Sweetpotato value chain and the potential role for commercial fresh root storage in selected areas of Mozambique

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SASHA

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We hope this report is of use in providing understanding of the different but related aspects of current and potential future sweetpotato value chains in Mozambique.

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Acronyms and Abbreviations

AFDB	African Development Bank
BAGC	Beira Agricultural Growth Corridor
CIP	Centro Internacional de la Papa, International Potato Centre
DVM	Decentralized Vine Multiplier
FAO	Food and Agriculture Organization of the UN
GAIN	Global Alliance for Improved Nutrition
ha	hectare
IIAM	Instituto de Investigação Agrária de Moçambique
INE	Instituto Nacional de Estatística, National Bureau of Statistics
kg	Kilogram
MAP	Months After Planting
MDC	Maputo Development Corridor
MEFSI	Manica Extended Food Security Initiative
mm	Millimetre
MINAG	Ministério da Agricultura e Segurança Alimentar
MZN	Metical (Mozambique's currency, currently trading at about 34 to 38 MZN to 1 USD)
NGO	Non-Governmental Organization
NRI	Natural Resources Institute
OFDA	Office for Disaster Assistance
OFSP	Orange-fleshed sweetpotato
PES	Plano Económico e Social, Economic and Social Plan
SASHA	Sweetpotato Action for Security and Health in Africa
SDAE	Serviço Distrital de Actividades Económicas, District Service for Economic Activities
SDI	Spatial Development Initiative
SIMA	Sistema de Informação dos Mercados Agrícolas, Agricultural Market Information System
SP	Sweetpotato
SUSTAIN	Scaling Up Orange-fleshed Sweetpotato Through Agriculture and Nutrition
TIA	Trabalho de Inquérito Agrícola, Agricultural Survey
tonne	1,000 kg
UCM	Universidade Católica de Moçambique
WFSP	White-fleshed sweetpotato

Executive Summary

In Mozambique, the Sweetpotato Action for Security and Health in Africa (SASHA) and the Scaling up Sweetpotato through Agriculture and Nutrition (SUSTAIN) projects are linked together to exploit the full potential of the sweetpotato (SP) crop developing various aspects of its value chain. This study aims to investigate fresh SP root production, availability, and trading in the main producing provinces of Maputo and Manica in Mozambique, with insights into the opportunities for further developing the chain and establishing fresh SP root storage facilities.
The data used in the study mainly come from interviews with key value chain agents (e.g. farmer focus groups and individual farmers; retailers; processors; and service providers, i.e. Non-Governmental Organizations (NGOs) and the Ministry of Agriculture (MINAG)) carried out in two Provinces, Maputo and Manica, at two different times: between 27th and 30th October 2014 and 20th and 30th April 2015. Other primary data were collected by the International Potato Center (CIP) as part of its market monitoring effort. Secondary data comes from relevant literature on Mozambique, SP value chains and storage.

From an overview on farming activities in Mozambique based on secondary data, it emerges that the agricultural sector is dominated by smallholder family farms, especially for the SP crop. Moreover, SP does not appear to be the major staple crop in the area visited. The most important crops produced and consumed in Mozambique are, in fact, maize and cassava. Maize is cultivated on 32% of national farmed area (with peaks of 51% and 43% in Manica and Maputo, respectively) while its annual consumption is estimated between 58 kg and 79 kg per person. Cassava occupies, instead, 15% of the national agricultural land while in Manica and Maputo the area under cultivation is 5% and 10% , respectively; the annual consumption of dry roots is estimated around 98 kg per person while the consumption in the two provinces under analysis is likely to be lower. Irish potato production in Mozambique is growing but is still small; its demand is higher than local production and it is mostly satisfied by imports.

Sweetpotato is produced only on 1% of the farmed area in Mozambique while in Manica this percentage increases to 2%. About one-third of the land is under the OFSP varieties and two-thirds under white-fleshed varieties. The average parcel under SP is also quite small, around 0.06 ha in Maputo and 0.25 ha in Manica. OFSP is more prevalent in Maputo province than in Manica. Combining different data sources with the information gathered during the field visits, the annual SP production volumes can be estimated to be between 104,000 and 150,000 tonnes in Manica province while the quantity produced in Maputo province range from 37,000 up to 54,000 tonnes. It is likely that the almost all SP produced in one province is consumed in the same province.

From the discussions with farmers, retailers, processor, and consumers interviewed during the field visits in Maputo and Manica, it emerges that the structure of the VC is quite similar in the two provinces. The farmers in Maputo and Manica provinces provide their rural and urban areas with fresh SP roots through different channels: i) selling the SP crop to the retailers operating in rural and urban markets; ii) acting themselves as traders/retailers in the local markets; iii) selling directly to the consumers without intermediation. The presence of middlemen, SP roots transporters and wholesalers as specialized agents was not observed and this lack was reported as one of the weaknesses for the whole SP value chain.
Important differences between the two focal SP producing areas are agro-ecology, size of urban market and the relative importance of white and orange-fleshed varieties.

The SP crop is cultivated once or twice a year following the rainfall patterns in non-irrigated lands. In Manica province, the harvesting of fresh SP roots starts in mid/late March after the end of the rainy

season that starts a few weeks earlier compared to Maputo province. SP varieties are cultivated in small parcels by farmers mainly for their own consumption and, to a lesser extent, for trade. Orange-fleshed varieties are less common and mostly commercialized

Data suggest that there are distinct areas supplying the urban markets: Manhiça to Maputo, and Macate to Chimoio. Farmers may harvest and deliver their SP roots in bags to the main markets by trucks or buses. The farmers are generally paid per bag basis with a lower price paid for the small or cut roots than for the medium and large-sized roots.

From the data collected during the field visits, it emerges that there is considerable price variation between the peak and low supply season. Choosing the retailers as the main agents providing broad and comparable information, the average buying price between the peak and low supply season varies by between 40%-60% in Chimoio and 30%-130% in Maputo. From our interviews, it was difficult to disentangle price variation of different SP varieties; what was clear is that the price of orange-fleshed SP roots is paid a premium price by the consumers, 40%-50% higher than the price of the white-fleshed SP varieties, especially in Maputo area. It is worth noting that these price values and growth percentages may change considering different agents: the commercial farmers able to cultivate SP crop on irrigated land, for example, do not vary their selling price during the year. Complementary data from the MINAG's Market Monitoring System (SIMA) and data collected by CIP, however, capture a lower price variation between the peak and low supply season.

Consumers select SP roots based on their size, freshness, colour, absence of damage; different retailers, however, serve different types of consumers. Formal and informal markets cater for a broad of clientele, many of whom with a relatively low income. Interviewed consumers prefer OFSP varieties that are eaten boiled mainly for breakfast, fried or cooked with fish meals. Other information collected at retailers' level, however, do not confirm a straightforward consumption preference for OFSP varieties. Urban supermarkets sell to middle and high income consumers who are more demanding with regard to quality and willing to pay a higher price. They often import SP from South Africa as South-African suppliers can guarantee timely delivery of clean, large quality roots. Imports are typically white-fleshed varieties.

From the study of the two provinces, a list of opportunities/recommendations for developing the sweetpotato value chain has been identified. This list includes: stabilizing farmers' access to SP vines; boosting OFSP cultivation considering an increasing demand by urban consumers due to the increasing awareness for their nutritional values; taking advantage of business opportunities with supermarkets substituting imports from South Africa by improving production and post-harvest activities to achieve a larger, more stable and better quality supply of fresh SP roots; promoting fresh SP roots in fairs, markets and road shows to push the consumption's side of the chain; exploring linkages with other crops for wholesaling activities to enlarge the scale of the SP trade; stimulating the interest of donors and/or international organizations through projects that develop the SP value chain, including the one promoting conservational agriculture techniques for selected sweetpotato varieties.

Given the lower supply of fresh SP roots for at least four months a year and the consequent price increase of the produce in the market during that time, the increasing business opportunities foreseen if a larger, constant and more quality supply was provided to supermarket chains that pay better prices to farmers, and the need for a smooth supply of OFSP fresh roots during the early stages of the processing activities, an assessment of appropriate storage facilities has been carried out.

Storage facilities represent a way to guarantee a smooth SP supply during the year, to keep surplus crops safe and to retain their quality for several months; moreover, there are also financial incentives to keep the crop stored due to transportation, quality and price fluctuation or demand issues.

At the moment, to our knowledge, until now commercial SP fresh root storages do not exist in the focal provinces of the study, or elsewhere in Mozambique.

Our analysis from field work detected the possibility to install curing and storage structures for a group of commercial farmers in Namaacha district (Maputo Province) and for a processor of OFSP-based products located in Chimoio (Manica Province). The agents' types and locations for storage facilities have been chosen among a range of options considering the following: their current and foreseen business opportunities; the feasibility to set up root storage in a relatively short time; their strategic location near to the main urban centres and all-weather roads; the relatively small financial investments for the investor(s) and the recipients; the commitment shown by the agents. For the Namaacha site, additional data are needed. Once the interest of the exact number of farmers and their supply has been confirmed and formalized, a further analysis needs to be done to select the exact location, the dimensions and evaluate the local environmental conditions to help ensure its technical and economic viability. For the processor, the location and the dimensions are clearer, but his overall business is still in the preparatory phase and, only after take-off and reaching a full capacity modality, final recommendations may be made.

