

The Uganda vegetables and fruit sector

Competitiveness and investment opportunities

Youri Dijkxhoorn, Michiel van Galen, Julian Barungi, John Okiira, Joyce Gema and Valerie Janssen

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The study assess the competitiveness of the fruit and vegetable sector and suggests specific recommendations for further development. It also provides insights in market, trade and investment opportunities. A focus is applied to a limited number of crop specific case studies. In Uganda the production of fruit and vegetable is gaining importance. Despite agricultural practices being weak, farmers in Uganda can make a reasonable profit margin from their farm plots. In addition, key performances indicators of Uganda compared with Kenya show that most products for the domestic and regional markets are very competitive in terms of quality, price and yield.

Key words: Vegetables, fruits, Uganda, competitiveness

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Summary

Uganda is located at the equator with a favourable climate for producing all kind of fruits and vegetables. Uganda is the second largest producer of fresh fruits and vegetables in sub-Saharan Africa, after Nigeria, producing about 5.3 million tonnes per year according to recent FAO statistics. However, production detailed data on Uganda's fruits and vegetables is very limited. Vegetables and fruits are a major crop produced in all the districts of Uganda. Fruits and vegetables are produced by smallholders, scattered all over the country. The agricultural and fisheries sector as a whole represents 24.2% of Uganda's GDP (World Bank, 2019) and 70.7% of its employment in 2018 (ILOSTAT, 2019).

Competitiveness
Vegetable and fruit farmers in Uganda can make a reasonable profit from their crops, if the harvest is not affected by pests, diseases or bad weather. Studied vegetable farmers obtain an average calculated profit margin between 50 and 80%. Fruit farmers have higher profit margins due to lower input needed.

Trade and investment
Based on our study the current investment and trade opportunities for the Dutch private sector are limited:

- Many Dutch horticulture suppliers are already active in the market through local and regional agents and distributors.
- Sourcing opportunities of fruits and vegetables from Uganda to Europe by Dutch importers are also limited. Almost all Ugandan exporters supply the ethnic market, focusing on specific fruits and vegetables for the Asian and African Diaspora. These fruits and vegetable are not in high demand by the Dutch importers supplying conventional retailers. In addition, the current non-legal requirements regarding certification and traceability for the conventional retail (and organic) EU market do not align with the current practices among the Ugandan exporters.

Opportunities for improvement for the domestic market
The local market demand for fruit and vegetables is likely to increase and will provide serious opportunities. The transition to being a middle-income country will impact the agricultural sector and its output will need to be improved to feed the increasing urban population.

The current competition levels can be raised by increasing yields so as to increase the margin per kg produced. Yields can be improved by supporting farmers with good agricultural practices trough extensions or training. Issues like seeds, planting, weeding, application of fertilisers and pest control, herbicides and fungicides should all be addressed. Food safety risks are high in the market due to overuse of chemicals and poor post-harvest practices. Sustainable pest control at farm level and more awareness among traders at markets to reduce the risks of contamination of fresh produce are needed. In addition, the horticulture education system is weak with limited exposure and needs to be supported.

The more serious farmers should be linked up with advanced value chains present in the domestic market, like supermarkets. Current supermarkets in Uganda present a big opportunity for the more serious farmers to provide a constant volume of high-quality products at a premium price.

Opportunities for the export market and investments
The current export inspections and procedures are not in line with international standards. Market development points that should receive attention include the production of the right varieties at the right moment, the use of the right packaging material, and the developing and sharing of market information.

Approach

The Ugandan fruit and vegetable value chain is the focus of this study. The study started with an inception phase. A limited number of relevant products were selected for further analysis and primary data collection, in-depth key informant interviews with key industry stakeholders were conducted in May 2019. A survey among 33 farmers in Uganda was conducted to collect primary data on costs and revenues for key production areas. We have estimated production costs, revenues and farmer income using a "typical farm approach" by working with local experts, industry experts, input suppliers and farmers. In addition, we analysed The Living Standards Measurement Study (LSMS), a dataset providing a sample of household level data on consumption, crop and livestock production output and costs, and the use of extension services. The preliminary results were validated in two separate workshops in Kampala with crop experts and high-level stakeholders.

1 Introduction

1.1 Background

The production of horticultural products is gaining importance. The horticulture sector has been supported by the Integrated Seed Sector Development (ISSD Plus Project) (2017-2020). The ISSD and the ISSD Plus Project have been coordinated by the Wageningen Centre for Development Innovation (WCDI) and funded by the Embassy of the Kingdom of the Netherlands (EKN) in Kampala, Uganda.

ISSD Plus Project strengthens the development of the seed sector development in Uganda. ISSD Plus Project promotes the use of quality seed and the cultivation of improved vegetables varieties. The use of better seeds and improved varieties is likely to contribute to increased earnings and improved competitiveness of the sector, which would subsequently contribute to improved national food and nutrition security. However, quality seeds and advanced varieties alone are not enough to increase competitiveness; there is a need for more in-depth information on the entire value chain.

1.2 Objectives

The seed sector cannot reach its potential without the development of the entire horticultural value chain. The purpose of the study was "to support the development of a vibrant, pluralistic and market-oriented fruit and vegetable sector in Uganda".

The study had two objectives (as described in the Terms of Reference):

1. To assess the competitiveness of Ugandan producers of vegetables and fruits and to recommend specific intervention strategies for Uganda.
2. To provide insights in trade and investment opportunities and challenges for Dutch agribusiness companies in the Ugandan vegetables and fruits sector (including export opportunities).

The Ugandan fruit and vegetable value chain was the focus of the study. In addition, we compared some key developments and performances with other East African countries, most notably Kenya.

2 Method

2.1 Introduction

To assess the competitiveness of the fruit and vegetable sector it is necessary to further define the concept of competitiveness. In the literature, there are various definitions, a commonly applied one being "the ability to deliver goods and services at the time, place and form sought by overseas buyers at prices as good as or better than those of other potential suppliers whilst earning at least opportunity cost returns on resources employed" (Freebairn, 1987; cited in Sharples and Milham, 1990). Although not fully addressed in the article by Sharples and Milham, the original article by Freebairn states several important issues related to the definition of international competitiveness at the firm or industry level (i.e. one supplier versus the other, or the performance of an aggregated sector versus another country or region):

- First, although not made explicit in the definition, Freebairn states that competitiveness is a dynamic concept, and the preferences of buyers may change from one location to the other and over time. What is good for one consumer may not be acceptable for another consumer. Segmentation of products and buyer markets is therefore a crucial part of the exercise.
- Second, one must look at all the costs involved in bringing a product to market; not only the costs of farm production.
- Third, competitiveness is about competing with alternative sources of supply. Alternative suppliers may learn, improve, and change their production methods, and other products may go on the market that compete with the firm's products (i.e. related to Porter forces of new entrants and substitutes).
- Fourth, it emphasises that suppliers are competing with other producers for the scarce resources like labour, land, water and other inputs. This latter point is important because it means that no nation will be competitive in the production of all products. Prices of labour and other resources will increase if a country becomes more competitive in one industry, at the expense of competitiveness in other industries.
- Finally, agricultural producers are seen as price takers in all markets, i.e. they cannot influence the prices of inputs and outputs. This and similar definitions have been used in many studies.

However, competition is a dynamic concept, and different customers require different products. Also, although Freebairn, and Sharples and Milham are studying the (long-term) competitiveness of the Australian agricultural sector as a whole, the definition is essentially a limited definition of competitiveness at firm level. Just because farmers are often seen as price takers, the definition equally applies to the whole industry, as farmers will only compete on price with other farmers. In reality however, firms do compete on price as well as quality. Finally, it does not explicitly give attention to sustainability of production and the well-being of the population and the nation as a whole. Following the definition of Freebairn, a company or industry is fully competitive if it produces at low costs by exploiting its labourers, or by receiving large subsidies from the government.

Most definitions of competitiveness (at firm level, industry level, or nation level) imply that staying competitive entails either producing at lower costs than other suppliers, or increasing the volume of production. Recently the volume aspect of productivity has been emphasized more than the cost aspect. If no improvement is achieved, competitiveness is almost inevitably reduced, as competing suppliers and competing products are invariably improving.

Based on the above and to address some the shortcomings identified, we have defined competitiveness as: "the medium- to long-run ability of a firm or significant part of the firms in an industry to increase productivity and/or lower costs in a sustainable way, and deliver goods and services at the time, place, form, and quality sought by the targeted customer segment(s) at prices as good as or lower than those of other potential suppliers, whilst earning a reasonable profit and paying at least opportunity cost of resources employed".

2.2 Approach

The report is based on a desk study and primary data was collected among a limited number of farmers in various districts of Uganda. We did an additional number of interviews in Uganda, the Netherlands and Kenya. See Appendix 1 for an overview of the interviewed stakeholders.

2.2.1 Product selection

We have limited the study to a few relevant products. This guarantees that data collection (interviews, focus groups, desk study) is feasible and focused. The final selection of a maximum of five products was done in agreement with ISSD and EKN. We included the following products for further analysis during this study:

Table 2.1 *Product selection*

	Product 1	Product 2	Product 3	Product 4	Product 5
Product name	Tomato	Hot Pepper	Onion	Avocado	Pineapple
Type	Vegetable	Vegetable	Vegetable	Fruit	Fruit
Dominant suppliers	Smallholders	Smallholders	Smallholders	Smallholders	Smallholders
Export	Increasing regional export e.g. Kenya	Successful export to EU market	Regional export	EU and Middle East	Regional export
Study area	Central Uganda	Central Uganda	Western & Eastern Uganda	Central Uganda	Eastern & Central Uganda

Selected crops:

- **Tomato is a major crop in Uganda.** It is widely consumed in the domestic market. Tomato demand is expected to increase with the rise in population and urbanization. In addition, the country supplies countries like Southern Sudan, DRC and Rwanda.
- **Hot pepper is a crop mainly produced for the distant export market.** It is one of the few crops that is currently being exported to the EU. It is mostly bought by traders who sell the produce on the export market that caters to the EU ethnic market.
- **Onion is a major vegetable widely consumed in Uganda**. It is consumed by almost all households on a daily basis and Uganda also supplies countries like South Sudan with onions. The crop has the potential to increase household incomes and provide work for women and youth.
- **Avocado is a priority fruit for development as a non-traditional export crop**. Local demand is high and there is potential for increased production since there are many opportunities for commercialisation for the export markets.
- **Uganda has favourable climatic conditions for the successful production of pineapples.** Uganda pineapples are considered sweeter and less acidic than those produced in other countries in the region. Uganda also produces dried pineapple for export.

2.2.2 Desk study

The initial overview of the sector is based on a combination of desk research and stakeholder interviews. The report is based on a desk study, with several additional interviews with Uganda and Dutch industry stakeholders (see Appendix 1 for an overview of the interviewed stakeholders).

The Living Standards Measurement Study (LSMS) provides a unique sample of household level data that is valuable to our study and has been used in addition to the information that we collected through the fieldwork. Data collection for the LSMS study was funded by the Government of Uganda, World Bank, and the Government of the Netherlands. To assess the input market, Wageningen Economic Research has access to the National Panel Survey 2013-2014 for Uganda that contains very detailed data at farm level about the types of inputs they use. The data is collected among more than 50,000 households. A separate study was done for agriculture with over 2,300 respondents in all districts in Uganda. The agricultural survey contains information on land,

crops, livestock, inputs, labour, production, and agricultural tools and machinery. In Appendix 6 we provide a separate analysis of the LSMS data on agriculture for tomatoes, onion, pineapple and avocado. However, the number of observations for vegetables and fruit (except for bananas) is limited and believed to be only partly representative for the production per region. Most notably, the average household crop production in the LSMS survey is found to take place at a lower scale and with less input than the more serious producers that are the main suppliers of the market crops in Uganda. Therefore, e.g. own consumption of the harvested crops are higher, and production per acre generally lower. Also, the data of the LSMS includes crop failures and poor agricultural practices – as it should to represent actual production – but in our fieldwork we have looked as much as possible for data on production taking place under normal circumstances without crop failures.

The Global Detector was used to analyse the climatic conditions and to identify suitable areas for the studied crops. The Global detector is a knowledge-based Geographic Information System that is used to detect the worldwide potential for production, demand and market strategies. The Global Detector can show data from a large number of indicators, such as climate, infrastructure, land characteristics, on a disaggregated spatial grid level for almost any place in the world (Hennen et al., 2016). A large set of indicators is readily available for use without any GIS-processing. For Uganda we identified on a very detailed level the rainfall and the temperature for each district in the country. In addition, we used this data to identify all possible areas were the selected crops can grow best. We used the commonly known crop parameters based on the current known production locations that allow these crops (climate, soil, altitude, water availability). By doing this we have identified the most promising areas for each crop. We excluded deserts, lakes, dense forests, dense urban centres, natural parks and steep hills in this analysis since they are not suitable for the production of fruit and vegetable crops.

2.2.3 In-depth interviews with key industry stakeholders

In-depth interviews with key industry stakeholders were conducted in May 2019. Various type of stakeholders were interviewed, including government representatives, sector organisations, NGOs, input suppliers, farmers, traders, exporters, processors, freight forwarders and supermarkets. Additional interviews in Kenya and Netherlands about the position of Uganda in the (regional/international) market were done.

2.2.4 Primary data collection and analysis

A survey among 33 farmers in Uganda was conducted to collect primary data on costs and revenues for key production areas. The survey did not take into account the costs for own labour, but only the costs for hired labour. Crop failure was not considered in our analysis, but if it occurred, the data was imputed by using estimates based on industry experts.

For each crop some of the key cultivation areas were visited by local enumerators. The selection of the farmers was done based on snowball sampling in the study areas. It provided information on costs of production, production techniques, challenges and farmers' needs. The results were compared to Kenya to compare the countries on different production parameters. For this, an expert on the Kenyan and Ugandan horticulture sector reviewed the studied parameters like costs for inputs, yields and seasonality. The focus was on one season only.

Table 2.2 *Farmers interviewed*

Crop	District	Type of farmer
Hot pepper	Mityana, Wakiso & Butambala	Export orientated (large and small)
Avocado	Butambala	Domestic and export market
Tomato	Mpigi, Kasanda, Nakaseke, Mityana & Gomba	Domestic market with good quality Open Pollinated Varieties (OPV), hybrid seed and irrigation
Pineapple	Luweero & Serere	Export and domestic market
Onion	Bulambuli, Bunyangabu & Kabarole	Domestic market with improved varieties (OPV) and hybrid seed

2.2.5 Validation of findings

We have estimated production costs and benefits using a "typical farm approach" by working with local experts, industry experts, input suppliers and farmers. The data represent all the costs and benefits under perfect conditions with Good Agricultural Practices and solid market prices. The collected data has been *triangulated* with the LSMS survey and our own primary data collected in different districts in Uganda. In July 2019, 2 Focus Group Discussions (FGDs) were organized to validate the preliminary findings with stakeholders in the fruit and vegetable sector. See Appendix 3 for the participants' active in the FGD in Kampala. The cost benefit data has been validated in the FGDs, which also has been used to identify any strengths, weaknesses, opportunities and threats.

2.3 Limitations of the study

The LSMS data set is a rich source of information. However, the LSMS data and other statistical data is outdated. The latest available LSMS dataset on agriculture refers to 2013/2014. Furthermore, the number of observations of households that produce the specific crops that are the focus of this study is limited. Nevertheless, the data provides some insights into the yields and production costs.

A focus on specific crops was applied in the case studies. To ensure some level of representativeness of the type of products, limited availability of data and limited time and budget meant that we had to focus on a limited number of case studies or take a broad view without going into much detail. Therefore in the case studies we focus on a maximum of 5 products which are important fruits and vegetables for Uganda. In that sense we will be representative of these important products, but not for smaller products. The same applies to the type of producers: we focus on both smallholders and larger producers, but the availability of data might imply that we are not fully representative for each group at all times.

Limitations of the study relate to representativeness of the primary data. The representativeness of the data is a potential risk. Uganda is a diverse country in terms of climate and different agro-ecological zones. Therefore, the collected data will not represent all regions of the country. However, we collected data in different regions to cover as much as possible different zones.

3 Ugandan fruit and vegetable sector

3.1 Introduction

The agricultural and fisheries sector represented 24.2% of Uganda's GDP (WB, 2019) and 70.7% of its employment in 2018 (ILOSTAT, 2019). According to the Uganda Bureau of Statistics (UBOS), about 40% of the population is working in subsistence farming. Women work in subsistence farming more than men (47% and 31% respectively). Major crops in terms of area include maize, banana, cassava, sweet potatoes, beans and pulses, and sugar cane. Coffee, tea, cotton and tobacco are traditional cash crops. Uganda is divided into 134 districts (as of 2019/2020) and the capital city of Kampala, all of which are grouped into four administrative regions: Eastern Region (green), Western Region (blue), Northern Region (yellow) and the Central Region (red), see figure 3.1 below. A list of the districts on the map is provided in Appendix 9. Each district is further divided into counties and sub-counties.

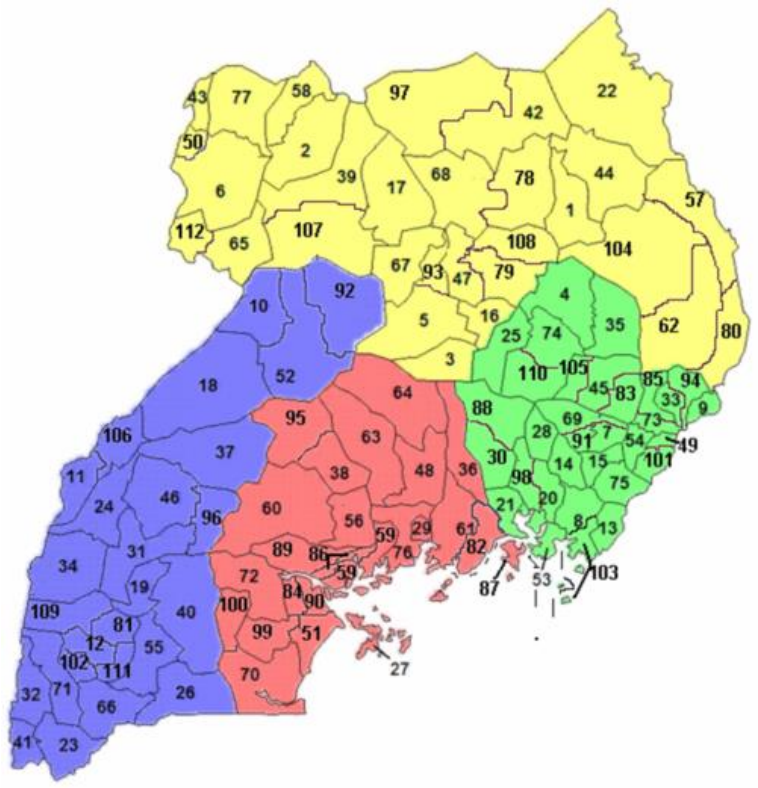

Figure 3.1 *Districts of Uganda*
Source: Wikipedia.

3.2 Climate, water and infrastructure

Uganda is located at the equator with a very favourable climate for producing all kinds of fruits and vegetables. The climatic and geographic conditions in Uganda were mapped with the Global-Detector tool. With this tool we can combine a large amount of data at grid-level (10x10km) to estimate the suitability of regions to produce specific crops. Data at grid-level in Uganda is used to produce maps that show the different values for the climate of Uganda for temperature and precipitation. In addition, we have produced several graphs that show the climatic variations throughout the year of different places in Uganda.

Figure 3.2 shows that Uganda receives relatively large amounts of precipitation throughout the year. Especially the western, central and eastern parts of the countries. There is a short rainy season (October, November, December) and long rainy season (March, April, May).

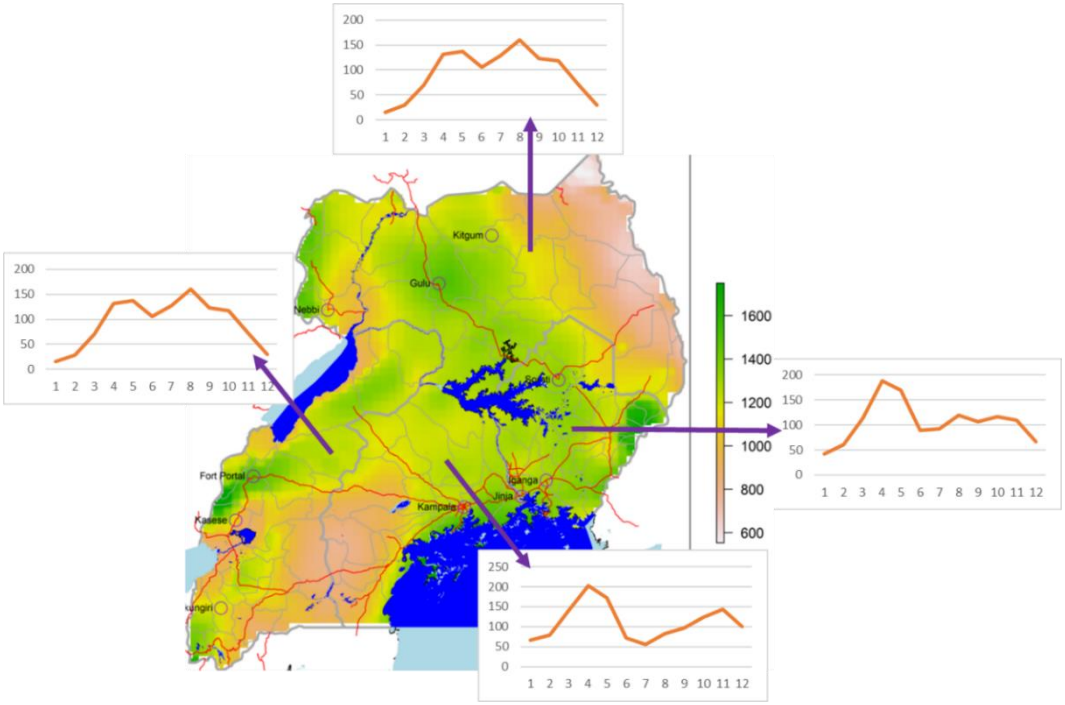

Figure 3.2 *Monthly and yearly precipitation in Uganda, in mm*
Source: Global Detector.

Figure 3.3 shows the Uganda temperature throughout the year. Uganda has a tropical climate, with temperatures ranging from 25 to 29°C in most parts of the country, apart from in the mountainous areas, which are much cooler (East and South-West). The hottest months are January and February.

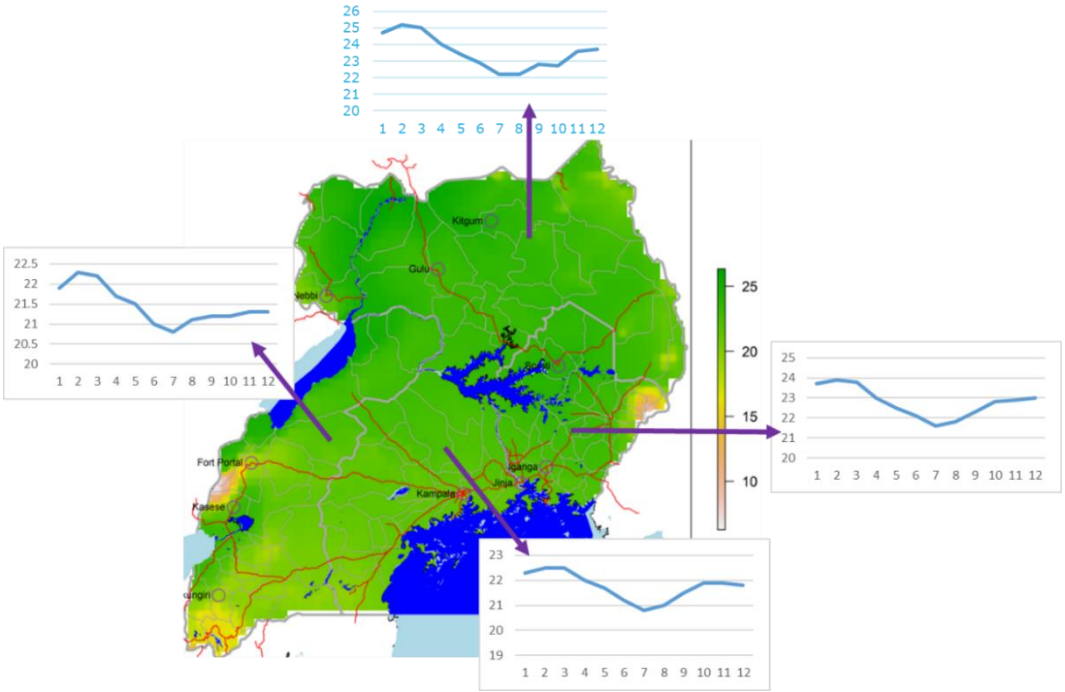

Figure 3.3 *Monthly and yearly temperature, in degrees Celsius*
Source: Global Detector.

The outcomes of a recent study show serious effects of climate change all over Uganda (Duku et al., 2019). Despite the study being mainly focussed on sesame, the general climate change also affects fruit and vegetable production. The main outcomes are:

- The temperature is expected to rise by about 3.2°C over southwestern and western Uganda especially during the long rainy season. This rise in temperature during the long rainy season is also anticipated in the rest of the country where temperature will rise by about 2.8°C over central, northern and eastern parts of Uganda. During the short rainy period, the temperature is expected to rise by about 2.8°C over the southwestern part of Uganda, and by more than 2°C over the rest of the country.
- The seasonal average rainfall in the short rainy season is projected to increase in the dry areas of the northeastern and northern part of Uganda by 40-50% for mid-century. In the northeastern and northern part of the country, the increase in the seasonal average rainfall in the short rainy period accompanied by an increase in the number of consecutive wet days by about 2-3 days could lead to an enhancement of rainfall in the region. However, the length of the longest wet spell in the southern half of the country during both rainy seasons is expected to decline by about 2-4 days.
- The projection of the longest period of consecutive dry days for the short rainy season show that dry spells are expected to decrease by about 3-5 days over most parts of the country except the southern tip. The decline in the dry spells coupled with the increase in the wet spells and seasonal rainfall in the northeastern part of Uganda can reinforce the likelihood of floods in the region. On the other hand, during the long rainy season, the consecutive dry days are expected to slightly increase (~1day) over southern parts of the country. This coupled with the decrease in seasonal average rainfall in the long rainy season (up to 5-10%) could lead to water scarcity in the region.

3.3 Production of fruits and vegetables

Uganda is currently the second largest producer of fresh fruits and vegetables in sub-Saharan Africa after Nigeria, producing about 5.3 million tonnes per year according to recent statistics (see figure below right). For fruits there was 900,000ha and for vegetables 250,000ha in 2017 (see figure left).

Production data on Uganda's fruits and vegetables is very limited. This was confirmed by all stakeholders in the sector. Most data (e.g. FAOSTAT / MAAIF) cannot be relied upon as they are rather estimations or calculated data instead of field-collected data.

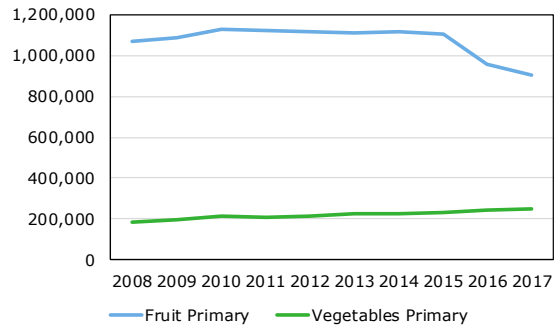

Figure 3.4 *Area horticulture crops Uganda 2008-2017 (ha)*
Source: FAOSTAT.

