

Kenya MARKUP - Market Access Upgrade Programme

Passion fruit and mango AS-IS value chain analysis



About this report

UNIDO commissioned passion fruit and mango value chain analysis in Kenya under the Market Access Upgrade Programme (MARKUP). The study focused on passion fruits and mangoes in 6 counties in Kenya. These are Uasin Gishu, Bungoma and Trans Nzoia for passion fruits and; Makueni, Machakos and Embu for mangoes.

This report presents findings of the study on passion fruit and mango value chain demand, supply, institutional arrangement & access to support services and proposes respective value chain upgrading strategies and recommendations. The study findings are aimed to among others inform MARKUP project interventions providing measurable performance indicators.

The study was undertaken by Tymax Agribusiness Solutions Ltd on behalf of UNIDO.

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Table of Contents

About this report.....	ii
LIST OF TABLES.....	v
LIST OF FIGURES.....	v
Acronyms and abbreviations.....	vi
EXECUTIVE SUMMARY.....	vii
Passion Fruit Value Chain.....	vii
Mango Value Chain.....	x
INTRODUCTION.....	1
1.1 Overview.....	1
1.2 Study background and objectives.....	1
1.3 Approach and methodology.....	1
1.4 Study area.....	1
2.0 PASSION FRUIT VALUE CHAIN.....	2
2.1 Macro environment.....	2
2.1.1 Value chain description.....	2
2.1.2 Value chain actors.....	2
2.2 Demand analysis.....	3
2.2.1 Competitiveness of the value chain.....	3
2.2.2 Market requirements.....	4
2.2.3 Competition.....	4
2.2.4 Marketing and trade.....	4
2.2.5 Key market growth potential; unmet market demand.....	5
2.3 Supply chain analysis.....	7
2.3.1 Demographic characteristics of producers.....	7
2.3.2 Production.....	7
2.3.3 Harvesting, yield and post-harvest management.....	9
2.3.4 Processing.....	10
2.3.5 Exports operations.....	10
2.3.6 Institutional arrangement and access to support services.....	10
2.3.7 Margin analysis across the supply chain.....	12
2.3.8 Environmental analysis.....	12
2.3.9 Gender analysis.....	12
2.4 Value chain upgrading strategy recommendations.....	13
3.0 MANGO VALUE CHAIN.....	16
3.1 Macro environment.....	16
3.1.1 Value chain description.....	16
3.1.2 Value chain actors.....	17
3.2 Demand analysis.....	17

3.2.1 Competitiveness of the value chain	17
3.2.2 Market requirements and operating environment.....	18
3.2.3 Competition	18
3.2.4 Marketing and trade	18
3.2.4 Key market growth potential; unmet market demand	19
3.3 Supply chain analysis	20
3.3.1 Producers demographic characteristics	20
3.3.2 Production	21
3.3.3 Harvesting, yield and post-harvest management	23
3.3.4 Processing	24
3.3.5 Exports operations	24
3.3.6 Institutional arrangement and infrastructure	25
3.3.7 Margin analysis across the supply chain.....	25
3.3.8 Gender analysis	25
3.3.9 Environmental analysis	26
3.4 Value chain upgrading strategy recommendations.	27
Annex.....	30
Data set.....	30

LIST OF TABLES

Table 1: Study areas.....	1
Table 2: Passion fruit value chain actors and their role	3
Table 3: Importers of Kenya's passion fruits: 2015 - 2019.	4
Table 4: Growth in export volumes for the past 5 years.	5
Table 5: Brief demographic information of passion fruit producers in the three counties.....	7
Table 6: Passion fruit land holding and production	7
Table 7: Passion fruit crop nutrition and protection	8
Table 8: Institutional arrangement and access to support services.....	11
Table 9: Passion fruits gross margin analysis	12
Table 10: Value chain upgrading strategy	13
Table 11: Mango value chain actors and their role	17
Table 12: Importers of Kenya's mango	18
Table 13: Marketing channels for mangoes	19
Table 14: Growth in export volumes of mangoes for the past 5 years.	19
Table 15: Land characteristics for mango farmers	21
Table 16: Farming technologies used in mango production	23
Table 17: Type of storage used by mango farmers	24
Table 18: Record keeping among mango farmers	24
Table 19: Mango pricing and yield.....	25
Table 20: Key value chain opportunities and constraints	27

LIST OF FIGURES

Figure 1: Purple passion fruit	2
Figure 2: Markets with potential for Kenya's export of fruits	6
Figure 3: Fresh Mango fruit.....	16
Figure 4: Markets with potential for Kenya's export of mangoes.....	20
Figure 5: Age of the Mango decision makers	20
Figure 6: Land tenure for Mango farmer	22

Acronyms and abbreviations

AFA	Agriculture and Food Authority
FPC	Fresh produce Consortium of Kenya
FPEAK	Fresh Produce Exporters Association of Kenya
ATVET	Agriculture Technical Vocational Education and Training
COVID 19	Corona Virus Disease
e.g.	For Example
EAC	East African Community
FOB	Free On Board
FSSC	Food Safety System Certification
GAP	Good Agricultural Practice
GHP	Good Manufacturing Practice
\$	United States Dollars
HCD	Horticultural Crops Directorate
IPM	Integrated Pest Management
ISO	International Organization for Standardization
ITC	International Trade Center
JKIA	Jomo Kenyatta International Airport
KAM	Kenya Association of Manufacturers
KEBS	Kenya Bureau Of Standards
KES	Kenya shilling
Kg	Kilogram
KPI	Key Performance Indicator
MARKUP	Market Access Upgrade Programme
M-pesa	Mobile banking service in Kenya
ODK	Open Data Kit
PPE	Personal Protective Equipment
SACCO	Savings and Credit Cooperative Organisation
SoCAA	Society of Crop Agribusiness Advisors
SSP	Spray service provider
UAE	United Arab Emirates
UK	United Kingdom
UNIDO	United Nations Industrial Development Organization
WRMA	Water Resources Management Authority

EXECUTIVE SUMMARY

Passion Fruit Value Chain

Demand

While data provided by ITC under product category 081090 comprises of multiple products not just passion fruits, UAE was the biggest importer of Kenya's passion fruits followed by the UK and Saudi Arabia valued at 933, 456 and 145 thousand Euros respectively in 2019. Overall, Kenya exported passion fruits valued at 2,063 thousand Euros during the year. Exported passion fruits volumes grew by 41% and 19% for periods 2017-2018 and 2018-2019 respectively indicating strong demand at regional and international markets. Despite the growth, according to ITC export potential map, there is untapped market with greatest potential for Kenya's exports being Netherlands, United Arab Emirates and China. Netherlands shows the largest absolute difference between potential and actual exports in value terms, leaving room to realize additional exports worth \$559.9 thousands.

Limited compliance to market requirements such as GLOBAL GAP certification where only 9% of farmers interviewed were certified is one of factors limiting exploitation of the untapped markets. There are also minimal direct linkages between exporters and farmers where 94% of the respondents indicated they sell their produce through brokers/agents. While some of the brokers export directly to Uganda, others act as aggregating agents for the exporters. The average selling price per Kg at farm level was KES 51.78 leading to an annual average income of KES 515,276 per acre. Farm gate price is low compared to KES 90 – 100 offered by exporters per Kg to agents/brokers.

Supply

The analysis covered three counties namely Uasin Gishu, Bungoma & Trans Nzoia with a sample size of 86, 31 and 46 respectively totalling to 163 farmers. The average acreage under passion fruits is 0.78 acres which is less in proportion to land operated by interviewed households averaging 9 acres. The overall yield per acre is 10,782 Kgs against a potential of 15,000 Kgs. Some of the key constraints leading to lower yield and quality includes:

- Limited availability of and access to quality seed/ certified planting materials within reach of the farmers.
- Low uptake of good agricultural practices negatively affecting productivity and food safety (e.g. soil testing at only 10%).
- Limited land under passion fruit
- Low uptake of smart water solutions and limited irrigation systems & reliance on rain fed production; only 4.9% of farmers irrigate their orchards

On average 8% of passion fruits are lost at farm level. This is mainly due to poor storage facilities, limited access to grading/pack house facilities and poor postharvest handling practices. Exporters reported an average pack house yield of 80% with grade outs being mainly due to bruising.

Institutional arrangements & access to support services

Only 11% of the passion fruits farmers interviewed are members of farmer organizations indicating that farmers mainly work individually limiting their bargaining power and access to essential services; 95% of farmers individually source farm inputs.

Very few (4%) of farmers have accessed finance despite 98% having access to mobile banking (mainly MPESA). This coupled with an average of 1.25 contacts with extension officers per annum

limits farmers access to knowledge and essential inputs and services that could contribute to increased productivity to meet the escalating demand.

Value chain upgrading strategy recommendations

Recommendations and activities	Key performance indicators (KPIs)	County specific priority areas
Certification and market linkages to increase quality and quantity.		
<ul style="list-style-type: none"> Support exporters to aggressively develop EU, Middle East and regional markets to tap existing opportunities. This will be among others promotion of the Kenyan passion fruits in the target countries and building capacity for Kenyan producers and processors to meet the market requirements such as certification e.g. GLOBAL GAP certification and phytosanitary certificates. 	<ul style="list-style-type: none"> Increase of regional, international trade volume for passion fruits of targeted farmers and enterprises. 	
<ul style="list-style-type: none"> Farmer trainings on GAP (GLOBAL GAP); Integrated Pest Management, Biological Control of Pests. Promote groups certification under GLOBAL GAP option 2. Link farmers to certifying agencies. Traceability: strengthen/upgrade the traceability system to reflect market needs. 	<ul style="list-style-type: none"> Percentage increase in number of GLOBAL GAP certified passion fruits farmers participating in the international markets 	
<ul style="list-style-type: none"> Support shift from farmers marketing through brokers to either through producer groups and or exporters direct. Support formation and or strengthening of producer groups for produce aggregation and collective marketing to improve farmer bargaining power. Support direct farmers (directly or through their organizations) contracting by exporters. 	<ul style="list-style-type: none"> Percentage increase of farmers having signed supply agreements directly with exporters and complying to market standards Percentage increase in income per acre 	<ul style="list-style-type: none"> Bungoma (price per Kg) Uasin Gishu (price per Kg)
Productivity, quality and food safety; target to increase productivity (yield per acre) and food safety through:		
<ul style="list-style-type: none"> Strengthen Agri-Research Institutions to promote production of clean planting materials and selection of marketable varieties suitable for each county. Establishment & registration of economically viable (business entities) fruit nurseries that will provide high quality seedlings to farmers consistently at county level. Accelerate uptake of good agricultural practices and improved access to, demand & effective use of certified inputs and smart farming technologies 	<ul style="list-style-type: none"> Percentage increase in production of safe, quality passion fruits (yield) per acre 	<ul style="list-style-type: none"> Trans Nzoia (Yield and quantities) Bungoma (quantities) Uasin Gishu (quantities)

<p>(through training in farmer field schools, extension services, collective input purchase by farmers & financial access as highlighted in 4 below).</p> <ul style="list-style-type: none"> • Build farmers' entrepreneurial capacity to run passion fruits production as a business adopting market driven production. Demand should guide development of planting calendars to support consistent production. • Work with competent authorities and county governments for policy/regulation formation and enforcement such food safety policy. 		
<p>Effective and efficient post-harvest management</p>		
<ul style="list-style-type: none"> • Identify & support investment opportunities to address postharvest spoilage & value addition processes such as recommended cold storage facilities at farmer level and pack houses at exporters' level. • Trainings of exporters on GHP, FSSC22000, ISO 14001; ISO 45001:2018, traceability, packaging & labelling 	<ul style="list-style-type: none"> • Percentage reduction in post-harvest losses. 	
<p>Support formation & strengthening of farmer organizations to facilitate farmers access to essential services</p>		
<ul style="list-style-type: none"> • Encourage farmers to form groups for easier access to services and inputs capitalizing on their economies of scale. • Promote blended extension services e.g. Spray service providers (SSPs) providing market information. This could be through trainings by the competent authorities such as HCD. • Financial literacy & linkages (tripartite agreements e.g. among banks, farmers and exporters) and tailor made financial products (e.g. cold storage facilities asset financing) • Promote smart services e.g. digital financial services for example Digi Farm & Agri Wallet. 	<p>Number of farmers consistently/easily accessing essential support services.</p>	

The passion fruit value chain needs to be prioritized as a high value subsector by all actors these include the public, private sectors and development organizations due to its increasing market potential and the improvement of the small scale farmers' economic status. Promoting this crop will be a wakeup call to farmers, aggregators, and processors to consider the passion fruit as a source of revenue as it presents huge income potential.