Detecting and developing the proposed two possibilities will help also to identify other opportunities for curing and storing the fresh SP roots in other parts of Mozambique. They can be seen as pilots that, once operating at full capacity, may convey information for future storage opportunities that may involve more agents and business opportunities.

1. Introduction

1.1. Objective of the study

In Mozambique, the Sweetpotato Action for Security and Health in Africa (SASHA) and the Scaling up Sweetpotato through Agriculture and Nutrition (SUSTAIN) projects are linked to exploit the full potential of the sweetpotato (SP) crop developing various aspect of its value chain. SUSTAIN is more directed to the scaling-up of production, nutrition benefits and marketing of orange-fleshed sweetpotato (OFSP) varieties while SASHA, with Phase 2, turns its strategic focus to the remaining bottlenecks to improve the utilization pathways for consumption and production.

To ensure continuous access to fresh roots to nutritionally at risk households, urban consumers and business activities processing SP-based products, one of the main issues remains to better understand the year round availability and supply of fresh SP roots. Due to climatic conditions and in particular the pronounced dry season, fresh SP root production has a defined seasonality in Mozambique. To help reduce SP root supply fluctuations it is important to deepen our understanding of appropriate SP root handling practices during and after harvest, including the development of appropriate and cost-effective fresh SP root storage technologies at medium/large and small-scale levels for different agents of the value chain.

This study investigates the:

- market for staple crops in Mozambique;
- the value chain structure of sweetpotato, including the fresh SP root production, availability and trade in the provinces of Maputo and Manica;
- potential for fresh SP root storage in the provinces of Maputo and Manica.

The aim of this study is threefold. Firstly, we assess how sweetpotato can be placed in terms of consumers' choice among the main conventional staple crops (i.e. cassava, maize, Irish potato). Secondly, we look at the SP value chain in two provinces where we gathered detailed information through interviews with agents at different segments of the chain (i.e. production, processing, transport, and trade) and assess the strengths and the weakness of each SP value chain. Thirdly, we aim to use the detailed value chain and root supply information identify opportunities for establishing fresh SP root storage facilities at farms' and processor's, respectively, in the provinces of Maputo and Manica.

This report is structured as follows: the remainder of Chapter 1 discusses the approach and methodology of the study and issues related to the data collected. Chapter 2 provides a brief overview of the geographical and socio-economic contexts of focal provinces. Chapter 3 presents an overview of the market for the main conventional staple crops, including price and demand information. Chapter 4 and Chapter 5 present, respectively, the structure of the value chain, identifying the agents and activities, in Maputo province and in Manica province, respectively. Chapter 6 provides an assessment of the potential role of fresh SP root storage facilities. Chapter 7 summarises the conclusions of the study and formulates recommendations on interventions to complement, operationalise and strengthen the fresh SP root supply and availability.

1.2. Approach and methodology

This section presents the approach and the methodological underpinnings of the study. The analysis of the value chains in the selected provinces provides an overview of the current situation, identifying strengths, weaknesses and bottlenecks considering the context and the different agents

engaged in one or more activities within the chain, to determine the feasibility of establishing and benefiting from a year round sweetpotato supply in selected urban centres.

The data used in the study mainly come from interviews with key value chain agents (e.g. farmer focus groups and individual farmers; retailers; processors; and service providers, i.e. Non-Governmental Organizations (NGOs) and the Ministry of Agriculture (MINAG) as well as from data collected by CIP as part of its market monitoring effort. Secondary data come from relevant literature on Mozambique, SP value chains and processing/storage. The (primary) data collection was carried out in two provinces (Maputo and Manica) in two different times: between 27th and 30th October 2014 and 20th and 30th April 2015. An overview of the interviews conducted during the field work is presented in Table 1.1; these interviews involved more than 55 respondents, through focus groups and individual discussions carried out by Ilaria Tedesco, researcher from the Natural Resources Institute (NRI), UK and Roland Brouwer, staff at International Potato Centre (CIP), Mozambique, with support of António Mata, Ezequiel Foi, Yvonne Tomé, and Edmundo Francisco as translators. Checklists for each value chain agent were prepared in advance and used during the fieldwork. The interviews were conducted in Portuguese, Xichangana, Ciutee/XiManica and English.

The selection of the agents to interview is based on the focus of the study and the availability of the respondents. Some were previously identified by CIP as key actors.

Table 1.1: Focus group discussion and case study interviews conducted for the sweetpotato value chain study

	Provinces	
	Maputo	**Manica**
Farmer focus group	X	X
Individual farmer	X X X X	X X X
Retailers	X X X X X X X X	X X X
OFSP Processors		X
Extn & NGO		X X X
Urban consumers	X X	
Total=25	14	11

Note: X represents each interview

The study can neither guarantee statistical representativeness nor complete coverage. The main reasons for this are time and resource constraints. At the same time, however, the data provide a useful image of the importance of sweetpotato in general and of orange-fleshed varieties in particular, and of the associated challenges and opportunities for their production and marketing. The primary data provides useful understanding of relevant activities, SP root exchanges and flows within these important SP producing and consuming locations of Mozambique.

In this report there are several tables reporting revenues, costs, margins and main characteristics of interviewed agents. The revenues take into account all the activities that deal with sweetpotato, orange-fleshed sweetpotato roots and vines; the costs listed represent all the expenses faced by each agent to run their activities. When some revenues and costs are shared among several activity and crops, assumptions have been made to disentangle the part pertaining to sweetpotato. Production and trading activities are recorded in per bag or per kg term; where possible, information about the dimensions of the bags are provided. The individual case studies with a few SP farmers at each location present data on the costs of labour that can either be hired and/or provided by family members. For family labour, the same wage was used as the one recorded for hired labour (with the calculation of two different gross margins, with and without family labour cost). The production of SP for home consumption is recorded as a production amount to be traded, as it may represent a shadow revenue (or opportunity cost) for the farming household.

2. Brief description of the selected areas

2.1.General information

Mozambique consists of 11 provinces and 128 districts. There are about 60 municipalities with territories that partially overlap with districts. Government is centralized in an elected president who appoints the ministers and the provincial governors. Elected are also parliament, and representative councils at provincial and municipal levels. Provincial governors nominate district administrators and *chefes de posto*. These *chefes de posto* respond for smaller territories within the districts, the so-called *postos administrativos.* In the municipalities elected mayors select their aldermen. Line ministries are represented at the provincial and the district level. At the district level they are grouped in district services.

Historically Mozambique has been an important transit area for landlocked countries such as Zimbabwe, Zambia, Malawi and Swaziland that lack territorial access to the sea (ATPC, 2010).
To connect these countries to the sea through Mozambique, there are three important corridors in: the Nacala Corridor in the North connecting Malawi to Nacala Porto, the Beira corridor in the Centre connecting Malawi, Zambia and Zimbabwe to the port of Beira, and the Maputo corridor connecting South Africa and Swaziland to the port of Maputo. Less important is the Limpopo corridor which connects Zimbabwe to the Maputo port by railway and road along the Limpopo River.

The International Potato Centre (CIP) with SUSTAIN focuses on two important economic corridors: the Beira corridor in the centre of Mozambique, and the Maputo corridor in the south. These corridors represent important lifelines to the *hinterland* and to a large extent drive the economic activities in their respective port cities. The economic corridor approach looks at regional transport routes not only as a means of transporting goods and services or as a gateway for land-locked countries, but also as a tool for stimulating social and economic development in the areas surrounding the route. Economic corridors accomplish this by creating industry and social facilities in conjunction with transport infrastructure. In doing so, they develop rural and border areas, increase the earnings of low-income groups, and create employment (AFDB, 2013). CIP is using transport corridors as a means to develop the regions.

Table 2.1 provides a list of key demographic data of the districts in the Beira and Maputo corridors where CIP is currently active. The districts are quite different in size and population densities with the urban centres of Beira, Chimoio and Maputo City having relatively small territories and high population densities.
Considering our focal provinces, CIP works in seven districts in Manica Province with a population of about 1 million in 2007[1]. In the Maputo corridor area, CIP works currently in five districts in Maputo Province and in Maputo City. Maputo City is at the same time a province and a municipality with a Governor appointed by the president and a Mayor elected by its population. In 2014 CIP has reached about 10,000 households in Manica (about 5% of all households in the target districts) and 1,500 households in the targeted districts in Maputo Province (about 1.5% of all households) through the distribution of vines and the dissemination of information of the dietary benefits.

[1] The districts of Macate and Vanduzi are not mentioned in the table because their territories were carved out of the districts of Gondola and Manica only in 2014. Their inhabitants therefore are counted in Table 2.1 as residents of these districts.