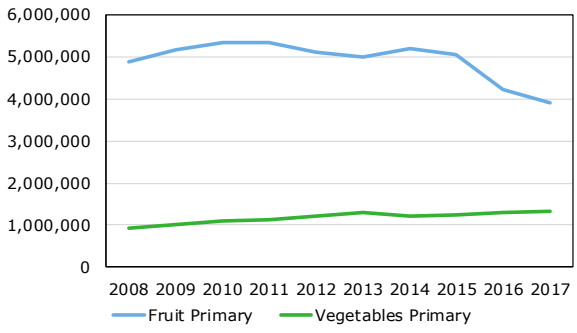

Figure 3.5 *Production horticulture crops Uganda 2008-2017 (tonnes)*

3.3.1 Vegetable production

Vegetables are a major crop produced in all districts of Uganda. Unfortunately, many vegetables are not specified in detail in the official national data.

Onions

Onion are among the most widely consumed vegetable crops in Uganda. The total area under cultivation is estimated to be 86,500ha, with a total production of 344,000 MT per year. Uganda is the leading producer of onions in East Africa.

Table 3.1 *Onion production in Uganda*

	2000	2005	2010	2015	2016	2017
Area harvested, in hectares	34,340	51,781	74,933	80,675	83,569	86,457
Production, in tonnes	137,286	203,411	296,032	320,516	332,390	344,261
Yield (tonnes per ha)	4.0	3.9	4.0	4.0	4.0	4.0
Yield (tonnes per acre)	1.6	1.6	1.6	1.6	1.6	1.6

Source: FAOSTAT.

Tomato

Tomato is a major crop in Uganda. Most of the tomatoes are bush tomatoes produced in the open field. There are two seasons of tomatoes a year, if irrigation is applied, tomatoes can be grown year-round (up to four harvests).

Table 3.2 *Tomato production in Uganda*

	2000	2005	2010	2015	2016	2017
Area harvested, in hectares	2,100	3,704	5,500	6,178	6,424	6,671
Production, in tonnes	14,000	22,770	31,000	37,176	38,650	40,124
Yield (tonnes per ha)	6.7	6.1	5.6	6.0	6.0	6.0
Yield (tonnes per acre)	2.7	2.5	2.3	2.4	2.4	2.4

Source: FAOSTAT.

Beans

Beans are the major source of proteins for low and middle-income households and is a widely grown vegetable crop in Uganda. Whereas there has been an increase in land allocated to bean production, yields have been falling mainly due to the unpredictable weather patterns. The potential for increased bean production is high, as there is a high demand for beans both on the local and regional markets (Kilimo Trust, 2012). Beans are also traded across the border with, for example, Kenya, South Sudan, DRC and Rwanda.

Peas

Peas are produced extensively in Uganda. Many types of peas are produced for the domestic and regional market (Pigeon peas, Cow peas and Field peas). Peas being produced for export are the Snow peas. Production of peas has been on the increase and the trend is likely to continue.

Asian vegetables.

The most common Asian vegetable produced in Uganda is the hot pepper. It is typically the Scotch Bonnet, mainly referred to as the "Caribbean" pepper. This has a rich, unique flavour and is used mainly as a condiment. Hot peppers are mostly bought by traders who sell the produce on the export market that caters to the EU ethnic market. Other important vegetables for this market are okra and garden egg.

3.3.2 Fruit production

Current fruit production is mainly in the hands of smallholders. Production is centred in the southern, central and eastern regions. In Uganda, there are hardly any large-scale fruit growers; fruits are produced exclusively as a smallholder crop.

The majority of the fruits produced are pineapples and bananas. Other fruits of significant importance include mango, passion fruit, apple, small sweet banana (Ndiizi), Cavendish banana (Bogoya), avocado, citrus, papaya and jackfruit. A variety of tropical fruits are produced in various districts of Uganda.

Bananas

There is significant production of bananas in Uganda. The area of banana production is 139,000ha. This area has been stable in recent years. However, before 2000 the banana sector faced a serious drop in area and production due to serious issues with pests and diseases (Kagezi, G.H. et al., 2006). Most of the bananas produced are the cooking bananas, which are a staple food crop. There is limited export of these bananas to Europe, mainly to serve ethnic tastes of the migrant African and Indian population.

There is also production of dessert bananas: apple bananas (Ndiizi) and Gros Michel bananas (Bogoya), but exact details or the area of production are not available:

- Apple bananas can be grown in most districts of the country and there is potential for increased production through the establishment of specialised farmers to produce the crop. Apple bananas have a high local demand and command a good price in the European market, but must be air freighted.
- The Gros Michel banana is a popular crop with a distinct flavour. Production of Gros Michel bananas has been growing and they have a high potential for export, particularly in the regional markets but also in the Arab countries and even Europe.

Table 3.3 *Banana production in Uganda*

	2000	2005	2010	2015	2016	2017
Area harvested, in hectares	135,000	137,837	143,000	138,274	138,716	139,162
Production, in tonnes	610,000	609,856	600,000	584,304	583,761	583,217
Yield (tonnes per ha)	4.5	4.4	4.2	4.2	4.2	4.2
Yield (tonnes per acre)	1.8	1.8	1.8	1.8	1.8	1.8

Source: FAOSTAT.

Pineapples

Uganda has a large area dedicated to pineapple production. Due to the climatic conditions being conducive to the successful cultivation of pineapples, Uganda is a leading pineapple producer in East Africa, with the largest crop area of 240,197ha (FRR, 2017). It appears that FAOSTAT significantly understates Uganda's actual pineapple production (see table below). Pineapples are produced exclusively as a small-holder crop, either as sole crop or inter-cropped with others such as bananas in a given Ugandan farming system. Uganda pineapples are considered sweeter than those produced in other countries in the region.

Table 3.4 *Pineapple production in Uganda*

	2000	2005	2010	2015	2016	2017
Area, in hectares	194	203	350	404	418	433
Production, in tonnes	1,650	1,700	2,800	3,398	3,520	3,642
Yield (tonnes per ha)	8.5	8.4	8.0	8.4	8.4	8.4
Yield (tonnes per acre)	3.4	3.4	3.2	3.4	3.4	3.4

Source: FAOSTAT.

Passion, papaya and citrus fruit

Production of passion fruits has been growing over the years thanks to increased demand for local consumption. The commercial passion fruit varieties grown in Uganda include the purple granadilla variety locally known as Kasese, Masaka, and the highly disease and pest resistant Kawanda. Kawanda Hybrid is the most preferred because of its big size and a lot of juice per fruit. The

Kawanda hybrid are produced in the Southern belt of Uganda at 1,000-1,200 m.a.s. (Sonko et al., 2005).

Many varieties of papayas are grown widely in all districts of Uganda. There are limited specialised farmers producing the fruit.

Citrus fruits produced in Uganda include several varieties of oranges, lemons and tangerines. The demand for citrus fruits on the local market is high, as indicated by the volume of imports of oranges from South Africa. There is a high potential for increased production mainly by getting more farmers to engage in the commercial production of citrus fruits.

Mangoes
Mangoes are commonly grown in Uganda. Mangoes grow in the wild and have been adapted to all ecological zones of Uganda: dry or humid lowland, mountain and Lake Shoreline. Production is argued to be on the rise over the years with increasing demand on the local and export markets. However, production statistics to support this claim are lacking.

Different varieties of mangoes are grown in almost all the districts of Uganda. Some of the varieties are suitable for the fresh fruit market and others for processing into juice and other products.

Avocado
A few varieties are grown in most districts of Uganda, some large and others small. Local demand is high and there is potential for increased production. Opportunities exist in commercial production of the fruit for the export markets.

3.4 The value chain

3.4.1 Value chain map

Most of the fruits and vegetables produced in Uganda are consumed locally and are produced by smallholder farmers. After harvest, they are transported to rural market centres for local consumers or are bought at the farm by neighbours. Other fruits and vegetables are transported to bigger market centres where many producers use the informal open-air markets that are organised once or twice a week. Post-harvest technologies are absent for locally consumed fruits and vegetables. However, fruits like pineapples and avocados exported to Europe and other destinations are graded and packaged according to export standards. The figure below presents the most relevant actors in the fruits and vegetables value chain.

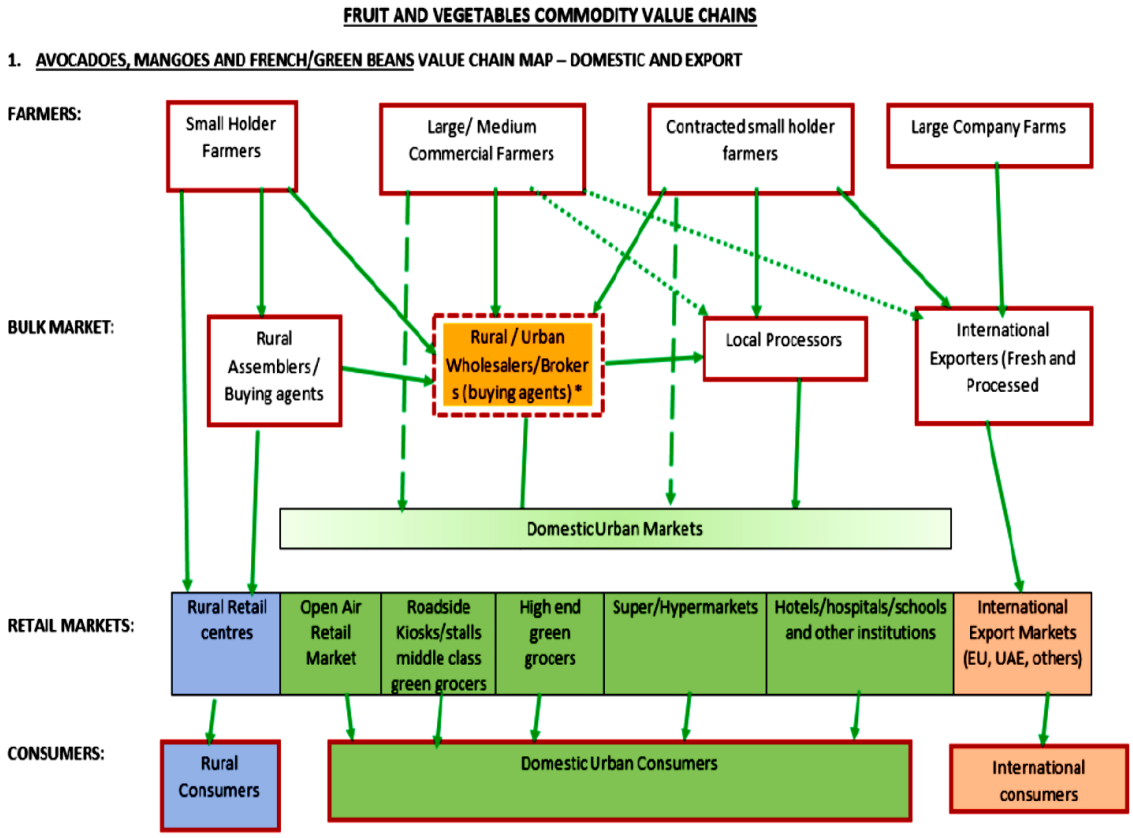

Figure 3.6 *Fruit and vegetables supply chain diagram*
Source: RS 2017.

3.4.1.1 Farmers

Good agricultural practices are not widely adopted by farmers. Only a small share of the farmers use hybrid seeds (estimated at 15% by interviewed experts). The rest of the farmers use OPV and farmer-saved seed. Overall there is a low germination rate due to poor nursery practices, high disease incidence (already at seedling level), decreased crop stand after transplanting and high plant population.

Poor fertility status of the soil due to limited use of fertilisers is low. The pest and disease pressure is high and farmers have limited knowledge of pest and disease control and often overuse crop protection agents. Overuse can lead to serious food safety issues further down the value chain. Furthermore, irrigation is not common and water is not harvested.

3.4.1.2 Wholesalers and brokers

Wholesale traders have a dominant position in linking rural producers to urban consumers. Only a minority of the farmers take their own produce to the market. Therefore, traders provide an important intermediary service for both farmers and consumers, since the main vegetable production fields are in rural areas of Uganda. Exploitative behaviour and high levels of informality are key challenges reported by different stakeholders. Stakeholders during the validation workshops also mentioned that farmers do not know their actual costs of production and sometimes sell their produce below their production cost. Also, the presence of cartels at urban markets by traders is often mentioned by interviewed farmers as a barrier for doing business. The main wholesale and retail markets in Uganda can be found in Kampala city. They are St. Balikuddembe market (Owino market), Kalerwe market and Nakasero market. Produce handling at the markets is not optimal and can cause food safety issues for consumers.

3.4.1.3 Retail

There are several types of markets in Kampala including open air retail markets, groceries and roadside kiosk, various institutions and supermarkets.

Supermarkets are a well-established segment in the food retail market in urban areas where incomes are higher. The scale of procurement is typically much larger and requires both volume and coordination among suppliers and between suppliers and retailers and their intermediaries. In Kampala there are various large multinational supermarkets, several locally owned small to medium-sized supermarkets spread out in all the suburbs, as well as different petrol stations that have small supermarkets.

Small groceries are numerous in Kampala and in urban centres, including fresh-produce kiosks and roadside vendors specialising in fruits and vegetables in strategic locations. At the lower-class market, roadside stalls and kiosks offer an opportunity. Many of these kiosks operate informally without license (Nyapendi et al., 2010).

3.4.1.4 International exporters

Professional exporters supplying the international markets are few. We estimate that there are about 7-10 serious exporters supplying the international market, supplemented with many opportunistic so-called 'brief case' exporters. The more serious exporters often have their own production fields, have additional out-growers, supply out-growers with technical support and assistance, and have their own packing facilities. The 'brief case' exporters often buy the produce on the open market or make informal agreements with farmers without providing any support. Both types of exporters lack GlobalG.A.P. certification and mainly focus on supplying the EU ethnic market or some markets in the Middle East. The capacity of the pack houses is not sufficient, according to stakeholders interviewed. Many pack houses are in residential houses that were turned into pack houses. Cold chain facilities during transportation from the farmer fields to the pack houses and from the pack houses to the airport were also reported to be lacking.

Current export of hot peppers is facing serious problems, with numerous interceptions in the EU market. This is related to organisms demanding quarantine (False Coddling Moth; FCM) and cases of exceeding the EU market's Maximal Residue Limit (MRL) for chemicals. As a result, the EU Commission has warned MAAIF several times to act.

3.4.1.5 Seed supply

According to the Access to Seed Index (2019), there are 21 seed companies in Uganda, see the table below. Only nine companies provide extension services in Uganda, and these are mainly regional companies. Bejo and East-West Seed are the only globally active companies to do so. However, during recent interviews in Uganda with the distributor of Rijk Zwaan we learned that they are also providing extension support to farmers. Local seed companies have basic and certified seed production activities on-farm or with dedicated seed growers. Major seed-selling outlets are facilitated by the government, agro input dealer distribution networks and non-governmental organizations operating in the region. Three companies have breeding locations, and five have processing locations in the country. Seed production, breeding and processing are carried out by the companies headquartered in the region. No globally active companies carry out these activities in the country, according to the Access to Seed Index (2019).

Table 3.5 *Seed companies active in Uganda*

	Crops in portfolio		Company activities in country					
	Field crops	Vegetables	Breeding location	Testing location	Seed production	Processing location	Sales	Extension services
Advanta	x	x		x			x	
Bayer	x	x		x			x	
Bejo		x					x	x
Corteva Agriscience	x						x	
East African Seed	x	x	x	x	x	x	x	x
East-West Seed		x					x	x
Enza Zaden		x					x	x
Equator Seeds **	x	x		x	x	x	x	x
FICA Seeds **	x	x	x	x	x	x	x	x
Kenya Highland Seed		x					x	x
Kenya Seed Company	x	x					x	
Known You Seed		x					x	
Limagrain	x	x					x	
NASECO **		x					x	
Pop Vriend Seeds		x					x	
Rijk Zwaan		x					x	x
Sakata		x					x	
Seed Co	x	x					x	x
Syngenta	x	x			x		x	
Victoria Seeds **	x	x			x	x	x	x

Source: Access to Seed 2019, adjusted by authors.

The value of imported seeds over the last three years is approximately USD7m. Since 2004 the value of the imported seed has increased significantly. Imported vegetable seed in Uganda mainly originates from Kenya. Other important seed-supplying countries are South Africa and the Netherlands (see figure below).

A serious problem in the Uganda seed sector is the presence of counterfeit seeds. Experts indicated during the validation workshop that this affects as much as 30 to 40% of the total seed market.

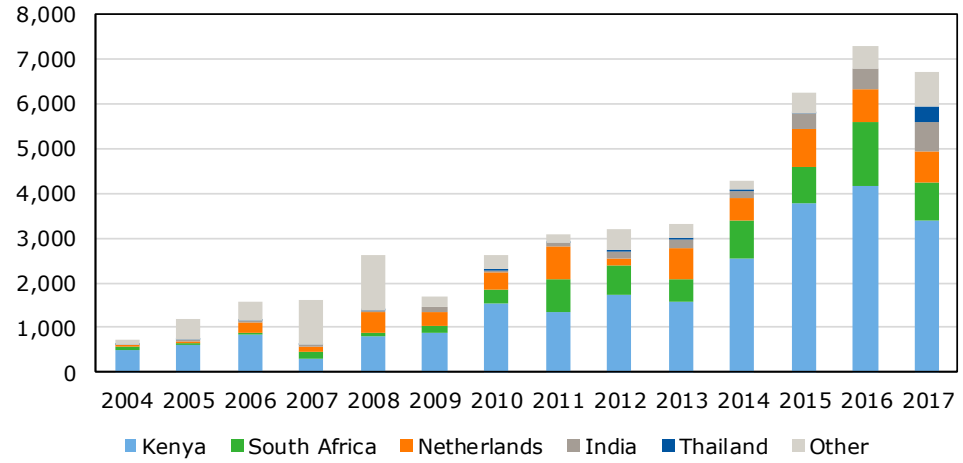

Figure 3.7 *Value of imported seeds in Uganda HS 12099100*
Source: UBOS.

3.4.1.6 Other input suppliers

In Uganda there are about 4,000 agro-input dealers, according to the Uganda National Agro-input Dealers Association (UNADA). The knowledge level of the agro dealers in Uganda is low and yet the agro dealer is the source of information and advice for the farmer. Therefore, the UNADA has started training 1,200 agro dealers in the safe handling of pesticides. Unfortunately, less than 300 agro dealers are officially licensed to trade in agrochemicals.

Most inputs are imported and the number has increased over the last decade. The current value of imported pesticides is almost USD70m. The value of the fertilisers is about USD23m (2014 data). The figure below presents the development of imported value.

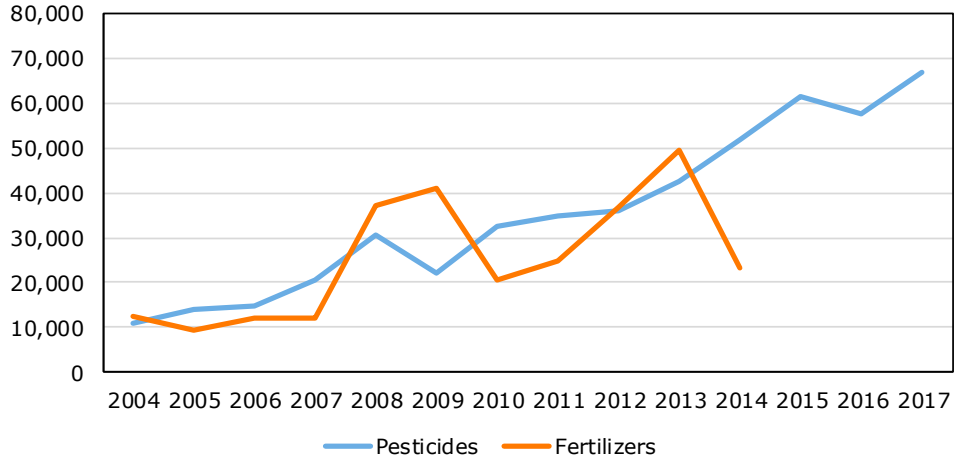

Figure 3.8 *Import value (x USD 1,000) of pesticides and fertilisers in Uganda*
Source: FAOSTAT.

3.4.1.7 Processing

The few players in the fruit processing sector are mainly for the domestic juice market. The current players in the fruit processing sector have made some backward linkages pursuing production agreements with some fruit farmers or aggregators but this has been minimal. As a result, a large share of the processed juice consumed in Uganda is still imported to meet the local demand.

Processing of vegetables is very limited in Uganda. It is difficult for local processors to compete with imported processed foodstuff like tomato ketchup, which is produced by a dedicated industry at a much lower cost of production.

3.4.2 Market structure and chain governance

The production of horticultural crops is largely by smallholder growers, scattered all over the country (Sonko et al., 2005). There are about 500,000 smallholders involved in the production of fruits and vegetables. The main production areas are Kabale, Kamuli, Kapchorwa, Kasese, the lake basin, Mbale, Masaka, Mubende, Mukono, Wakiso and West Nile Districts and North and Northeastern region (Sonko et al., 2005). Most fruits and vegetables are not irrigated and are thus entirely dependent on rainfall, which has often affected the supply.

There is limited coordination among actors. There are different fruits and vegetables associations, but each has its own limitations according to the stakeholders interviewed. For example, Hortexa is considered to be limping, without adequate support and work, UFVEPA is not fully representative, and UHEPA comprises high-end exporters with better and bigger contracts, access to finance and arbitration capacity. UHEPA comprises about 12 members, only seven of whom constitute the movers and shakers in the association, and some of these used to be members of Hortexa. UFVEPA was formed by the government and ought to have brought some sanity to the fruits and vegetable sector, however, some members quit because they felt they did not belong. Others contested the high

membership costs. Some actors think that UFVEPA should be disbanded and a new association that is more representative should be formed. With the expansion of Entebbe airport, the fruits and vegetable sector could lose out on the new cold chain facilities in favour of the flower sector because the latter is more organised, coordinated and can lobby better.

3.4.3 The enabling and supporting environment

Liberal economic reforms in Uganda have weakened the enabling environment for the horticulture sector. Wiegratz (2010) describes the process of liberal economic reforms in detail: "Since the late 1980s but especially in the 1990s, the government neoliberalised the Ugandan state, economy and society extensively according to 'market society'-oriented prescriptions – all with significant financial and technical donor assistance and related pressure. The new economic reforms included a currency reform, the liberalisation of the foreign exchange markets and the export crops sectors (coffee, cotton), the abolition of the respective marketing boards, the dismantling (directly or indirectly) of cooperatives, the transformation of ministerial responsibilities and practices including the agricultural extension service (towards 'demand-driven' and consultancy-type services), the laying off of an estimated 150,000 or more public servants and a further administrative restructuring in accordance with 'new public management' doctrines. Further, they included new 'business-friendly' laws (e.g. regarding investment and profit expatriation), the privatisation of most state-owned businesses/parastatals and properties and the creation of state institutions such as the Uganda Investment Authority (UIA) and the Uganda Revenue Authority (URA), a general deregulation across the economy and the lifting of protective buffers for (weak) economic actors (such as peasants and workers)."

Past agricultural extension reforms failed. In line with this another author states the following: "The need to improve agricultural extension services had long been recognized as necessary to improve agricultural productivity in Uganda. In 2000, a high-profile and substantial reform of agricultural extension services was initiated, and a relatively strong and efficient agency was set up to implement it. Initially, the program appeared successful. However, the reform gradually stalled and was reversed after a series of political interventions. Finally, in 2012 it was effectively abandoned in its original form, and extension services remain highly inadequate in Uganda (Kjaer, 2015)". Therefore, the use of extension services is relatively low: recent LSMS data indicates that countrywide 18% of the farmers use extension services provided by the National Agricultural Advisory Services (NAADS). The table below gives an overview of the different sources of extension.

Table 3.6 *Use of extension services, in % of households*

	Central	East	North	West	Total
National Agricultural Advisory Services (NAADS)	13%	17%	21%	19%	18%
Input supplier	0%	1%	2%	0%	1%
NGO	2%	2%	5%	1%	3%
Cooperative/farmer's association	1%	2%	0%	0%	1%
Large scale farmer	1%	0%	0%	0%	0%
Other	1%	0%	0%	0%	1%
No use of extension	82%	78%	72%	80%	76%

Source: LSMS 2013/2014, unweighted, calculations Wageningen Economic Research.

Wiegratz (2010) also describes that many past government programmes, for example in the agricultural sector, were characterised by severe corruption and implementation problems and thus could not deliver on the outlined ambition. Wiegratz (2010) argues that ultimately "the reforms did not remove many of the sources of economic and social uncertainty but endorsed and kept many in place and unleashed new ones."

Various policies were developed by the government to support the sector, but they lack a successful implementation strategy. Uganda Vision 2040 aims to transform Uganda from a predominantly peasant and low-income country to a competitive upper middle-income country. The Ugandan government has identified fruits and vegetables as priority crops in the Framework

Implementation Plan. The government also heads up the creation of an enabling environment and oversees regulations and aims to connect subsistence farmers to the markets. They aim to increase production and productivity, market access, and value added. The government of Uganda has pursued previous policies and strategies under the Plan for Modernization of Agriculture (PMA) – a multi-sectoral framework aimed at transforming subsistence farming to commercial agriculture. The Uganda National Bureau of Standards (UNBS) is the body concerning standardization and implementation of food standards, other activities are scattered amongst many ministries and agencies and uncoordinated. Combined with outdated legislation and poor facilities, enforcement appears to be difficult. For example, the Uganda Food and Nutrition Policy was developed in 2003, but strategies mentioned in that document have hardly been implemented.

Despite government efforts in the PMA, progress was made mainly in research and agricultural advisory services (only two of seven pillars of the PMA), while limited progress was achieved in the other five pillars (MAAIF, 2010). As such, government has identified areas of weakness in the PMA framework and addressed them in this five-year Agricultural Sector Development Strategy and Investment Plan (DSIP) 2010/11 – 2014/15, which is in line with the agricultural priorities in the National Development Plan (NDP):

(i) Enhancing production and productivity, aiming at supporting Ugandans to engage in productive and profitable agricultural and agribusiness activities to ensure food security and increase household income;
(ii) Significant improvements in market performance through facilitating access to high quality inputs and participation in value addition activities, expanding the rural network infrastructure, improving capacity for regulation and enforcing standards, among others;
(iii) Providing an enabling environment involving a body of statutes, regulations and standards to remove critical constraints to private sector growth; supporting opportunities that improve market efficiency; and improving the incentive environment facing the private sector in the key market chains;
(iv) Development of institutions to deal with structural challenges faced under MAAIF since most of the agriculture sector challenges were compounded by institutional challenges. Support structures that were expected included the restructuring MAAIF to create an Agribusiness, and Regulatory Services Departments in each of the three 'commodity' directorates of Crop Resources, Animal Resources and Fisheries (MAAIF, 2010).