Mango Value Chain

Demand

Kenya's share of world market for mangoes is negligible standing at 0.5%. Approximately 14,048 tonnes of mangoes were exported in 2019 at a unit price of 951.44 Euros per tonne. Kenya exports mangoes mainly to the Middle East with United Arab Emirates accounting for 49%, others include; Saudi Arabia (23%), Oman (13%), Qatar (6%) and Bahrain (3%). Mangoes are also exported to the neighbouring country Uganda which accounts for 4% of the total exports.

The annual growth rate of quantity exported in the past 5 years is at the rate of 2%. However, Kenya registered a negative growth in value in the last 2 years (-20%). The export of mangoes declined by 26% in 2019 with major market destinations in Middle East declining by over 10%. This coupled with the inability to export to EU due to fruit fly menace leaves Kenya with a huge export potential gap. The markets with the greatest potential for Kenya's mango (fresh/dried) export are Netherlands, United Kingdom and United Arab Emirates.

The inability to export to the EU may have led to farmers' not seeking or renewing GLOBAL GAP certification where none of the farmers interviewed was certified. Brokers are a key farmers' marketing channel at 99% whereby decline in exports volumes could have led to farmers selling to the local markets through the traders. The average selling price per piece of mango at farm level was KES 5 and an annual average income of KES 29,875 per farmer.

Supply

The analysis covered three counties namely Makueni, Machakos and Embu with a sample size of 138, 86 and 48 respectively totalling to 272 farmers. The average acreage under mangoes is 3 acres in comparison 8 acres of land operated by the households. It was noted that majority of the farms did not have pure stand of mangoes, hence an average of 28 trees per farmer were spread within the available land across the three counties. The overall yield per tree was 245 pieces against a potential of 500 pieces. Some of the key constraints leading to lower yield and quality includes:

- Low uptake of good agricultural practices negatively affecting productivity and food safety (e.g. IPM at an average of 37.5% mainly in Makueni)
- Low uptake of smart water solutions and limited irrigation systems & reliance on rain fed production; only 1.4% of farmers irrigate their orchards

On average 12% of mangoes are lost at farm level with the highest being 30%. This is mainly due to: Ineffective pest control leading to pest damage, limited market access (explained by the decline in exports volumes) and unavailable/poor storage facilities, limited access to grading/pack house facilities & poor postharvest handling practices.

Institutional arrangement & access to support services

44% of farmers are members of farmer organizations led by Makueni County. Despite this 98.5% of farmers' source inputs individually limiting bargaining power.

7.4% of farmers have accessed finance limiting investments at farm level that could lead to improved productivity or management of post-harvest losses. The farmers had an average of 1.2 contacts with extension officers per annum.

Value chain upgrading strategy recommendations

Recommendations and activities	Key performance indicators (KPIs)	County specific priority area(s)
Hot water treatments, certification and market linkages to increase quality and quantity.		
<ul style="list-style-type: none"> Support initiatives that would enable exporter's better trade with the Middle East market to improve export volumes of fresh mangoes. Support initiatives aimed at enabling Kenya export fresh mangoes to the EU which provides greatest export potential. This includes among others effective and efficient fruit fly management such as hot water treatments. Support exporters and growers meet market requirements such as certification e.g. GLOBAL GAP certification (especially for re-entry to the EU market) 	<ul style="list-style-type: none"> Increase of international trade volume for mango of targeted farmers and enterprises. 	
<ul style="list-style-type: none"> Farmer trainings on GAP (GLOBAL GAP); Integrated Pest Management, Biological Control of Pests. Promote groups certification under GLOBAL GAP option 2. Link farmers to certifying agencies. Traceability: strengthen/upgrade the traceability system to reflect market needs. 	<ul style="list-style-type: none"> Percentage increase in number of GLOBAL GAP certified mango farmers participating in the international markets 	
<ul style="list-style-type: none"> Support shift from farmers marketing through brokers to either through producer groups and or exporters direct. Support formation and or strengthening of producer groups for produce aggregation and collective marketing to improve farmer bargaining power. Support direct farmers (directly or through their organizations) contracting by exporters. 	<ul style="list-style-type: none"> Percentage increase of farmers having signed supply agreements directly with exporters and complying to market standards Percentage increase in income per acre 	
Productivity, quality and food safety; target to increase productivity (yield per tree) and food safety through:		
<ul style="list-style-type: none"> Accelerate uptake of good agricultural practices and improved access to, demand & effective use of certified inputs and smart farming technologies (through training in farmer field schools, extension services, collective input purchase by farmers & financial access as highlighted in 4 below). Build farmers' entrepreneurial capacity to run mango production as a business. 	<ul style="list-style-type: none"> Percentage increase in production of safe, quality mangoes (yield) per acre 	<ul style="list-style-type: none"> Makueni (Quality) Embu (Quality) Machakos (Quality)

<ul style="list-style-type: none"> Assistance towards enabling efficient and effective fruit fly management and controls to improve production of quality fruits. 		
<p>Effective, efficient post-harvest management and accelerated value addition.</p>		
<ul style="list-style-type: none"> Put in place mechanism for pest control through trainings and fruit fly management as in 1 and 2 above. Identify & support investment opportunities to address postharvest spoilage & value addition such as drying technologies and markets. Trainings of processors (dried and pulp) on GHP, FSSC22000, ISO 14001; ISO 45001:2018, traceability, packaging & labelling 	<ul style="list-style-type: none"> Percentage reduction in post-harvest losses. 	
<p>Support formation & strengthening of farmer organizations to facilitate farmers access to essential services</p>		
<ul style="list-style-type: none"> Encourage farmers to form groups for easier access to services and inputs capitalizing on their economies of scale. Promote blended extension services e.g. Spray service providers (SSPs) providing market information. This could be through trainings by the competent authorities such as HCD. Financial literacy & linkages (tripartite agreements e.g. among banks, farmers and exporters) and tailor made financial products Promote smart services e.g. digital financial services for example Digi Farm & Agri Wallet. 	<p>Number of farmers consistently/easily accessing essential support services.</p>	

INTRODUCTION

1.1 Overview

UNIDO commissioned value chain analysis under the Market Access Upgrade Programme. The study focused on passion fruits and mangoes in 6 counties in Kenya. These are Uasin Gishu, Bungoma and Trans Nzoia for passion fruits and; Makueni, Machakos and Embu for mangoes. The study was undertaken by Tymax Agribusiness Solutions Ltd on behalf of UNIDO.

1.2 Study background and objectives

The EU in partnership with the EAC launched the Market Access Upgrade Programme (MARKUP) to support member countries improve market access of agro-food products to the EU and regional markets. The MARKUP is structured around two intervention levels: the EAC Regional Window and the Partner States National Window with country specific projects. UNIDO is the implementation partner for the Kenya-Partner States Window.

The main purpose of this project is to contribute to the economic development of Kenya by increasing the value of both extra and intra-regional agricultural exports in selected horticulture sub sectors; (snow peas and peas, mangoes, passion fruit, chillies, herbs and spices, nuts). Recent studies have analysed the reasons for low productivity and competitiveness in these value chains such as the need of specialized extension services and a diffuse lack of knowledge on appropriate good agricultural practices. These value chains for exports are also lacking compliance with market requirements and standards. National quality infrastructure is at advanced development stage including for conformity assessment services; however, some conformity assessment services are not yet fully recognized by the targeted international markets. This project addresses these challenges through an intervention, and aims to:

- Improve the institutional and regulatory framework for better conformity assessment services in Kenya's horticultural sector;
- Increase revenue and MARKUP for Kenya's smallholder producers and enterprises in export-oriented horticulture sectors.

1.3 Approach and methodology

The consultants undertook the analysis through embedding a participatory approach with the involvement of UNIDO MARKUP team and respective stakeholders. Desk exploratory methods were used to review various documents/reports and other necessary literature relating to the targeted commodity value chain activities. Field data collection and focus group discussions were carried out by enumerators based at the respective counties and guided by the county government officials. The enumerators were trained online prior to data collection. The data was captured using ODK platform for effective and efficient data management after which it was analyzed.

1.4 Study area

The study areas were as in Table 1:

Table 1: Study areas

No.	Value chain	Producers	Exporters
1	Passion Fruit	Uasin Gishu, Bungoma and Trans Nzoia	Target counties and Nairobi
2	Mango	Makueni, Machakos and Embu	Target counties and Nairobi

2.0 PASSION FRUIT VALUE CHAIN

2.1 Macro environment

2.1.1 Value chain description

Passion fruit is produced as a commercial crop by medium and smallholder farmers in Kenya. The fruit does well in the coastal, central, eastern, western and the rift valley regions. The common varieties produced are the purple passion (*Passiflora edulis*) which has a strong aromatic scent and the yellow passion (*Passiflora flavicarpa*) - that are grown mainly for the fresh produce markets and juice extraction. The crop has a life expectancy of 3 to 5 years and is sold in the local, regional and international markets.



Figure 1: Purple passion fruit

The product could contribute to economic development in the rural areas, starting from the point of production where members of the local community are gainfully employed in propagation/establishment of certified nurseries, planting, weeding, harvesting, packaging and setting up produce collection and marketing centres contributing to employment, quality control and enabling farmers to participate in price negotiations breaking the order that has been the preserve of brokers as the study now confirms; provision of transport and improvement of the local road network infrastructure; packaging is an area that has high potential to create employment especially for the youth and women increasing the circulation of money within these communities.