Table 2.1: Key demographic data for the districts covered by CIP under the SUSTAIN project in Mozambique

Province	District	Number of Inhabitants	Number under five	Number of households	Average household size	Area (km^2)	Pop density (ha/km^2)
Manica	Barue	137,352	29,221	28,111	4.9	5,750	23.9
	Chimoio	247,497	41,274	46,406	5.3	174	1,364.9
	Gondola	258,548	50,704	52,484	4.9	5,290	48.9
	Manica	215,275	41,406	43,280	5.0	4,391	49.0
	Sussundenga	128,866	27,132	25,242	5.1	7,060	18.3
	Subtotal	987,538	189,737	195,523	5.1	22,665	43.1
Sofala	Beira	431,583	58,944	94,804	4.6	633	681.8
	Dondo	141,003	22,339	30,835	4.6	2,306	61.1
	Nhamatanda	207,987	38,717	43,243	4.8	3,975	52.3
	Subtotal	780,573	120,000	168,882	4.6	6,914	112.9
Maputo Province	Boane	102,555	16,302	25,393	4.0	820	125.1
	Matola	671,556	95,454	142,296	4.7	373	1,800.4
	Manhiça	157,642	25,668	35,454	4.4	2,380	66.2
	Marracuene	84,975	13,703	20,712	4.1	5,387	6.9
	Namaacha	41,954	10,505	10,588	4.0	4,628	12.2
	Subtotal	1,058,682	161,632	234,443	4.5	15,732	67.9
All		2,826,793	471,369	598,848	4.7	45,311	62.4
Maputo City	All districts	1,244,227	159,583	212,813	5.8	347	31,53.6
Total		4,071,020	630,952	811,661	5.0	45,658	85.9

As part of fieldwork, for this study, data were collected in Chimoio, Macate (formerly part of Gondola district), Vanduzi (formerly part of Manica district), Boane and Marracuene (during fieldwork in October 2014), Manhiça and Namaacha and in Maputo City (in 2015). In Chimoio and Maputo City data collection was focused on retailers and in the other territories on farmers and traders. Macate (until 2014 part of Sussundenga) and Manhiça are important supply areas to the urban markets in Chimoio and Maputo respectively.

The following two sections provide more insight into the general characteristics and dynamics of the Beira and Maputo corridor which may be relevant for the production and marketing of fresh and processed sweetpotato.

2.2.Beira corridor

According to a report developed for the Beira Agricultural Growth Corridor (BAGC) Initiative, the Beira Corridor has huge agricultural potential that is, as yet, unrealized. In order to properly develop this region a significant amount of agriculture-supporting infrastructure needs to be built and suitable finance needs to be provided.

The BAGC covers an area of 227, 000 km^2 of which 10 million ha is arable land in four countries. Only 1.5 million ha is currently being used. However, Beira is not only an area of agricultural opportunity. The Port of Beira is a critical import/export point for Mozambique, Malawi, Zimbabwe and Zambia. These countries are developing better road and rail networks to link their industries to the port[2] (Figure 2.1)
Within Mozambique, the Beira corridor crosses the provinces of Manica, Sofala and Tete. Manica is a plateau with mountains reaching up to 2436 masl at Mount Binga. Sofala is a lowland area defined by the Púnguè river floodplain. Sofala's capital, the port city of Beira, is a natural harbour at the Púnguè river mouth.

Figure 2.1: The Beira corridor in a regional perspective *(http://www.beiradevelopmentcorridor.com/)*

Figure 2.2 summarizes the most important crops along the corridor. Important cash crops are tobacco, cotton and sugarcane. There is very little large-scale commercial agriculture, with important commercial crops such as tobacco being produced by smallholders through out-growers' contracts to Mozambique Leaf Tobacco under a monopolistic system. Maize is the main staple. In addition to being consumed at home maize is sold by smallholders to commercial grain mills such as DECA near Chimoio and ECA close to Catandica in Báruè. Soybean is an emerging commercial crop almost exclusively used to sustain the production of poultry.

The soy market is also highly monopolistic with the Abílio Antunes Chicken Farms company buying most of the produce. The most important commercial vegetable producer is the Vanduzi company in Vanduzi district, a subsidiary of MozFoods. Vanduzi is the main fresh vegetable exporter in Mozambique.[3] Companhia do Vandúzi grows, sells and exports fresh produce.

Figure 8: Smallholder production in BAGC

Smallholder production	Hectares (ha)	Estimated total production (tonnes)
Tobacco	80,000	20,000–30,000
Cotton	20,000	5,000–10,000
Maize	645,000	500,000–600,000
Beans & groundnut	212,000	n/a
Sorghum & millet	207,000	n/a
Vegetables & spices	140,000	n/a
Rice	40,000	20,000–30,000
Livestock	5.2m chickens; 1.9m goats; 0.6m cattle; 0.6m swine	

Figure 2.2: Summary of major crops under small holder production in the Beira Corridor *(http://www.agdevco.com/sysimages/BAGC_Investment_Blueprint.pdf)*

[2] http://www.beiradevelopmentcorridor.com/ visited 16/05/15
[3] Vanduzi company website, http://www.vanduzi.co.mz/ visited 16/05/15.

It employs more than 1,800 people and works with 750 out-growers[4]. Sugarcane is another important crop in the Beira Corridor. There is an important plantation in Mafambisse in Dondo, close to the main road between Chimoio and Beira neat the Púnguè River. Sugarcane is typically a plantation crop and not grown by individual farmers, although the sugar companies, in a bid to increase their acreage, have engaged neighbouring farmers through outgrowing.

Figure 2.3 shows the climate chart for Chimoio (Manica) and Beira (Sofala). Chimoio/Manica has a relatively humid climate with an average annual rainfall of 1,080 mm. The rainy season is from November until March, with 82% of the average rainfall. In Beira average annual rainfall is 1,523 mm.

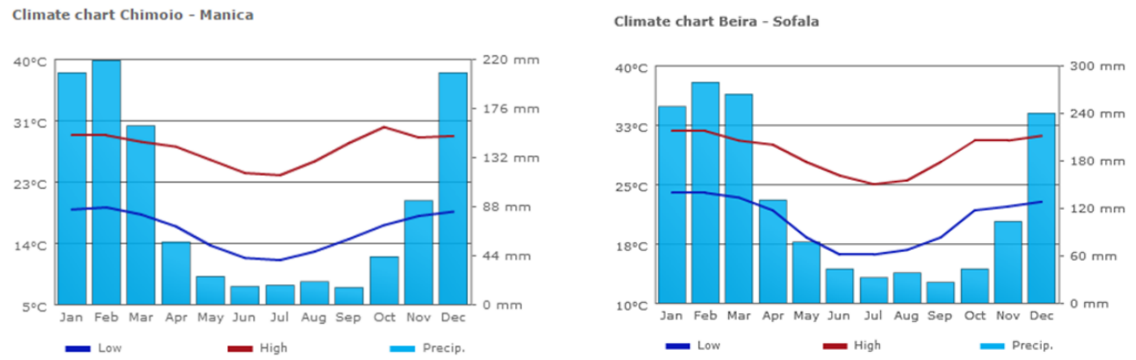


Figure 2.3: Climate chart for Chimoio (Manica) and Beira (Sofala) (source: www.climatedata.eu)

The difference between these two cities show that rainfall and temperature are modified by altitude and distance to the sea. For that reason, the agro-ecology varies strongly along the corridor due to differences in elevation.

Figure 2.4 shows the elevation profile from Machipande border in the west at 1,066 masl to Beira port (about 9 masl). It shows clearly the highlands close to the border with Zimbabwe, the plateau around the towns of Manica and Chimoio, the rapid descent into the lowland near Inchope on the border with Sofala province with a small rise after crossing the Púnguè River close to Mafambisse in the Dondo area and then gradually descending to the coast at Beira. The variation in altitude and the presence of the Púnguè River has a direct impact on sweetpotato production. Sweetpotato production in the higher areas takes place in the second half of the rainy season December to April), with most people planting after the first weeding of maize (from February onward). In the lowland of Sofala sweetpotato is planted in rotation with rice: during the rainy season the flow in the river increases and rice is planted in the inundated floodplains. When the waters recede and the rice is harvested the area is used for sweetpotato.

Figure 2.4: Elevation profile for the road between Machipande border and Beira port (source: Google Earth)

[4] Mozfoods SA is for 100% owned by AQUIFER, which is supported by the Gatsby Foundation, (http://www.gatsby.org.uk/africa/programmes/aquifer-limited visited 16/05/15). Its connection to a not-for-profit organization may affect its business logic as it may have access to additional support.

The map in Figure 2.5 shows the location of the districts in the Beira corridor where CIP is currently active. Macate and Vanduzi are not yet shown separately as they have been created recently. In 2014 CIP has concentrated its activities on Manica due to political instability in Sofala. A key market area in Manica is Chimoio, the provincial capital with about 240,000 inhabitants. An important supply area is Macate, since 2014, an independent district but prior to this an administrative post within the district of Sussundenga. The present study focuses on Chimoio and Macate.
It should be added that CIP has developed activities in Manica and Sofala under previous projects, in particular the Office for Disaster Assistance (OFDA) project.