The National Development Plan-II (NDP-II) proposes government support and investments in 12 agricultural value chains, however, excludes high value fruits and vegetables. The NDP is focused on cotton, coffee, tea, maize, rice, cassava, beans, fish, beef, milk, citrus and bananas. The NDP-II is the second in a series of six five-year plans aimed at achieving the Uganda Vision 2040. The NDP-II is expected to be implemented from 2015/16 through 2019/20, seeking to leverage opportunities and honour obligations presented by emerging developments at the national, regional, continental levels, and even the global level. The areas of attention will be strengthening agricultural research, implementing a single spine extension system, promoting technology adoption at the farm level, increasing access to and effective use of critical farm inputs, promoting sustainable land use and soil management, increasing access to agricultural finance with specific options for women farmers, and strengthening agricultural institutions for effective coordination and service delivery. This is expected to lay the foundation for the establishment and expansion of agro-processing in the country. The plan recognises stages along the value chains of the selected enterprises where interventions will be focused, as well as offering potential leverage.

National Extension Policy 2016 will develop and invest in various agricultural extension approaches and systems with varying demand for human, capital and financial resources. In 2014, the government made a decision to re-structure the entire national agricultural extension system to address past weaknesses in extension services. It has various policy objectives:

(i) To establish a well-coordinated, harmonised pluralistic agricultural extension delivery system for increased efficiency and effectiveness.
(ii) To build institutional capacity for effective delivery of agricultural extension services.
(iii) To develop a sustainable mechanism for packaging and disseminating appropriate technologies to all categories of farmers and other beneficiaries in the agricultural sector.

(iv) To empower farmers and other value chain actors (including youth, women and other vulnerable groups) to effectively participate in agricultural extension processes and build their capacity to demand for services.

A new Agriculture Sector Strategic Plan (ASSP) was developed following a comprehensive review of the DSIP for the period 2010/11 to 2014/15 and contains 12 additional priority crops including fruits and vegetables. The review identified some implementation challenges, lessons learnt, opportunities, emerging issues and generated key recommendations to guide future action. The ASSP is the flagship plan for investment and development of the agricultural sector, in line with the NDP to be implemented through a multi-sector-wide approach. The ASSP aims to increase the income of households, support food and nutrition security, strengthen institutions, and increase access to inputs and to markets.

- For the ASSP there has been a Framework Implementation Plan with four strategic commodities: oil palm, oil seeds, cotton, cocoa.
- There are 12 additional priority crops: bananas, beans, maize, rice, cassava, tea, coffee, fruits and vegetables, dairy, fish, livestock (meat).

Despite the above efforts, the specific policies in the fruits and vegetables subsector in Uganda have been inadequate (MAAIF, 2018). In addition, many industry stakeholders have argued that the fruit and vegetable sector has been neglected by the government. Therefore, specific policies have been critically reviewed and MAAIF developed 'The FRUITS AND VEGETABLES FRAMEWORK IMPLEMENTATION PLAN' which is currently on its way to being finalised and implemented. The framework involves different horticultural crops, focusing mainly on technical support, with various thematic themes like youth, gender, HIV/AIDS, nutrition and environment (MAAIF, 2018).

The current export inspections and procedures are not in line with international standards. Interviewed stakeholders mentioned that some exporters actually export without prior inspection at the production site and/or the pack house. However, the Government is trying to address this by restricting current hot pepper exports to the EU market to 'clean the house'. There is currently no ban on exports but there could be a ban in November 2019 if Uganda does not take serious measures on time to address the issues identified by the EU notably the FCM and the high MRLs. The EU mandated Uganda to address specific issues causing interceptions and in November, the EU will send a team to Uganda to check if the identified issues with MRL and quarantine organisms have been addressed accordingly. However, interviews with various stakeholders revealed that there was misunderstanding among them on the state of hot pepper exports to the EU and the farmers were not aware of the policy decision by MAAIF. Other actions by government as reported by stakeholders during the validation workshops include: requiring exporters to have production sites or out-growers, recruitment of more extension workers, retooling of extension workers and building capacity for the inspection of horticultural products. Stakeholders reported that the Uganda Agricultural Chemicals Board lacks the capacity to carry out a full sampling of export consignments. Sometimes even random sampling for the consignments is lacking.

There is a mismatch between phytosanitary regulations between the Netherlands and Uganda. According to formal seed importers it is difficult to operate in Uganda and to import seeds. There is a strong focus on bulk crops like soy, but very little attention to vegetable seeds. Uganda requires additional ISTA certificates to be able to import seeds. This adds costs to the selling price of seeds that the grower is unwilling to pay. Another challenge was that seeds had to be treated according to the ISTA from 2019 with certain chemicals (Thiram) and in the EU this product was banned, no longer available, and will be replaced by a more expensive product. European seed breeders are not able to make exceptions for export to Uganda. A suggestion by various industry stakeholders is to follow the Dutch NAL norms, which are considered to be more advanced than ISTA.

Fruits and vegetables education system is weak with limited practice and exposure. There is a 2-year diploma course in Bukalasa Agricultural College supported by the government of Denmark and the Netherlands. Other universities like Makerere and Mt. of the Moon also offer horticultural courses at degree level.

Actors in the fruits and vegetable sector have limited access to finance. Limited access to financial resources presents many potential challenges, as access to financial resources is critically important for development. Many stakeholders in the fruit and vegetable sector confirmed that all actors have difficulties in obtaining external credit. Most actors willing to invest rely on informal credit through family and friends. In addition, commercial bank interest rates and interest rates of private money lenders are high, averaging at 25% year. But also, short term credits with rates of 5-10% per month have been identified. This high interest rates make borrowing in the horticulture sector difficult.

3.4.3.1 Investment environment

The level of FDI inflows as a share of the GDP in Uganda is relatively high compared to neighbouring countries. Since 2016 Foreign Direct Investments (FDI) inflow has increased again and has a value of almost USD1.4bn (4.8% of GDP). For example, the share of FDI as a share of the GDP in Kenya is 0.9%; in Rwanda 3.2%; and in Tanzania 2.2%.

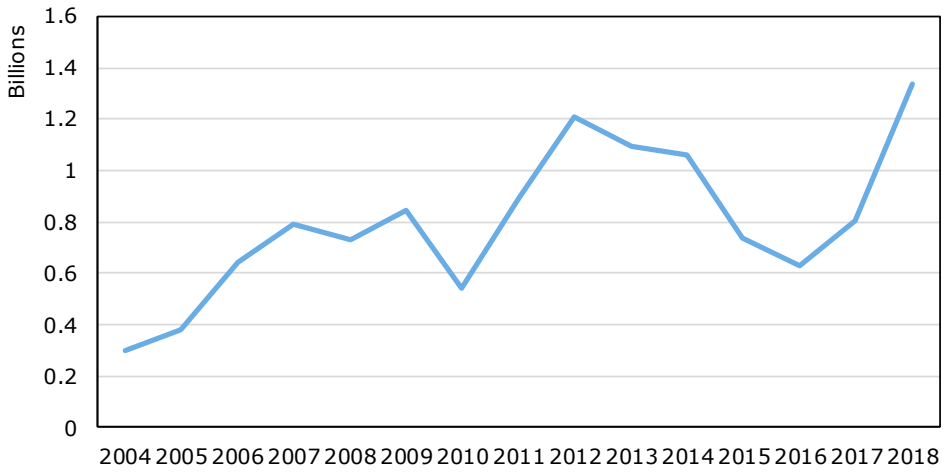

Figure 3.9 *FDI in Uganda in current USDbn*
Source: World Bank.

Comparing Uganda with its regional peers the business climate is less attractive. We see some interesting difference related to the business climate (WB Doing Business, 2019):

- Uganda ranks 127 out of 190 countries;
- Kenya ranks 61 out of 190; and
- Rwanda ranks 40 out of 190;

For example: In Uganda it takes 24 calendar days to register a company; in Rwanda only 4. The main limitations affecting doing business in Uganda include: poor access to finance, corruption, high tax rates, inadequate supply of infrastructure, poor work ethic and government bureaucracy.

Land is available for investment purposes. The Ministry of Lands and Urban Development is mandated "To ensure a rational, sustainable and effective use and management of land and orderly development of urban and rural areas as well as safe, planned and adequate housing for socio-economic development". It has two departments that are directly related to land acquisition for investment. The Department of Land Administration (DLA) is responsible for the supervision of land administration institutions and the valuation of land and other properties. The DLA issues certificates of titles, general conveyance, keeping custody of the national land register, coordination, inspection, monitoring and back-up technical support relating to land registration and acquisition processes land in Uganda is under the following land tenure systems which may be available for investment purposes, as described in a publication by the Uganda Investment Authority (2015):

- *Leasehold tenure.* Leasehold tenure is a form of tenure whereby one-party grants to another the right to exclusive possession of land for a specified period, usually in exchange for the payment of rent. The longest lease term is 99 years.

- *Free hold land tenure.* This tenure derives its legality from the Constitution and the written law. Freehold tenure may involve either a grant of land in perpetuity, or for a lesser specified period. Only citizens of Uganda are entitled to own land under freehold tenure. Noncitizens may lease it for a period up to 99 years.
- *Mailo Land tenure.* This tenure is almost identical to freehold tenure. Registered land can be held in perpetuity and a Mailo owner is entitled to enjoy all the powers of a freehold owner
- *Customary tenure.* In some places the land is held communally, in some it belongs to a clan while in others it is held by individuals. The rules of customary law also vary in different parts of the country.

3.4.3.2 Activities of development partners

At the moment not many donors are active in the fruit and vegetable sector. In the past there were many projects in the sector (e.g. SNV is active in the pineapple sector, USAID has a focus on commodity production and marketing for coffee, maize and beans)). At the moment it appears that the fruits and vegetables sector is not receiving a lot of attention. *Solidaridad* is doing projects in the sector, e.g. with onion production, youth involvement and bringing Uganda exporters to Kenya for exposure purposes.

SNV in partnership with Wageningen University and Research (WUR), CGIAR's Climate Change Agriculture and Food Security Programme, Agriterra and Rabo Partnerships published a series of climate risk assessment reports as part of the Climate Resilient Agri-businesses For Tomorrow (CRAFT) project (funded by the Netherlands Ministry of Foreign Affairs). Some of the cases studied are based in Uganda but do not concern the fruits and vegetables situation.

3.5 Market demand

3.5.1 National demand

Local market demand for fruit and vegetables is likely to increase. Various indicators support this:

- Urbanisation rate (since 2012 +3% per year)
- Population growth (since 2012 +7m)
- Moderate GDP growth (5% per annum)

The transition to middle income country will impact the agricultural sector and yields need to be improved at farm level to be able to feed the increasing urban population. Uganda's Vision 2040 envisions a transition to middle income country status with a largely non-agrarian workforce and urban-dwelling populace. However, the Ugandan economy is still heavily reliant on the agriculture sector, with 69% of household's dependent on subsistence farming for their main source of income, and nearly 75% of all households residing in rural areas (UBOS, 2014). In addition, food insecurity is still a problem for some regions of Uganda (FSOU, 2019).

The studied LSMS data shows an increasing diversity in all regions of Uganda. The biggest increase in household diversity intake can be observed in Central Uganda. In this part of the country the consumption goes from almost 8 to above 9 food groups that are consumed, based on a 24hr recollection (figure 3.10). Looking at the detailed data the fruits (85%) and vegetables (73%) are an important contributor to the daily diet of the household in all parts of Uganda. Between 2012 and 2016 especially the importance of fruits gained importance in the diet. Appendix 5 presents an overview of the different food groups. However, the volumes of the vegetables consumed per capita remain relatively low (insert FAO data, food supply).

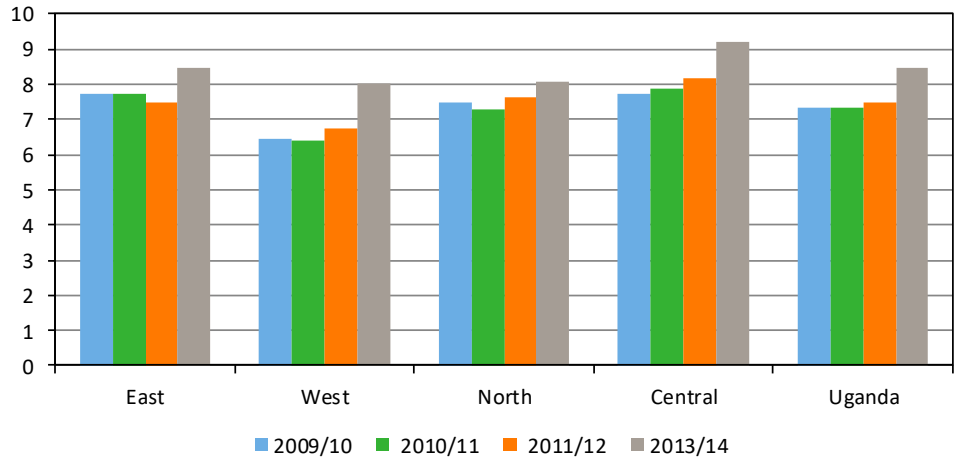

Figure 3.10 *Household Dietary Diversity Score*
Source: LSMS 2013-14.

3.5.2 Regional demand

Uganda has a good position in the region and Uganda supplies neighbouring countries like Kenya, South Sudan, Democratic Republic of Congo (DRC) and Rwanda.

3.5.2.1 Kenya imports from Uganda

Main imports from Uganda are:

a. *Bananas*: Imported through the year; greatest demand is for cooking banana varieties, as Kenya has an adequate supply of ripening bananas. Three traders reported to import ripening banana recently when Kenya had inadequate supply due to climate change and increased banana panama disease, which is impacting the Mount Kenya production region. Upon fact checking, it was found that there is also a significant problem of fusarium wilt and nematodes in the Mount Kenya region – especially bananas from tissue culture production – as farmers do not manage hygiene in the field. Cooking bananas, which are in shorter supply than the ripening bananas, are imported throughout the year.
b. *Pumpkins*: Kenya imports pumpkins from Uganda year-round due to production shortages, inadequate volumes for aggregation in the areas where pumpkins grow. There is a culture of farmers using pumpkin leaves as vegetables and only growing pumpkins as boarder crops, as they are low value.
c. *Oranges and tangerines*: Oranges are imported into Kenya from Uganda during April and May as seasons differ. Kenya used to produce a lot of oranges in the same season in its Thika, Machakos and Embu regions, however, the citrus greening disease wiped out production in these areas ten years ago and the regions have not gone back into production. There are pockets of production, the volume of which is mainly consumed in the same regions. Oranges are produced in the lower parts of the Eastern Counties and coast especially in Kwale, Kilifi and lower Tana. Infrastructure and aggregation constraints restrict these regions' access to the market. There are new plantings by medium-scale farmers in Kibwezi County who produce export varieties, as they also export mangos from the region. Kenya does not produce tangerines, relying mainly on imports from South Africa and Egypt.
d. *Lemons*: These are grown in coastal Kenya in limited volume and shipped to Nairobi. Kenya relies on Tanzania and Uganda, plus a limited quantity from its Mt. Kenya and Kibwezi regions. These regions do have potential, and if production improves, they will supply more citrus to the market than they do now. Investments from counties are prioritizing citrus, especially in Kibwezi, Kilifi and Kwale. It remains, however, to be seen how this will improve production and productivity.
e. *Pineapples*: Pineapples in Kenya are mainly grown in Thika, Malindi and Kisii, however, there are few pineapples to harvest during the cold season from June to September. It is during this window that Kenya imports pineapples from Uganda. The taste of pineapple from the Kisii region is similar to that of Ugandan pineapples, so traders who buy pineapples from that region prefer to purchase Ugandan fruits, as that results in the Thika plantations selling off–grade pineapples to the local

market in order to maintain the taste that consumers favour. Homabay County is promoting pineapple cultivation, which may allow a year-round supply from Kenya, as the weather is hot and new smallholders may grow the region's market share. However, it is not yet clear how new plantings will impact the market, as the scale is still small.

f. *Watermelons*: Watermelons in Kenya are grown by medium-scale farmers, as its production requires scale and investments. Production is limited from June to September due to the cold weather and susceptibility to diseases, making it expensive for the producers to grow during this season and the costs of importing from Uganda lower. Medium-scale farmers prefer contract production and as watermelons are controlled by a select number of traders who dictate prices and sourcing trends, smaller wholesalers who cannot engage in contract production opt to buy from Uganda where volumes are sufficient. We found trading relations outside the shortage window among emerging wholesalers not connected to wholesale markets who import from Uganda year-round. These traders are few and mainly supply to hotels and institutions, making them less visible than the traders in wholesale markets.

3.5.2.2 Kenya exports to Uganda

Main exports from Kenya to Uganda are the following:

- *Tomatoes*: mostly in the month of May.
- *Carrots*: year-round from Nakuru County but climate change is limiting year-round production.
- *Garden peas*: year-round from Nakuru County but climate change is limiting year-round production: while demand from Tanzania is also growing.
- *Mangoes*: February to April.
- *Passion fruits*: February and May.
- *Potatoes*: year-round from Nakuru County but climate change is limiting year-round production: while demand from Tanzania is also growing.

3.5.2.3 Transport costs

Transport from Uganda to Kenya is often 30% cheaper than transport from Kenya to Uganda. Demand for transport from Kenya to Uganda is higher as more goods are shipped from and through Kenya to Uganda than the reverse. Transport from Uganda averages KES 30,000 (USD 290 or UGX 1,08m) for 10MT while transport from Kenya to Uganda averages KES 50,000 (USD 480 or UGX 1.79m) for 10MT.

The vehicles that are used to transport produce from Uganda to Kenya are mainly used to transport industrial goods to Uganda like chemicals, especially lime and salt from Mombasa and Kajiado. Due to their size, 10MT, they are more suitable for transporting fresh agricultural produce back to Kenya, while the larger trucks transport cereals, maize and animal feed inputs.

3.5.2.4 Cross-border trade

The nature of cross-border trade differs from trade between Uganda and the rest of the country. The communities along the border are interconnected and related. On the Busia border, the Luhyia community that dominates the area lives on both sides of the border and therefore trades on a different scale than the rest of the country. Dry cereals – especially beans, maize and ground nuts – are traded across the border in higher volumes. While other horticultural produce is also traded in Malaba border markets, cross-border trade statistics are more difficult to ascertain.

3.5.2.5 Drivers for trade

Several factors influence the trade from Uganda to Kenya:

- **Seasonality**: the most important factor is seasonality for all products. The two countries have different production seasons, and due to the exclusively rain-fed nature of agriculture in the two countries and the seasonality of production, there is a symbiotic relationship in the demand and supply.
- **Taste**: There are two products that Kenya prefers to consume out of Uganda, as they find them to have a better flavour than those grown in Kenya: pineapple and watermelon. The Thika region produces quite acidic pineapples – not as sweet as pineapples from Uganda. The same is said for watermelon, but there is no clear characteristic (like acidity) that the traders use to distinguish watermelons grown in Uganda.

- **Reliability of supply**: Watermelon traders prefer to source from Uganda due to the reliability in supply and the demand for volumes which are not consistently supplied by Kenya. Uganda therefore has priority over Kenya among the traders.
- **Variety**: There is a huge preference for "Kiganda" green bananas in the Kenyan market that is quite distinct from the Kenyan green bananas. While Kenya produces high volumes of green bananas, there is a market perception that Kiganda is a better green banana variety for children than Kenyan green bananas. There is a culture of weaning children using green banana, which gives the Ugandan-grown bananas a higher market share in Kenya.
- **Underutilised transport capacity**: Uganda imports products through the port of Mombasa; but ships back less products than available capacity. Transporters therefore lower return transportation costs to increase their chances of moving products back to the country: transport from Uganda to Kenya is often 30% cheaper than transport from Kenya to Uganda. Demand for transport from Kenya to Uganda is higher, as more goods are shipped from and through Kenya to Uganda than the reverse.

The only quality parameters that the traders mentioned are those related to taste. No trader mentioned price to be an issue except when Kenya is off-season and prices are higher than Uganda's prices. However, FAO statistics on wholesale price in Kenya and Uganda give the impression that the prices in Uganda are lower (excluding transport). See the figure below.

Uganda's location at the centre of the Great Lakes region and in the EAC offers Ugandan farmers access to a regional market with over 150 million consumers. Recent export growth has been stimulated by demand in neighbouring countries such as South Sudan, which has emerged as an important trading partner, demanding food and other manufactured materials. However, due to unrest in South Sudan, this market has now been reduced in importance for export from Uganda. Moreover, the border with Rwanda has been closed for some time due to political issues and this affects cross-border trade.

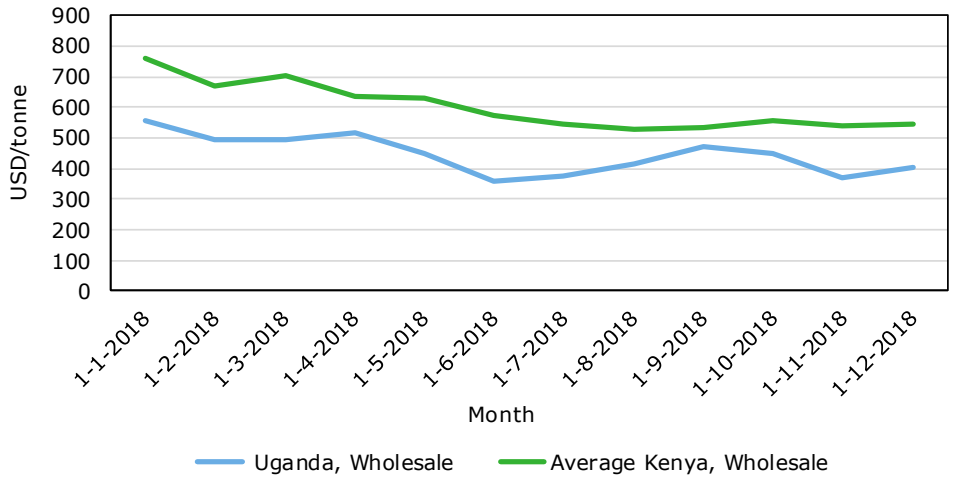

Figure 3.11 *Wholesale price of beans in Uganda versus Kenya*
Source: FAOSTAT.

3.5.3 International demand

Current export volumes of fruits and vegetables from Uganda are estimated by COMTRADE to be almost 400,000 tonnes of produce with a value of USD118m in 2017. Most of the exported produce consists of vegetables, with the key products being capsicums (hot peppers, including Scotch Bonnet, habanero, chilies, etc.) and the garden eggs. As such, the horticultural sector has become important in the Ugandan economy as it contributes an increasing share of the non-traditional exports.

The major destinations for horticultural exports include the UK and Belgium and are consumed by ethnic buyers in Europe. This niche market is relatively limited in size and is subject to only the bare minimum legal requirements regarding MRLs and sanitary and phytosanitary aspects.

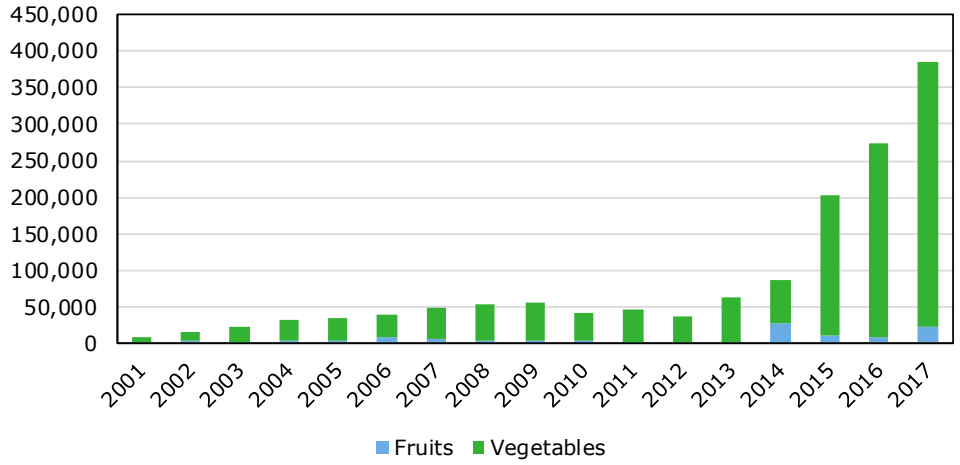

Figure 3.12 *Export quantity of fruits and vegetables (HS07&08) in tonnes 2001-2017*
Source: UN COMTRADE.

Despite increasing export during recent years, Uganda continues to struggle in comparison to export volumes of surrounding countries. See the tables below. Interviewed importers in the EU mention many challenges in the export value chain, including a lack of cold storage, lack of traceability and certification, lack of monitoring at farm level of chemical use, lack of adequate packing material, and other factors. In the case of beans and peas, the climatic conditions are not favourable (USAID, 2002). In the case of fresh tropical fruits, due to their weight, they are generally shipped by sea and the distance to the nearest seaport is further away, compared to countries like Kenya and Tanzania. Appendix 2 gives an overview of the value of exported fruits and vegetables.

At present, there is no commercial farmer in Uganda that is producing fresh vegetables up to the standards of major European supermarkets. Foreign supermarket requirements regarding quality, traceability, and food safety are increasing, and this leaves room only for serious and professional production of fresh produce. In Uganda there is no producer nor exporter that has GlobalG.A.P. certification.

Table 3.7 *Export of fruit from Uganda 2008-2017 in tonnes*

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fresh or dried mangoes	0	12	5	64	51	49	64	1,313	2,521	10,112
Fresh or dried pineapples	2,426	1,981	1,746	2,299	522	815	671	1,012	2,481	3,470
Fresh or dried avocados	6					4	60	122	128	191
Citrus fruit, fresh or dried	13	7	298	99	206	311	594	3,758	3,139	13,582
Melons, incl. watermelons, and papaws (papayas), fresh	1523	1951	1328	668	264	446	183	1,114	1,738	5,299
Bananas, incl. plantains, fresh or dried	409	813	461	637	270	632	25,522	4,647	2,807	2,501
Fresh strawberries, raspberries, blackberries, back, white or red currants, gooseberries and ...	748	204	106	257	153	55	16	115	72	995
Apples, pears and quinces, fresh	18	8	7	98	65	232	264	597	801	522
Other	1,371	70	35	173	140	77	532	230	138	45

Source: UN Comtrade.

Table 3.8 *Export of vegetables from Uganda 2008-2017 in tonnes*

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dried leguminous vegetables, shelled, whether or not skinned or split	34,042	47,972	24,188	31,698	28,845	38,092	39,813	15,3526	21,4144	26,6794
Leguminous vegetables, shelled or unshelled, fresh or chilled	637	611	1,835	4,785	1,471	5,314	1,902	3,193	6,337	39,952
Roots and tubers of manioc, arrowroot etc	9,159	898	11,416	5821	445	8942	5961	12729	14,317	16,950
Tomatoes, fresh or chilled	2	14	5	23	20	14	1351	3215	5,852	15,862
Potatoes, fresh or chilled	25	74	2	14	98	190	867	9,892	15,803	13,564
Vegetables, uncooked or cooked by steaming or boiling in water, frozen	3,076	2,298	2,112	1,016	1,807	5,601	6,577	6,583	6,859	7,069
Other vegetables, fresh or chilled (excluding potatoes, tomatoes, alliaceous vegetables, edible **...**	983	983	488	1,347	2,593	1,789	1,025	1,346	7,24	1,546
Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled	3	125	52	92	104	61	985	1,407	545	726
Other	14	7	2	10	22	5	336	336	270	214

Source: UN Comtrade.