2.1.2 Value chain actors

In the passion fruit value chain, the key actors are the smallholder farmers who make the majority of producers and a small number of medium size producers; the aggregators who comprise of traders/brokers and producer groups (Table 2). These in turn sell to exporters, wholesalers, supermarkets, local markets and export markets such as Uganda. The producers also channel some of their produce to the local markets. The value chain receives support from the national and county governments, with the county governments playing a key role promoting the crop, HCD, KEPHIS, KARLO, Ministries of agriculture and trade and cooperatives. The table below gives a comprehensive list of some of these actors.

Table 2: Passion fruit value chain actors and their role

	Value chain node	Actors	Role
Direct actors	Consumer	Consumers	<ul style="list-style-type: none"> Buy from producers, local markets & supermarkets for consumption
	Wholesale & retailing	Traders, supermarkets, wholesale & retail stores, digital platforms	<ul style="list-style-type: none"> Buy from producers & aggregators and sell to consumers
	Import	Importing agents (for the international markets)	<ul style="list-style-type: none"> Imports from diverse regions and distributes to wholesalers and retailers
	Export	Freight agents & airlines	<ul style="list-style-type: none"> Exports logistics
	Processing	Exporters	<ul style="list-style-type: none"> Source raw materials, process at either company owned or leased facilities and markets in the local, regional and international markets
	Aggregation & transportation	Aggregators/traders & producer organizations	<ul style="list-style-type: none"> Aggregates produce from producers, stores at collection centres and transports or distributes to exporters, wholesalers and retailers.
	Producers	Smallholder farmers and medium scale plantations	<ul style="list-style-type: none"> Production
	Input supply	Manufactures/importers, distributors, agro dealers/stockists and tree nursery operators	<ul style="list-style-type: none"> Sell inputs to producers and where possible provide advisory services.
Support system	Facilitators	National and county governments ministries and departments; competent authorities (A.F.A., KEPHIS, KEBS); Business associations (such as FPEAK, FPC, KAM); Financial institutions (Banks, SACCOs); Packaging materials suppliers; utility providers; research and learning institutions (Universities, ATVETs); private service providers (e.g. SoCAA); development organizations; certification bodies (GLOBAL GAP)	<ul style="list-style-type: none"> Regulation and policy making Support services to actors along the chain (such as extension services, financial access)

Source: Survey findings

2.2 Demand analysis

2.2.1 Competitiveness of the value chain

While data provided by ITC under product category 081090 comprises of multiple products not just passion fruits, UAE was the biggest importer of Kenya passion fruits followed by the UK and Saudi Arabia in 2019 valued at 933, 456 and 145 thousand Euros respectively (Table 3). In overall Kenya exported passion fruits valued at 2,063 thousand Euros.

Table 3: Importers of Kenya's passion fruits: 2015 - 2019.

Importers	Unit : Euro thousand				
	Exported value in 2015	Exported value in 2016	Exported value in 2017	Exported value in 2018	Exported value in 2019
World	1,631	1,457	1,398	1,898	2,063
United Arab Emirates	729	620	675	814	933
United Kingdom	164	155	415	419	456
Saudi Arabia	96	67	81	166	145
Somalia	20	43	40	163	134
Netherlands	78	119	43	173	101
Yemen	-	-	-	-	88
Belgium	232	139	17	36	44
Qatar	23	20	34	38	39
Uganda	141	153	9	3	39

Source: ITC

Consumption patterns

Passion fruit is consumed in fresh and processed form. Fruit extract or the natural concentrate is diluted with water or other juices to make cold drinks. Passion fruit juice produces syrup which has several uses such as sauces, gelatin, candy, jams, and wine. It is also used as a flavouring agent for ice-creams, yoghurt, combined with other fruits to make tropical juices/beverages.

Bargaining power across the value chain

The passion fruit producers are more of price takers and have limited bargaining power mostly because they sell individually to brokers and are yet to capitalize on the economies of scale. The brokers and supermarkets set the prices. Producers have to be more innovative to reduce operating costs and remain competitive. Smallholder farmers who carry out direct marketing especially to restaurants/hotels and supermarkets earn more (KES 100 – 120 a Kg) than the farm gate price of an average of KES 50 per Kg. Identifying potential markets and negotiating favourable contracts is one of key intervention areas.

2.2.2 Market requirements

While there are multiple market requirements, the study focused on GLOBAL GAP certification which is a key export requirement. Of the farmers interviewed, only 9% of farmers were GLOBAL GAP certified limiting access to international markets. To improve export volumes, there is need to have more farmers GLOBAL GAP certified.

2.2.3 Competition

At 846,952 tons, Viet Nam was the world's leading exporter of passion fruits according to ITC data on product category 081090 in 2019. This is followed by Thailand and Egypt. Other key competing nations include Turkey, China, India, Netherlands and Spain. While Columbia is currently the highest producer of passion fruits producing over 50% of the total quantities produced, it was the 23rd world largest exporter in 2019.

2.2.4 Marketing and trade

The demand for passion fruits remains unmet both regionally and internationally with additional export potential as highlighted in 2.2.5. The three counties produced an average of 10,782 Kgs per acre against a potential of 15,000 Kgs during the year under review most of which was sold in

the regional market of Uganda and the remainder to the domestic markets and supermarkets. Despite the high demand for passion fruits most of the smallholder farmers are producing low quantities and small sized fruits (quality) that do not satisfy the regional markets at the same time not meeting international market specifications.

As highlighted in 2.2.2, low GLOBAL GAP certification has limited access of Kenyan passion fruits to the international markets as most of the farmers are non-compliant to the market standards.

In Uasin Gishu 93%, Bungoma 96.7% and Trans Nzoia 60.87% percentage of farmers reported having access to market information mainly from traders/brokers, while the distance to the nearest markets is an average of 4.45 Km. Most of the farmers (94 %) across the three counties use the brokers as their key marketing channel though a few also sell through the producer groups. A key intervention area is to support farmers shift from individual selling (to brokers) to group selling. Working in producer groups will benefit the farmers in more ways including but not limited to collective marketing and procurement of inputs. One of the ways is the possibility of getting group certification instead of each individual looking for own certification; secondly the group members will aggregate produce and thereby maximize on collective bargain/price negotiations.

Digital marketing has not been embraced among these counties as shown by an overall uptake of only 4.29%.

Average price and income

The study established that the average selling price at farm level was highest in Trans Nzoia at KES 80, followed by Bungoma at KES 55 and the least price was in Uasin Gishu where farmers sold their produce at an average price of KES 50. Income from passion fruit sales was highest in Bungoma at KES 706,374, followed by Uasin Gishu at KES 646,983, and Trans Nzoia at KES 209,223. There is need to link farmers directly to exporters for the former to get higher returns.

2.2.5 Key market growth potential; unmet market demand

The passion fruit demand is steadily growing both in the domestic and export markets. In overall exported passion fruits volumes grew by 41% and 19% for periods 2017-2018 and 2018-2019 respectively as tabulated in Table 4.

Table 4: Growth in export volumes for the past 5 years.

Importers	Exported growth in quantity between 2015-2016, %	Exported growth in quantity between 2016-2017, %	Exported growth in quantity between 2017-2018, %	Exported growth in quantity between 2018-2019, %	Exported quantity in 2019, Tons
World	-45	-12	41	19	1180
United Arab Emirates	-26	15	13	-1	303
United Kingdom	-24	253	8	4	237
Uganda	-35	-85	-50	980	216
Somalia	67	173	383	-7	185
Saudi Arabia	-36	57	134	-13	90
Yemen					48
Netherlands	170	-76	346	-53	27

Source: ITC

The fruit is rich in vitamin A and C and is a source of carotene. The popularity of the passion fruit is set to rise higher as consumer preferences are changing from carbonated drinks to fresh juices.

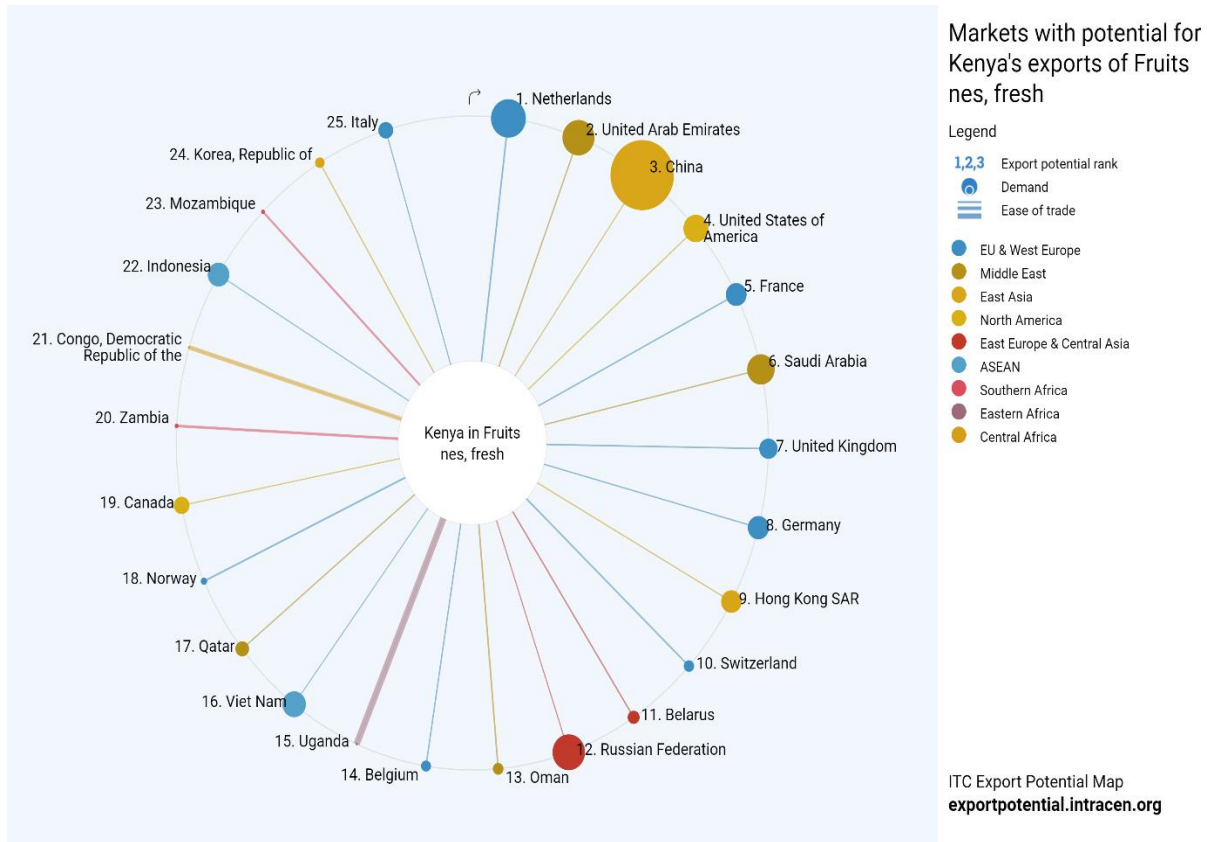


Figure 2: Markets with potential for Kenya's export of fruits

Source: ITC

According to ITC export potential map, the markets with greatest potential for Kenya's exports of 0810XX Fruits nes, fresh are Netherlands, United Arab Emirates and China. Kenya has closest export links with Uganda which indicates why exporters are exporting to this market. Netherlands shows the largest absolute difference between potential and actual exports in value terms, leaving room to realize additional exports worth \$559.9 k.

