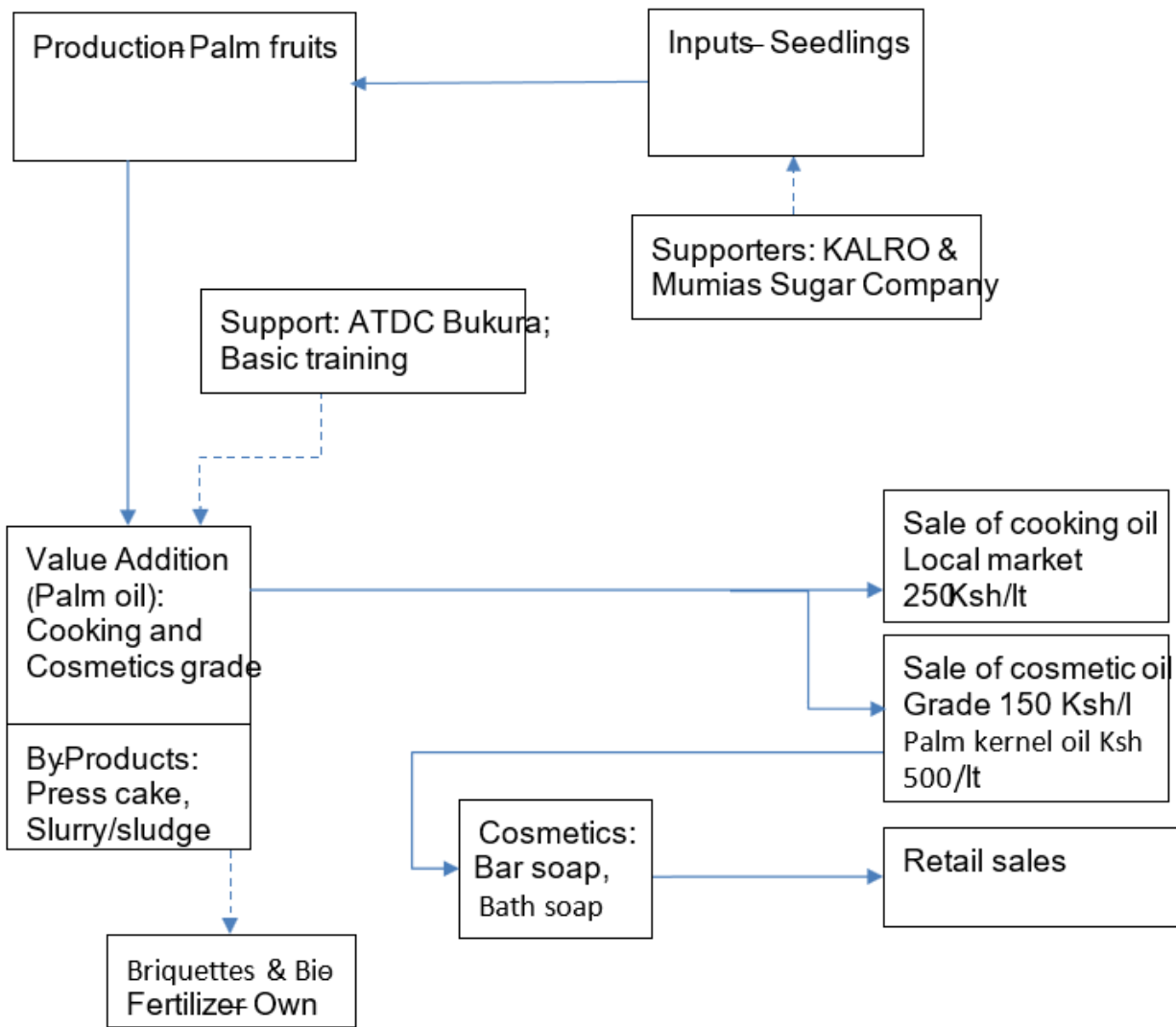


Figure 2

Palm Oil value chain in Butere County

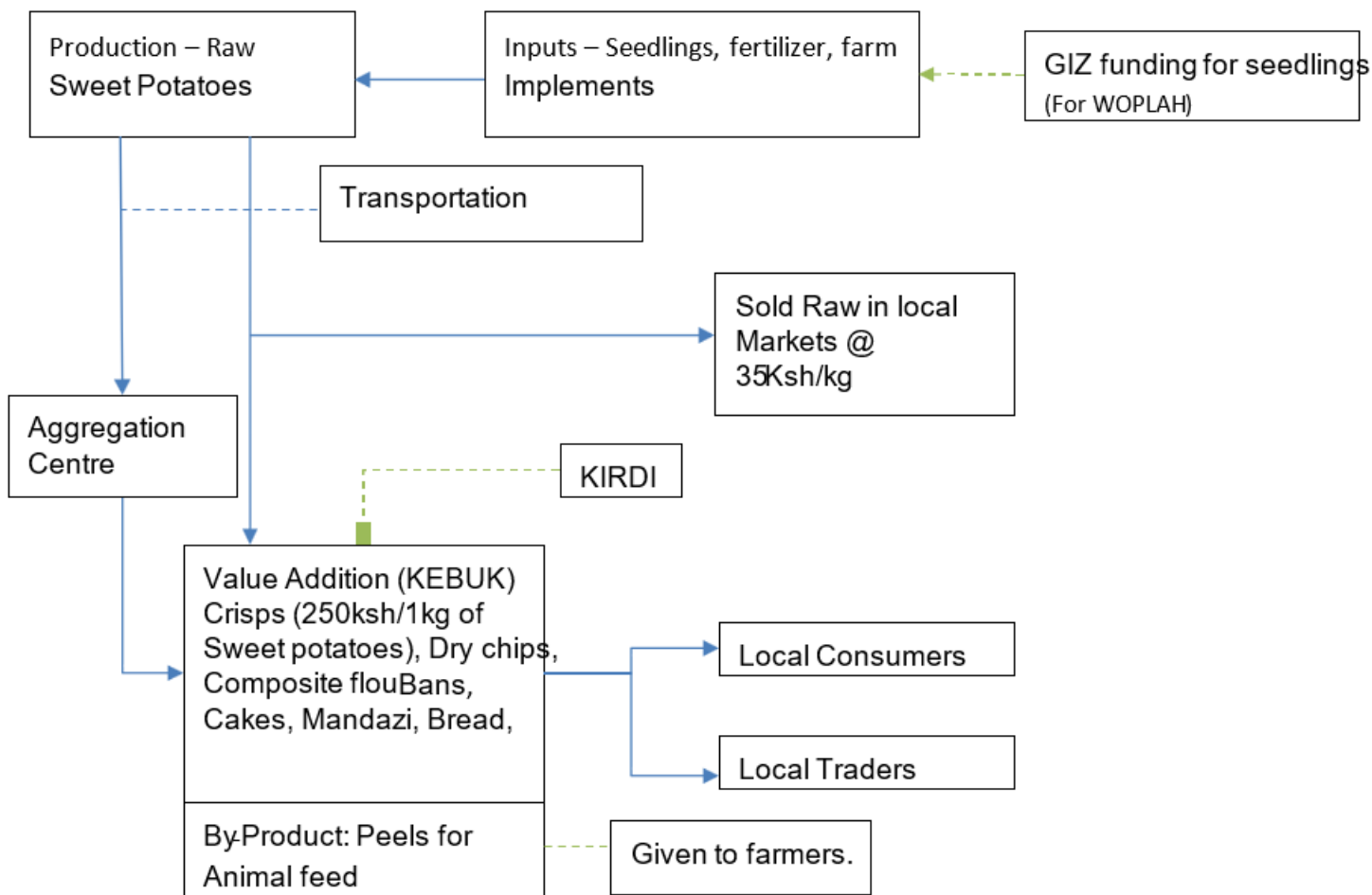