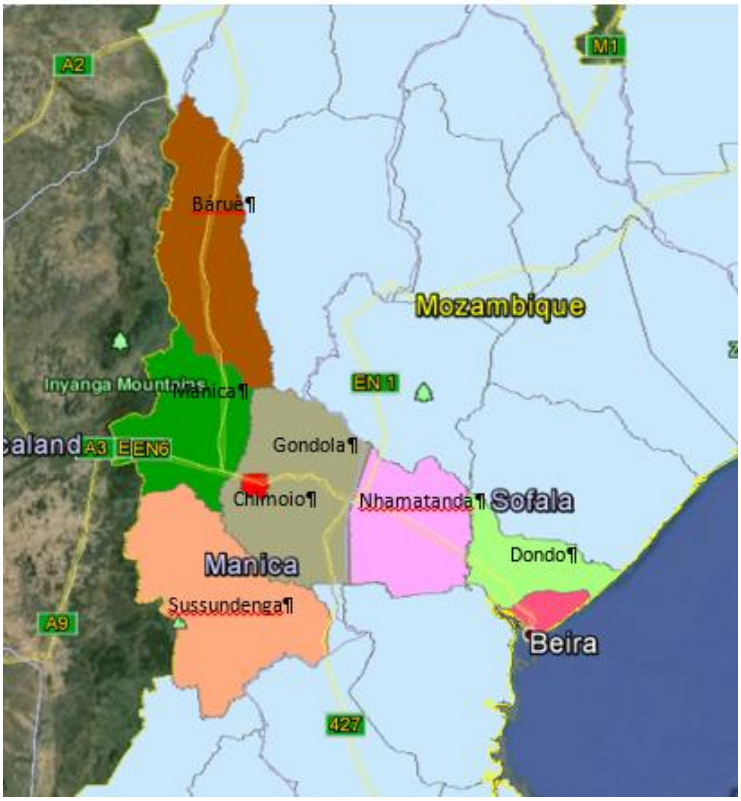


Figure 2.5: Map with the districts covered along the Beira corridor (not covered are light blue)

Some of the vine multipliers that had been established under the OFDA project in Manica were reactivated in 2014 whereas new multipliers were added to boost supply to rural households. Prior to CIP the NGO Africare between 2002 and 2006 has distributed sweetpotato varieties in Manica whereof some were orange-fleshed. The planting material was obtained from IIAM/CIP. Some of these varieties are still present on the local market.[5]
Agriculture is dominated by smallholder family farms. At the level of the province in 2010, according to the Agricultural Census, 265,486 smallholders farmed 55,900 hectares. The 53 large-scale commercial farmers only farmed 2,788 hectares (INE, 2011). Smallholders are defined as farming up to 50 hectares non-irrigated land or 10 hectares of irrigated land (INE, 2009).
Table 2.2summarizes statistics provided by the provincial government of Manica as part of its Social and Economic Plan (*Plano Económico e Social* –PES) for 2013 for the eight most important crops (GPM, 2013). The data confirm the importance of maize as a staple. It represents about three-quarters of the total volume of these eight selected crops. Sweetpotato is the second most important staple, followed by cassava. Irish potato production is about half the volume of sweetpotato. Sweetpotato is exclusively grown by smallholders. In contrast, a significant proportion of Irish potato is grown on commercial farms even though the percentage produced by smallholders has steadily increased over the 2010-2013 period.

[5] Africare Manica Extended Food Security Initiative (MEFSI). The initiative reached about 3400 households in four districts (Báruè, Gondola Manica and Sussundenga).
http://www.iiam.gov.mz/documentos/dfdtt/wshop_namp_mar_07/africare_batata_doce-usaid_presentation_marco_06-07_2007.pdf, retrieved 4/6/2015.

Table 2.2: Production volumes (tonnes) for selected crops and the respective percentage contribution from smallholders and from commercial farms (GPM, 2013)

Crop	2010			2011			2012		
	Small scale	Large scale	Total	Small scale	Large scale	Total	Small scale	Large scale	Total
Maize	98%	2%	625,398.4	96%	4%	866,765.4	93%	7%	1,027,202.6
Rice	83%	17%	1,637.0	100%	0%	1,969.6	0%	0%	0.0
Sorghum	98%	2%	37,678.8	99%	1%	52,743.8	100%	0%	60,021.0
Cassava	100%	0%	49,532.0	100%	0%	61,259.8	100%	0%	95,860.0
Irish potato	82%	18%	23,095.9	88%	12%	45,921.2	90%	10%	67,255.3
Sweetpotato	100%	0%	130,525.8	100%	0%	98,945.8	100%	0%	149,899.5
Soy	88%	12%	3,504.3	58%	42%	5,692.4	94%	6%	6,575.3
Wheat	100%	0%	6,024.4	100%	0%	4,666.0	97%	3%	5,303.5

Source: GPM 2013

Figure 2.1shows the commercialized volumes as percentages of the production figures. About two-thirds of the maize is traded against about one-third of sweetpotato. Irish potato is imported with trade representing more than 100% of the produced volume. Chapter 3.2.3 contains additional information about the production and trade in Irish potato. After being a net-importer in 2010 now about half of the cassava appears on the market. In terms of volume, sweetpotato trade is 8% of the trade in maize; cassava is roughly the same volume. Irish potato trade is the double of sweetpotato and about 14% of the volume of maize on the market. For more details on the sweetpotato value chain see Chapter SP retailing 3.3.3 and after.

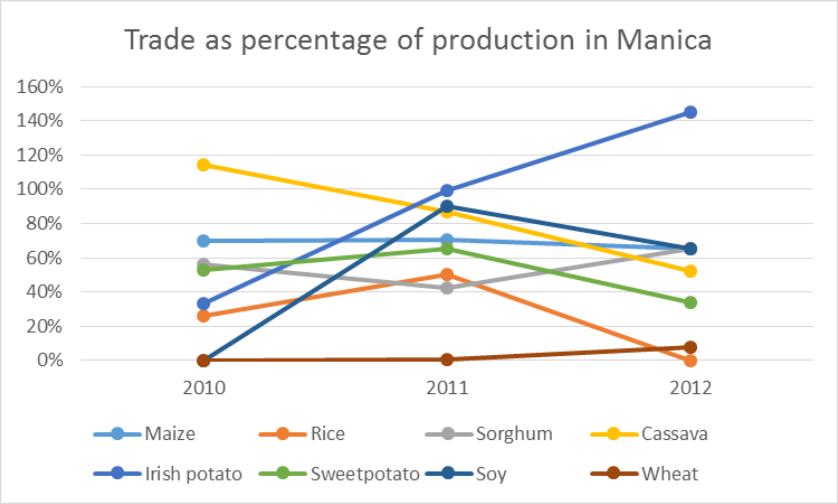


Figure 2.6: Trade as a percentage of production in Manica province (based on PES 2013)

2.3.Maputo corridor

The Maputo Development Corridor (MDC) was officially launched in May 1996 in Maputo by the presidents of South Africa and Mozambique. Within two years it became known as the 'most advanced international development corridor in Africa' (Department of Transport, 1997; (Mitchell, 1998).

The Maputo corridor was originally conceived as the connection between South Africa through Ressano Garcia (in Moamba District) and the harbour in Maputo City by road and by rail. Ultimately, the Maputo Corridor is envisaged to be extended through Botswana, along the new Trans-Kalahari Highway, to Namibia, with its end point at the at Walvis Bay (Simon 1998c). This is known as the

TransAfrica Coast2Coast Spatial Development Initiative (previously the TransKalahari Transport Corridor). The Lubombo Spatial Development Initiative is a tourism-led initiative that links South Africa, Swaziland and Mozambique through the roads between Maputo City and Namaacha/Goba and Maputo and Ponto de Ouro in the South of the Maputo province. The Maputo Development Corridor is designed on the basis of an existing but underperforming economic development corridor. Central to the strategy was infrastructural upgrading comprising the N4 toll highway between Witbank and Maputo, the railway line, portside facilities, telecommunications links, along with dredging of the port (Simon, 2002).
While the Spatial Development Initiatives focus on the transport and communication connections between distinct areas and the promotion of investment at strategic locations along these connections, CIP's role is associated with livelihood and nutrition of the communities in the surrounding areas through the promotion and up-scaling of the production and consumption and marketing of OFSP along the connecting corridors.

Key to agriculture is obviously the climate. The climate in Maputo province is much drier than in Manica. In Manhiça (Maputo province), average annual rainfall is 850 mm (Figure 2.7). Like in Manica, there is one dry and one rainy season. The rainy season is roughly from November till April. During this period about 74% of total average annual rainfall is registered. In Changalane, more to the south and west in the district of Matutuíne, total average annual rainfall is only 647 mm.