With the high potential in the local, regional and international markets, promoting this crop would enable value chain actors mainly smallholder farmers exploit the income potential of the unmet demand. A vine of passion fruit that is well tended can produce a high of 2 Kgs every week with the price ranging from KES 50 to a high of 100 for choice fruit in the export markets. The different ripening stages enable a farmer to harvest weekly and hence have weekly sales.

2.3 Supply chain analysis

2.3.1 Demographic characteristics of producers.

The selected counties have different levels of education attained by the household decision makers. Overall, 50.31% of household decision makers in the three counties have completed form four (Table 5), 16.56% college or higher, 23.31% primary or secondary, 3% reached standard 7 and 3% did not attend school at all. The level of education that one attains is important in the evaluation of passion fruit business. This will inform the type of intervention and the level at which to start/ communicate important messaging.

Table 5: Brief demographic information of passion fruit producers in the three counties.

Demographic area / County	Uasin Gishu	Bungoma	Trans Nzoia	Overall average
Age of decision maker	43.9	49	44	44
Education level (form 4)	47.76%	70.79%	24.58%	50.31%
House hold size	6	6	6	

Source: Household survey findings

2.3.2 Production

The average land holding for the passion fruit farmers in the three counties is 9 acres. Uasin Gishu has the highest with 12.4 acres followed by Trans Nzoia with 5.31 and Bungoma with 5.26 acres. Actual land under passion fruits in acres is 0.81 for Uasin Gishu, 0.98 in Trans Nzoia and 0.42 in Bungoma which is less in proportion to that operated by the households.

The main tenure system by households in these three counties is individual land ownership with a high percentage holding title deeds. Households with title deeds in Uasin Gishu, Bungoma and Trans Nzoia counties were 91.86%, 96.77% and 91.3% respectively. All the farmers (100%) in Bungoma County own their parcels of land. Uasin Gishu and Trans Nzoia county farmers own 97.67% and 93.48% of their land parcels since they rent in 2.33% and 2.17% respectively to supplement them in production of passion fruits. Bungoma passion fruit farmers however, do not rent in land. The overall average acreage of land owned by passion fruit farmers in the three selected counties is 5.88. In general, passion fruit production is fairly new in Trans Nzoia and older in Uasin Gishu County which has grown the crop for over 3 years (Table 6).

Table 6: Passion fruit land holding and production

County/parameter	Uasin Gishu	Bungoma	Trans Nzoia	Overall
Average land holding (in acres)	12.45	5.25	5.31	9
Average land under passion fruit crop	0.81	0.42	0.98	0.78
Land tenure – with titles	91.86%	100%	91.3%	
Land Tenure – owned	97.67%	100%	93.48%	
Average years in production	4.7	3	1	

Source: Household survey findings

Access to agricultural inputs

The study revealed most (95%) of farmer's access to farm inputs was on individual basis, an indicator of low collective action amongst farmers. Economically, it implies that farmers are not enjoying the benefits of pulling resources together and bargaining power for a bigger voice and better input prices and support by the input suppliers.

Crop nutrition & protection

Very few passion fruit farmers conduct soil testing before they plant. This is indicated by the low average percentage (10.43%) among the counties affiliated to the practice. Trans Nzoia has the highest percentage (17.39%) of the farmers doing the soil tests whereas Uasin Gishu and Bungoma counties are 5.07% and 12.9% respectively (Table 7). In awareness and use of IPM, Uasin Gishu, Bungoma and Trans Nzoia counties have their farmers aware as indicated by an overall average percentage of 10% distributed among the three counties at 7%, 3% and 20% respectively. This therefore calls for sensitization of farmers in all of these counties to be trained on the importance of using IPM in their production of passion fruits.

Most of the farmers in these counties use the general knapsack which they can use for other purposes with only 29.07%, 19.35% and 36.96% of farmers in Uasin Gishu, Bungoma and Trans Nzoia counties respectively using dedicated knapsack. When applying the chemicals during spraying passion fruits, Uasin Gishu and Trans Nzoia counties have the highest percentages of 22.09% and 36.96% in mixing different chemicals to be used.

Using an approved list of agrochemicals is not adhered to among the three counties as evidenced by the low overall percentage of 35.58%. Chemicals packed in sealed containers are embraced by the farmers. Most of them opt for the sealed ones as shown by a high percentage (85.89%) in overall. Uasin Gishu, Bungoma and Trans Nzoia counties have 98.84%, 83.87% and 63.04% of passion fruit farmers buying chemicals packed in sealed containers. Whenever these passion fruit farmers buy the chemicals, they first confirm that the chemicals bought are not expired.

Table 7: Passion fruit crop nutrition and protection

County	Uasin Gishu	Bungoma	Trans Nzoia	Overall
Parameters				
Soil Testing	5.07%	12.9%	17.39%	10.43%
Awareness & use of IPM	7%	3%	20%	10%
Use of dedicated knapsack	29.07%	19.35%	36.96%	29.45%
Use of approved agrochemical list	25.58%	29.03%	58.7%	35.58%
Mixing of different chemicals	22.09%		36.96%	
Using packed & sealed chemicals	98.84%	83.87%	63.04%	85.89%
Checking expiry date of chemicals	86.05%	41.94%	65.22%	
Read & Understand product labels	100%	63.04%	45.16%	76.07%
Clean pumps after use	98.84%	70.97%	69.57%	85.28%
Type of pumps used – Manual	100%	100%	99.2%	
Type of pumps used – Motorized	0	0	0.8%	
Incomplete PPEs	97.8%	90%	40.74%	84.26%
Keep pest control records	13%	13%	30%	18%

Source: Household survey findings

On the decision to apply agrochemicals, farmers in Uasin Gishu County apply chemicals after certain time periods. This is the most preferred technique to them compared to that of scouting (25.58%) and following a chart embraced by 6.98% of the farmers. Most of the farmers in Bungoma County (48.39%), prefer following a chart to other techniques when making the decision to apply agrochemicals. Other passion fruit farmers however use scouting and after time period when deciding when to apply agrochemicals represented by 25.81% and 6.52% respectively. In Trans Nzoia County however, only two techniques are preferred with most farmers opting to adopt after

time period (69.57%) and the rest scouting (23.91%) in making the decision to apply agrochemicals.

After spraying, most farmers prefer to clean their pumps after every spraying job. This is represented with an overall percentage of farmers in all the three counties at 85.28 Uasin Gishu, Bungoma and Trans Nzoia counties farmers often clean their pumps after every spraying job. This is illustrated by their high percentages of 98.84%, 70.97% and 69.57% respectively. All the farmers in the three counties embrace manual spraying of the passion fruits. In Trans Nzoia County, 99.2% of farmers use manual spraying whereas 0.8% have embraced the motorized spraying technique. Overall 84.26% of the farmers have incomplete set of PPE. Both Uasin Gishu and Bungoma counties have higher percentages of 97.87% and 90% respectively of the passion fruit farmers using PPEs but have incomplete sets. In Trans Nzoia, the households with complete set PPEs are 40.74%, which means that the passion fruit farmers are not well protected.

Access to labor

Labour challenges affect the passion fruit farmers, with a relatively low percentage of 33.74% of the farmers experiencing these challenges. The most challenged set of passion fruit farmers are those from Uasin Gishu County with a 51.16% of them facing these labour challenges. Bungoma (9.68%) and Trans Nzoia County (17.39%) farmers face less labour related challenges. This means that Bungoma and Trans Nzoia counties are more labour abundant.

Use of farming technology

Farmers interviewed indicated they have had a problem of acquiring clean planting material and intensive interventions are needed to ensure access to quality planting materials.

Irrigation is an important aspect in the production of passion throughout the year. The study indicates that farmers using irrigation in the three counties is very low. An overall average of 4.91% of the interviewees were irrigating their crops and only 1.23% have a WRMA license. The county with the highest number of farmers practicing is Uasin Gishu with 6.98% of the farmers, Trans Nzoia with 3.23% and Bungoma with 2.17%. Adoption of smart water solutions (climate smart irrigation technologies; drip irrigation, solar powered pumps, water pans) would contribute to increased water productivity leading to increased incomes and help in countering climate change by the smallholder.

2.3.3 Harvesting, yield and post-harvest management

During harvesting which is mainly manually done, 63.19% of the farmers across the counties use the harvest containers exclusively while the rest use other containers and means to harvest. 83.72% of farmers in Uasin Gishu County embrace these harvest containers exclusively whereas a few passion fruit farmers in Bungoma (38.71%) and Trans Nzoia (41.3%) counties embrace the exclusive use of the harvest containers.

Current yield per Acre

The overall average yield in the three counties is 10,782 Kgs per acre with the distribution among the three counties being; Uasin Gishu with an average of 13,063 Kgs, Bungoma with 13,105 Kgs and Trans Nzoia being the lowest with 2,615 Kgs. Trans Nzoia experiences higher rates of post-harvest losses (12%) compared to the other counties despite its low production. From the study findings Trans Nzoia has the largest land under crop but produces the least and has the most postharvest losses. There has been a gradual decline in commercial passion fruits production in Trans Nzoia leading to the current low yields per acre.

Post-harvest management

Two counties are very low on traceability records. Uasin Gishu farmers keep none, Bungoma only 3.23%, Trans Nzoia on the other hand has 41.3% of farmers keeping traceability records. This means that these farmers need to be sensitized on the importance of keeping records.

Farmers mostly use open stores and in field storage. On average 7.9% have cold storage in the three counties while 24.4% store their produce in a closed non temperature controlled stores. Considering the nature of the produce it is important that farmers are sensitized and uptake improved storage technologies to stem postharvest losses and improve the quality of produce going to the markets.

2.3.4 Processing

Passion fruits are sold in fresh form in the local, regional and international markets with minimal processing (mainly packaging into customer specific packing materials) by the exporters. While there is processing going on at the county level for example in Bungoma where companies such as Fruited Plains Ltd packages from, other exporters interviewed processes in pack houses within Nairobi metropolis.

The reported yield at the pack house was an average of 80% with grade outs being as a result of largely mechanical damage such as bruising while on transit. Packing closer at the raw material sources could lead to higher processing yield but this calls for comprehensive cold chain management from pack houses to the airport for passion fruits destined for the international market. However, packing within Bungoma is economically viable for exporters serving Ugandan market.

2.3.5 Exports operations

Exporters to the international markets such as the UK indicated they at all times have their consignments exported through JKIA. While COVID 19 had at the onset of the pandemic led to sharp increment of freight costs, the freight costs are usually as high as an average of 40% of the sales price. This is an area that requires intervention. Regional exporters mainly use the Malaba border.