4 Case studies

4.1 Introduction

In the following case studies, we analysed five different crops in more detail. For each case study we provide a brief overview of the following:

- The main production area;
- A detailed value chain description and the role of the different actors;
- The cost and benefit analysis; and
- We conclude with a SWOT that gives an overview of the key strengths, weaknesses, opportunities and threats.

4.2 Tomato

4.2.1 Main production areas

Tomatoes are grown throughout the country. The main production districts include;

- Central region: Luweero, Mpigi, Masaka, Kayunga, Nakaseke
- Eastern region: Mbale, Kapchwora
- Western region: Kabale, Kasese

4.2.2 Value chain

Tomato farmers are linked in various ways with the market. Most of the farmers sell to middlemen, agents or brokers that travel around the rural areas to buy produce and resell it again at the wholesale markets in rural areas, or in urban markets. Some farmers close to the markets sell their produce themselves at the market, however, the majority of the farmers sell to travelling middlemen. Others supply regional exporters.

Seed suppliers sometimes supply farmers directly, but they mostly work with agro-input dealers that supply input retailers located in the villages.

For growing tomatoes there are two seasons, based on the rain. The first growing season runs from April to May. The second growing season runs from September to November. In the meantime, there is also some production with irrigation. Overall quality is less during the rainy season due to lots of pests and diseases. Farmers are selling their produce mostly to middlemen in boxes with top-up, which can contain between 100 and 200kg but are not weighed.

A recent study by ABA (2018) for the USAID supported Feed the Future Program in Rwanda shows that on average farmers are losing on 21% of their crop during harvest. At the collection point, another 11.5% of tomatoes are lost. At the wholesale level 10% of tomatoes are rejected and at the retail level 13.6% of tomatoes are discarded. In total they estimate that on average 40% in the value chain is lost. Unfortunate we were not able to retrieve any reliable data on Uganda, however, given the comparable production and marketing system in a comparable climate, it is reasonable, based on field observations and expert indications, to assume that this share is similar.

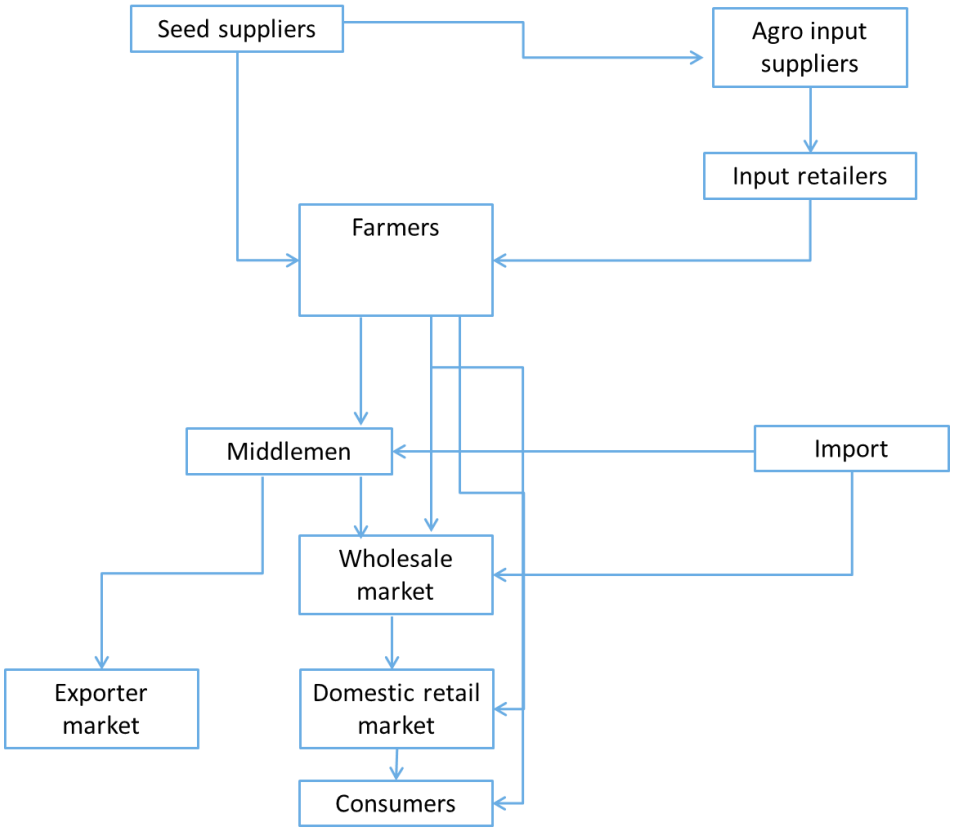

Figure 4.1 *The tomato value chain*

4.2.2.1 Farmers

Many of the tomato farmers in Uganda are involved in subsistence farming. The number of tomato farmers is minimal considering how serious a business the tomato cultivation is. Tomato farmers can benefit from at least two growing seasons with sufficient rain in a year.

The more serious farmers are often using improved seed, irrigating and sometimes have a small greenhouse, while the subsistence farmers use mainly OPV seeds or farmer saved seeds with very limited additional inputs. In general the current level of agricultural practices is low and misuse and overuse of pesticide is very common. The planting of seeds is mainly done directly in the soil or at small nursery plots at the farm.

We found that the level of irrigation is still low, although the results from our study show that irrigation is adding value.

Tomato "quality" is very subjective and hardly rewarded in the market with a price premium. Interviewed farmers consider "quality" to refer to the large size of the tomatoes as well as to the hardness of the tomato skin. They also mentioned that their customers prefer tomato varieties with a longer shelf life. Some of the tomato farmers also sell directly on the markets and therefore pay taxes to market authorities.

Actors in the tomato value chain mention the following yields as realistic, under good agricultural and climate conditions:

- 15 tonnes per acre for hybrid varieties including irrigation. Irrigation can enable farmers to have a maximum three to four harvests per year. The initial investment in irrigation is between UGX 8 and 14m for the pump and pipes for one acre. It also requires additional running costs for fuel;
- 8 tonnes per acre for hybrid varieties only;
- 6 tonnes per acre for OPV varieties.

The current farm gate sales price is UGX 1,000-1,500 per kg. Given the reported yields at the farm level and the reported average tomato price per kg at farm gate, the margin is between 40 and 55%.

Our analysis of the LSMS also confirms a positive margin for farmers that produce tomatoes; see Appendix 6 for a more complete analysis.

We studied different type of farmers: farmers that work only with OPV seeds, farmers that use hybrid seeds and farmers with irrigation. It appears that farmers that have hybrid seed are able to have better financial results due to increased yields but also due to four harvests per year compared to only two without irrigation. Irrigation also increases the annual yields (see the figure below).

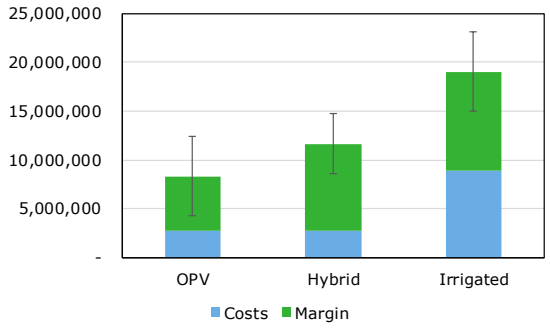

Figure 4.2 *Margin and costs of studied tomato farmers in Uganda per acre per year*
Source: Author's field data.

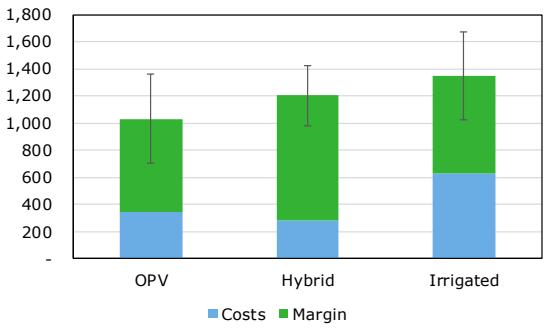

Figure 4.3 *Margin and costs per kg produced of studied tomato farmers in Uganda per year*
Source: Author's field data.

4.2.2.2 Traders

Tomatoes are transported in wooden crates and traded in basins and wooden crates (boxes). Not much trade is actually weighed in kilograms; instead, volumes traded are per crate, or per basin. Retailers pay a commission to the market. For example, a small retailer that was selling from a 230kg box paid about UGX 2,000 for a morning of selling the tomatoes. Larger traders pay more, and this can go up to UGX 30,000 for a full truck. Most smaller retailers, however, buy from middlemen. A common crate has a weight of 230-250kg and has a sourcing value of about UGX 270,000. The farm-gate price equals about UGX 1,200 per kg and the wholesale price adds another 300 per kg, which can be sold for 2,000 UGX per kg at retail (see table 4.1).

Table 4.1 *Average tomato prices along the value chain (2019)*

	Farm to wholesale	wholesale to retail	Retail to consumer
Price per kg	1,000-1,200 UGX	1,200-1,500 UGX	2,000 UGX

Source: Author's field data.

4.2.2.3 Markets

The major markets for tomatoes are Balikuddembe market (Owino market), Kalerwe market and Nakasero market, all of which are located in Kampala. However, some commercial farmers with irrigation even supply supermarkets and regional exporters. There are middlemen in these markets who sell the tomatoes for a commission, usually UGX 10,000 per wooden crate. The middlemen bargain with the buyers and the farmer only gets to know the price after the middleman has sold.

The regional export market has a big influence on pricing. In May the prices are high due to the volume of tomato export to Kenya. Prices without a significant export demand can be as low as UGX 60,000 per wooden crate. Tomatoes are neither sorted, displayed, nor labelled according to size: consumers can select for themselves. Not even the damaged or old tomatoes are sorted out, which results in overall unappealing appearance and quality in the market display. A small number of tomatoes are imported from Kenya in the 'dry season' between December and February. Some supermarkets in Uganda also import tomatoes from Holland and these serve a niche market for upscale restaurants in the country.

4.2.3 Most suitable areas for tomato production

The outcomes of the Global Detector are presented in the figure below. It clearly shows that there are many locations in Uganda where tomatoes can be produced. The main area of production is Central and West Uganda, which is very much in line with the current production areas.

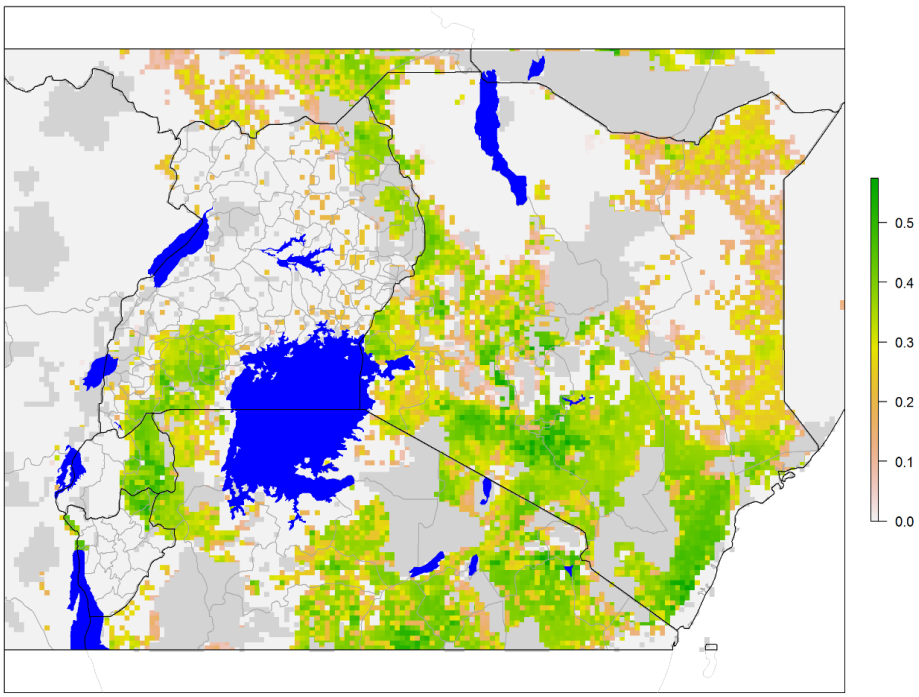

Figure 4.4 *The potential for tomato production in East Africa*
Source: Global Detector.

4.2.4 Challenges and opportunities

A SWOT is presented below to show the strengths of the tomato value chain. The main one is the minimum of two growing seasons, which, with irrigation can be extended to three or even four seasons. Other strengths are the availability of good seed varieties in the market. The main problems encountered in tomato production are the substantial presence of counterfeit seeds in the market and a lack of support from the government (e.g. the absence of financing and extension services).

Opportunities are related to the growing market demand on the domestic and the regional markets. Threats are related to new pests (like Tuta Absoluta) and the declining soil fertility. Another important threat is climate change: the changing rain patterns make farming more and more unpredictable.

Table 4.2 *SWOT for the tomato sub sector*

Strengths	Weaknesses
• Minimum of two growing seasons • Relatively fertile land • Availability of high yielding varieties in the market	• Unstable market prices • Poor agricultural practices, including post-harvest • Low productivity and quality • Counterfeit inputs • Limited financing • Weak policies and weak extensions service
Opportunities	**Threats**
• Population growth • Availability of water for irrigation • Growing regional markets	• New pests • Declining soil fertility • Climate change especially drought & changes in rain patterns

4.3 Onion

4.3.1 Main production areas

Uganda is the leading producer of onions in East Africa. Due to Uganda's climate they are considered the most suitable for production (Sonko et al., 2005). Popular varieties in the market are Red Bombay and Red Creole. Onions are produced in areas between 1,500-2,100m above sea level:

- Eastern region: Kapchorwa, Kween, Bukwo, Naminsidwa, Bulambuli, Bududa, Sironko, Manafwa, Tororo;
- Western region: Rukiga, Kabale, Kisoro, Ntungamo, Kasese, Kabarole.

4.3.2 Value chain

Middlemen play an important role in the onion supply chain by reducing time and transaction costs for sourcing onions by wholesalers. The onion value chain lacks storage facilities, which renders the onions especially vulnerable during rainy seasons. This forces farmers to sell immediately after harvesting at low prices to prevent the onions from rotting. The figure below gives an overview of the onion value chain in Uganda.

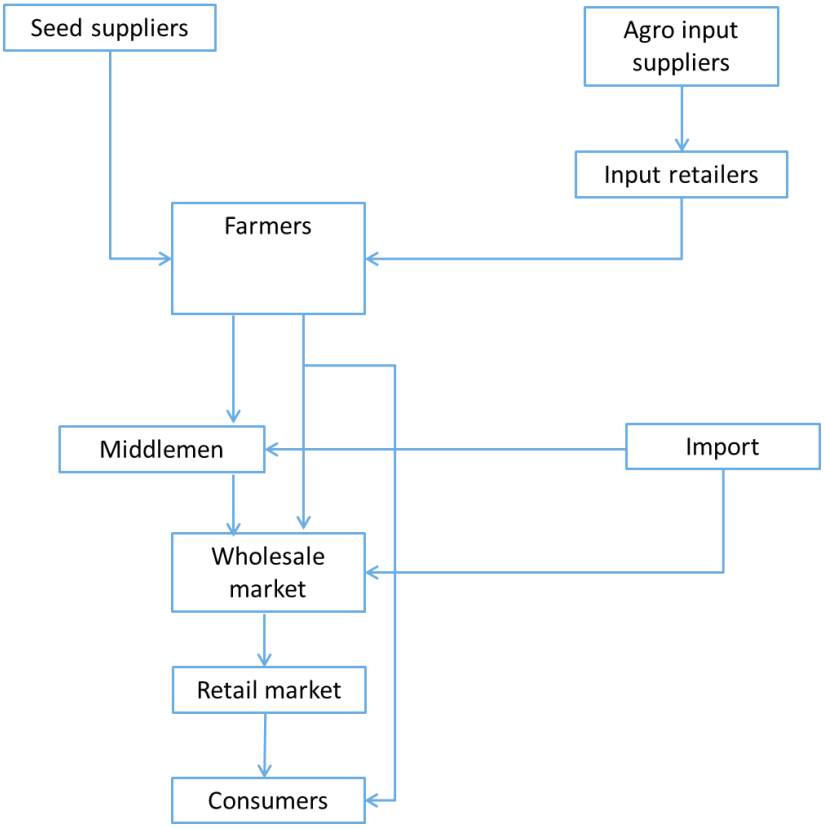

Figure 4.5 *Onion value chain*

4.3.2.1 Farmers

In Uganda onion crops are usually rain-fed rather than irrigated, and we identified the size of the plots to be between 0.25 and 2 acres. However, there are also more advanced farmers that can cultivate large areas of land up to 10 acres. Farmers are able to harvest onions twice a year. Most farmers plants in March and harvest all the onions in June. They plant again in September and harvest all the onions in December (rainy season). Current agronomic practices of farmers are very poor. They often harvest too early and overuse both pesticides and fertilisers.

The achievable yield under good conditions and applying Good Agricultural Practices differ per season. In the wet season the yields are slightly higher. In general the achievable yields are as follows:

- 10 to 20 tonnes per acre for hybrid seeds per season, depending on variety.
- 2 to 5 tonnes per acre for OPV per season.

We have collected data among onion farmers with OPV varieties and with hybrid varieties. It appears that the hybrid farmers are performing better. The major cost for onion farming is the costs for labour and fertilisers. The analysis of the LSMS provides further insights and confirms an average margin of about 70%. See Appendix 6 for more information on the analysis of the LSMS data.

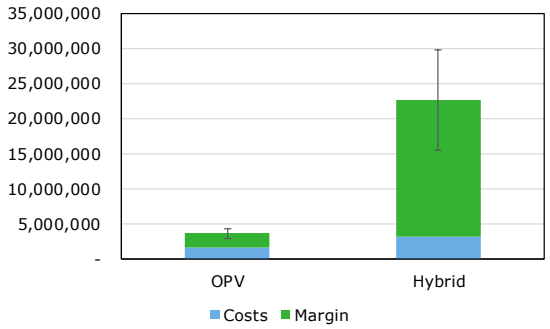

Figure 4.6 *Margin and costs of studied onion farmers in Uganda per acre per year*
Source: Author's field data.

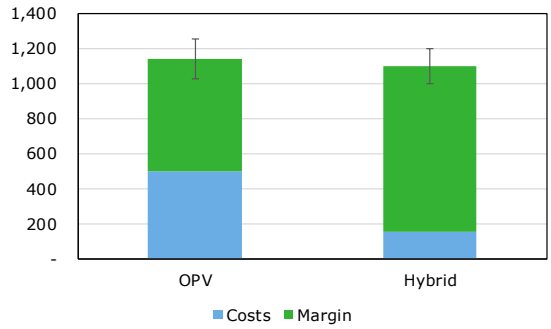

Figure 4.7 *Margin and costs per kg produced of studied onion farmers in Uganda per year*
Source: Author's field data.

4.3.2.2 Traders

There is a considerable level of fragmentation of onion production. It appears that middlemen are very important in the supply chain of onions, with 38% of wholesalers procuring onions from individual farmers, whereas other traders source from fellow traders (Kilimo Trust, 2017). Some middlemen even buy complete onion plots. Onion trade is highly informal, however, in compliance with some trade requirements, traders – mostly wholesalers – incur costs from local taxes (at the areas of operations), business licenses and market fees.

In the same study by Kilimo Trust (2017) they found that more than half of all wholesalers interviewed reported that they go to farmers or aggregation centres near farmers to source their onions, while at most 30% of them have other traders who deliver the produce at their premises. Middlemen from all the East African countries that border Uganda move freely to production areas in the country to obtain onions at lower prices from farmers themselves. On the other hand, they play a vital value chain role: they offer an alternative market to farmers who consider packaging and transportation of onions to major markets, an expensive undertaking.

4.3.2.3 Markets

Red bulb onions produced in Uganda are consumed in rural and urban areas with Kampala being the hub of consumption. There is also a considerable export market for onions produced in Uganda in neighbouring countries such as Rwanda and Kenya. However, urban consumers prefer onions imported from Tanzania, as they have superior quality characteristics such as medium size and long shelf life. Consequently, onion importers expressed the desire to source onions almost exclusively from Tanzania, and there is now a significant volume of imports from Tanzania to meet local demand. Available official statistics indicate that the volume imported from Tanzania in 2018 was 18,000 tonnes. It is very likely that this volume is higher, however, since a lot of cross-border trade is not being registered.

In the onion sector there is some grading: grade 1 is of medium size, (the size of an egg) while bigger sizes are regarded as grade 2. Medium sized onions are preferred by households because they just use one onion without having to cut a piece from a large-sized one and reserving the rest for later use, a practice that reduces the shelf life of a piece of onion. On the other hand, institutions like hotels and schools prefer large-sized onions due to the large quantities they cook at one time. Small onions are considered 'rejects' and are sold to low-end consumers at the lowest price.

Table 4.3 *Onion prices along the value chain (2019)*

	Farm to wholesale	wholesale to retail	Retail to consumer
Price per kg	800-1,000 UGX	1,300-1,500 UGX	3,000 UGX

Source: Author's field data.

4.3.3 Most suitable areas for onion production

The outcomes of the Global Detector are presented in the figure below, showing the physical boundaries for onion production in Uganda at 1,500-2,100 metres above sea level, as identified during the FGD validation workshop. It clearly shows that there only a few locations in Uganda where onions can be produced. The main areas of production are in Central and East Uganda, which is very much in line with the current production areas.

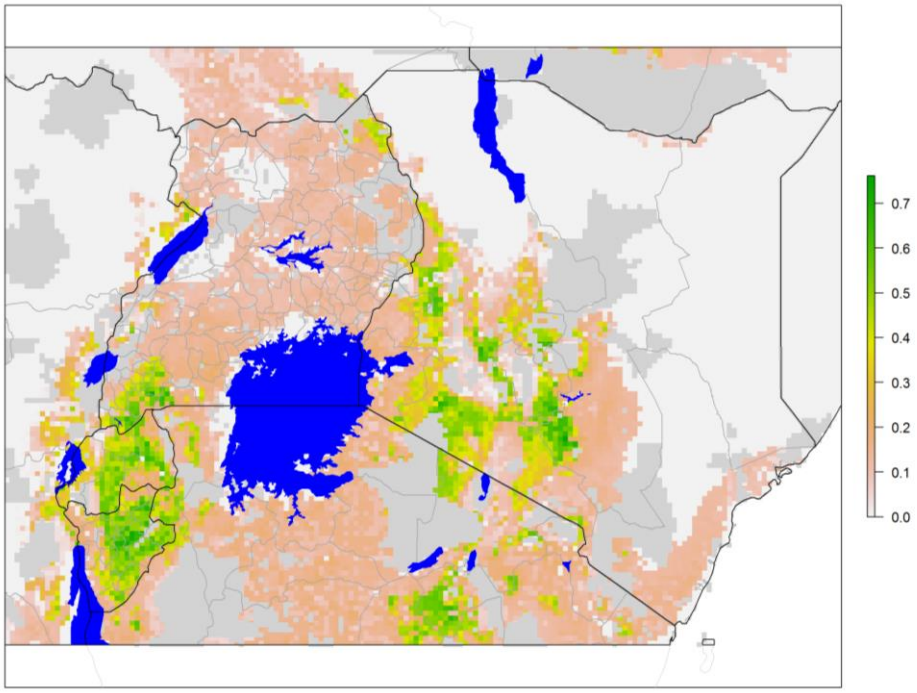

Figure 4.8 *The potential for onion production in East Africa*
Source: Global Detector.

4.3.4 Challenges and opportunities

The key strengths identified and mentioned by industry stakeholders vis-à-vis onion production are that the Ugandan market is able to absorb more onions; that the current climate is very suitable for onion cultivation; and that it is possible to store onions for long periods of time provided they are cured and stored properly. Two challenges that were identified were the limited cultivation locations within Uganda and the poor agricultural practices due to the limited availability of extension services.

Table 4.4 *SWOT for the onion subsector*

Strengths	Weaknesses
• Ready market (local & regional) • Climate suitable for production • High shelf life (up to 6 months if cured)	• Inadequate public & private extension services • Farmers lack storage facilities • Poor accessibility from some production areas to markets • Poor agronomic practices
Opportunities	**Threats**
• Prospects for new markets • Introduction of new high yielding varieties	• Climate change • Competition from neighbouring countries • Depletion in soil fertility

4.4 Hot pepper

4.4.1 Main production areas

The main production districts of hot pepper in Uganda include:

- Central Region: Wakiso, Mukono, Kayunga, Luweero and Mubende;
- Eastern region: Mbale, Bulambuli, Bududa, Bugiri, Bukwo, Tororo, Iganga, Kamuli, Jinja, Namayingo, Kibuku and Mayuge;
- Western region: Masindi, Hoima, Ibanda, Ntungamo and Mbarara.

4.4.2 Value chain

The products are consolidated by the buying agents from the different production areas and later transported to the urban markets with a major focus on Kampala. The product is later sold via two different avenues:

a. The majority of the hot peppers are sorted and prepared for exporters targeting European markets.
b. A small share is sold to supermarkets in urban Kampala, but a limited share is also processed into chili sauce and chili powder for the domestic market.

Hot peppers are very suitable for export since it is a crop that can withstand harsh post-harvest conditions before leaving the country and being integrated in a cooled supply chain, which often only starts once the product enters the airplane. The figure below gives an overview of the hot pepper value chain in Uganda.

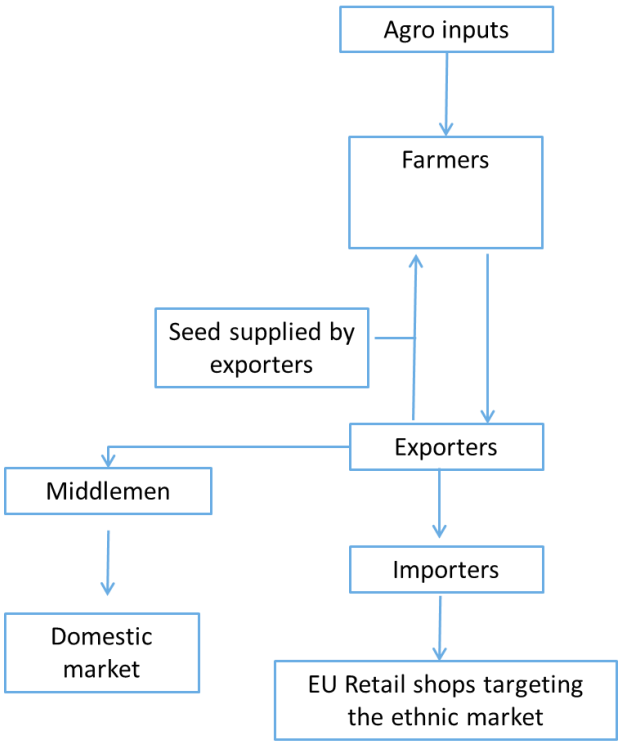

Figure 4.9 *Hot pepper value chain*

4.4.2.1 Farmers

The majority of the hot peppers cultivated are Scotch Bonnets. Currently there are many problems in the field, particularly with the presence of the FCM that is widely found in all production areas in Uganda. Farmers have serious problems in controlling this FCM, which is considered a quarantine organism in the EU market.

Hot pepper production in Uganda is mainly rain-fed and has one season per year. The season starts in November and December with the first harvesting and it ends in May/June. In total there is a possibility to harvest for 24 to 28 weeks at two-week intervals. The current yield of hot peppers is estimated by experts to be four tonnes per acre. This crop is mainly cultivated on rented land.