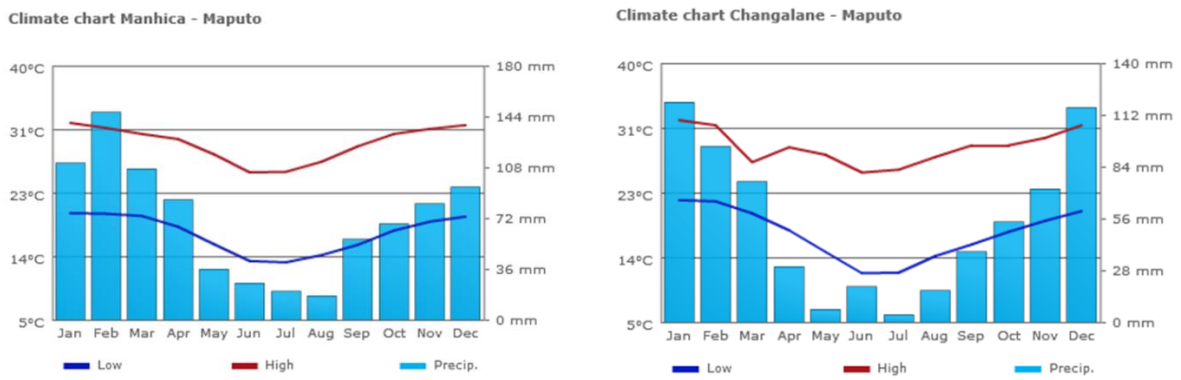


Figure 2.7: Climate charts for Manhiça and Changalane, Maputo province www.climatedata.eu

Strictly speaking only Boane, Moamba and Namaacha are part of the Maputo corridor, as they are crossed by the road and railway connections between Maputo and South Africa and between Maputo and Swaziland respectively. Manhiça, where most activities have been concentrated, is strictly speaking not crossed by the Maputo corridor. However, it is crossed by the N1, which is the road that connects the North and South of Mozambique, and by a railway that offers Zimbabwe access to the Maputo port along the Limpopo River.
In Manhiça there are also two important sugar plantations: Xinavane and Maragra. In the colonial era it used to produce rice. The rice mill in Palmeira village (on the N1 between Manhiça town and Xinavane) has been reactivated but is milling rice from Chókwè in Gaza Province rather than from Manhiça itself.

Manhiça is also a key sweetpotato production area. It benefits from the low-lying clay soils along the Incomati River. This river allows for year-round irrigation so that in principle the district can produce potato all year. However, in reality the farming cycle is constrained by the raising river: during the rainy season the floodplain gets inundated and cannot be farmed. As a result, in reality sweetpotato farming occurs mainly from March till November.

In Maputo from 2014 CIP has been working through SUSTAIN in the districts of Boane, Manhiça, Marracuene, Matutuine, and Namaacha. Moamba will be added in 2015 (Figure 2.8). The selection of these districts is largely in response to request and actions by local governments and NGOs.

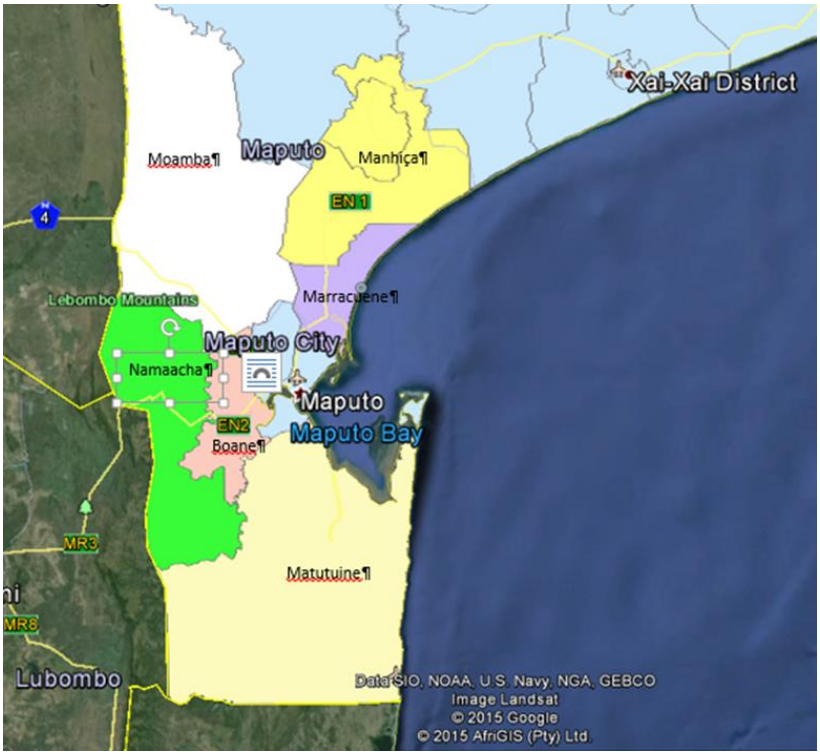


Figure 2.8: Map with the districts currently covered by SUSTAIN along the Maputo corridor (not covered are blue)

Trade statistics for Manhiça district for the first three months of 2015 provided by the local government (Serviço Distrital de Actividades Económicas – SDAE) (Table 2.3) confirm the importance of three crops: maize, sweetpotato and cassava. In the district trade in sweetpotato appears to be more prominent than that trade in cassava and even maize.

Table 2.3: Trade statistics for Manhiça for Jan-March 2015

Crop	Planned	Obtained	Percentage
	Tonnes	Tonnes	
Maize	21967	8949	40.8
Sweetpotato	29617	19258	65
Cassava	20013	8931	44.6
Peanut	5536	1845	33.3
Beans	604	305	50.6
Vegetables	2010	839	
Fruit	4491	1942	

Source: SDAE Manhiça

The main market is obviously the Maputo/Matola urban area. Maputo City alone has about 1.1 million inhabitants. Most of these do not farm but rely on the market to gain access to their food. Geographically the city is stratified in two main areas: the old colonial “cement” city, which is surrounded by the peri-urban “straw” neighbourhoods. The central areas have a more prosperous population whereas the residents of the “straw” belt are poorer (Brouwer & Low, 2014). As will appear in the more detailed discussion of the commodity chain this stratification is relevant for how commodity markets in the city are operating.
The 2015 fieldwork was restricted to farmers in Manhiça and Namaacha and to traders and retailers in Manhiça and Maputo. In 2014 however, the team visited one important producer in Boane and interviewed a producer with land in Moamba, and traders/retailers in Marracuene.

3. Market for staple crops in Mozambique

3.1. Introduction

Table 3.1 and Table 3.2 show at national level the role of the staples in the diet and the trade balance, respectively. They show that the main source of calories is cassava followed by maize. Wheat and rice are relatively less important with about 7% of the caloric intake each. Mozambique is basically self-sufficient for maize with imports and exports essentially balanced, whereas the country is highly import dependent for wheat and rice. Cassava, is produced and consumed domestically.

Table 3.1: Importance of staple foods in diet in Mozambique 2005-2007 average (Donovan & Tostão, 2010)

Commodity	Quantity consumed (kg/person/year)	Daily caloric intake (kcal/person/day)	Share of total caloric intake (percent)
Maize	58	462	22%
Cassava	247	740	36%
Wheat	20	147	7%
Rice	15	145	7%
Others	87	587	28%
Total	427	2082	100%

Source: FAO, 2009a

Table 3.2: : Production and trade of food staples in Mozambique, 2009/2010 Balance Sheet (Donovan & Tostão, 2010)

Commodity	Production	Imports	Exports	Imports as a percentage of apparent consumption	Exports as a percentage of production
Maize	1932	220	233	11.5%	12%
Cassava	7437	0	5	0%	<1%
Wheat	10	429	2	99%	<1%
Rice	165	258	0	61%	0%

Source: MIC, 2009.

Note: Apparent consumption is production plus imports minus exports and non-food uses. These data are considered provisional, and the production estimates reflect higher estimates than would be predicted based on TIA household survey data.

The Ministry of Agriculture operates the Agricultural Markets Information System (SIMA). SIMA employs a group of surveyors who monitor the key markets in their areas on a weekly basis. SIMA collects and aggregates these data and produces a weekly summary with information about market prices and supply as well as important supply routes. The sections below are derived mainly from their data. The sections address two staples (Maize and Cassava) and Irish potato, which in many ways "compete" with sweetpotato, even though it has a drastically different position in domestic consumption patterns.

3.2.Main staple crops

3.2.1. Cassava

Cassava is sold fresh and as flour. The volume of the cassava market is unknown. PES 2013 figures for Manica estimate total production at about 96 thousand tonnes. Assuming that all is consumed in the province (there are 1.4 million inhabitants in 2007) – either by the producers or bought at the market – average per capita consumption here is 67 kg of fresh roots per year. Assuming that 1 kg of fresh root is the equivalent of about 0.4 kg of dry root, consumption is about 28 kg of dry root per year which is less than the average estimated for the maize belt area (43 kg). This suggests that the difference of about 15 kg is imported from other provinces.

According to SIMA the market price in Chimoio varies between 5 and 20 Meticais per kg. In Maputo it varies between 11 and 18 meticais per kg (Figure 3.1). This would fit with the previous observation that cassava is imported from other territories. On the average, in Maputo cassava is about two meticais per kg more expensive than in Chimoio.