2.3.6 Institutional arrangement and access to support services

Group Membership

Very few passion fruit farmers from Uasin Gishu, Bungoma and Trans Nzoia counties representing 3.49%, 6.45% and 28.26% respectively are members of a crop farmer organization. This limits the farmers bargaining power and access to both input and output markets. This is affirmed by the overall percentage of farmers accessing inputs individually at 95.09%. Those farmers that use collective means when acquiring farm inputs are quite few (4.91%). There is need therefore to encourage farmers to operate in groups to enjoy economies of scale.

Financial services access

More than half (65.03%) of the farmers in all the three counties have active bank accounts. Some of them however, have other means of storing their money apart from the banks as illustrated by the percentage of those with active accounts in the counties. Uasin Gishu, Bungoma and Trans Nzoia counties have 72.09%, 70.97% and 47.83% of the passion fruit farmers bearing active bank accounts.

Farmers are able to access mobile banking services average 66.26% in the three counties. This enables them to make transactions without having to go to the banks. Uasin Gishu County is the highest with 74.42% of its passion fruit farmers able to access mobile banking services. Bungoma and Trans Nzoia counties had relatively fewer farmers accessing mobile banking services at 61.29% and 54.35% respectively.

Very few passion fruit farmers are able to access credit for passion fruit production. Only an average of 4.29% of the farmers' access credit among the three counties in overall. Bungoma County has the least number of farmers who are able to access credit at 3.23% of the total passion fruit producing households, followed by Uasin Gishu at 3.93% and Trans Nzoia at 6.52%.

Uasin Gishu and Bungoma counties have good phone connection with 98.84% and 93.55% respectively meaning its internet is steady compared to that of Trans Nzoia with 50% phone connection. Despite Trans Nzoia County having the least average number of passion farmers with steady phone connection, their internet connection is relatively higher (43.48%) compared to Uasin Gishu and Bungoma counties with 4.65% and 6.45% of the farmers with a steady internet connection.

Farmer training and extension

Not all the farmers across the three counties had access to training services. Only 63.19% of them in overall access the training services (Table 8). The distribution in percentage of the passion fruit farmers who could access the training services in Uasin Gishu, Bungoma and Trans Nzoia counties were 82.56%, 41.94% and 41.3% respectively. Farmer trainings should be increased in Bungoma and Trans Nzoia counties since they are below average. The average number of trainings that the passion fruit farmers attended per annum was an average of only one. This shows that most people did not either show up for trainings organized in these counties or less trainings were conducted each year.

Table 8: Institutional arrangement and access to support services

County	Uasin Gishu	Bungoma	Trans Nzoia	Overall
Parameters				
Farmers group membership	3.49%	6.45%	28.26%	11.04%
Access to farm inputs collectively	0	0	17.39%	11.04%
Access to farm inputs individually	100%	100%	82.61%	95.09%
Access to extension	1.26	1.31	1.22	1.25
Access to training services	82.56%	41.94%	41.3%	63.19%

Source: Household Survey data

The number of extension contacts with the extension officers on average per year in Uasin Gishu, Bungoma and Trans Nzoia counties per year was 1.26, 1.31 and 1.22 respectively. The average contact with extension service providers in the three counties is at an overall average of 1.24 leaving farmers demanding technical advice on passion fruit production. In Uasin Gishu demand for advice is 97.6%, 93.5% in Bungoma and 71.4%, only 10.4% of those interviewed did not need production advice. To meet the high extension services demand, village based service providers model (mainly young men and women) could be trained to provide support on demand such as aggregation, spray service provision, weeding, pruning and other related activities. The service providers can also provide technical knowledge or help the farmer to access this knowledge,

supply inputs in essence reach the farmer at the grass root – providing the farmer with essential services and creating self-employment.

2.3.7 Margin analysis across the supply chain

The farmers sell their produce at an average of between KES 50 to KES 80 to the traders/agent. The agents sell to exporters at an average price of KES 90 - 100. Exporters sell passion fruits between KES 300 – 400 per Kg in the international markets (FOB) and regionally (Uganda) at KES 120 – 150 per Kg.

Table 9: Passion fruits gross margin analysis

Node of the value chain	Farmer to trader/agent	Agent to exporter	Exporters to importing agents (international markets); FOB	Exporters to importing agents (Uganda)
Selling price (range); season dependent	KES 50 – 80	KES 90 – 100	KES 300 - 400	KES 120 - 150
Gross margin (before operating costs and net margin)	KES 10 -20	KES 40 – 20	KES 210 – 300	KES 30 - 50

Source: Survey findings

2.3.8 Environmental analysis

Farmers interviewed are in agreement that climate change is real and has adversely affected production in the three counties. The farmers are ready to embrace conservation programs that promote sustainable use and preservation of available natural resources and enhance sustainable food production. With the right measurements the passion fruit orchard can accommodate kales that would be used for household consumption and sales.

2.3.9 Gender analysis

Although males dominate in land ownership and decision making the passion fruit value chain provides opportunities for women and youth participation across the value chain. More women and youth are involved in providing labor for planting, pruning, harvesting and even minor processing, but this number reduces towards marketing and advanced value addition processes.

The move towards increasing women participation in market and value addition is key to this sector and has to be supported. As the world continues to expand the digital space, youth should be brought on board to provide services such as operation of digital farming /marketing platforms (e.g. Digifarm, Isoko) at grass root level. Trained village service providers can support research and crop development initiatives targeting increased production and incomes.

2.4 Value chain upgrading strategy recommendations.

Table 10 summarizes key value chain opportunities and constraints with respective recommendations (inclusive of specific activities) and key performance indicators.

Table 10: Value chain upgrading strategy

Opportunities and constraints	Recommendations and activities	Key performance indicators (KPIs)	County specific priority areas
<p>1. Marketing</p> <p>Untapped markets: there is high market potential in the local, regional and international markets for fresh passion fruits.</p> <p>Netherlands, United Arab Emirates and Uganda are some of the markets with huge export potential for the Kenyan passion fruits.</p> <p>Compliance to market requirements (standards): only 9% of farmers interviewed are GLOBAL GAP certified limiting access to international markets.</p> <p>Marketing channels and income: brokers are a key farmer marketing channel at 94%. Farmers also sell through producer groups. The average selling price per Kg at farm level is KES 51.78 with an annual</p>	<p>Certification and market linkages to increase quality and quantity.</p>	<ul style="list-style-type: none"> Increase of regional, international trade volume for passion fruits of targeted farmers and enterprises. 	
	<ul style="list-style-type: none"> Support exporters to aggressively develop EU, Middle East and regional markets to tap existing opportunities. This will be among others promotion of the Kenyan passion fruits in the target countries and building capacity for Kenyan producers and processors to meet the market requirements such as certification e.g. GLOBAL GAP certification and phytosanitary certificates. Farmer trainings on GAP (GLOBAL GAP); Integrated Pest Management, Biological Control of Pests. Promote groups certification under GLOBAL GAP option 2. Link farmers to certifying agencies. Traceability: strengthen/upgrade the traceability system to reflect market needs. 	<ul style="list-style-type: none"> Percentage increase in number of GLOBAL GAP certified passion fruits farmers participating in the international markets 	
	<ul style="list-style-type: none"> Support shift from farmers marketing through brokers to either through producer groups and or exporters direct. Support formation and or strengthening of producer groups for produce aggregation and collective marketing to improve farmer bargaining power. 	<ul style="list-style-type: none"> Percentage increase of farmers having signed supply agreements directly with exporters and complying to market standards 	<ul style="list-style-type: none"> Bungoma (price per Kg) Uasin Gishu (price per Kg)

average income of KES 515,276 per acre.

2. Production

The overall yield per acre is 10,782 Kgs against a potential of 15,000 Kgs with an overall area under passion fruits per farmer being 0.78 acres out of 9.06 acres operated by the households. Some of the key constraints leading to low yield and quality includes:

- Limited availability of and access to quality seed/certified planting materials within reach of the farmers
- Low uptake of good agricultural practices negatively affecting productivity and food safety (e.g. soil testing at only 10%)
- Limited land under crop
- Low uptake of smart water solutions and limited irrigation systems & reliance on rain fed production; only 4.9% of farmers irrigate their orchards

3. Harvesting, post-harvest management and processing

On average 8% of passion fruits are lost at farm level. This is mainly due to:

- Support direct farmers (directly or through their organizations) contracting by exporters.
- Percentage increase in income per acre

Productivity, quality and food safety; target to increase productivity (yield per acre) and food safety through:

- Strengthen Agri-Research Institutions to promote production of clean planting materials and selection of marketable varieties suitable for each county.
- Establishment & registration of economically viable (business entities) fruit nurseries that will provide high quality seedlings to farmers consistently at county level.
- Accelerate uptake of good agricultural practices and improved access to, demand & effective use of certified inputs and smart farming technologies (through training in farmer field schools, extension services, collective input purchase by farmers & financial access as highlighted in 4 below).
- Build farmers' entrepreneurial capacity to run passion fruits production as a business adopting market driven production. Demand should guide development of planting calendars to support consistent production.
- Work with competent authorities and county governments for policy/regulation formation and enforcement such food safety policy.
- Percentage increase in production of safe, quality passion fruits (yield) per acre
- Trans Nzoia (Yield and quantities)
- Bungoma (quantities)
- Uasin Gishu (quantities)

Effective and efficient post-harvest management

- Identify & support investment opportunities to address postharvest spoilage & value addition processes such as recommended
- Percentage reduction in post-harvest losses.

- Unavailable/poor storage facilities, limited access to grading/pack house facilities & poor postharvest handling practices

Processing yield at the pack houses averages 80%.

4. Institutional arrangement & access to support services

Farmers mainly work individually limiting their bargaining power and access to essential services.

Only 11% of the farmers are members of farmer organizations. 95% of farmers individually source farm inputs.

Financial access: very few (4%) of farmers have accessed finance despite 98% having access to mobile banking (mainly MPESA).

Extension services: on average farmers had 1.25 contacts with extension officers per annum.

cold storage facilities at farmer level and pack houses at exporters' level.

- Trainings of exporters on GHP, FSSC22000, ISO 14001; ISO 45001:2018, traceability, packaging & labelling

Support formation & strengthening of farmer organizations to facilitate farmers access to essential services

- Encourage farmers to form groups for easier access to services and inputs capitalizing on their economies of scale.
- Promote blended extension services e.g. Spray service providers (SSPs) providing market information. This could be through trainings by the competent authorities such as HCD.
- Financial literacy & linkages (tripartite agreements e.g. among banks, farmers and exporters) and tailor made financial products (e.g. cold storage facilities asset financing)
- Promote smart services e.g. digital financial services for example Digi Farm & Agri Wallet.

Number of farmers consistently/easily accessing essential support services.

3.0 MANGO VALUE CHAIN

3.1 Macro environment

3.1.1 Value chain description

The mango fruit is most popular for its unique sweet and juicy nature, is rich in nutritional vitamins A, C, E and K. The mango has different varieties differentiated by taste, shape, size, aroma, colour and fibre content. Common varieties planted in Kenya are Apple, Ngowe, Kent/Keit and Tommy Atkins. The mango is best adapted to a warm tropical monsoon climate with a pronounced dry season (>3 months) followed by rains. However, information from other countries indicates that crops cultivated for a long time over an extended area show a high degree of diversity due to varied environmental influences.