A box of 6-7kg of hot pepper is usually sold for UGX 5,000 to 9,000 but can also go up to UGX 16,000 if the market is willing. Given the achievable yields at the farm level and the average price at the farm gate, the margin is on average 75%. The main cost is labour (circa 70 to 90%). We found that larger farmers can benefit from economies of scale due to efficient allocation of labour.

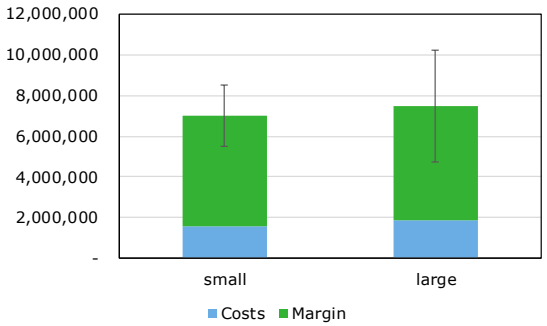

Figure 4.10 *Margin and costs of studied hot pepper farmers in Uganda per acre per year Source: Author's field data.*

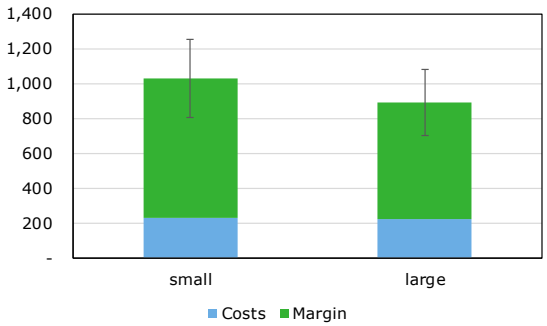

Figure 4.11 *Margin and costs per kg produced of studied hot pepper farmers in Uganda per year Source: Author's field data.*

Ugandan hot pepper farmers hardly use improved seed. The majority of the farmers use farmer-saved seed and this is often sold to them by the exporters, who in turn source the seeds from rejects (fruits not suitable for export). At farm level there is hardly any sorting, so they sell everything to the exporters, who then manage the sorting and grading of the product for the export market. All the rejects are prepared for the domestic market and are used for harvesting seeds for the next season. The farmers are thus essentially buying back their own product, much of which is faulty. As a result, the disease incidence among hot pepper crops is high and the fruits are reducing in size. Findings from the field also revealed that some farmers intercropped hot peppers with tomatoes. Because both hot peppers and tomatoes belong to the Solanaceae family, if they are not intercropped in moderation, the pest incidence could increase as they are attacked by similar pests.

4.4.2.2 Traders and exporters

As it happens in other African countries, the role of the hot pepper traders in Uganda is often obscured and hard to pinpoint. We consider two basic models:

- Large exporters with own land that often work with out-growers.
- Small-scale exporters with no land who rely on smallholders' produce gathered through informal trading relationships. This group of exporters is often referred to as 'briefcase exporters' and has an opportunist business mentality.

Overall, no formal agreements with farmers are in place. Furthermore, exporters interviewed also emphasised the lack of access to financing. Due to the current situation with the FCM and the lack of sincere communication between exporters and farmers, there is a lack of trust between the parties. In addition, the 'briefcase exporters' are opportunistic and if the export market prices are not good they will not buy the farmers' products.

A problem the exporters face is the lack of cargo space available, since fresh produce is only loaded onto passenger airplanes. If the airplane is full, the cargo is offloaded and postponed to the next day's flight.

4.4.2.3 Markets

The European market is dominated by large supermarket retailers. However, there are also retailers that are specialised in vegetables for the ethnic population.

About 60-90% of produce is sold through supermarkets, depending on the product and country. Supermarkets have many requirements for suppliers in place. A minimum requirement to supply EU retailers is a GlobalG.A.P. certificate. In Uganda there is no producer nor exporter that has GlobalG.A.P. certification.

The ethnic market in Europe is informal and certification is not required. Many of the importers are relatively small. They supply ethnic wholesale traders and grocery shops with an assortment for the ethnic communities. In the United Kingdom and the Netherlands there are several markets that have many specialised importers focusing on the ethnic market. In the United Kingdom the main FFV wholesale markets are in Southall (Western International Market), Stratford (Spitalfield Market) and Birmingham (Birmingham Wholesale Market). In the Netherlands the main wholesale market is in Amsterdam (Food Centre), and it includes several traders specialised in the ethnic market. In these markets, shopkeepers buy fresh produce every 3 or 4 days, although this varies largely depending on the season and the final users' needs.

The conventional market demands high-quality and 'safe sourcing'. The main difference between the two markets is the final consumer. Supermarket customers expect transparent information about the sourcing and a high-quality product. To cater for these needs, supermarkets require suppliers' adherence to stringent global standards that include certification of social and environmental standards and/or GlobalG.A.P. The latter is the private sector standard most used by European retailers. Although attaining GlobalG.A.P. is not a legal requirement nowadays, it is widely regarded as the minimum standard for exporters to be able to supply to the main supermarket retailers in Europe.

Besides GlobalG.A.P., many supermarkets demand compliance with other more specific certifications. Nevertheless, if an exporter can achieve GlobalG.A.P., then supermarket-specific standards are often not a problem. One of the key facets of private sector standards is the ability to trace the history of a product throughout the supply chain from field to the consumer.

The world production of chilies amounts to around 31m tonnes, which is cultivated on approximately 1.9m hectares of land (FAOSTAT). China is the world leader in chilli production, followed by Indonesia and Ethiopia. However, these countries do not supply the European market. The bulk share of chilies is produced by Asian countries for the regional Asian market.

The main competitors for Uganda on the EU market are India, the Dominican Republic, Ghana and Kenya. They supply comparable types of hot chilies (Scotch Bonnet). India is a dominant exporter, but export tends to fluctuate due to availability issues. The market peak is September to December. Their most important export destination is the United Arab Emirates, where about 1.8 million Indians live. Export to the EU is limited to the United Kingdom where ethnic market outlets are supplied. However, an increasing number of chilies from India are being sold in the mainstream supermarket segment. Ghana is another important competitor on the market from March to September. Freight from West Africa to the UK is less expensive due to being on average two hours shorter flight time. As a result, freights cost is about 30-40% more expensive in Uganda.

4.4.3 Most suitable areas for hot pepper production

The outcomes of the Global Detector are presented in the figure below. It shows that hot pepper production can take place in basically all parts of the country. This is very much in line with the current production areas.

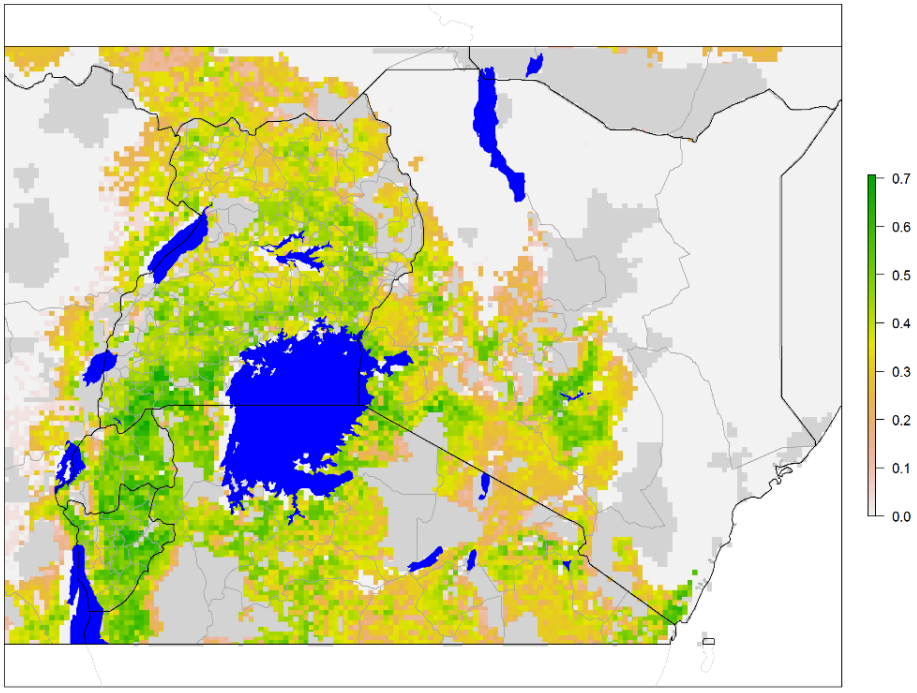

Figure 4.12 *The potential for hot pepper production in East Africa*
Source: Global Detector.

4.4.4 Challenges and opportunities

Key strengths of hot pepper cultivation in Uganda that were identified and mentioned by industry stakeholders are the good profits, the presence of an export market that (under normal conditions; FCM not considered) is able to take the volume of hot peppers and the ability to grow the produce in many parts of the country. Even in the dryer areas of Uganda it is possible to grow hot peppers. The weaknesses identified are: the current system of reusing seeds (F2,F3,F4 etc), which is weakening the strength of the plant and making it more and more vulnerable to pests and diseases. Another issue identified is the poor agricultural practices due to the limited availability of extension services. Finally, the poor adherence to quality standards weakens the position of Uganda on the export markets in the hot pepper subsector.

A big threat is the current situation regarding the interceptions on the EU market (MRLS, and FCM) that might jeopardise the continuous flow of export going to the United Arab Emirates. Also, the weak governance of the sector is a big threat that might influence the performance of the sector. Despite these threats, there are also opportunities like increasing the value additions as well as the uptake of improved varieties by the sector to increase both yields and resistance to pests and diseases.

Table 4.5 *SWOT for hot pepper*

Strengths	Weaknesses
• Good profits • Ready export market • Ability to grow in many parts of the country	• Recycling of seed • Knowledge of good agronomic practices • Poor adherence to quality standards
Opportunities	**Threats**
• Limited value addition • Good quality seed available	• MRLs interceptions • Quarantine pests e.g. FCM • Weak market connections

4.5 Pineapple

4.5.1 Main production areas

The main production districts for pineapple cultivation include;
- Central region: Kayunga, Luweero, Wakiso (Busi Island), Mubende;
- Eastern region: Serere;
- Western region: Kasese.

Pineapple production has consistently increased over the years. The majority of the pineapples produced in Uganda are the Sweet Cayenne variety.

4.5.2 Value chain

Pineapple farmers mainly obtain suckers from their own gardens and most of the pineapples are sold to middlemen who also do the harvesting. The figure below presents the pineapple value chain. The majority is produced for the local market by numerous smallholder farmers. There is a small share that is being exported, mainly to Kenya but also to some other countries in the Middle East and even the EU. Processing is also done, often by exporters, in the form of dried fruit slices.

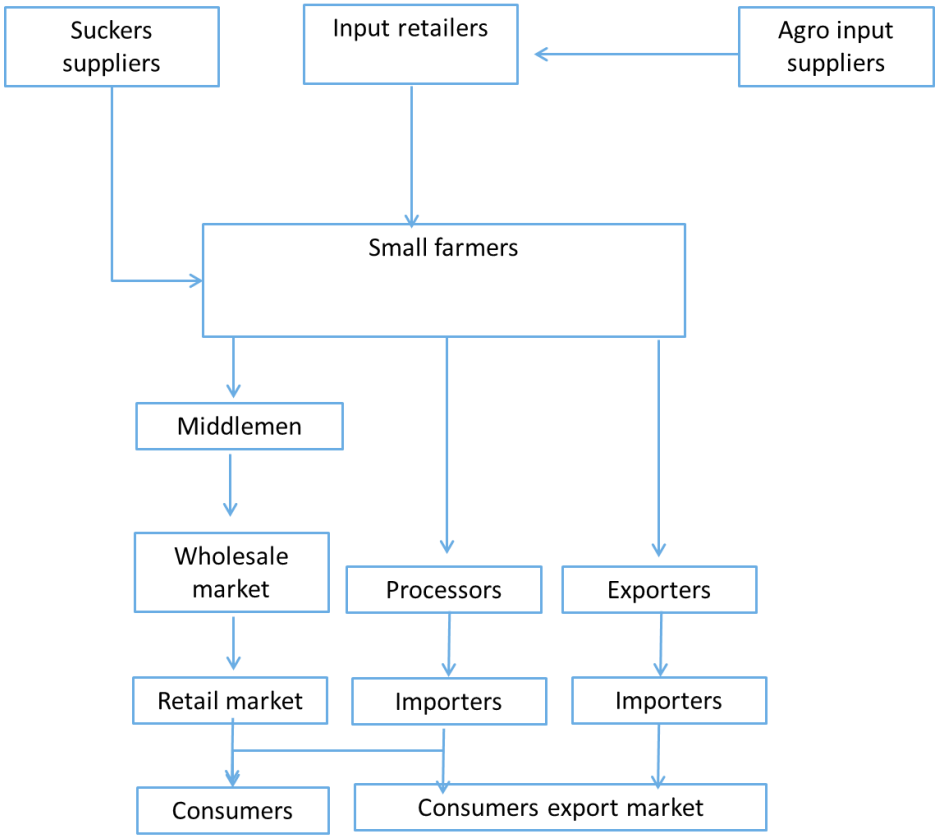

Figure 4.13 *Pineapple value chain*

4.5.2.1 Farmers

In Uganda, there are no large-scale pineapple growers at present – it is exclusively a smallholder crop. A typical pineapple plot of one acre lasts for three years with three harvests. Between 20-30,000 suckers are needed to plant one acre. Pineapples are often mixed with fruits like banana, if the land is owned.

The last harvest typically gives smaller fruits. Many of the pineapple producers are organic by default. This implies that they hardly use any chemical inputs. There are not many diseases in pineapple cultivation except brown rust-like patches called Endogenous Brown Spot (EDS). The major pests of pineapple include scales, mealybugs and nematodes.

We found that pineapple production can be very profitable and can enhance incomes among rural households. However, pineapple farming in Uganda is linked with soil nutrient depletion. As a result, farmers obtain low crop yields and sometimes experience crop failure, making it difficult for the farmers to get sustainable incomes from farming. This is worsened by poor agronomic practices. Furthermore, soil degradation is widespread in Uganda, mainly due to loss of soil nutrients from fields with no or minimal replacement. Nutrient depletion in Uganda is estimated at 66kg ha per year (Zziwa et al., 2017). Consequently, farmers are constantly searching for virgin land in order to expand cultivation. Pineapples are often grown on land that was previously fallow or under forest cover due to the fruit's need for high fertility; pineapple cultivation thus has a serious environmental impact.

We also observed differences between Luweero and Serere: the prices in Luweero are generally lower because the pineapples are produced in bulk. Many farmers in Luweero grow pineapples and all these pineapples ripen at the same time, so the abundant supply explains the lower prices. In fact, some of the farmers pointed this out as one of the reasons for high post-harvest losses: because everyone has pineapples and there is no market, some pineapples rot or get damaged because they are not able to sell them and also cannot consume them all. Serere District in Eastern Uganda has fewer growers and consequently a limited supply, which might explain the higher prices. Also, the Luweero farmers sell to middlemen who buy at lower prices, while the farmers in the Serere District sell directly to consumers, who usually offer better prices than the middleman.

During our fieldwork we identified the average pineapple yield to be between 20,000 and 25,000 fruits per acre per year, with an average sales price of UGX 300 to 900 per unit. We calculated a profit margin of between 70 and 90%, see the figures below. The analysis of the LSMS also confirms this profit margin; see Appendix 6 for more background information. One must bear in mind that pineapple prices do fluctuate heavily, peaking around September, with prices per unit at farm going up to UGX 2,000-2,500.

Labour is an import factor in the production of pineapples and most is provided by family members. At 75% of total costs, however, hired labour also makes a significant contribution too. Family labour is dominant for sensitive tasks such as acquisition of planting materials, while hired labour is mostly used for labour-intensive and demanding activities such as land clearing, planting and weeding.

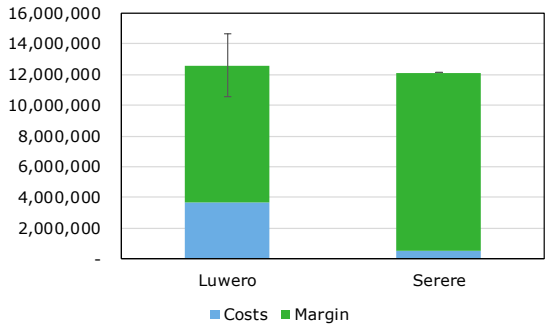

Figure 4.14 *Margin and costs of studied pineapple farmers in Uganda per acre per year*
Source: Author's field data.

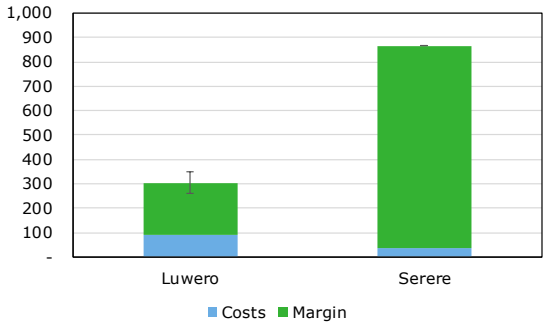

Figure 4.15 *Margin and costs per kg produced of studied pineapple farmers in Uganda per year*
Source: Author's field data.

A study by Zziwa et al. (2017) shows that pineapple farmers obtain information mainly from fellow farmers and farmer groups. The majority of farmers (57.8%) participate in trainings organised by extension workers, buyers of processed pineapples, and farmer groups. Generally, pineapple farmers have limited access to agricultural extension services at the grassroots level. Consequently, extension services including information are provided though non-traditional sources including farmers' associations, research institutions and trading companies that buy farmers' pineapples. Respondents indicated that it is through these sources that they have been able to receive training on pineapple agronomic practices. Even though the pineapple sector has been identified as a priority crop by the government, it has not received any significant interest in the last decade in terms of research capacity, extensions and support.

4.5.2.2 Traders

For the domestic market the middlemen buy directly from farmers (see figure below). There are no fixed contracts with farmers. The trader arranges transport – a full truck with about 2,000-3,000 pineapples can cost between UGX 450-500,000 for transportation to the market. The farmers interviewed stated that if a middleman buys a pineapple at UGX 1,000 they will sell it at UGX 1,200 if small and UGX 1,300 if bigger in size and then the final consumer buys the same pineapple at UGX 2,000 if small and then UGX 2,500 shillings if bigger in size (see table below).

From our interviews it appears that some of the Ugandan middlemen who buy from farmers later sell to Kenyan traders who come to Uganda.

For the export, there are some contracts in place but if the market is poor the contracts are often breached to the disadvantage of the farmer. Exporters also double as processors.

Table 4.6 *Pineapple prices in Uganda, 2019*

	Farm to wholesale	wholesale to retail	Retail to consumer
Large pineapple (price per unit)	800-1,000 UGX	1,300 UGX	2,000 UGX
Small pineapple (Price per unit)	700-900 UGX	1,200 UGX	2,500 UGX

Source: Author's field data.

4.5.2.3 Markets

Imports of fresh pineapples into the European market have stabilised at around 900,000 tonnes in recent years (CBI, 2019). The pineapple trade is dominated by the MD2 variety, which has now replaced Smooth Cayenne pineapples as the preferred variety in every major market. Over 80% of all European imports are MD2, but ripe Sweet Cayennes, with their superior flavour, get air-freighted to the specialist and catering sectors. The Dutch Centre for the Promotion of Imports from developing countries (CBI) advises that smaller exporters from developing countries distinguish themselves with quality, price, and sustainability. The market is dominated by a few multinational companies: Dole Food Company, Del Monte Foods, Fyffes and Chiquita.

Pineapples are judged mature when they have reached full size and a have nice colour. The products for the local market get no pre-treatment prior to marketing. Those for export purposes are, however, brushed before packing and are trimmed to leave a stock of one inch. Other post-harvest practices among exporters are limited. In Uganda various important steps considered to be essential for exporting pineapples are lacking (e.g. the waxing of the fruits). Fresh pineapples are classified according to Size Codes A–H, with average weights (including the crown) ranging from 2,750 grams (Size A) to 800 grams (Size H).

The climate and agronomic practices in Uganda favour larger sized fruits, which are regarded unsuitable for export since the European markets prefer smaller sized fruits. For instance, Sweet Cayennes do not ship well and normally grow bigger than the preferred size on the EU market. However, the pineapples that can be exported are graded according to colour and size. The export product is directly packed into cartons and transported by trucks or pickups. At the airport the package is palletised. Produce destined for the local market is put on pick-ups without any form of padding. All the loading and off-loading is done manually, and this can amount up to 3 times before being loaded onto the aircraft.

A trader pays UGX 10,000 for a space at local urban markets like Nakesero, and more like 30,000 if he comes with a truck. He can stay there from midnight to 9am the following morning, when part of the market becomes a road. The trader sells to retailers that in turn sell to consumers. Grading for local markets usually takes place at the retailer's. Preferences vary: some clients prefer green pineapples which are not so ripe, while others want them to be riper.

There is always a surplus in the market during peak harvest time, resulting in low prices. Farmers that get to the market early can benefit from better prices.

4.5.3 Most suitable areas for pineapple production

The outcomes of the Global Detector are presented in the figure below. It clearly shows that there are many areas in Uganda where pineapple can be produced, the main ones being Central and West Uganda. This corresponds with the current production areas.

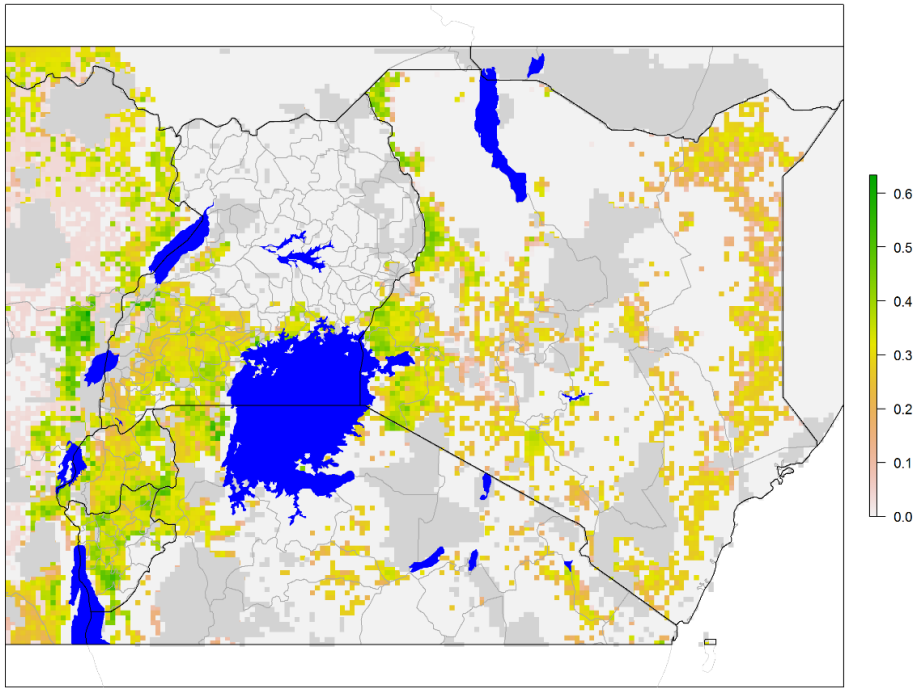

Figure 4.16 *The potential for pineapple production in East Africa*
Source: Global Detector.

4.5.4 Challenges and opportunities

Industry stakeholders identified the key strengths of pineapple production as being the good taste and the fact that the crop can easily be cultivated in many parts of the country. Weaknesses identified are the poor agricultural practices due to the limited availability of extension services. Finally, the lack of knowledge regarding market standards, which weakens Uganda's position on the export markets. For example, the fact that the Sweet Cayenne consistently produces large sized fruits that are too large for the EU export market.

A serious threat is the pineapple farmers' constant quest for new farm land, compounded by the limited extension services and the weak support received by the government. Despite these threats there also opportunities, like increasing the value additions and promoting the uptake of improved varieties by the sector to increase yields, as well as boosting the resistance of the crop to pests and diseases.

Table 4.7 *SWOT for pineapple*

Strengths	Weaknesses
• Sweet taste & flavour (Sweet Cayenne) in the regional market • Grown in many parts of the country • Relatively easy agronomy	• Poor management practices • Misuse of pesticides • Ignorance of market requirements (variety less suitable for export to EU) • Absence of seed certification • Limited research on pineapple
Opportunities	**Threats**
• High demand for fresh pineapple in the domestic and international market, is it the right variety? • Available market for pineapple value added products (pulp, juice, dried)	• Farmers keep on searching for new lands to use for production • Limited extension services • Weak implementation of policy provisions on developing pineapple value chains

4.6 Avocado

4.6.1 Main production areas

Production districts include;

- Northern region: Zombo, Arua, Gulu
- Western region: Ntungamo, Kabarole
- Eastern region: Mbale, Mayuge, Buikwe, Iganga

4.6.2 Value chain

The main players in the avocado value chain are the farmers, the rural assemblers, wholesalers and retailers. The avocado marketing channels are similar to those presented for other fruits. Exporters interviewed in the study mentioned that they obtained their avocados from middlemen. Small avocado farmers interviewed were also selling to market vendors (retail market). As avocados are an important fruit in any grocery store, it has the potential to be developed as a non-traditional export crop.

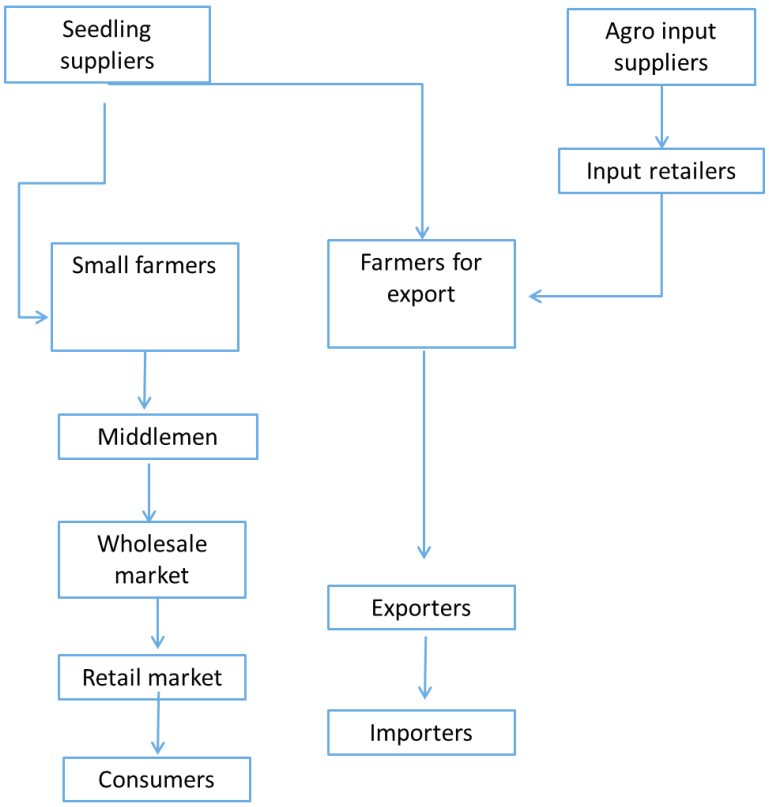

Figure 4.17 *Avocado value chain*

4.6.2.1 Farmers

There are only a few advanced large-scale farmers engaged in avocado cultivation, and they focus their efforts on growing 'Jumbo' varieties (any variety whose fruit weighs more than 500gram). There is hardly any Hass production yet; in the last five years they have planted a lot but the trees are not in yet in full production. Largely due to the fruit being grown mainly at 1,400-1,600 metres above sea level, actors in the avocado sector claim to have better production conditions and a longer season compared to neighbouring countries.