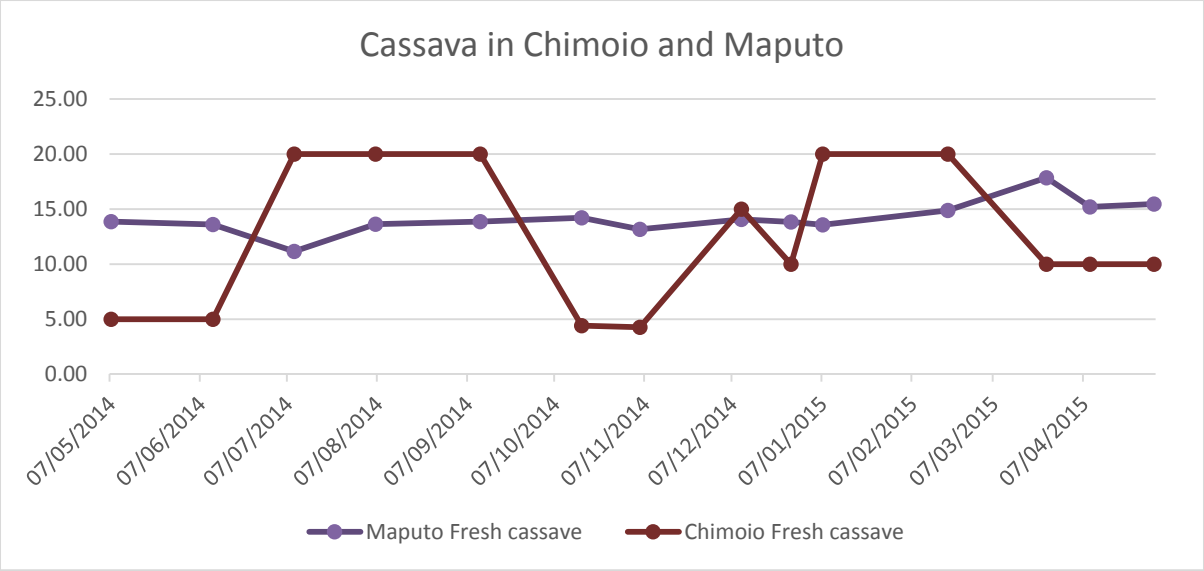


Figure 3.1: Price variation for cassava per kg between May 2014 and May 2015 (Source SIMA)

SIMA data indicate a strong seasonal variation for prices in Chimoio. The reason for this is not obvious. For Maputo there are no production data available and seasonal variation is about 50% (between 11 and 18 meticais) with a low in July and a high in March.

3.2.2. Maize

Maize is the main staple. According to the Government of Manica Province's Economic and Social Plan (PES) for 2013 in Manica the production for 2012 is estimated at more than one million tonnes (GPM, 2013). In Manica about 93% of the maize is produced by smallholders. Trade is dictated by urban demand and by the farmers' need for cash. Maize is milled at small mills dispersed over the territory and by some major grain mills. In Manica there are DECA in Chimoio and ECA in Catandica.

Estimating average consumption at about 79 kg per person per head, Manica produces a surplus of about 916 thousand tonnes. This is probably sold to other provinces.

In Maputo prices vary between 12.70 and 13.45 meticais per kg. The price difference between both markets ranges between 1.27 and 6.59 meticais per kg which makes it probably attractive to export maize from Manica to Maputo. SIMA emphasizes that Sofala (Nhamatanda district) is an important supplier to Maputo.

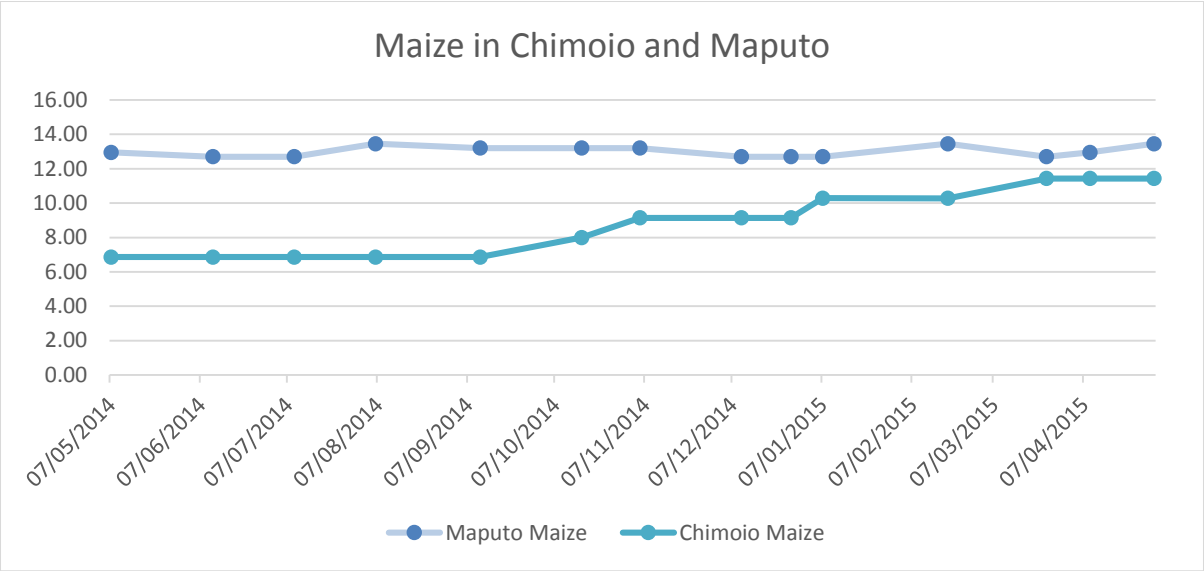


Figure 3.2: Retail prices for maize per kg in Chimoio and Maputo (from SIMA)

Maize is a seasonal crop (harvests in April-May). SIMA price data for maize in Manica in Figure 3.2 surprisingly do not reflect seasonal variation. Instead, they show a gradual increase over the entire period. They are lower than in Maputo which may mean that Manica is one of the supply areas. However, surprisingly over the observed period the difference between both markets decrease. In Maputo prices are stable. Over the 12-month period summarized in the graph price variation is only 5%. There is no visible influence of season.

3.2.3. Irish Potato

Irish potato production is growing but still small. The crop is grown by smallholders and commercial farmers. One of the areas with a strong potential is Manica province. Total output in Manica has almost tripled over the 2010-2012 period. This increase is taking place mainly among smallholders with their share of land increasing from 10% in 2010 to 18% in 2012. Irish potato is a commercial crop and demand is much higher than local production satisfied by imports (GPM, 2013).

Figure 3.3 graphically summarizes prices for national and imported Irish potato. In Chimoio nationally produced Irish potato costs between 7 Meticais and 35 Meticais, with the price of import varying between 25 and 45 Meticais per kg. In Maputo the imported Irish potato has a stable price of 30 Meticais throughout the year, whereas domestic potato is sold in Maputo between 14 and 30 Meticais. In Chimoio the prices of imported and domestic Irish potato appear correlated; in Maputo not.

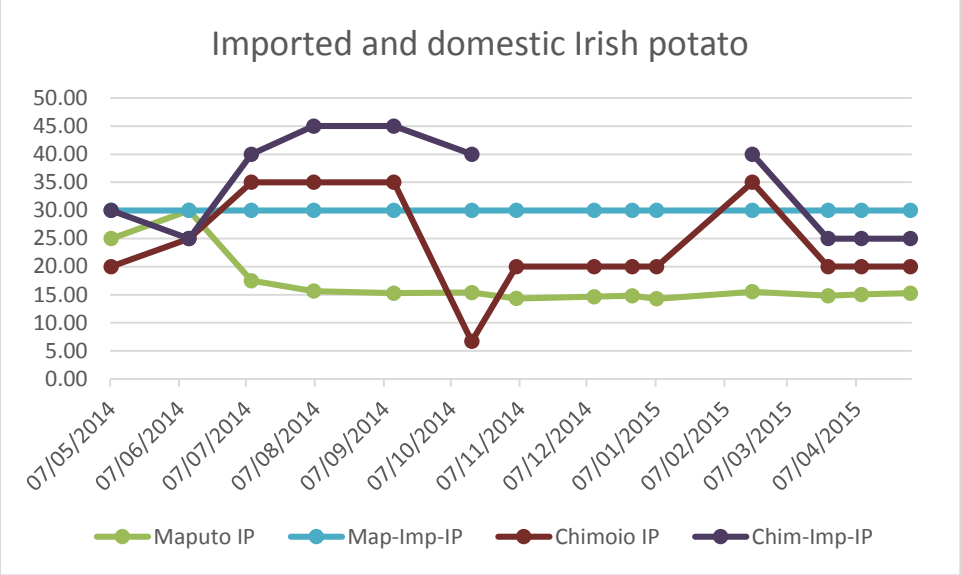


Figure 3.3: Prices per kg of national and imported Irish potato in Chimoio and Maputo between May 2014 and May 2015 (from SIMA)

The figures presented by SIMA and summarized in Figure 3.3 are rather odd. In December potato prices tend to rise sharply during the festive season. But this rise is not reflected in the data collected and published by SIMA for Chimoio and Maputo even though the SIMA bulletin for 27 December refers to pronounced hikes on other markets including Manica Town and Beira, both also in the Beira corridor-

Figure 3.4 provides summary of the actors in the Irish potato chain. CIP (with the wrong abbreviation CPI) is highlighted as a contributor to R&D in this chain.