The mango is an important crop in tropical regions throughout South America, Hawaii, Central America, Asia, the Caribbean, and Africa. Mango farmers often practice grafting in order to ensure fruit production. In recent years, mangoes have become well established as fresh fruit and processed products in the global market. World demand for mango is ascertained to be increasing particularly from temperate countries where mangoes are rapidly gaining in popularity. Leading importing country is US and in the EU are the Netherlands, France, England, Portugal, Spain, Belgium, Denmark, and Sweden. Apart from India, other major producers of mango are China, Mexico, Thailand, Indonesia, Pakistan, Philippines, Nigeria, Brazil, Peru, Australia, South Africa, Malaysia and Venezuela.



Figure 3: Fresh Mango fruit

In Kenya, mangoes are the second most important fruits, contributing to 21% of the total value of fruits produced compared to bananas, which contribute 32% of the total value. According to Kenya Plant Health Inspectorate Service (KEPHIS), approximately 49,098 Ha is under mango production producing 779,147 metric tons. The Horticultural Crops Directorate (HCD) ranks the top 10 producing counties by value as Makueni (30%), Machakos (23%), Kilifi (16%), Kwale (8%), Meru (4.5%), Embu (2.8%), Bungoma (2.1%), Tana River (1.8%), Elgeyo Marakwet (1.1%) and Murang'a (1.1%). There are so many varieties of mango planted in Kenya. The main varieties are apple, ngowe, kent/keitt, Tommy Atkins. The mango industry in Kenya has grown over years, expanding in size and regional coverage in the country. Significant plantations now cover the larger Eastern, Coast, Central, Rift valley and Western regions. The bulk of mango production is in the Eastern region which produces over 61% of all mangoes, followed by the Rift valley at 30% and the coast at 28%. The value chain analysis covered three counties of Makueni, Machakos and Embu.

3.1.2 Value chain actors

In the mango value chain, the key actors are the smallholder farmers who make the majority of producers and medium size producers; the aggregators who comprise of traders and farmers' groups/farmer organizations. Table 11 gives a comprehensive list of some of these actors.

Table 11: Mango value chain actors and their role

	Value chain node	Actors	Role
Direct actors	Consumer	Consumers	<ul style="list-style-type: none"> Buy from producers, local markets & supermarkets for consumption
	Wholesale & retailing	Traders, supermarkets, wholesale & retail stores, digital platforms	<ul style="list-style-type: none"> Buy from producers & aggregators and sell to consumers
	Import	Importing agents (for the international markets)	<ul style="list-style-type: none"> Imports from diverse regions and distributes to wholesalers and retailers
	Export	Freight agents & airlines	<ul style="list-style-type: none"> Exports logistics
	Processing	Exporters	<ul style="list-style-type: none"> Source raw materials, process at either company owned or leased facilities and markets in the local, regional and international markets
	Aggregation & transportation	Aggregators/traders & producer organizations	<ul style="list-style-type: none"> Aggregates produce from producers, stores at collection centres and transports or distributes to exporters, wholesalers and retailers.
	Producers	Smallholder farmers and medium scale plantations	<ul style="list-style-type: none"> Production
	Input supply	Manufactures/importers, distributors, agro dealers/stockists and tree nursery operators	<ul style="list-style-type: none"> Sell inputs to producers and where possible provide advisory services.
Support system	Facilitators	National and county governments ministries and departments; competent authorities (A.F.A., KEPHIS, KEBS); Business associations (such as FPEAK, FPC, KAM); Financial institutions (Banks, SACCOs); Packaging materials suppliers; utility providers; research and learning institutions (Universities, ATVETs); private service providers (e.g. SoCAA); development organizations; certification bodies (GLOBAL GAP)	<ul style="list-style-type: none"> Regulation and policy making Support services to actors along the chain (such as extension services, financial access)

Source: Survey data

3.2 Demand analysis

3.2.1 Competitiveness of the value chain

Kenya exported approximately 14,048 tonnes of mangoes in 2019 at a unit price of 951.44 Euros per tonne. Kenya's share of world market for mangoes is negligible standing at 0.5%. The annual growth rate of quantity exported in the past 5 years is at the rate of 2%. However, Kenya registered

a negative growth in value in the last 2 years (-20%). Kenya exports Mangoes mainly to the Middle East with United Arab Emirates accounting for 49% of the Kenyan market while others include; Saudi Arabia (23%), Oman (13%), Qatar (6%), and Bahrain (3%). Kenya also exports its mangoes to its neighbouring country Uganda which accounts for 4% of the total exports (Table 12).

Table 12: Importers of Kenya's mango

Importers	Exported value in 2015	Exported value in 2016	Exported value in 2017	Exported value in 2018	Exported value in 2019
World	17,256	16,213	15,403	17,182	14,457
United Arab Emirates	11,311	10,104	9,112	8,692	7,081
Saudi Arabia	3,600	4,464	3,504	3,532	3,278
Oman	27	186	568	1,745	1,918
Qatar	712	501	763	1,082	833
Uganda	757	152	674	1,274	586
Bahrain	521	389	343	561	421
Kuwait	92	55	83	99	63

Unit: Euro thousand; Source: ITC; Product: 080450

3.2.2 Market requirements and operating environment

On GLOBAL GAP certification, all (100%) farmers across the surveyed regions were not certified, which could be as a result of Kenya not exporting fresh mangoes to the EU where the certification is key a requirement.

The study revealed that traceability is still relatively low in Kenya with only 12.13% of the farmers reported traceability data. Only Makueni County farmers reported 23.91% cases of traceability data. The rest did not report any case of traceability data. Therefore, in order to compete effectively farmers, need to observe good agricultural practices and the regulators need to demonstrate effective control along the entire supply as proof of compliance to market requirements.

3.2.3 Competition

Kenya faces stiff competition from Thailand which accounts for 17.5% of the world market, Mexico (12.5%), Netherlands (10.2%), Vietnam (9.5%), Peru (7%), Brazil (6.4%) and India (4.2%). However, in Africa, Kenya is facing competition from Ghana and Egypt. Fruit fly menace is the major contributor to low volumes exported by Kenya. Mango farmers in Kenya are also affected by factors such as climatic factors, markets and seasonality in production and traceability challenges.

3.2.4 Marketing and trade

The use of digital marketing platform is still low in Kenya as only 2.21% of the farmers have adopted it. Only 6.98% of the Machakos farmers used digital platform to market their mangoes. The most popular market outlet for the interviewed farmers was aggregators/brokers as they account for about 99.60%. Only 0.39% of the mangoes were sold directly to the exporters by farmers. Only 0.78% of Makueni mango farmers sold direct to exporters representing 0.40% of the total output sold direct to exporters (Table 13). It was noted that, whereas exporters collect from the growing regions, they engage brokers as aggregation agents.

Table 13: Marketing channels for mangoes

Marketing Channels	Makueni	Machakos	Embu	Overall
Aggregators/brokers/supermarkets	99.22	99.99	100.00	99.60
Exporter	0.78	0.00	0.00	0.39

Source: Household survey findings

Average price and Income

The study revealed that the average price for a piece of mango was KES 5. On average, the farmer's annual income stood at KES 29,875. Makueni farmers reported the highest average income per farmer of KES 32,798, Machakos KES 21,375, and Embu farmers receiving KES 19,276 per farmer.

3.2.4 Key market growth potential; unmet market demand

Table 14: Growth in export volumes of mangoes for the past 5 years.

Importers	Exported growth in quantity between 2015-2016, %	Exported growth in quantity between 2016-2017, %	Exported growth in quantity between 2017-2018, %	Exported growth in quantity between 2018-2019, %	Exported quantity in 2019, Tons
World	-17	16	28	-26	14,048
United Arab Emirates	-6	-4	-4	-24	5,135
Uganda	-77	324	107	-40	3,584
Saudi Arabia	29	-19	2	-10	2,395
Oman	373	127	232	-15	1,885
Qatar	-26	49	41	-24	492
Bahrain	-26	-11	79	-30	261
Rwanda					74
Turkey					69
Kuwait	-39	36	9	-33	33

Source: ITC

Kenya's export of mangoes declined by 26% in 2019 with major market destinations in Middle East declining by over 10% (Table 14). This coupled with the inability to export to EU due to fruit fly menace leaves Kenya with a huge export potential gap. The markets with the greatest potential for Kenya's mango (fresh/dried) export are Netherlands, United Kingdom and United Arab Emirates. Kenya has close export links with Uganda and Rwanda because of they are immediate neighbours and the movement logistics of products is easy compared to the rest. However, as shown in the (Figure 4), the ease of trade (represented by the size of the lines) varies across countries.

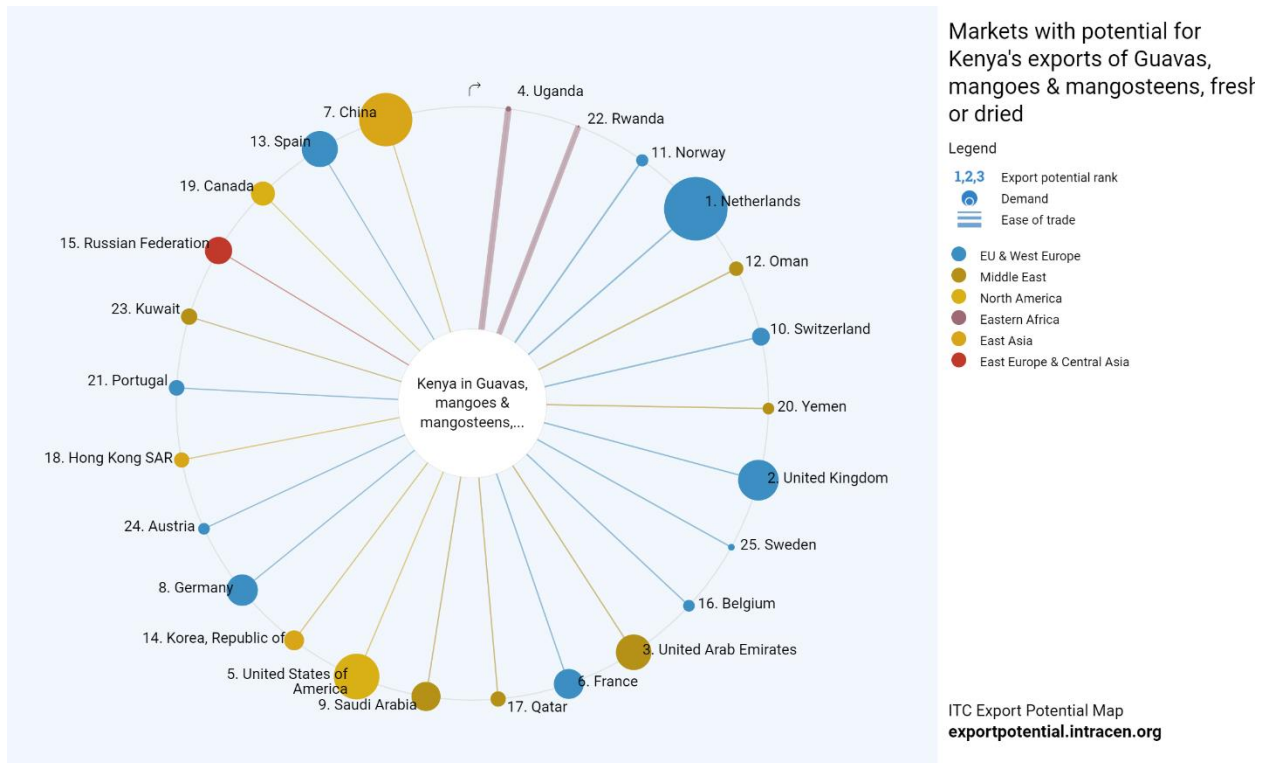


Figure 4: Markets with potential for Kenya's export of mangoes.
 Source: ITC

3.3 Supply chain analysis

3.3.1 Producers demographic characteristics

Age

The average age of the household decision makers producing mangoes was 50 years. Mango decision makers in Makueni had an average of 50 years while Machakos and Embu had an average of 49 and 52 years respectively. The average household sizes is 4 members with at least 1 child under the age of 18 (Figure 5).