Avocado is often intercropped with coffee, bananas and other fruit tree crops. In Uganda, avocado is grown without much manure or fertiliser application, but most of the avocado trees do well, as the soils are fertile by nature. Yields vary greatly according to cultivar, tree age, and weather conditions. Production varies from 20-100 kg per tree for young trees and doubles for mature trees. Hass avocado seedlings are in high demand now and are therefore expensive, at UGX 5,000.

Yields are on average between 5 and 25 tonnes per acre. The average sales price will be around UGX 800 per kg or between UGX 50 and 150 per fruit. There is a difference in price for the smaller avocados that normally fetch a lower price and are sorted at the farm. For a smallholder producer focusing on the domestic market, with no cash input requirements and who uses only family labour, net revenue is calculated equal to the total revenue. A smallholder, therefore, can expect annual earnings of almost 100%. The more intensive production of avocado, typically for the export market, does use some inputs like fertilisers. The average calculated profit margins among the studied farmers was nonetheless still 90% (see figure below). Our analysis of the LSMS confirms a positive profit margin – see Appendix 6 for more background information.

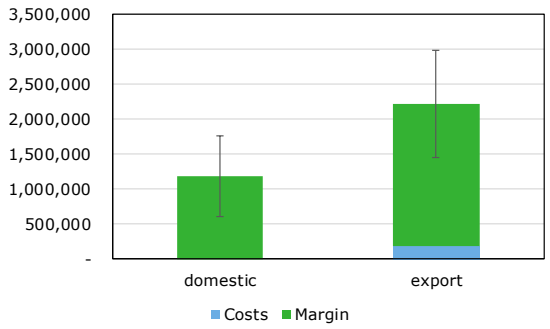

Figure 4.18 *Margin and costs of studied avocado farmers in Uganda per acre*
Source: Author's field data.

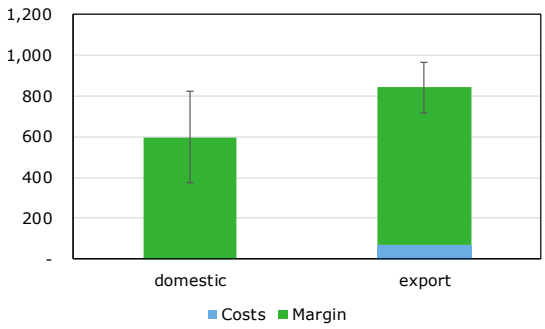

Figure 4.19 *Margin and costs per kg produced of studied avocado farmers in Uganda*
Source: Author's field data.

4.6.2.2 Traders

The marketing of avocados for the domestic market is not given much attention with respect to the post-harvest care of the fruits. At the retail market premises, the fruits are stored in wooden boxes, and displayed on wooden tables for selling. The unsold ones are always covered with mats, and not returned to the stock container. This prevents damage that may arise from storing and displaying. The price range is usually UGX 333 to UGX 1,000 per unit. Traders and retailers in Kampala pay a commission to the market of UGX 2,000 depending on the size of their market stall. Traders and retailers buy during the night from farmers that bring their produce to the market, at prices that had already been negotiated during the day by phone.

Table 4.8 *Price of avocado in Uganda per unit, 2019*

	Farm to wholesale	wholesale to retail	Retail to consumer
Price per unit	50-100 UGX	150 UGX	250-350 UGX

Source: Author's field data.

4.6.2.3 Markets

The EU import value of avocados almost tripled in the period between 2013 and 2017 (CBI, 2019). This upward trend is driven by consumer demand for ready-to-eat and healthy food. It creates opportunities for producers and exporters, especially for the Hass avocado variety, although competition is increasing.

The green varieties are losing market share to Hass quickly. Green varieties are mostly sold loose or in small nets, while Hass dominates the market for ready-to-eat avocados. Green varieties are still sold because they have a different harvest period, but Western European countries mainly favour the taste and ease of the ready-to-eat Hass variety.

Avocados are classified according to Size Codes 1 to 30, with a minimum weight of 123 grams (or for Hass 80 grams). In Europe, the preferred sizes for Hass avocados range between size 16 and 20 (for the Fuerte variety size 14 to 16). EU buyers prefer the weight and quality to be the same throughout

the year, and prefer the smaller ones, whereas consumers in Uganda like the bigger avocados. In addition, the oil content of the avocados must also be aligned with the market requirements. Stakeholders at the validation workshops mentioned that there is a growing market for younger/immature avocados in the Middle East, as they are processed into drinks. They also mentioned that the Jumbo avocado varieties exported to the Middle East were popular in the catering industry that mainly used them to make salads.

4.6.3 Most suitable areas for avocado production

The outcomes of the Global Detector are presented in the figure below. It clearly shows that there are many areas in Uganda where avocados can be produced, which corresponds with the current production areas.

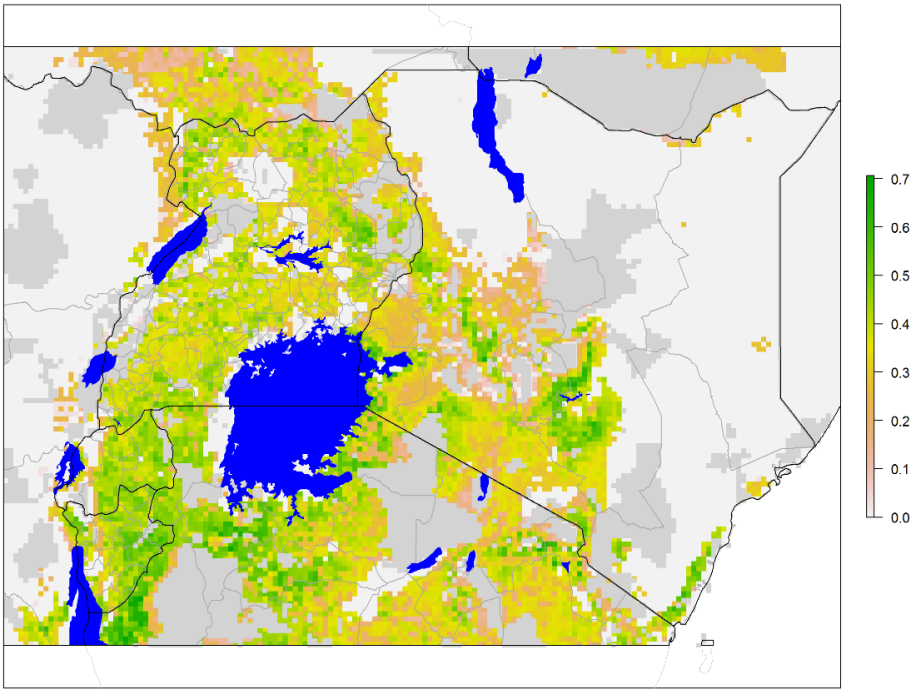

Figure 4.20 *The potential for avocado production in East Africa. Source: Global Detector.*

4.6.4 Challenges and opportunities

As local and international demand is high and there is potential for increased production, an opportunity as regards the avocado is that it can been taken up as a priority fruit for development as a non-traditional export crop. Seeing a future in avocado cultivation, in recent years many farmers have been planting Hass varieties, which will be ready in a few years for harvest and export.

Table 4.9 *SWOT*

Strengths	Weaknesses
• Availability of land & water for production • Ready market (national & international)	• Limited availability of good quality planting materials • Lack of technical knowledge among the growers • Limited knowledge on existing varieties & their attributes
Opportunities	**Threats**
• Potential for value addition • Favourable weather & soils for production • Development of varieties preferred in the market	• Pest and diseases • Changing climatic conditions • Changing consumer preferences

4.7 Kenya as the benchmark

Various production parameters in Kenya (e.g. technology level, seasonality, cost of productions, revenues, quality) serve as a comparison with Uganda's situation. An expert on the Kenyan and Ugandan horticulture sector reviewed the studied parameters, focussing on one season only. Appendices 7 and 8 give an overview of the detailed crop budgets for Kenya.

4.7.1 Tomato

The high season of tomato production in Kenya is from August to October, and there is another short window between April and June when there is good supply. June and July is the cold season, so supply is limited, but there is still some supply. March to April is low season.

As presented in the table below, the estimated reliable yields by industry experts in Kenya and Uganda is comparable. The farming systems are also the same. The majority of the tomato farmers in Kenya also apply low-input farming, for example non-irrigated farming in combination with OPV varieties. With improved irrigation (drip), tomato farmers are able to increase yields.

Table 4.10 *Comparison yields between Uganda and Kenya tomato*

	OPV non irrigation	Non irrigated hybrid	Irrigation (drip)
Kenya per acre	6 tonnes	7 - 8 tonnes	15-18 tonnes
Uganda per acre	6 tonnes	8 tonnes	15 tonnes

Source: Authors.

The cost price of tomato production for irrigated farming in Uganda is much higher compared to Kenya. This is mainly related to the fact that the irrigation in Kenya is centrally arranged and the farmers only pay a small fee to the local irrigation associations. In Uganda farmers have to arrange this themselves and are required to invest in pumps, diesel and pipes. An initial investment for irrigation is between UGX 8 and 14m for the pump and pipes for one acre.

Table 4.11 *Comparison cost price between Uganda and Kenya tomato*

	Season	Costs per acre per season (UGX)
Uganda hybrid with irrigation	Season 1 April - June	6,377,000
	Season 2 October - January	7,242,000
Kenya with irrigation	April - June	3,857,000

Source: Authors.

4.7.2 Onion

In Kenya, onion is one of the most important vegetable crops for the domestic market. It is also an important source of income for smallholder farmers. They are grown in a wide range of agroecological zones, ranging from sea level to the upper highland areas below 2,000m above sea level.

The main growing areas include the Central, Rift valley, Western and Eastern Provinces of Kenya (FAO cropping calendar). Favourable conditions for onion production exist in Kenya and the majority of the farmers produce with hybrid seeds. In Kenya there is onion production throughout the entire year, however, the low seasons are March to April (the wet season) and June to July (the cold season).

In Kenya there is hardly any OPV onion production. Yields for a single season of hybrid onion production at larger scale are higher in Kenya compared to Uganda.

Table 4.12 *Yield comparison between Uganda and Kenya*

		OPV	Hybrid variety
Kenya per acre	Small	6 - 7 tonnes	9 - 10 tonnes
	Large	10 tonnes	25-28 tonnes
Uganda per acre	Small	2-3 tonnes	-
	Large	10 tonnes	20-25 tonnes

Source: Authors.

Cost of production is also comparable between Uganda and Kenya for one season. The costs of OPV varieties are much lower per season compared to the hybrids. See table below: given the higher yields of hybrid production, it appears that the farmers in Kenya are performing better.

Table 4.13 *Comparison between Uganda and Kenya for the total cost (UGX) per acre for one season*

	Kenya hybrid	Uganda hybrid	Uganda OPV
Total cost per acre for one season from December to February	2,387,000	2,828,000	1,612,000

Source: Authors.

4.7.3 Hot pepper

Hot pepper is mainly produced in the tropical areas near Mombasa, Kenya. It is irrigated and the seeds are mainly OPV. Yields are comparable between Kenya and Uganda, at about three to four tonnes per acre per season. An important cost driver in Uganda is labour, at 66%, while in Kenya, it is only 35%. In Kenya there is also some level of irrigation for the hot pepper, constituting 20% of the costs compared to Uganda, including additional labour.

Table 4.14 *Comparison between Uganda and Kenya for the total cost per acre for one season*

	Uganda UGX	Kenya UGX
Input	12,000	754,950
Other costs	1,549,867	1,279,820
Total costs	1,561,867	2,034,770

Source: Authors.

4.7.4 Pineapple

For pineapple on a single acre, a typical Kenyan farmer plants 4,000 to 4,500 suckers and will harvest about 2,000 fruits per season. In Uganda it is common to plant more suckers – between 12,000 and 25,000 suckers per acre – which yields much more harvest. In Kenya pineapple production has two harvests in a year and is harvested for three consecutive years. The high season is from October to April. The harvest starts at the beginning of each dry season, however, during the colder season, a limited harvest of pineapple is possible, especially from June to August. In Uganda the high season has its peak around September. Appendix 8 gives an overview of the cost price for pineapples in Kenya.

4.7.5 Avocado

Just like Uganda, Kenya also enjoys a year-round avocado yield for local varieties; the main harvests last from April to July and October to December. Important avocado production areas are located in Embu and Nakuru. According to our interviewed experts, avocado production in Embu is generally low input, while the farmers in Nakuru use more inputs (e.g. fertilisers and chemicals). In Kenya there is

already a large export sector of avocado producers focussing on shipping produce to the EU and the Middle East.

The current cost price per acre for an orchard in Embu, Kenya is UGX 2m, while the cost of production for Nakuru is almost UGX 3m per acre per season. Appendix 8 gives an overview of the cost price for avocado in Kenya, which is much lower in Uganda. Many of the orchards have no costs at all, whereas the more intensive orchards have costs of only UGX 50,000 to UGX 500,000 per acre per season. Yields per acre depend largely on the tree density and age of the trees. Among the studied farms in Uganda this was very diverse: from 10 to 200 trees per acre. In Uganda yields vary between one and six tonnes per acre per year. In Kenya this is estimated at 300 fruits per tree per season, so with an average tree density of 75, the orchard will generate 75,000 fruits after seven years (see table 4.15). This equals 0.6 to 15 tonnes per year, depending on the tree age.

Table 4.15 *Age of trees and estimated production by experts in Kenya*

Age of trees	Trees per acre	Fruits per tree/ year	Yield acre per year	Annual yield
3 years	75	40	3 tonnes	0.6 tonnes
4 years	75	200	15 tonnes	3 tonnes
5 years	75	600	45 tonnes	9 tonnes
7 years	75	1,000	75 tonnes	15 tonnes

Source: Authors.

5 Conclusions

5.1 Conclusions

Current farming practices in Uganda are rather weak. Farmers must improve overall agronomic practices, including sustainable pest control, water use, and efficient pre- and post-harvest practices. It is also necessary to realize a higher added value by developing national and international markets for fresh produce from Uganda. This requires training, as well as (private and public) investments for advancing Uganda's currently low-cost low-output vegetables and fruits sector.

The domestic and regional market is providing opportunities. The demand for fruits and vegetables has increased in the last decade and is likely to further increase. The demand for Ugandan fresh produce was observed to be increasing but the poor production methods prevent the sector from increasing volumes enough to meet the demand. Also, the supermarket has become a well-established market segment in Kampala and this can provide opportunities for the more advanced farmers in terms of supply. A recent systematic review of contracts between the more advanced farmers and supermarkets (e.g. Ton et al., 2018) showed that smallholders can benefit from contractual arrangements that include services and inputs. In the most effective cases there was a price premium for farmers as well.

Food safety risks are high in the market due to overuse of chemicals and poor post-harvest practices. Sustainable pest control at farm level and more awareness among traders at the markets to reduce the risks of contamination of fresh produce are required.

Reaching the export market is a big challenge for the fruit and vegetable sector. The export sector keeps on failing to comply with current legal market norms and standards requirements. The Uganda export sector has a poor reputation in the EU market; supplying the conventional EU retail market is not feasible due to a lack of tracking and tracing, certification, consistent volumes and a lack of professionalism amongst many exporters. Additional challenges include the quality of inputs and regulations that safeguard the quality of inputs, phytosanitary protocols during production and transport, and limited market understanding – specifically on buyer requirements in export markets.

The government of Uganda has failed to support the sector in a conducive and coherent way. The actors in the sector therefore feel neglected. Supportive incentive policies and frameworks for consistent policy implementation are missing and only limited data are available on the horticulture sector.

5.2 Competitiveness, investment and trade opportunities

We defined competitiveness earlier as the medium to long-term ability of a firm or significant part of the firms in an industry to increase productivity and/or lower costs in a sustainable way, and deliver goods and services at the time, place, form, and quality sought by the targeted customer segment(s) at prices as good as or lower than those of other potential suppliers, whilst earning a reasonable profit and paying at least the opportunity costs of resources employed. Profitability in this definition is therefore an important concept.

Vegetable and fruit farmers in Uganda can make a reasonable profit. The vegetable farmers in this study obtain a calculated average profit margin of 50% to 80%. The studied fruit farmers have higher profit margins due to lower input needed (see figures 5.1 and 5.2 below), assuming that market prices remain average, there is adequate pest and disease control and there is no extreme drought or rainfall. For many crops Uganda is performing equal to Kenya in terms of costs and yields.

Competitiveness can be further improved by increasing the yields so that that the margin per kg produced will be further increased. Yields can be improved by supporting farmers with good agricultural practices through extensions or training. In addition, products like tomato and pineapple are perfectly able to compete with the Kenyan fruit and vegetable sector. Tomato is very comparable in terms of quality and variety but in Kenya there is a shortage in supply during certain months of the year. Ugandan pineapples are well rewarded in the Kenyan market due to their superior taste over the local produce.

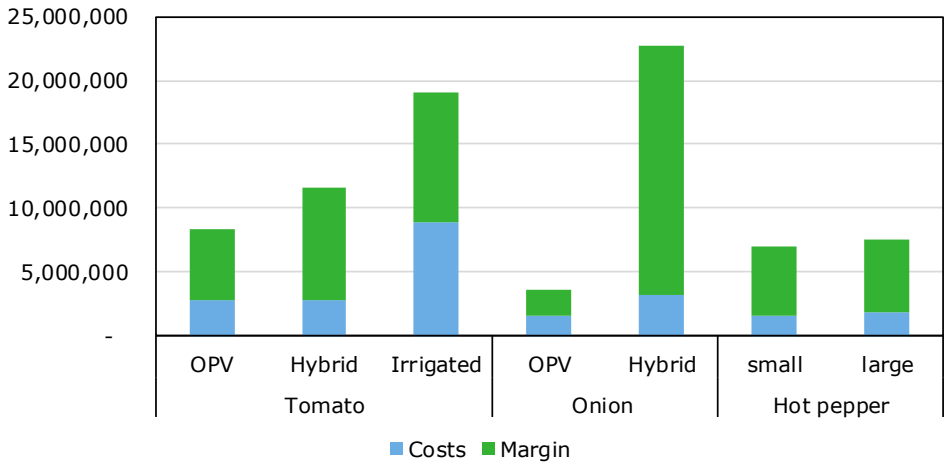

Figure 5.1 *Margin of vegetable crops*
Source: Author's field data.

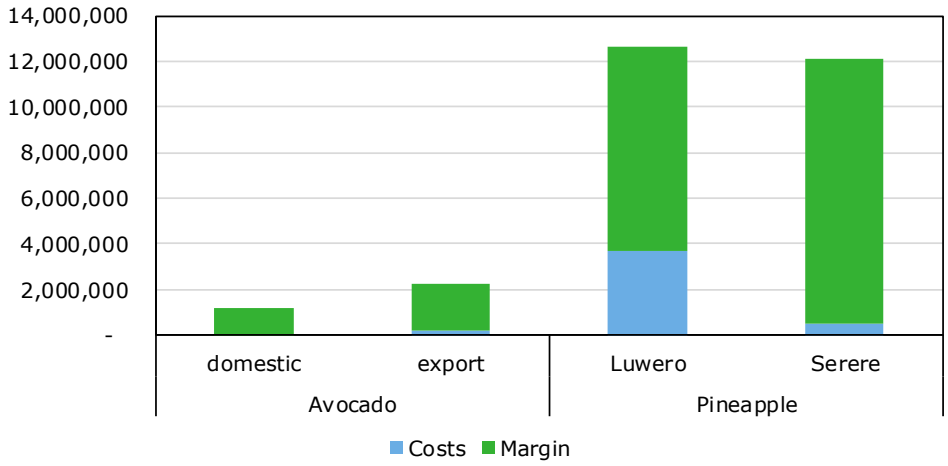

Figure 5.2 *Margin of fruit crops*
Source: Author's field data.

Based on our study the investment and trade opportunities for the Dutch private sector are limited right now. Many suppliers are already active in the market through agents and distributors. Sourcing opportunities of fruits and vegetables from Uganda to Europe by Dutch importers are also limited. Most products targeting the ethnic market are not in high demand by the Dutch importers, who traditionally supply more conventional markets like the EU supermarkets and groceries. The current practices of Ugandan exporters need to be improved to meet the non-legal requirements for the conventional (and organic) EU market.

5.3 Recommendations

For the recommendations we focus on different levels of the fruits and vegetables sector, namely the farm, the value chain and the enabling environment. At the farm and value chain level we focus on the five case studies. The enabling environment can be an important socio-economic driver and therefore we address this for the entire food system because there are many overarching recommendations. See the figure below for a graphic representation.

The theory of the most limiting factor is often applied for identifying those deciding elements in a sector that blocks further development (de Wit, 1992). We have therefore identified this factor for the farm and value chain levels, and if it is adequately addressed, we expect that further promising development opportunities will arise.

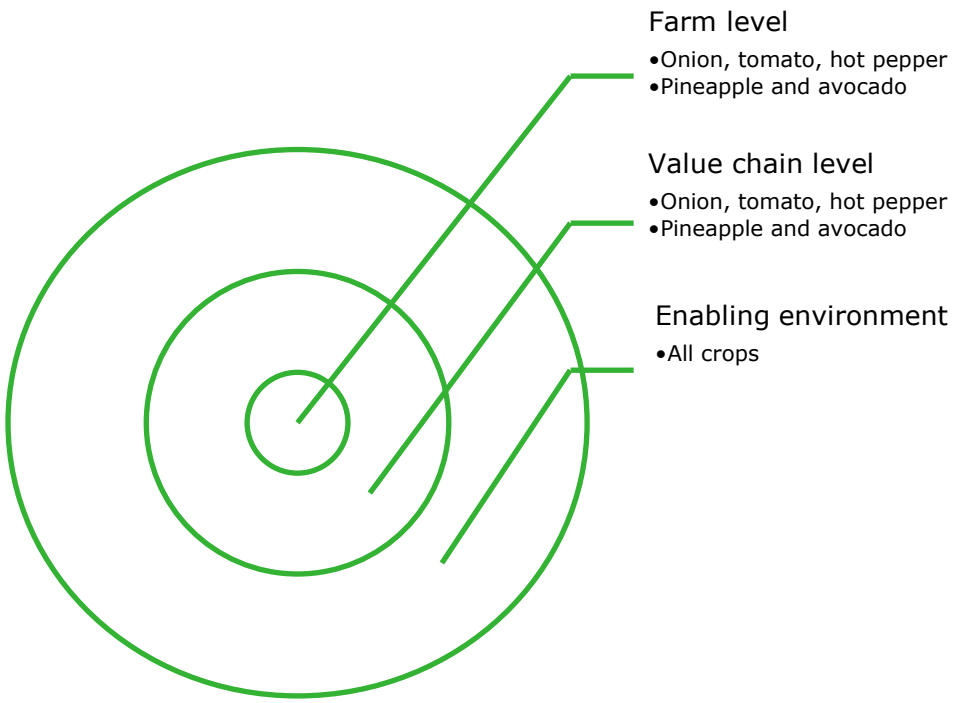

Figure 5.3 *Different levels of suggested recommendations*

5.3.1 Farm level

Below we have addressed the most limiting factor and related recommendations at farm level for the different case study crops:

- Tomato is a crop that requires key inputs like seeds, fertilisers, fungicides and pesticides. Improving the availability of these products in the market and their accessibility by farmers is essential for realizing yield increase.
- Onion farmers should get better access to hybrid seeds and sensitization on crop rotation to overcome challenges related to soil-borne pests and diseases and to increase their yield.
- Low input use among pineapple farmers should be addressed. Currently, pineapple farmers keep on searching for and clearing large portions of virgin lands for their production. This practice is regarded as very unsustainable and is not needed. If farmers are able to use efficient fertilisers and apply crop residue management practices they can continue farming on the same plots.
- The most limiting factor for avocado farmers is that they produce the wrong variety for the export market. The popular variety in the export market is Hass due to favourable features (like oil, size) but this variety is not yet produced in large numbers in Uganda and its seedlings are not widely available. It would be a great opportunity if farmers can get access to this variety.
- Good quality seed is paramount in hot pepper growing. However, many hot pepper growers in Uganda use diseased seeds that have been recycled on the farm for decades and realise high crop

losses. Improving availability of good quality seeds and access by growers in various parts of the country will greatly improve yields and minimise crop losses.

5.3.2 Value chain level

Below we address the most limiting factors and related recommendations at value chain level for the different case study crops. Addressing those factors is important, insofar as they are leverage points for change:

- The post-harvest losses in the tomato value chain are high and interventions are needed to reduce them. Possible interventions can be related to improving cooperation amongst value chain actors to jointly target the reduction of losses and to increase the quality of the produce along the value chain. This can only be addressed with full cooperation of all actors in the value chain. Therefore projects with different value chain actors should work together for introducing innovations and practices that reduce losses. This can include supermarket buyers and high-end restaurants, since this higher market segment normally does appreciate high quality tomatoes.
- Hot pepper is a difficult crop, since there is a lot of information asymmetry between farmers, middlemen and exporters. Any serious initiative to improve the cooperation between the value chain actors should be encouraged since it will increase the market share of Uganda's horticulture export sector. Farmers should get proper information about the export market conditions and any agreements with the exporter. Moreover, they need a fair compensation for their efforts.
- The lack of storage in the onion value chain is a key limiting factor; this forces farmers to sell immediately after harvesting at low prices. Some middlemen even buy complete onion plots before the harvest. In general, adequate storage facilities in the entire onion value chain are missing. This forces farmers to sell early; they cannot store their onions to benefit from better prices.
- Pineapples are often exported but farmers and potential exporters are currently not aware of the market requirements at the export market. Initiatives to further support the export-orientated value chain of pineapples are recommended. This includes: awareness training on legal and private standards and all other market demands set by exporters (e.g. cooling, packaging and preferred fruit sizes).
- Avocados are in high demand at the export market but farmers and potential exporters are currently not aware of the market requirements for the export market, therefore current export volumes remain low and production acreage per farmer is also still low. Initiatives to further support the export-orientated value chain of avocados are recommended. This should include awareness training on legal and private standards (including training on favoured varieties, sizes, physical appearance et cetera).

5.3.3 Enabling environment

It is recommended that a well-functioning extension system should be available in Uganda. This requires decisive support from the Government of Uganda. It is clear that the Government of Uganda is making serious steps in this direction, after the past privatization of the governmental extension service; however, it appears that until now many farmers do not receive any field-level support. MAAIF needs to recruit additional extension workers (or contract private agencies and/or NGOs to complement the public extension service) who should be equipped with adequate knowledge and skills in fruits and vegetables and should receive facilitation (transport, training materials, etc.) to undertake their work and to foster development. In addition, the EKN can support the training of extension workers jointly with private extension services (e.g. training provided by commercial seed companies). Key elements of the expertise transferred to farmers should be the awareness of the importance of good quality seed and good agronomic practices for fruits and vegetables, advice regarding how to increase crop yields and farm income and how to reduce negative environmental impacts.