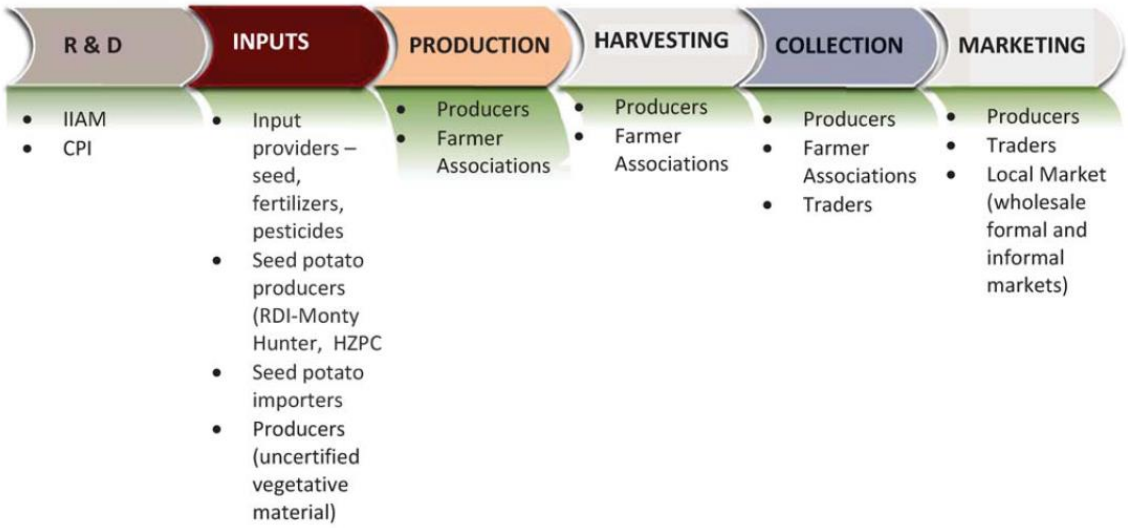


Figure 3.4: Irish potato value chain *(Ministry of Economic Affairs, 2014)*

A 2014 report published by the Dutch Embassy in Pretoria on horticulture and potato market highlights the huge demand (1 million worth fresh vegetable imports per month according to Custom data from September 2013) and the impact of the lack of a vegetable processing unit in Maputo leaving the producers having to sell on-farm at low prices even for good quality produce.

There is no processing due to too little potato production and its seasonality. Production is concentrated in a small area. The districts of Angonia and Tsangano in Tete province produce over 70% of the potatoes in the country (Ministry of Economic Affairs, 2014).

Total area dedicated to Irish potato is estimated at 18,000 hectares. About 14,800 is farmed by smallholders, 529 ha by medium-scale farmers and the remaining 2652 ha by large-scale farmers (Figure 3.5).

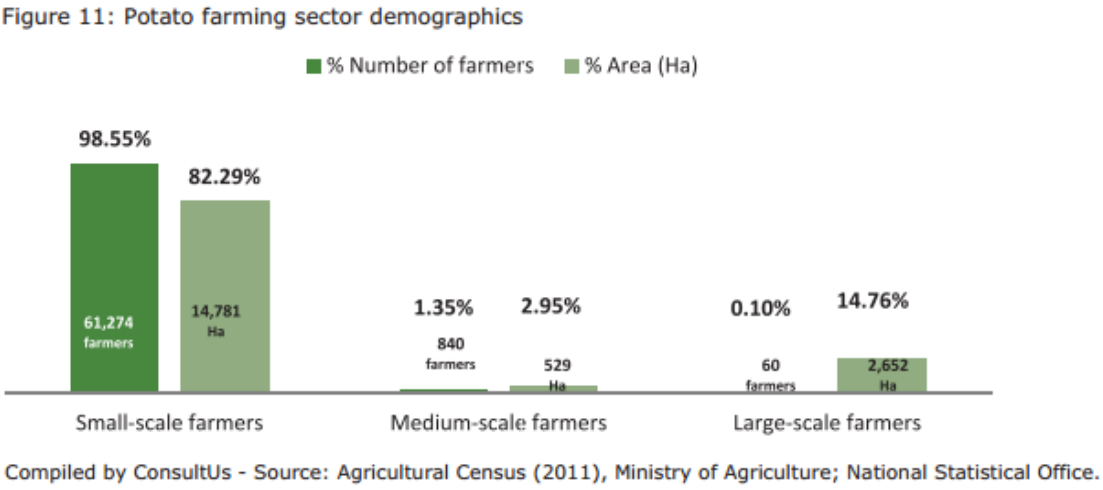


Figure 3.5: Area under Irish potato by type of farmers *(Ministry of Economic Affairs, 2014)*

Most of the production capacity is located in the Beira corridor (Angonia and Tsangano in Tete). There are also some activities in the Maputo area. The Beira corridor (Tete, Manica and Sofala) is the region with the highest number of potato farmers and area under potato production. The Beira corridor harbours 46,240 potato producers, over 74% of the potato farmers in the country and they produce on over 76% of the land under potatoes. Tete province, mainly in the districts of Angonia and Tsangano, is the single outstanding potato producing province in the country with 70.3% of the potato farmers producing on 69.6% of the total area under potatoes. Niassa province in the Nacala corridor comes second. Overall, Tete and Niassa provinces secure 85% of the farmers and 82% of the total area under potatoes. Manica contributes 5.16% and Maputo 4.88%. Irrigation allows for year-round production in Tete and Niassa and two harvests in the other areas. (Ministry of Economic Affairs, 2014). The importance of imports is estimated at 17% for 2010/2011 (MINAG, 2008).

It should be noted that until economic liberalization in the 1990s the marketing of Irish potato was a state monopoly under the state-owned Hortifrutícula company. The company would transport the potatoes from Tete to a warehouse house in the Umbeluzi area close to the IIAM research station. The point is still called Mazambanine, which means something like “potato spot” in Xichangana but the warehouse has fallen into disrepair and is no longer used. It managed also a cold storage in the Machava area called Frio (which means “cold” in Portuguese). This is now used by Customs as a storage for all kinds of commodities waiting for clearance for import. Hortifrutícula still exists but has lost its dominance in the value chain and is mainly a wholesaler for other less perishable vegetables (e.g. onions) and foodstuffs (e.g. sodas). It would like to recuperate part of its role and is looking for possibilities to recuperate its storage.

3.3.Sweetpotato and orange-fleshed sweetpotato

3.3.1. Production

Any discussion of the sweetpotato value chain requires an understanding of the crop as part of the agricultural sector. Sweetpotato is part of a wider farming system. This system consists of other crops, animal husbandry and other activities including trade. It goes beyond the scope of this study to present a profound description of the farming systems that exist in the two provinces that are the focus of this study.

The most important crop nationally, including in the area of Manica and Maputo, is maize. It occupies 32% of the farmed area at the national level, and covers an even broader percentage of total land in Manica and Maputo of 51% and 43%, respectively. The second and third most important staples are cassava and beans (15% at the national level). There is important regional variation: in Manica, sorghum is an important staple (8%) while in Maputo peanut is even more important than beans (19% compared with 13%). Sweetpotato occupies about 1% of the farmed area: about one-third is under the OFSP varieties and two-third white-fleshed ones (Table 3.3).

Table 3.3: Land under crops measured in hectares and the % of each crop over the total land (TIA 2012)

Crop	Manica		Maputo		Total	
Maize	255,780	51%	43,133	43%	1,572,009	32%
Rice	456	0%	0	0%	363,392	7%
Sorghum	40,180	8%	115	0%	307,272	6%
Millet	10,459	2%	21	0%	54,627	1%
Peanut	21,476	4%	19,053	19%	389,264	8%
Beans	48,463	10%	13,466	13%	759,313	15%
Irish potato	133	0%	52	0%	11,791	0%
Cassava	27,037	5%	10,206	10%	762,598	15%
OFSP	**3,354**	**1%**	**1,588**	**2%**	**16,562**	**0%**
WFSP	**7,033**	**1%**	**2,128**	**2%**	**54,728**	**1%**
Cotton	21,785	4%	0	0%	206,532	4%
Other	64,830	13%	11,215	11%	428,565	9%
Total	500,988	100%	100,978	100%	4,926,652	100%

Table 3.4 summarizes the importance of white-fleshed sweetpotato (WFSP), orange-fleshed sweetpotato and cassava at the national level and per province expressed by the numbers of households farming each of these crops. The data suggest that the percentage of households farming cassava is about 4.1 times the percentages for WFSP, and that OFSP is farmed by approximately one-third of those farming white-fleshed sweetpotato. In Manica and Maputo alike, about 40% of the households farm cassava. The percentage producing WFSP is slightly higher in Manica (15.76% compared to 8.25%) but the proportion of households farming OFSP is much lower in Manica (0.3) than in Maputo (1.1) In Maputo OFSP penetration appears to be much larger. It should be noted that these figures are taken from TIA. TIA data are based on samples and not on a census, and it does not contain information at district level.