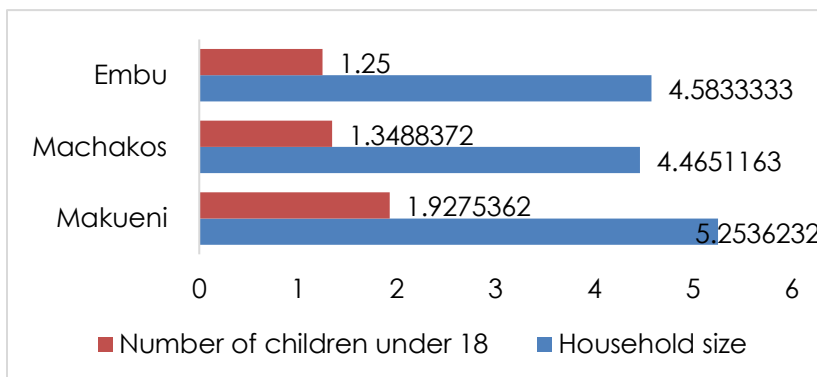


Figure 5: Age of the Mango decision makers
 Source: Household survey findings

Decision maker's main occupation

The main occupation for mango decision makers in terms of the time spent was farming (76.1%) which differed significantly across the county. In Embu County the biggest proportion (97.92%) of mango producers relied only on farming compared to 81.88% and 54.65% in Makueni and Machakos respectively. Machakos' proximity to Nairobi County makes it more urban and people tend to move to off-farm employments. In Machakos County the distribution of occupations of the decision makers was casual workers (24.42%), self-employment (10.47%), public and private sector employment at 4.65% & 3.49% respectively. Since most of mango producers spend the highest proportion of their time in the farm rolling out of a training program concerning mangoes production will most likely have a high turnout.

Education Level

There were different levels of education attained by the household decision makers. Overall, 31.02% of household decision makers have completed form four, 20.8% college or higher, 22.63% primary or secondary, 18.98% reached standard 7 and only 1% did not attend school at all. With such literacy levels of the household's major decision maker, it will be easier to manage the production of the mangoes in terms of monitoring the crop, attending trainings on the management of the enterprise as well application of GAP.

3.3.2 Production

The total land size operated by mango farmers is approximately 8.13 acres where half of it (4.12 acres) is used for agriculture. The land size operated by the households differed significantly across the counties where Makueni, Machakos and Embu had 10.35, 4.56 and 8.14 acres respectively (Table 15). Embu County households allocated bigger parcels of land to crop compared to other counties. Makueni County, with an average of 4.31 acres total land under mangoes, leads Machakos (0.9) and Embu (3.6).

Table 15: Land characteristics for mango farmers

Land (acres)	Makueni	Machakos	Embu	Overall
Total land size operated	10.35	4.56	8.14	8.13
Land under Mango production	4.31	0.9	3.6	3.04
Percentage of land under Mango production	41.64%	19.74%	44.23%	37.39%

Source: Household survey findings

From the survey findings above, it is evident that there is room for expansion of mango production in the surveyed regions especially in Machakos County where land under mangoes is still low.

Mango production has been taking place for more than 8 years at the time of this survey. Individual land ownership among the Mango farmers is the main tenure system. This is indicated by the highest percentages of individuals with title deeds. All the households included in the survey in Embu had title deeds indicating complete ownership. Households with title deeds in Makueni and Machakos were 97.1% and 86.05% respectively. The farmers rent in some land in Makueni and Embu at averages of 0.1 acres and 0.2 acres respectively to supplement production of mangoes. Farmers in Machakos however, do not rent land (Figure 6).

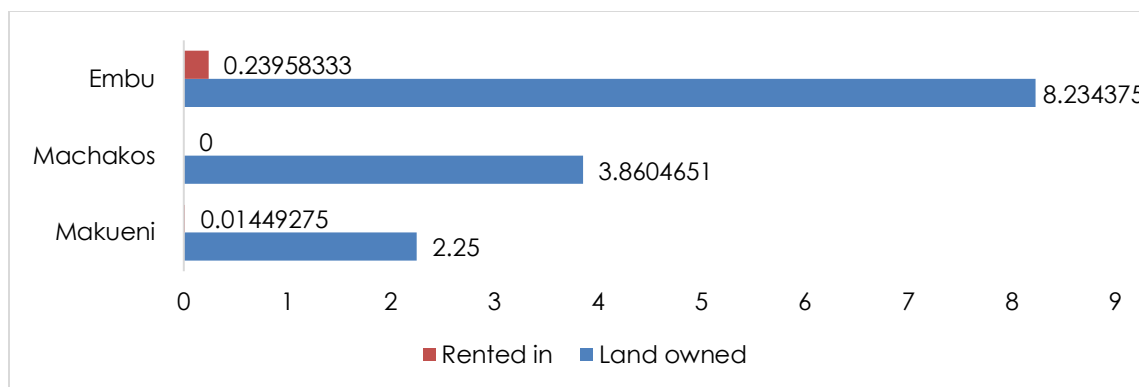


Figure 6: Land tenure for Mango farmer

Source: Household survey findings

Access of agricultural inputs

The study revealed most (98.53%) farmers' access farm inputs individually, an indicator of low collective action amongst farmers. All farmers in Machakos, 97.92% from Embu and 97.83% from Makueni acquired farm inputs individually. About 2.17% of Makueni and 2.08% of Embu farmers acquired farm inputs collectively representing the 1.47% of the overall farmers who access farm inputs collectively.

Crop protection

When spraying their mangoes, an overall percentage of farmers (3.31%) among the three counties, use a dedicated knapsack. When applying the chemicals to be used in spraying mangoes, Machakos and Embu have the highest percentages of 94.19% and 89.58% in mixing different chemicals whereas Makueni resident farmers do not mix their chemicals bringing the overall average among the three counties to 45.6% which is below average.

Chemicals packed in sealed containers are embraced by the farmers. Most of them opt for the sealed ones as shown by a high percentage (95.22%) in overall. Makueni, Machakos and Embu have 94.2%, 95.35% and 97.92% of mango farmers buying chemicals packed in sealed containers. Whenever these mango farmers buy the chemicals, they first confirm that the chemicals bought are not expired. All mango farmers in Embu check on the expiry of the chemicals whereas 97.1% and 96.51% of mango farmers in Makueni and Machakos counties respectively confirm that the chemicals bought are not expired.

After spraying, most farmers prefer to clean their pumps after every spraying jobs. This is represented with an overall percentage of farmers in all the three counties at 98.16%. Makueni, Machakos and Embu county farmers often clean their pumps after every spraying job. This is illustrated by their high percentages of 99.28%, 97.67% and 95.83% respectively. All the farmers in both Makueni and Machakos embrace manual spraying of the mangoes. In Embu, 97.92% of farmers use manual spraying whereas 2.08% have embrace the motorized spraying techniques. In overall, when handling most production practices, 86.45% of the farmers have in complete set of PPEs. Both Makueni and Machakos counties have higher percentages of 95.65% and 96.51% respectively of the mango farmers using PPEs.

Water management

Approximately 98.6% of the Kenya's mangoes are grown under rain-fed agriculture. The study findings revealed that only 9.93% of the farmers used irrigation which varied significantly across the regions. Out of these, only 0.37% had obtained WRMA license which was reported by only 2.08% of Embu County mango farmers. Only Makueni County had farmers adopted irrigation at 2.9%. The low adoption of irrigation technology in the regions could be attributed to low margins. This implies that there is a big untapped water licensing potential that WARMA needs to consider in order to expand irrigation in the regions.

Use of farming technology

Mango production uses both seedlings raised from seeds or grafted seedlings. Some farmers still use seedling naturally raised from mango seed. Other technologies that farmers adopted included soil testing before planting, and use of compost manure; however very few mango farmers conduct soil testing before they plant. This is indicated by the low average percentage (12.13%) among the counties affiliated to the practice. Embu has the highest percentage (47.92%) of the farmers doing the soil tests whereas Makueni and Machakos are 5.07% and 3.47% respectively. No farmer used compost manure for mango production.

Table 16: Farming technologies used in mango production

Technologies Used	Makueni	Machakos	Embu	Overall
Use of Compost manure	0.00	0.00	0.00	0.00
Soil testing before planting	5.07	3.49	47.92	12.13

Source: Household survey findings

3.3.3 Harvesting, yield and post-harvest management

During harvesting, only 16.54% of the farmers across the counties use the harvest containers exclusively while the rest use other containers and means to harvest. Machakos do not embrace these harvest containers exclusively whereas a few mango farmers in Makueni (21.01%) and Embu (33.33%) counties embrace the exclusive use of the harvest containers. Most (68.01%) of the workers involved in harvesting of the mangoes have access to clean toilets. This improves the hygiene required for the crops. Despite the very high percentages in Makueni County (99.28%) and Embu County (97.92%), Machakos County have the least percentage (1.16%) of workers accessing clean toilets.

Current yield per mango tree

The yield was captured in terms of pieces per tree per year. Farmers reported an average yield of 245 pieces per tree per year. Farmers reported an average of 255, 201 and 177 for Makueni, Embu and Machakos counties respectively. Farmers had an average of 28, 27, and 27 of mangoes trees in Makueni, Machakos and Embu respectively.

Post-harvest management

Post-harvest losses were at an average of 12% in the three counties. Makueni recorded 7.80%, 9.90% in Machakos and 30% in Embu, this being the highest of the three counties. The mango is sensitive to impact and therefore the harvesting and handling process must be carefully considered. Other contributors to post-harvest losses include lack of proper storage facilities. The study therefore sought to establish how farmers stored their mangoes before selling. Among storage facilities used are open and closed stores, cold room or left open in the field. Use of closed

store was the most common (51.10%) followed closely by leaving the produce in the field (no store) at 38.6% (27.34%). Use of cold room and open stores were the most unpopular storage methods used by the farmers at 8.09% and 2.21% respectively.