Figure 3

Sweet potatoes value chain mapping

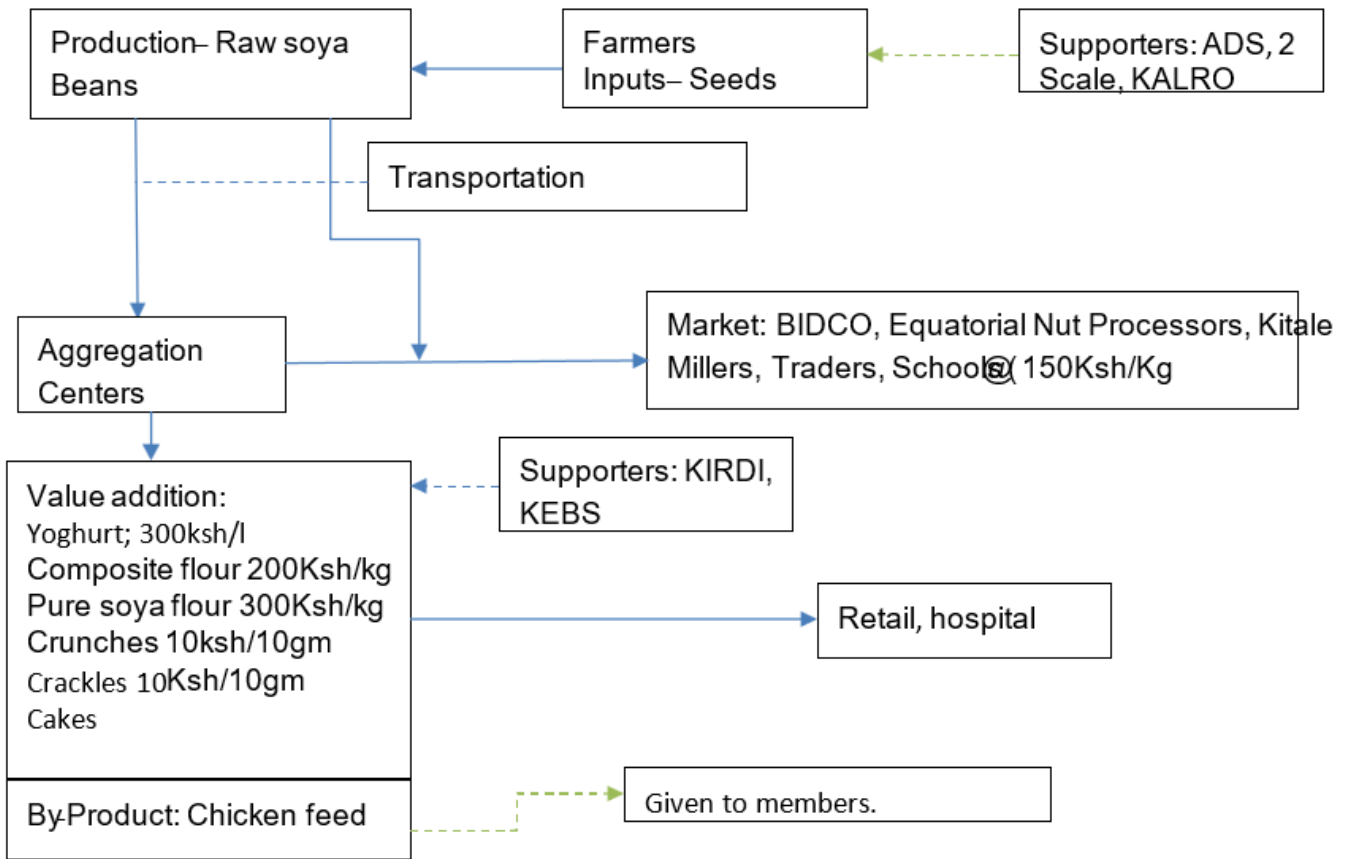


Figure 4