Support towards the development of more efficient regulations and enforcement is recommended:

- The horticulture export value chain is a serious contributor for Uganda obtaining foreign currency, however, the sector lacks consistent support and coordination from the Government. Advanced policies and regulations and their enforcement are needed to address critical issues in the sector, like controlling quarantine organisms and MRL control. For this purpose, investments need to be

made in hardware (laboratories) and manpower (more horticulture inspectors). The current export inspections and procedures need to be improved to align with international standards. Market development should receive attention, which includes the production of the right varieties at the right moment, the use of the right packaging material, development and sharing of market information for both domestic and foreign markets.

- Climate change is likely to have a serious impact on the fruit and vegetable sector. Recent studies show that farmers need to adopt climate-smart technologies, including irrigation and water harvesting.
- The sales of agrochemicals and seeds should be done by registered agro-input dealers by ensuring that only licensed agro-input dealers sell authentic agrochemicals and that agro-input dealers can sell seed whose quality has been certified by MAAIF (e.g. ban counterfeits). Also it is important to keep enabling importers of quality foreign seeds by aligning the import regulations with international standards.
- Support healthy food and also safe food for the Ugandan consumers, so that overuse of chemicals and poor harvest and post-harvest practices will be limited. Sustainable pest control at farm level and more awareness among traders at markets to reduce contamination risk of fresh produce is therefore essential. This requires the support to sector-wide multi-stakeholder platforms of key stakeholders and the development of an integrated National Food Policy addressing food safety issues. Consumer demand for safe food is likely to be an important socio-economic driver for systemic change in the horticulture sector and should be addressed accordingly.

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Appendix 1 Stakeholders interviewed

Enabling and supporting environment:

- MAAIF Crop production Commissioner Mr Alex Lwakuba
- SNV Mr Appolo Muyanja
- USAID Dr. Simon Byabagambi
- MAAIF Crop inspection Commissioner Mr Paul Mwambu
- MTIC Commissioner External Trade Mr. Emmanuel Mutahunga
- UNFFE Farmers Federation Mr. Humphrey Mutaasa
- Hortexa Mr. David Lule
- UEPB Mr. Sam Karuhanga
- UHEPA & KK Foods Dr. James Kanyije
- Solidaridad Mr. Julius Ssemyalo
- Uganda Fruit & Vegetables Exporters and Producers Association Mr. Micheal Owino, Mr Henry Kasoma
- Integrated Seed Sector Development Plus Program Mr. Patrick Oyee (Chief of Party)

Traders, forwarders and input suppliers

- East Africa Seed Company Mr Reddy
- Sulma Group Mr Godfrey Bogere
- House of Seeds Ms Anja de Feijter
- Holland Greentech Ms Victoria Nakyagaba & Mr Maarten Hermus
- Kuehne & Nagel Freight Forwarder Ms Inge Wagner

Farmers

- Avocado farmer 1 export market David Lule
- Avocado farmer 2 domestic market Asuman Nkolo
- Avocado farmer 3 export market Zakayo Mukalazi
- Avocado farmer 4 domestic market Ali Lutakome
- Avocado farmer 5 export market Cyprian Sekubulwa
- Hot pepper farmer 1 Rahma Nabatanzi
- Hot pepper farmer 2 Pauline Nabbumba
- Hot pepper farmer 3 Rehema Nakimera
- Hot pepper farmer 4 Mohammed Ssentongo
- Hot pepper farmer 5 Ismail Tomusange
- Hot pepper farmer Mr Thomas Nyombi
- Tomato farmer Mrs Hellen and Mr Duncan Mwesigwa
- Tomato farmer 1 improved seeds Joseph Kasule
- Tomato farmer 2 OPV George William Semusu
- Tomato farmer 3 OPV & improved variety Ismail Kizimula
- Tomato farmer 4 OPV Vincent Lubega
- Tomato farmer 5 improved variety Najib Kitaka
- Tomato farmer 6 improved variety Michael Kawalya
- Tomato farmer 7 improved variety Ramadhan Sebuliba
- Tomato farmer 8 improved variety Yvonne Asiimwe
- Avocado farmer6 larger export in Luweero District Godfrey Bogere from Sulma Foods
- Pineapple farmer Mr Lawrence Batte
- Pineapple organic farmer1 in Luweero District John Sekitoleko
- Pineapple organic farmer2 in Luweero District Godfrey Segawa
- Pineapple organic farmer3 in Luweero District Mary Namirembe
- Pineapple conventional farmer4 in Serere District Emmanuel Oluka
- Pineapple conventional farmer5 in Serere District Julius Osaa
- Onion farmer OPV1 in Bulambuli District Michael Gimwali
- Onion farmer OPV2 in Bulambuli District James Manana

- Onion farmer hybrid3 in Bulambuli District Oluba Balunaba
- Onion farmer hybrid4 in Bulambuli District Antonina Namabumbi
- Onion farmer5 OPV western region in Kabarole District Moses Kwezi
- Onion farmer6 OPV western region in Kabarole District Robinson Tumuhimbise
- Onion farmer7 hybrid western region in Kabarole District Kate Basemera
- Onion farmer8 hybrid western region in Bunyangabu District Vincent Nyakoojo

European market

- Fruit Consultancy Europe Piet Schotel, director
- Natures Pride exotic fruit and vegetable import Bart Quartel

Appendix 2 Export value of fruits and vegetables from Uganda

Fruit

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fresh or dried mangoes				12	4			0	12	5	64	51	49	64	1313	2521	10112
Fresh or dried pineapples	42	27	42	323	467	1305	3409	2426	1981	1746	2299	522	815	671	1012	2481	3470
Fresh or dried avocados	3	3		17	52	2	6	6					4	60	122	128	191
Citrus fruit, fresh or dried			6	1	8	16		13	7	298	99	206	311	594	3758	3139	13582
Melons, incl. watermelons, and papaws (papayas), fresh	3	5	25	339	1602	6223	3096	1523	1951	1328	668	264	446	183	1114	1738	5299
Bananas, incl. plantains, fresh or dried	1336	1560	1644	1751	2199	521	1185	409	813	461	637	270	632	25522	4647	2807	2501
Fresh strawberries, raspberries, blackberries, back, white or red currants, gooseberries and **...**	336	503	297	369	440	576	935	748	204	106	257	153	55	16	115	72	995
Apples, pears and quinces, fresh		1					1	18	8	7	98	65	232	264	597	801	522
Coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled	39	93	14	114				1336	48		1	45	0	264	5	48	34
Dried apricots, prunes, apples, peaches, pears, papaws "papayas", tamarinds and other edible **...**	24	72	35	74	137	55	36	2	12	13	146	69	44	95	85	84	11
Other nuts, fresh or dried, whether or not shelled or peeled (excluding coconuts, Brazil nuts **...**	49	3		25		91	99	29	1	22	11	12	23	72	97	4	0
Grapes, fresh or dried														8	28	2	
Apricots, cherries, peaches incl. nectarines, plums and sloes, fresh			1									7		5			
Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not **...**		20		0		13	22	0		0	12	6	2		1		
Fruit and nuts, provisionally preserved, e.g. by sulphur dioxide gas, in brine, in sulphur **...**				8	6	4	3	4	0		3	1	7	81	9		
Peel of citrus fruit or melons, incl. watermelons, fresh, frozen, dried or provisionally preserved **...**			0						9				1	7	5		

Source: Comtrade.

Vegetables

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Dried leguminous vegetables, shelled, whether or not skinned or split	6465	9734	16629	23361	27110	26746	20243	34042	47972	24188	31698	28845	38092	39813	153526	214144	266794
Leguminous vegetables, shelled or unshelled, fresh or chilled	264	1005	978	273	845	387	910	637	611	1835	4785	1471	5314	1902	3193	6337	39952
Roots and tubers of manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar **...**	27	67	10	97	128	91	20541	9159	898	11416	5821	445	8942	5961	12729	14317	16950
Tomatoes, fresh or chilled			1	43			6	2	14	5	23	20	14	1351	3215	5852	15862
Potatoes, fresh or chilled	1	8	1	8	2	51		25	74	2	14	98	190	867	9892	15803	13564
Vegetables, uncooked or cooked by steaming or boiling in water, frozen	527	2309	2846	3709	1323	2980	1928	3076	2298	2112	1016	1807	5601	6577	6583	6859	7069
Other vegetables, fresh or chilled (excluding potatoes, tomatoes, alliaceous vegetables, edible **...**	3	8	428	441	562	260	480	983	983	488	1347	2593	1789	1025	1346	724	1546
Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled	1	142	29	11	53		1	3	125	52	92	104	61	985	1407	545	726
Lettuce "Lactuca sativa" and chicory "Cichorium spp.", fresh or chilled			1				1	11	0			4	1	283	263	168	110
Dried vegetables, whole, cut, sliced, broken or in powder, but not further prepared		89	144	31	107	3	9		1			1	1	4	42	35	51
Vegetables provisionally preserved, e.g. by sulphur dioxide gas, in brine, in sulphur water **...**	174		2	18	4		1	0	3	2	9	17	3		0	19	46
Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh or chilled			10				25	2	2	0	1			47	26	47	7
Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh **...**			0					1							1		
Cucumbers and gherkins, fresh or chilled									1					2	4	1	

Source: Comtrade.

Appendix 3 List of stakeholders participating in validation workshops

	Name	Designation	Organisation
Workshop 1 17/7	Dr. Gabriel Ddamulira	Head, Horticulture Program	National Crops Resources Research Institute
	Dr. Idd Ramathan	Vegetable breeder	National Crops Resources Research Institute
	Dr. Robinah Ssonko	Re. Lecturer	Makarare University
	Mr. Jackson Onyinge	Agronomist	Brac Seeds
	Mr. John Ssenkayi	Vegetable Agronomist	ISSD Plus
	Mr. David Kayemba	Vegetable Agronomist	ISSD Plus
	Ms. Victoria Nakyagaba	Business Developer	Holland Green Tech
	Ms. Anja de Feijter	Chief Executive Officer	House of Seeds
	Ms. Sylvia Kyeyune	General Manager	Simlaw Seeds
	Mr. Denis Ochan	Head of Procurement for Fresh Supplies	Shoprite Supermarket
	Ms. Jane Nalunga	Head of Programmes	National Organic Agriculture Movement of Uganda
	Mr. Arnold Mbowa	Project Officer, Partnership for Africa Seed Technology Transfer Activity	AATF
	Mr. Emmanuel Adira	Project Officer	House of Seeds
	Mr. Ronald Mwisaka	Operations Manager	Cycas International
	MS. Sandra Kamenya	Horticulture Lecturer	Uganda Christian University
	Mr. Paul Sigombe	Managing Director	REAL IPM
	Florence Nakitto	Coordinator	HortExA
	Dr. James Ssemwanga	Managing Director	TSC's pack house
	MS. Esther Nekambi	Acting Executive Director	Uganda Flower Exporters' Association
	Mr. Cherop Joel ZAK	Managing Director	ARII
	Mr. Frank Namudoyi	Executive Director	UFVEPA
	Mr. Joshua Mwanguhya	Project Coordinator	East West Seed International
	Mr. Philip Musoke	Asst. Manager Production	Soroti Fruits Ltd
	Mr. Kagaba Muhumuza	Treasurer	UFPFA
Workshop 2 19/7	Mr. Edmund Bishaka	Principal Agricultural Officer	Department of Crop Production, Ministry of Agriculture, Animal Industry and Fisheries
	Mr. Gilbert Sebutare	Inspector	Department of Crop Inspection and Certification, Ministry of Agriculture, Animal Industry and Fisheries
	Mr. Steven Wabusanyi	Senior Commercial Officer	Department of External Trade, Ministry of Trade, Industry and Cooperatives
	Mr. Anno Galema	Food security officer and private sector development	EKN
	Mr. Josephat Byaruhanga	Food security and agribusiness officer	EKN
	Mr. Sam Karuhanga	Export Marketing Executive	Uganda Export Promotion Board
	Mr. Apollo Muyanja Mbazzira	Agriculture Advisor	SNV
	Mr. Ysakor Haile Selassie	Country Director	Agriterra
	Mr. Julius Ssemyalo	Country Project Manager	Solidaridad
	Ms. Sheila Mugyenzi	Director, Investment Promotion	Uganda Investment Authority
	Mr. Chris Ibyisintabyo	Executive Director	Uganda National Agroinput Dealers' Association
	Mr. David Slane	Chief of Party	IFDC Uganda
	Mrs. Cate Adilu	Vegetables program ISSD	ISSD
	Mr. Patrick Oyee	Chief of Party	ISSD
	Mr. Rinus Van Klinken	Project Manager	SNV
	Mr. Michael Kirya	Manager Agribusiness	KCCA
	Mr. John Senkayi	Veg. Agronomist	ISSDPlus
	Ms. Darlene Nagitta	Production Manager	Gittands Agro Ltd
	Mr. Peter Sseruwagi	CEO	Gittands Agro Ltd
	Ms. Racheal Nabbira	Finance &Admin	SOLIDARIDAD
	Mr. David Kayemba	Veg. Agronomist	ISSD Plus

Appendix 4 Cost benefit data for studied crops per year Uganda

	Tomato			Onion		Hot pepper	
	OPV n=3 (2 season)	Hybrid n=3 (2 season)	Irrigated n=3 (4 season)	OPV n=4 (seasons)	Hybrid =n4 (2 seasons)	small n=3 (1 season)	Large n=2 (1 season)
Seeds	53,000	187,895	606,762	280,000	758,933	12,000	-
Fertilisers	227,500	251,368	457,143	258,211	1,186,222	40,000	84,444
Pesticides	29,500	243,579	306,667	37,895	23,844	60,000	53,333
Fungicides	79,500	253,474	314,286	60,000	143,333	-	-
Inputs other	758,000	420,842	2,560,000	12,000	206,151	9,600	8,889
Durables	54,313	69,484	812,483	10,711	16,615	376,000	13,889
Fuel	-	-	549,333	-	-	-	-
Labour	903,500	874,526	2,499,048	826,211	151,778	1,038,667	1,654,328
Transport	596,000	417,474	839,048	-	178,133	25,600	21,333
Land	-	-	-	52,632	13,333	-	22,222
Other costs	87,000	42,105	-	72,632	533,333	-	-
Total costs	2,788,313	2,760,747	8,944,769	1,610,289	3,211,677	1,561,867	1,858,439
Revenue	8,330,000	11,666,772	19,042,570	3,660,537	22,702,889	7,030,520	7,470,329
Margin	5,541,688	8,906,024	10,097,801	2,050,247	19,491,212	5,468,653	5,611,889

	Avocado		Pineapple			
	Domestic n=2 (2 season)	Export n=4 (2 season)	Luweero n=3 3 years	Serere n=1 3 years		
Seeds	-	-	-	200,000		
Fertilisers	-	16,333	-	-		
Pesticides	-	10,000	-	-		
Fungicides	-	2,400	-	-		
Inputs other	-	-	-	-		
Durables	-	27,880	-	7,000		
Fuel	-	-	-			
Labour	-	94,733	2,814,000	131,000		
Transport	-	35,200	340,800	125,000		
Land	-	-	540,000	-		
Other costs	-	-	-	32,000		
total costs	-	189,659	3,694,800	495,000		
Revenue	1,185,625	2,219,594	12,613,100	12,119,000		
Margin	1,185,625	2,029,935	8,918,300	11,624,000		

Appendix 5 Food intake

Food group	2011-2012	Rank	2015-2016	Rank
Cereals	80%	5	83%	5
Dairy products	38%	9	36%	11
Eggs	11%	12	18%	12
Fish	38%	10	39%	10
Fruit	38%	11	45%	9
Meat	47%	8	49%	8
Oils and fats	68%	6	75%	6
Outside food and drinks, condiment and beverages	99%	1	100%	1
Pulses & Nuts	89%	4	89%	4
Roots & Tubers	90%	3	90%	3
Sweets	61%	7	69%	7
Vegetables	92%	2	93%	2

Source: LSMS.

Appendix 6 Results of the 2013-2014 LSMS Survey for Uganda

Introduction

The data from the LSMS (Living Standards Measurement Study) Agricultural survey describe the results of farming in 2013-2014. The data are collected during two separate visits to the households throughout the country, during which the production and farming practices of the households can be observed in two separate seasons. The timing of the two visits differs greatly between households, but roughly the first visits were done in the second half of 2013 and the second visits in the first half of 2014. In some cases the two 'visits' were conducted at the same time and farmers were asked to recall the situation of the previous season. The first season roughly coincides with the period February to May 2013 for planting, and from May-July 2013 for harvesting, while the second season was mostly reported to range from August-October 2013 for planting and from November-December 2013 for harvesting. This means that the first season is a dry season (planting at the end of the wet season) and the second season is a wet season.

The data is presented per season, only if different seasons apply. For pineapples and avocado the data are aggregated and all the costs and revenues are attributed to the entire period of the survey. In some cases however, for tomatoes and onions, the costs of planting and fertilizing or spraying appear to be registered in one season while the revenues of the crop are made in the other season. There was no way of correcting this without additional information.

For this analysis, the households that grew tomato, onion, avocado or pineapple crops – no data on peppers is available in the LSMS survey of 2013-2014 – were selected, i.e. households with some area of production of these crops. This were 134 households, out of a total of 2,495 households in the survey. The data about the size of the parcels and plots of the specific crops was combined with data on the use of fertilisers, pesticides, labour and other inputs on these plots. In some cases, costs of inputs were allocated to different crops that were grown on the same plot. Harvested production, sold production, transport costs, if any, and the value of sales were also available for most households. However, in a number of cases information was missing on e.g. the quantity sold or harvested. We estimated these whenever possible from the existing data of the household (e.g. when a quantity unit for production sold was missing but clearly the same quantity unit applied as for product harvested). The remaining observations were inspected for outliers, looking at them specifically in terms of production per acre and in terms of prices of sold production. Generally, these outliers were related in the sense that abnormal high production per acre was usually accompanied by abnormally low prices. Outliers were eliminated per season and for the year aggregate if they were lower than two times the interquartile range below the value of the first quartile, and if they were above two times the interquartile range above the value of the third quartile. From this procedure it follows that the aggregated (total) costs and margins over the year can include different households than the separate seasons.

The resulting production and costs estimates look plausible. However, we note that the LSMS survey was not designed to produce estimates of costs and production of serious tomato or pineapple farmers. The households in the survey often produce multiple crops and livestock and the average size of the farms is lower than those that we visited during the fieldwork in this project. More importantly we corrected some of the fieldwork data for failed crop harvests based on expert estimates of potential harvests. The data in the LSMS survey is not corrected for failed crops. Therefore, when the results of the LSMS survey are compared with our results of the fieldwork, mostly, the produced quantities per acre are lower in the LSMS survey. In addition, we note that five years have passed since 2013/2014 and that inflation has increased prices by about 25%-30%. It is likely that prices of vegetables and fruit have risen as well.

A final remark is made about the use of own resources. Much of the labour and other inputs such as seeds and fertilisers are neither hired nor bought, but come from the family or the other farming

activities of the family. These costs are not included in the data; hence, the remaining margins are used as family income but also, for example, to feed cattle whose manure is used as a fertiliser.

Tomato

The costs and margin division in percentage of the total sales value of tomatoes is presented in figure 1. The margins are between 60 and 80%. The second season has a lower margin because of the lower harvest, with roughly equal – to somewhat higher - costs of production. Especially the costs of fertilisers was higher in the second season. Note that some of the produce was consumed in the household (about 7%). This was not valued as revenue. At the same time most of the labour is performed by the members of the household. This labour is not valued, either – it is the margin that remains for the household that is the compensation for the family labour.

The findings from the LSMS survey differ in a number of ways from the data in the fieldwork. In terms of production per acre, the average firm in the LSMS data only produced about 2,800kg of tomatoes per acre per year, including two seasons.

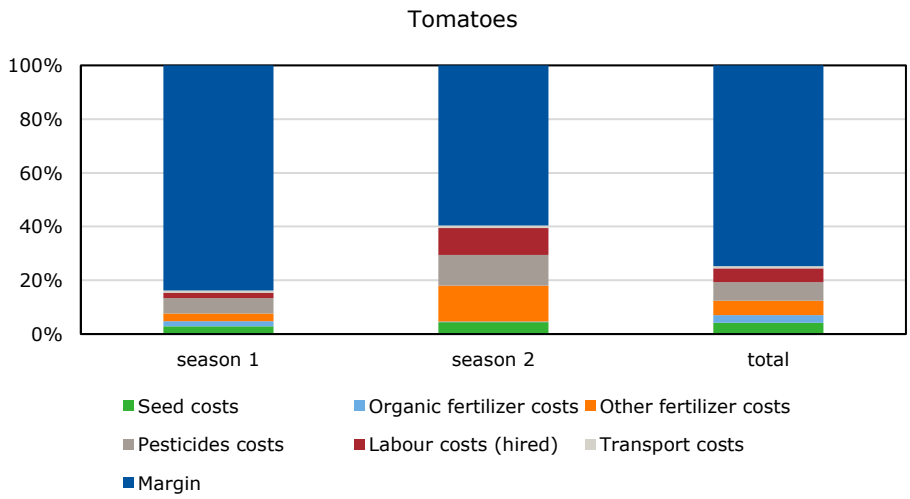

Figure 2 *Costs and margins of tomatoes production in Uganda, in % of total sales revenue, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

In the table below the results of the costs and revenues estimates per acre are given for tomatoes. The data is based on 24 observations in season 1 and 36 observations in season 2. In total there were 52 households reporting the production of tomatoes in either one of the seasons that fit within the sample selection criteria (outliers excluded). Sixty of these households actually sold tomatoes, and five only produced tomatoes but for some reason did not sell any. The reasons for this could be that tomatoes were intentionally only produced for own use, but another reason could be a loss of harvest. Because we want to give a reliable picture of the production and revenue capacity of the sector, we included all these households in the reported figures. Also, some plots were sown and fertilised but not harvested yet (immature crops). We have also included these plots in the calculations because it increased the amount of data on the use of pesticides, fertilisers and seeds, and their respective costs. Of course, excluding these plots from the data would imply a small increase in the production per acre. The differences are minimal however, as the observation period is quite long and most crops were harvested.

The data reveal that the average acre of tomatoes yielded about 1,300kg of tomatoes per season. The harvests were much higher in the first season than in the second season. The highest reported yields per acre in season one reached 30 tonnes, which is much higher than the average yield. This particular farmer used certified improved seeds on a half-acre plot, without much more costly inputs besides own labour. The highest costs per acre are reported to be pesticides, labour and seeds. Some differences between seasons exists although variations between households are also quite high. The

production quantities in season two (November -December harvest) were reported to be much lower, while the selling prices were higher.

On average the margin per acre was higher in the first season than in the second season. The 'average column' is calculated as the sum of the two seasons' costs and revenues divided by the sum of the planted areas in the two seasons, meaning that it is the average costs and revenues over both seasons. The 'total' column, on the other hand, takes the total costs and margin and divides it by the average acreage of the two seasons. It is an estimate of the total production capacity and costs if the same plot is planted and harvested twice in a year.

Table 2 *Cost and revenues of tomato production in Uganda, per acre, in UGX, in 2013/2014*

	Season 1	Season 2	Average per season	Total all seasons
Production harvested kg	1,559	814	1,223	2,575
Production sold kg	1,457	721	1,131	2,381
Seed costs	38,852	42,532	48,885	102,936
Organic fertiliser costs	24,283	1,779	33,760	71,088
Other fertiliser costs	38,573	126,701	64,361	135,522
Pesticides costs	75,816	108,476	81,398	171,397
Labour costs (hired)	28,256	94,218	60,568	127,535
Transport costs	10,949	9,685	9,462	19,923
Total costs	216,729	383,392	298,435	628,400
Revenues	1,332,009	948,114	1,179,285	2,483,162
Margin	1,115,279	564,722	880,850	1,854,762
Selling price per kg	914	1,316	1,043	1,043

Source: LSMS Survey 2013-2014, calculations Wageningen Economic Research. N= 24 in seasons 1, 36 in seasons 2, 52 in total.

The two charts below show the same costs and revenues, expressed per acre (as in the table above), and per kilogram of tomatoes produced (harvested). Again, some of the produce was not sold, so if we expressed the costs in terms of quantities sold, the costs and the revenues would both be a little bit higher, but their proportions would remain the same. The main difference between the two is in the differences between the first and second season. Per acre the margin is much higher in the first season, while per kg the margin is somewhat higher in the second season. This reflects the situation that the yields are higher in the first season: with low inputs a higher yield means a higher margin. Per kilogram, however, the second season is somewhat more interesting, but also requires more inputs. Labour costs and especially fertiliser costs are higher in the second season. It shows that while yields are not great in the second season, it can be profitable to produce tomatoes if the land is available. Obviously, with higher input costs, the risk of losing a harvest is also higher and controlling production is more important. This means irrigation, good crop protection, as well quality seeds are very important.

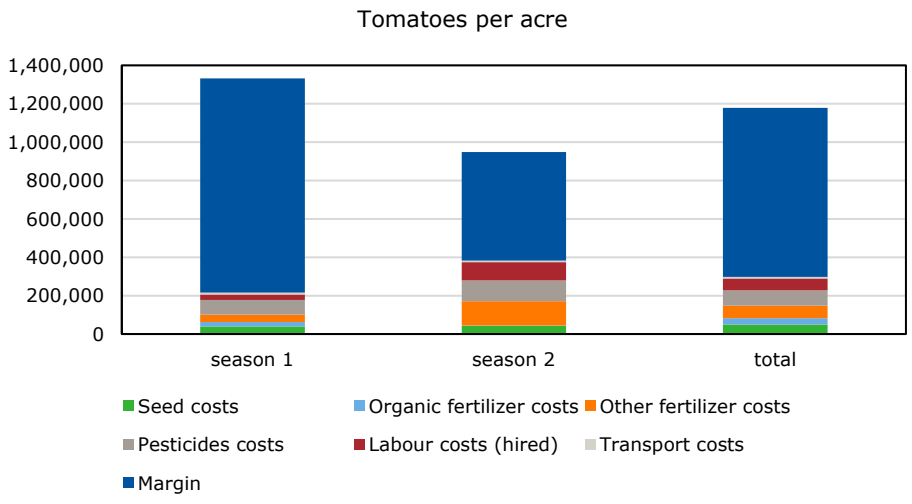

Figure 3 *Costs and margins of tomato production in Uganda, in UGX per acre, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

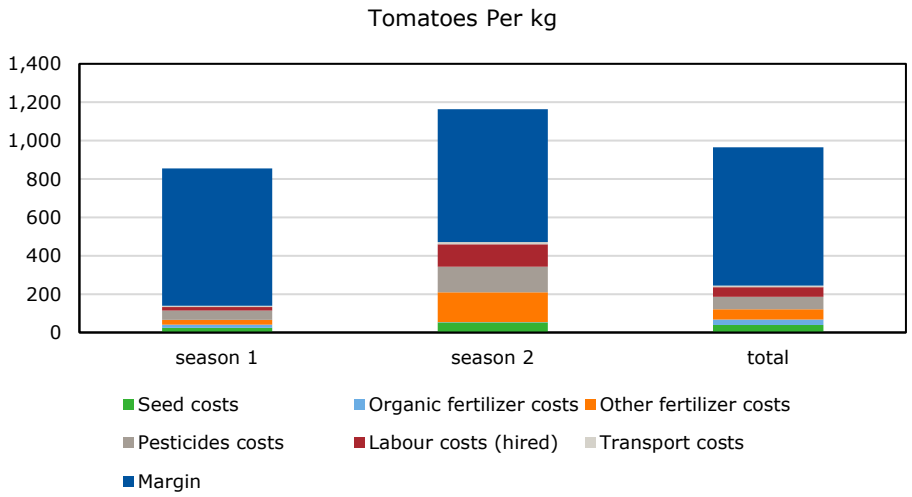

Figure 4 *Costs and margins of tomato production in Uganda, in UGX per kg, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

Onion

For onions, the LSMS dataset of 2013-2014 contains 23 complete observations of households producing onions after removing outliers, of which 16 in season one and 14 in season two. The onions were planted between March and May in season one and harvested between June and August. In season two the growing season lasted roughly from June-August for planting to November-December for harvesting. Most of the growing households were found in the Western and Northern regions. The data on the households in the northern region, were, however, incomplete for some of these household, yielding only two of the observations per season for the northern region.