Closed store was common in Makueni (100%). Leaving mangoes in the open field was mostly used in Machakos (73.26%) and Embu (87.50%). Apart from leaving mangoes in the open field, some of the Machakos farmers (25.58%) also used cold room for storage immediately after harvesting (Table 17).

Table 17: Type of storage used by mango farmers

Type of storage	Makueni	Machakos	Embu	Overall
Open store	0.00	1.16	10.42	2.21
Closed store	100.00	0.00	2.08	51.10
In the field (no store)	0.00	73.26	87.50	38.60
Cool room	0.00	25.58	0.00	8.09

Source: Household survey findings

Record keeping is key for traceability. Not all farmers keep records and this could be explained by lack of resources or knowledge. This survey revealed the information below on various farm records (Table 18).

Table 18: Record keeping among mango farmers

Record Description	Makueni	Machakos	Embu	Overall
Maintain traceability records	23.91	0.00	0.00	12.13
Pest control records	73.19	0.00	2.08	37.50

Source: Household survey findings

3.3.4 Processing

The exporters interviewed deals in fresh and processed mangoes. Some companies have set up processing facilities within the producing counties such as Vert Fresh and Goshen Exporters both based in Machakos County. Other exporters processes at facilities within Nairobi metropolis.

Majority of the fresh mangoes were packed for Middle East market while processed (mainly pulp) were destined for local and regional markets.

3.3.5 Exports operations

Exporters to the international markets indicated while they have their consignments exported mainly through JKIA, some have started exporting from the Mombasa International airport with an aim of saving on freight costs. While COVID 19 had at the onset of the pandemic led to sharp increment of freight costs, the freight costs are usually as high as an average of 40% of the sales price. This is an area that requires intervention. Regional export of pulp is undertaken using the borders such as Namanga for produce destined for the Zambia market.

3.3.6 Institutional arrangement and infrastructure

Group Membership

None of the farmers in Embu is a member of the crop farmer organization membership. In Makueni and Machakos however, 65.94% and 33.72% of the mango farmers are member of a crop farmer organization respectively. Most farmers across the three counties prefer to access their farm inputs individually. This is affirmed by the overall percentage of farmers accessing inputs individually at 98.53%. Those farmers that use a collective means when acquiring farm inputs are quite few (1.47%).

Credit access

56.25% of the farmers in all the three counties have active bank accounts. Makueni, Machakos and Embu counties have 52.17%, 50% and 79.17% of the mango farmers bearing active bank accounts. An average percentage (59.5%) of the farmers is able to access mobile banking services. Very few mango farmers are able to access credit for mango production. An overall average of 7.35% of the farmers' access credit in the three counties. Embu County has the least number of farmers who have accessed credit at 4.17% of the total mango producing households, followed by Makueni at 5.8% and Machakos at 11.63%.

Training and extension

46.69% of farmers across the three counties had previously accessed training services. The distribution in percentage of the mango farmers who could access the training services in Makueni, Machakos and Embu were 50.72%, 36.05% and 54.17% respectively. The average number of trainings that the mango farmers attended per annum was an average of only one. This shows that most people did not show up for trainings organized in these counties or less trainings were conducted each year. The number of farmer contacts with the extension officers on average per year was 1 in Makueni, 1.6 in Machakos and 2 Embu per year. This shows that the extension officers are not fully utilized by the mango farmers in these counties.

3.3.7 Margin analysis across the supply chain

The farmers sell their produce at an average of KES 5 all-round to the brokers. 20% of produce exported is sold at KES 25 per Kg and 80% sold to processors attracts KES 15.

Table 19: Mango pricing and yield

	Makueni	Machakos	Embu	Overall
Average number of trees per farmer	28	27	27	28
Average yield per tree (pieces)per year	255	177	201	245
Average selling price in KES per pc	5	5	5	5
Average income per farmer in KES	30,319	19,772	36,329	27,894

Source: Household survey findings

3.3.8 Gender analysis

The mango value chain generates jobs for the community on a seasonal basis. During the peak season there are considerable job opportunities for harvesting, packing and transportation of

produce, this may not be permanent but it provides the community with a source of income. This is however a challenge because due to the high turnover of personnel (and in this case the youth) those trained do not stay behind to use the skills taught. This dynamic should be considered when planning for training activities and recruit people who will stay to implement skills learnt. The off season period engages spray service providers and scouts majority of whom are male youth, women are mostly involved at processing (peeling, washing, slicing, drying). There is for development of a gender strategy to address the inclusion of women and youth in the mango value chain.

3.3.9 Environmental analysis

Mango is a perennial crop that does not require major topographic changes on the farm. It provides fruit and tree cover in the areas grown which happen to be arid and semi-arid/water scarce areas. The tree is easy to grow and maintain with its rooting capacity keeping water requirement moderate. In terms of awareness and use of IPM, only Makueni County has its farmers aware as indicated by an average percentage of 78.5%. Farmers in both Machakos and Embu have not embraced IPM practices. This therefore calls for sensitization of farmers in both of these counties to be trained on the importance of using IPM in their production of Mangoes.

In case most of the farmers do not make any changes in the way they farm over the next 20 years, the production levels for most of the farmers in Makueni (98.55%), Machakos (58.14%) and Embu (72.92%) will decrease, highly decrease and decrease respectively according to the farmers. All the land under mangoes in Embu is prepared manually but in Makueni County, most of the mango farmers (96.38%) prefer it to be animal drawn. In Machakos county, land is mainly prepared by a majority of the farmers both manually (47.67%) and animal drawn (51.16%).

3.4 Value chain upgrading strategy recommendations.

Table 20 summarizes key value chain opportunities and constraints with respective recommendations (inclusive of specific activities) and key performance indicators.

Table 20: Key value chain opportunities and constraints

Opportunities and constraints	Recommendations and activities	Key performance indicators (KPIs)	County specific priority area(s)
1. Marketing	Hot water treatment, certification and market linkages to increase quality and quantity.		
<p>Untapped markets; Kenya's export of mangoes declined by 26% in 2019 with major market destinations in Middle East declining by over 10%. This coupled with the inability to export to EU due to fruit fly menace leaves Kenya with a huge export potential gap. The markets with the greatest potential for Kenya's mango (fresh/dried) export are Netherlands, United Kingdom and United Arab Emirates.</p>	<ul style="list-style-type: none"> • Support initiatives that would enable exporters' better trade with the Middle East market to improve export volumes of fresh mangoes. • Support initiatives aimed at enabling Kenya export fresh mangoes to the EU which provides greatest export potential. This includes among others effective and efficient fruit fly management such as hot water treatments. • Support exporters and growers meet market requirements such as certification e.g. GLOBAL GAP certification (especially for re-entry to the EU market) 	<ul style="list-style-type: none"> • Increase of international trade volume for mango of targeted farmers and enterprises. 	
<p>Compliance to market requirements (standards): None of the farmers interviewed were GLOBAL GAP certified which could be as a result of Kenya not exporting fresh mangoes to the EU where the certification is key a requirement.</p>	<ul style="list-style-type: none"> • Farmer trainings on GAP (GLOBAL GAP); Integrated Pest Management, Biological Control of Pests. • Promote groups certification under GLOBAL GAP option 2. • Link farmers to certifying agencies. • Traceability: strengthen/upgrade the traceability system to reflect market needs. 	<ul style="list-style-type: none"> • Percentage increase in number of GLOBAL GAP certified mango farmers participating in the international markets 	
<p>Marketing channels and income; brokers are a key farmer marketing channel at</p>	<ul style="list-style-type: none"> • Support shift from farmers marketing through brokers to either through producer groups and or exporters direct. 	<ul style="list-style-type: none"> • Percentage increase of farmers having signed supply 	

99%. The average selling price per mango at farm level is KES 5 per pc leading to an annual average income of KES 29,875 per farmer.

2. Production

Farmers reported an average yield of 245 pieces per tree per year (255, 201 and 177 for Makueni, Embu and Machakos counties respectively). This is against a potential of 500 pieces.

Farmers had an average of 28, 27, and 27 of mangoes trees in Makueni, Machakos and Embu respectively.

Some of the key constraints leading to low yield and quality includes:

- Low uptake of good agricultural practices negatively affecting productivity and food safety (e.g. IPM at an average of 37.5% mainly in Makueni)
- Low uptake of smart water solutions and limited irrigation systems & reliance on rain fed production; only

- Support formation and or strengthening of producer groups for produce aggregation and collective marketing to improve farmer bargaining power.
- Support direct farmers (directly or through their organizations) contracting by exporters.

- agreements directly with exporters and complying to market standards
- Percentage increase in income per acre

Productivity, quality and food safety; target to increase productivity (yield per tree) and food safety through:

- Accelerate uptake of good agricultural practices and improved access to, demand & effective use of certified inputs and smart farming technologies (through training in farmer field schools, extension services, collective input purchase by farmers & financial access as highlighted in 4 below).
- Build farmers' entrepreneurial capacity to run mango production as a business.
- Assistance towards enabling efficient and effective fruit fly management and controls to improve production of quality fruits.

- Percentage increase in production of safe, quality mangoes (yield) per acre

- Makueni (Quality)
- Embu (Quality)
- Machakos (Quality)

1.4% of farmers irrigate their orchards

3. Harvesting, post-harvest management and processing

On average 12% of mangoes are lost at farm level with the highest being 30%. This is mainly due to:

- Ineffective pest control leading to pest damage
- Limited market access
- Unavailable/poor storage facilities, limited access to grading/pack house facilities & poor postharvest handling practices

4. Institutional arrangement & access to support services

44% of farmers are members of farmer organizations led by Makueni county. Despite this 98.5% of farmers' source inputs individually limiting bargaining power.

Financial access: only 7.4% of farmers have accessed finance.

Extension services: on average farmers had 1.2 contacts with extension officers per annum.

Effective, efficient post-harvest management and accelerated value addition.

- Put in place mechanism for pest control through trainings and fruit fly management as in 1 and 2 above.
- Identify & support investment opportunities to address postharvest spoilage & value addition such as drying technologies and markets.
- Trainings of processors (dried and pulp) on GHP, FSSC22000, ISO 14001; ISO 45001:2018, traceability, packaging & labelling
- Percentage reduction in post-harvest losses.

Support formation & strengthening of farmer organizations to facilitate farmers access to essential services

- Encourage farmers to form groups for easier access to services and inputs capitalizing on their economies of scale.
 - Promote blended extension services e.g. Spray service providers (SSPs) providing market information. This could be through trainings by the competent authorities such as HCD.
 - Financial literacy & linkages (tripartite agreements e.g. among banks, farmers and exporters) and tailor made financial products
 - Promote smart services e.g. digital financial services for example Digi Farm & Agri Wallet.
- Number of farmers consistently/easily accessing essential support services.

Annex
Data set