Soya value chain

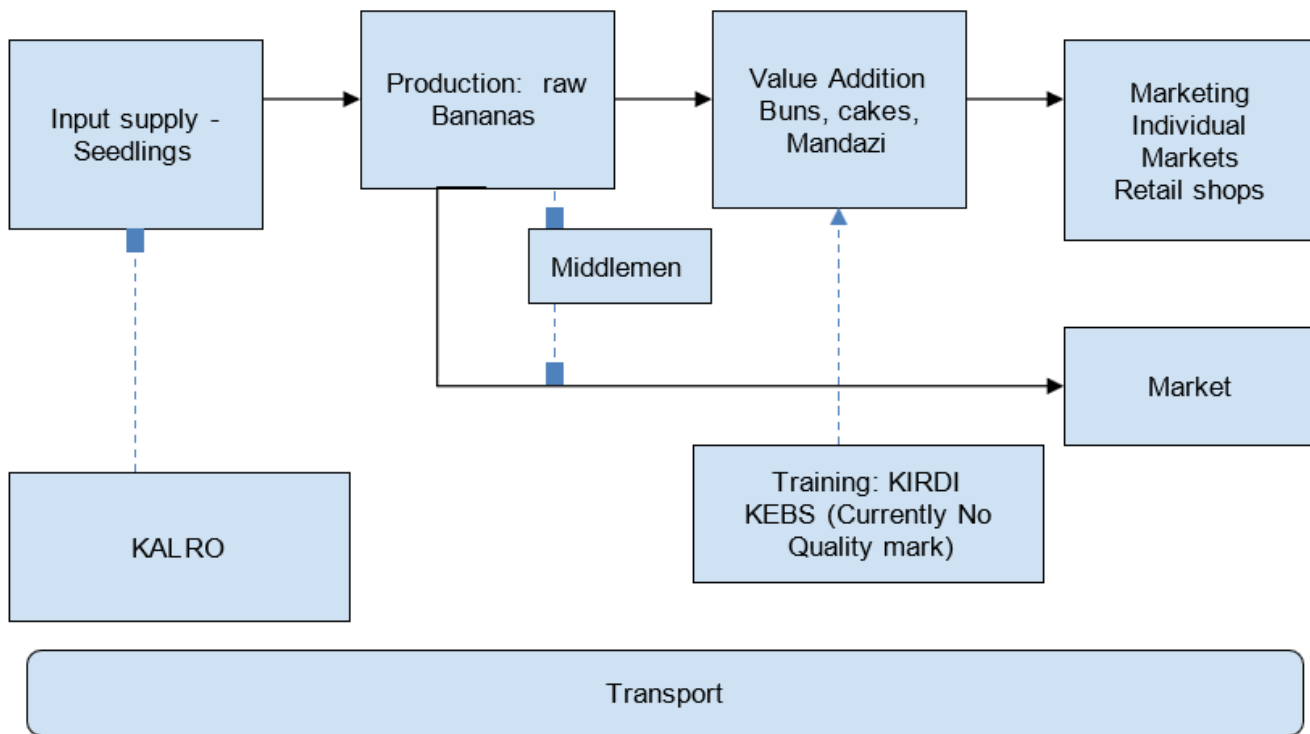


Figure 5

Banana Value chain

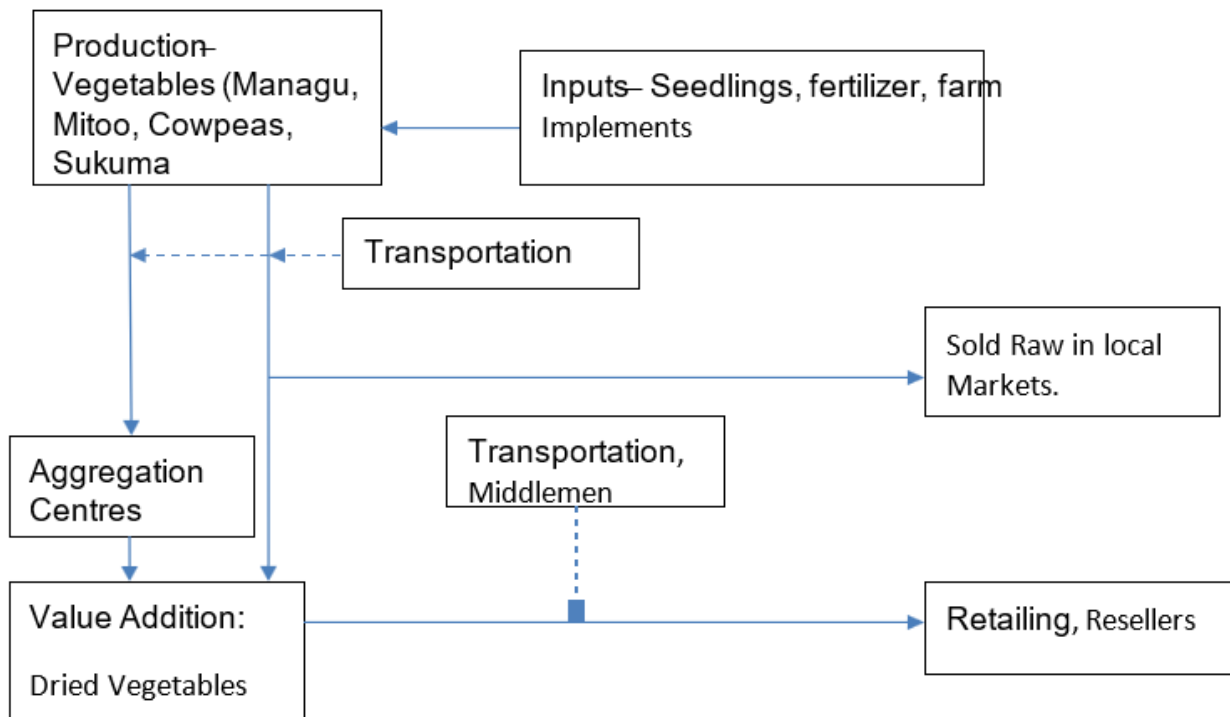


Figure 6

## Supplementary Files

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- [Appendix.docx](#)