The figure below gives the shares in total revenue of the various costs of inputs and labour, and the margin. The average margins fluctuate between 70% and 80%. The fact that the margin for the 'total' is somewhat lower is caused by a few firms with incomplete data per season (missing quantities sold or quantities harvested) but which were included in the total. The production in especially the Northern region of the country is (according to the available data) characterised by very low input costs; almost no (bought) seed costs, fertilisers or pesticides are used. The figure presents the averages for all observations in all regions.

Labour costs are an important component of the cost structure for onions. This is due to the fact that harvesting is labour intensive. This is especially apparent in the regions where the harvested areas are larger and non-family labour is hired. These higher labour costs are mostly recorded in the Eastern and Western part of the country. The average size of the onion-growing areas per household are also much higher in these regions, although still small with an average of about 0.5 to 1 acre. In the Northern region, the recorded area averaged about 0.20 acre in season one and 0.37 acre in season two.

The cost structure is somewhat comparable between the seasons. The costs of pesticides are quite low for onions in comparison to e.g. tomatoes, because onions grow underground.

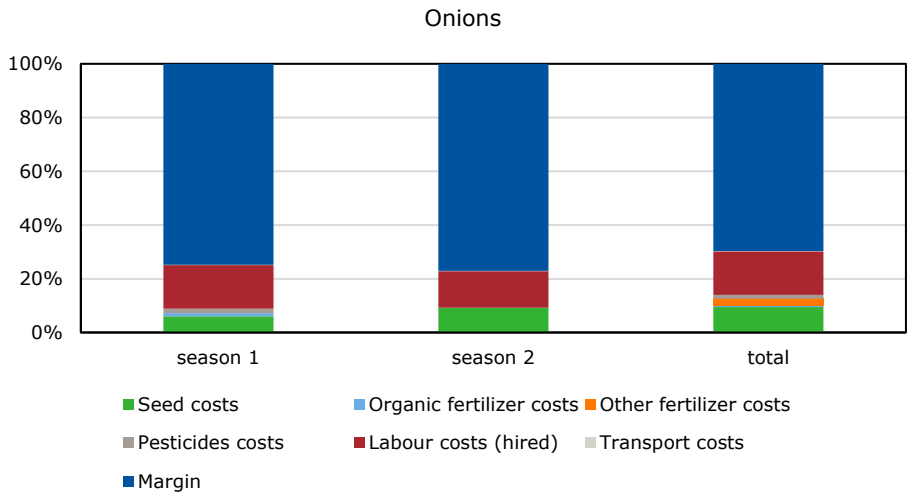

Figure 5 *Costs and margins of onion production in Uganda, in % of total sales revenue, in 2013/2014. Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.*

In the table below the costs per acre are specified. Note again that the number of observations is limited and the absence of costs for a particular input in a season does not mean that it was not used at all. The overall 'total' costs and revenues include the most observations and give the most accurate picture of production costs. Selling prices were about UGX 850 to 1,000 per kg. The prices were a little bit higher in the second season. Combined with higher production per acre, the average margin per acre was higher in the second season.

In the figure below the table, the same data is shown as in the table above. When compared to figure 6, it is clear that the onion market was quite stable. The production per acre was higher in the second season and prices were also higher in the second (dry) season.

Table 3 *Costs and revenues of onion production in Uganda, per acre, in UGX, in 2013/2014*

	Season 1	Season 2	Average per season	Total all seasons
Production harvested kg	690	828	668	1,430
Production sold kg	641	757	608	1,302
Seed costs	32,956	71,414	50,528	108,172
Organic fertiliser costs	6,289	~	3,018	6,460
Other fertiliser costs	~	~	13,881	29,716
Pesticides costs	9,057	~	7,242	15,504
Labour costs (hired)	88,050	106,242	86,904	186,047
Transport costs	881	1,062	905	1,938
Total costs	137,233	178,718	162,477	347,836
Revenues	544,654	778,088	535,244	1,145,866
Margin	407,421	599,369	372,767	798,030
Selling price per kg	850	1,028	880	880

Source: LSMS Survey 2013-2014, calculations Wageningen Economic Research. N= 16 in season 1, 14 in season 2, 23 in total.

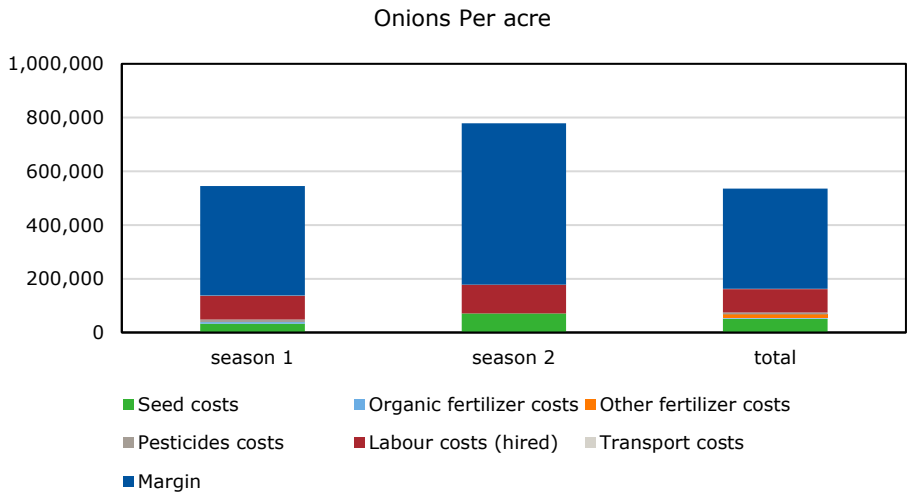

Figure 6 *Costs and margins of onion production in Uganda, in UGX per acre, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

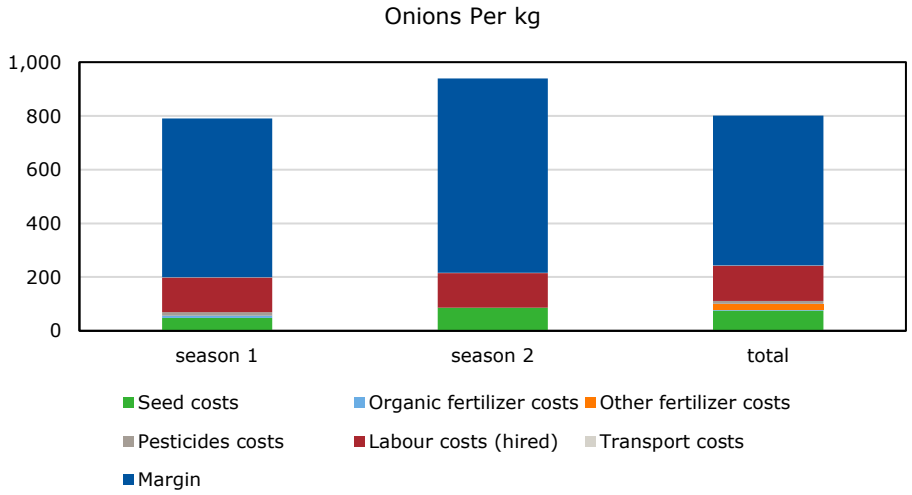

Figure 7 *Costs and margins of onion production in Uganda, in UGX per kg, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

Pineapple

In the LSMS data on pineapple production was reported in all regions, but most of the production was found in the Western region. The typical acreage per household was a little bit higher in the Central region than in the other regions, though still small – around one acre.

In the LSMS data, harvesting is reported between about May and August in season one and between November and December in season two. In the data there were a total of nine complete observations in the two seasons of pineapple producing households.

Pineapples are produced low input. Seed costs (suckers) are one of the main costs, along with labour and transport. Pesticides or chemical fertilisers are hardly used. The figure below expresses the total reported costs over the whole year (by the households reporting to have produced pineapples in season one or two or both) as a fraction of the total value of the sold production. Keep in mind that a part of the production is not sold, although this part is rather small for pineapples (about 96% reported to be sold).

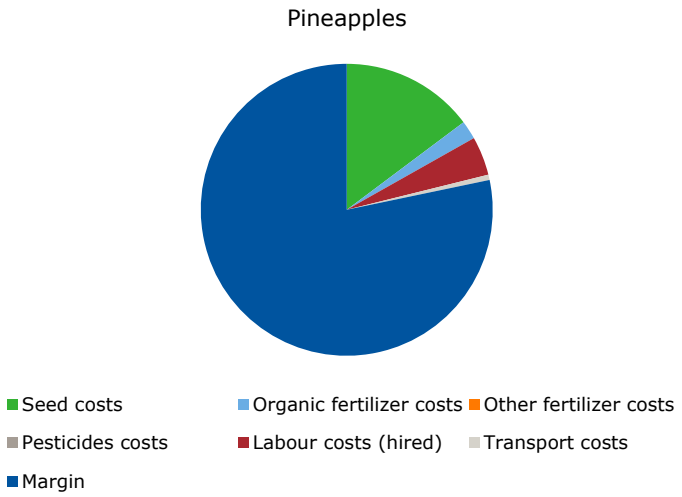

Figure 8 *Costs and margins of pineapple production in Uganda, in % of total sales revenue, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

The average production per acre (for the whole year) was about 750kg. Note that we do not have a balanced sample of households producing pineapples in each of the two seasons, but most of the households in the survey reported to be producing pineapples in both seasons on the same plots (as expected).

Table 4 *Cost and revenues of pineapple production in Uganda, per acre, in UGX, in 2013/2014*

	Total, *)
Production harvested kg	754
Production sold kg	672
Seed costs	52,863
Organic fertiliser costs	7,401
Other fertiliser costs	0
Pesticides costs	0
Labour costs (hired)	15,383
Transport costs	2,115
Total costs	77,761
Revenues	357,985
Margin	280,224
Selling price per kg	533

Source: LSMS Survey 2013-2014, calculations Wageningen Economic Research. N=6 in season 1, 8 in season 2, 9 in total. *) per acre on the basis of total harvest and costs over the whole year and average area as reported in seasons one and two.

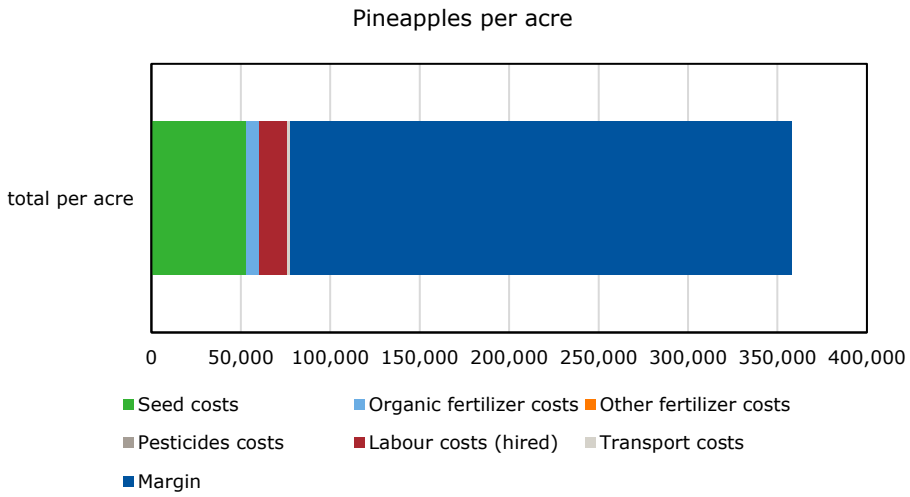

Figure 9 *Costs and margins of pineapple production in Uganda, in UGX per acre, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

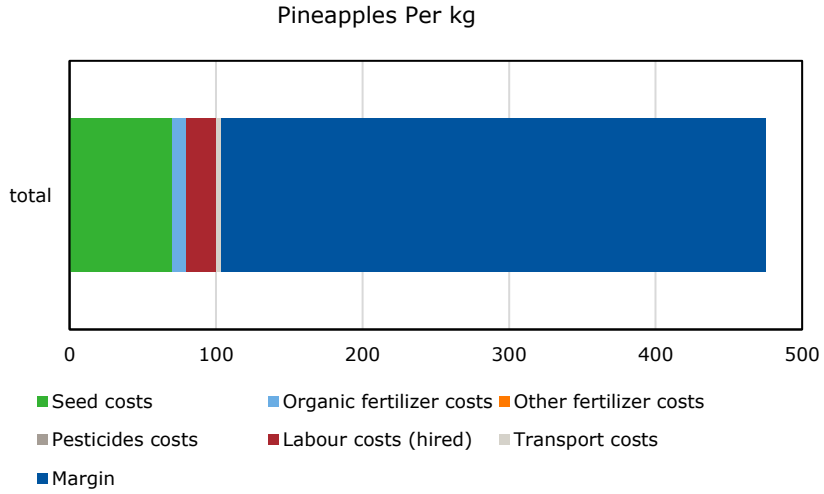

Figure 10 *Costs and margins of pineapple production in Uganda, in UGX per kg, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

Avocado

Avocado is a perennial crop. The avocado trees can be productive for many years, but if grown from a young tree from a nursery the trees are not productive for the first three to four years. The trees from the 23 households in the LSMS survey were on average about 10 years old, but some trees were not yet productive. In the figure below, the average cost structure for the two seasons and the total survey period 2013-2014 of the survey are given. The first seasons was roughly reported as the period from January to June, while the second season was the period from July to December. Harvesting happened year-round. Most of the avocado growers in the LSMS data were found in Northern and Western Uganda; in the LSMS data no growers were found in Eastern Uganda.

Most households use very little or no inputs other that what is already available at the household. The reported inputs of avocado production were mainly fertiliser costs, which were organic fertilisers in most cases, but the number of households that actually reported any use of inputs was very limited. Only in some cases, did households report using hired labour and similar numbers were found for fertilisers. Pesticides were used by two households as well. This illustrates the very low number of inputs used for avocado production in Uganda. Because avocado is a perennial crop, we presented the data for the whole year (mostly the year 2013).

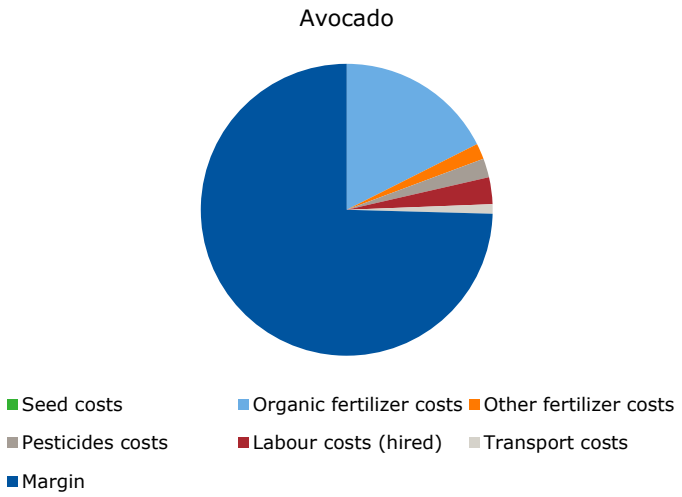

Figure 11 *Costs and margins of avocado production in Uganda, in % of total sales revenue, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

The production quantities per acre are presented in the table below.

Table 5 *Cost and revenues of avocado production in Uganda, per acre, in UGX, in 2013/2014*

	Total *)
Production harvested kg	1,638
Production sold kg	1,225
Seed costs	0
Organic fertiliser costs	92,212
Other fertiliser costs	9,175
Pesticides costs	11,010
Labour costs (hired)	15,598
Transport costs	5,505
Total costs	133,502
Revenues	524,831
Margin	391,329
Selling price per kg	428

Source: LSMS Survey 2013-2014, calculations Wageningen Economic Research. N = 8 in total. *) per acre on the basis of total harvest and costs over the whole year and average area as reported in seasons one and two.

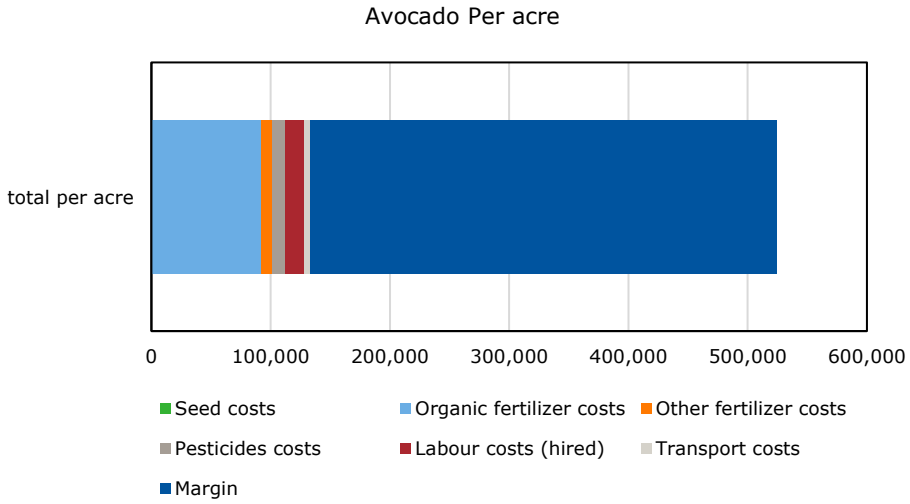

Figure 12 *Costs and margins of avocado production in Uganda, in UGX per acre, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

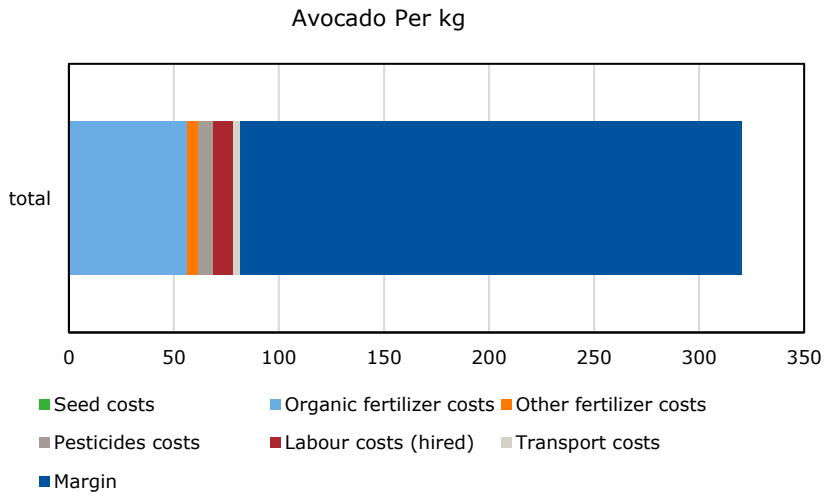

Figure 13 *Costs and margins of avocado production in Uganda, in UGX per kg, in 2013/2014*
Source: LSMS Survey 2013/2014, calculations Wageningen Economic Research.

Appendix 7 Cost benefit data for studied vegetable crops Kenya

		Onion in Machakos			Tomato in Kirinyaga			Capsicum in Machakos		
	UNIT	QUANTITY	UGX	TOTAL UGX	QUANTITY	UGX	TOTAL UGX	QUANTITY	UGX	TOTAL UGX
LAND PREPARATION										
Land clearing	M/DAYS	-		-	3	12,446	37,338	-	-	-
Ploughing	ACREAGE	1	142,240	142,240	1	88,900	88,900	1	142,240	142,240
Harrowing	ACREAGE	1	12,4460	12,4460		-	-	1	124,460	124,460
Ridging	ACREAGE	1	-	-	1	44,450	44,450	-	-	-
Cost of manure	TONS/Kgs		-	-	10	14,224	142,240		-	-
Labour for manure application	M/DAYS	10	12,446	124,460	5	12,446	62,230	10	12,446	124,460
SUB TOTAL COST				*391,160*			*375,158*			*391,160*
COST OF INPUTS										
Fertiliser	50Kg BAG	1	42,672	42,672				70kg	124,460	124,460
Seeds	50Kg BAG	3	53,340	160,020	4	113,792	455,168	2	53,340	106,680
Seedling preparation	Kgs/gms	1kg	224,028	224,028		391,160	-	1	142,240	142,240
Herbicide	Kgs/LITS	1	106,680	106,680		-	-	-	-	-
Insecticide 1	Kgs/LITS	1	106,680	106,680		-	-	-	-	-
Insecticide 2	Kgs/LITS	1	231,140	231,140	200mls	142,240	142,240	1	177,800	177,800
Fungicide 1	Kgs/LITS	1	231,140	231,140	200mls	35,560	35,560	-	-	-
Fungicide 2	Kgs/LITS	-	-	-	5	42,672	213,360	1	177,800	177,800
Foliar feed 1,2,3	Kgs/LITS	-	-	-	5	42,672	213,360	-	-	-
Strings, staking sticks	Kgs/LITS	50kg	71,120	71,120		-	-	-	-	-
Fuel	Pick-ups	-	-	-	8,000	71	568,960	-	-	-
Others	LITS		177,800	177,800	140	4,089	572,516		177,800	177,800
SUB TOTAL COST				*1,351,280*			*2,201,164*			*906,780*
CROP MANAGEMENT										
Planting labour	M/DAYS	5	10,668	53,340	2	17,780	35,560	5	10,668	53,340
Fertiliser application labour split 1st and 2nd	M/DAYS	10	10,668	106,680	10	7,112	71,120	10	10,668	106,680
Spraying labour 1st,2nd and 3rd	M/DAYS	5	10,668	53,340	2	28,448	56,896	5	10,668	53,340
Weeding labour 1st and 2rd	M/DAYS	2	10,668	21,336	5	28,448	142,240	2	10,668	21,336
Harvesting 1st,2rd,3rd……..	M/DAYS	10	10,668	106,680		-	-	10	10,668	106,680
Grading, sorting, packing	M/DAYS	20	10,668	213,360	40	7,112	284,480	20	1,067	21,336
Irrigation labour cost	M/DAYS	10	10,668	106,680	1	8,890	8,890	10	10,668	106,680
Others	M/DAYS	20	10,668	213,360	5	7,112	35,560	20	10,668	213,360
SUB TOTAL				*874,776*			*634,746*			*682,752*
TOTAL COST				**2,617,216**			**3,211,068**			**1,980,692**

Appendix 8 Cost benefit data for studied fruit crops Kenya

		Pineapple in Kericho			Avocado in Embu			Avocado in Nakuru		
	UNIT	QUANTITY	UGX	TOTAL UGX	QUANTITY	UGX	TOTAL UGX	QUANTITY	UGX	TOTAL UGX
LAND PREPARATION										
Land clearing	M/DAYS	1	142,240	142,240	4	14,224	56,896	20	7,112	142,240
Ploughing	ACREAGE		-	-	1	56,896	56,896		-	-
Harrowing	ACREAGE		-	-	110	533	58,674		-	-
Ridging	ACREAGE	1	106,680	106,680		-	-		-	-
Cost of manure	TONS/Kgs		-	-	7	35,560	248,920	10	35,560	355,600
Labour manure application	M/DAYS		-	-	6	14,224	85,344		-	-
SUB TOTAL COST				248,920			506,730			*497,840*
COST OF INPUTS										
Fertiliser 50kg bag/kg	50Kg BAG		-	-	2	124,460	248,920	1	99,568	99,568
Seedling / suckers	PIECES	2	142,240	284,480	110	7,112	782,320	160	10,668	1,706,880
Insecticide 1	Kgs/LITS	5	7,112	35,560		-	-	1	64,008	64,008
fungicide 2	Kgs/LITS		-	-		-	-	1	42,672	42,672
SUB TOTAL COST			-	320,040		-	1,031,240		-	*1,913,128*
CROP MANAGEMENT										
Planting	M/DAYS	30	7,112	213,360	3	14,224	42,672	30	7,112	213,360
Fertiliser application labour split 1st and 2nd	M/DAYS		-	-	2	14,224	28,448		-	-
Spraying 1st, 2nd and 3rd	M/DAYS		-	-	1	14,224	14,224		-	-
Weeding 1st and 2nd	M/DAYS	12	124,460	1,493,520	4	14,224	56,896	20	7,112	142,240
Harvesting 1st, 2nd, 3rd……..	M/DAYS		-	-		-			-	-
Grading, sorting, packing	M/DAYS		-	-		-			-	-
Irrigation	M/DAYS		-	-	4	12,446	1,493,520		-	-
SUB TOTAL				1,706,880			1,635,760			*355,600*
TOTAL COST				2,275,840			3,173,730			2,766,568

Appendix 9 List of Districts in Uganda

Central Region		Eastern Region		Northern Region		Western Region	
Map	District	Map	District	Map	District	Map	District
82	Buikwe	4	Amuria	1	Abim	81	Buhweju
84	Bukomansimbi	7	Budaka	2	Adjumani	10	Buliisa
86	Butambala	49	Bududa	78	Agago	11	Bundibugyo
87	Buvuma	8	Bugiri	79	Alebtong	12	Bushenyi
89	Gomba	83	Bukedea	3	Amolatar	18	Hoima
27	Kalangala	9	Bukwa	80	Amudat	19	Ibanda
90	Kalungu	85	Bulambuli	39	Amuru	26	Isingiro
29	Kampala	13	Busia	5	Apac	23	Kabale
36	Kayunga	15	Butaleja	6	Arua	24	Kabarole
38	Kiboga	88	Buyende	16	Dokolo	31	Kamwenge
95	Kyankwanzi	20	Iganga	17	Gulu	32	Kanungu
48	Luweero	21	Jinja	22	Kaabong	34	Kasese
99	Lwengo	25	Kaberamaido	42	Kitgum	37	Kibaale
100	Lyantonde	28	Kaliro	43	Koboko	40	Kiruhura
51	Masaka	30	Kamuli	93	Kole	92	Kiryandongo
56	Mityana	33	Kapchorwa	44	Kotido	41	Kisoro
59	Mpigi	35	Katakwi	97	Lamwo	96	Kyegegwa
60	Mubende	91	Kibuku	47	Lira	46	Kyenjojo
61	Mukono	45	Kumi	50	Maracha	52	Masindi
63	Nakaseke	94	Kween	57	Moroto	55	Mbarara
64	Nakasongola	98	Luuka	58	Moyo	102	Mitooma
70	Rakai	101	Manafwa	62	Nakapiripirit	106	Ntoroko
72	Sembabule	53	Mayuge	104	Napak	66	Ntungamo
76	Wakiso	54	Mbale	65	Nebbi	109	Rubirizi
		103	Namayingo	107	Nwoya	71	Rukungiri
		14	Namutumba	108	Otuke	111	Sheema
		105	Ngora	67	Oyam		
		69	Pallisa	68	Pader		
		110	Serere	77	Yumbe		
		73	Sironko	112	Zombo		
		74	Soroti				
		75	Tororo				

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