Table 3.4: Percentages of farmers cultivating cassava, OFSP and SP per province in 2012 (TIA)

Territory	Cassava	OFSP	WFSP	Cassava/WFSP	OFSP/WFSP
Niassa	38.65	7.03	9.37	4.1	0.8
C. Delgado	70.17	0.55	1.56	45.0	0.4
Nampula	87.13	1.36	3.91	22.3	0.3
Zambezia	78.98	3.46	29.99	2.6	0.1
Tete	6.94	6.14	6.38	1.1	1.0
Manica	**39.32**	**4.69**	**15.76**	**2.5**	**0.3**
Sofala	42.12	4.48	29.16	1.4	0.2
Inhambane	82.28	3.48	2.54	32.4	1.4
Gaza	67.19	7.37	29.37	2.3	0.3
Maputo	**43.55**	**9.04**	**8.25**	**5.3**	**1.1**
National	**61.94**	**4.02**	**14.98**	**4.1**	**0.3**

There are also differences between regions with regard to the importance of staples: cassava dominates in Cabo Delgado, Nampula, Zambézia. In other areas maize is dominant or the importance of different staple crop is more mixed. Cynthia Donovan and Emilio Tostão therefore distinguish zones according to the dominant staple (Donovan & Tostão, 2010). In the cassava belt they estimate per capita cassava consumption at 107 kg per person per year (dry weight) and maize at 38 kg/person yearly. In the mixed belt these figures are 79 and 43 kg respectively, whereas in the dual staple area these figures are 87 compared to 59 kg per person per year. Manica is a dual staple area whereas Maputo province is a maize area.

Table 3.5 provides a summary of the evolution of the area under OFSP per producer as measured by TIA between 2005 and 2012. The data suggest that the area per household has remained stable over time. The total acreage has slowly increased at the national level. Figure 3.6 summarizes the tendency graphically.

Table 3.5: Evolution of acreage OFSP *in hectares* per producer according to TIA (2005-2012)

Territory	2005	2006	2007	2008	2012
C. Delgado	0,067	0,092	0,136	0,052	0,022
Gaza	0,119	0,094	0,071	0,107	0,045
Inhambane	0,061	0,063	0,160	0,046	0,039
Manica	**0,130**	**0,103**	**0,102**	**0,135**	**0,246**
Maputo	**0,146**	**0,145**	**0,128**	**0,136**	**0,062**
Nampula	0,093	0,216	0,107	0,097	0,060
Niassa	0,212	0,133	0,182	0,264	0,224
Sofala	0,075	0,094	0,080	0,104	0,064
Tete	0,182	0,136	0,106	0,166	0,162
Zambezia	0,051	0,033	0,103	0,062	0,070
National	0,116	0,098	0,113	0,118	0,105

Figure 3.6 shows the total acreage as the product of area per farmer and number of farmers. So while acreage per farmer may have declined this has been compensated by a higher number of farmers producing OFSP.

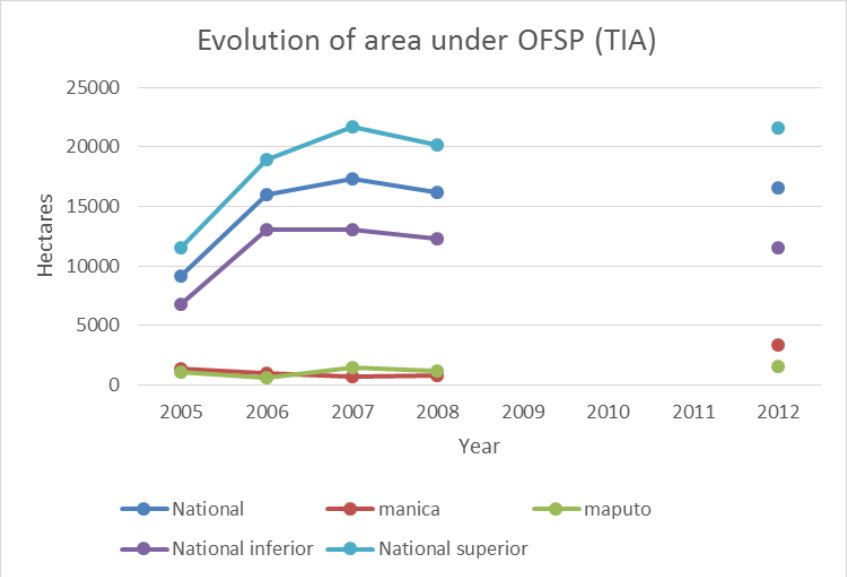


Figure 3.6: The evolution of the acreage under OFSP at the national level and at the provincial levels of Manica and Maputo

TIA is a survey and not a census, so that the data in refer to samples. Standard errors for the national estimate range between 9% and 13%. For example, for 2012 the estimated total area is just above 16.5 thousand hectare, with a confidence interval ranging from 11.5 to 21.5 thousand. As the samples at the provincial level are smaller the standard errors for the provincial average acreage estimates are much higher. For example, for 2012, the acreage under OFSP in Manica is estimated at 3.3 thousand hectares, with a standard error of 44%. This means that the real acreage is somewhere between 400 and 6200 hectares. For Maputo the confidence interval is between 50 and 3100 hectares.

In Manica the provincial government estimates sweetpotato production at about 150,000 tonnes (Table 2.2). Crossing this information with the TIA estimates for acreage in Table 3.4 productivity would be about 14.4 tonnes per hectare. This is an acceptable figure: although higher than the productivity achieved by CIP during on-farm trials in Manica it is well below the estimated on-station values of about 20 tonnes per hectare. Applying the estimated value for Manica to Maputo Province total production in this province rounds 54,000 tonnes.

3.3.2. SP demand

There is little information available that allows us to estimate the volumes of supply and demand. One possible source is a study carried out by CIP in April 2014. In the last week of that month CIP enumerators interviewed 656 people residing in six of the seven districts that compose Maputo City.[6] The results show that many people eat white and orange fleshed sweetpotato: only 15% of the population eats sweetpotato never or almost never, with more than a quarter eating the crop over the entire year. Sweetpotatoes are most commonly eaten cooked or raw. Fried, mashed and roasted sweetpotatoes are less common dishes. Only very few people prepare dishes such as soup, bread or cake; juice, chips and biscuits are virtually unknown. The consumption of OFSP is less wide spread, with 31% never or almost never eating OFSP. Consumption is concentrated in the production season, when almost 60% of the population eats white fleshed or orange fleshed varieties (Table 3.6).

[6] The only district not covered is KaNyaka. This is an island with about 5300 residents, a negligible fraction of the total population of the city.

Table 3.6: Percentages of the population eating sweetpotato and OFSP

Ate either SP or OFSP:	Sweetpotato	OFSP
Yes, the entire year	27%	10%
Yes, mainly during the season	59%	59%
Never or almost never	15%	31%

Source: CIP data

Most people eat sweetpotato less than once a week. Less than one third of the meals has OFSP. This suggests that sweet potato is served on average about once each four days. OFSP is less frequently consumed: 67% estimate that the proportion of SP meals containing OFSP is less than one third, 17% less than two thirds and 14% more than two thirds but not all. Overall, those who eat OFSP eat it about once in two weeks (Table 3.7).

Table 3.7: Proportion of OFSP by estimated number of meals with SP

Share of OFSP	Number of meals with SP				Total
	Stated: Less than one per month	Stated: Up to one per week	Stated: Up to one per day	Stated: More than one per day	
Less than one third	25%	22%	16%	5%	67%
Less than two thirds	3%	8%	4%	2%	17%
More than two thirds but not all	2%	5%	5%	3%	14%
All	0%	1%	0%	0%	2%
Total	30%	35%	25%	9%	100%

Table 3.8 makes it possible to make a very rough estimate of the volume of SP eaten over the year. Considering that between 2007 and 2014 the population of Maputo has grown to 1,200,000 residents and assuming that on average each person will eat one root weighing between 100 and 200 gram during a meal containing SP total annual consumption at the level of Maputo City is somewhere between 16,000 and 31,000 tonnes.

Table 3.8: Estimated demand for SP in Maputo

	Number of meals with SP				Total
Stated frequency (number of meals)	Less than one per month	Up to one per week	Up to one per day	More than one per day	
Converted to meals per year by central value	12/2= 6 meals/year	(12+52)/2=32 meals/year	(52+365)/2=209 meals/year	365*2=730 meals /ear	
Percentage of 1.2 million people	30%	35%	25%	9%	100%
Tonnes assuming 0.1 kg per capita per meal	216	1,344	6,270	7,884	15,714
Tonnes assuming 0.2 kg per capita per meal	432	2,688	12,540	15,768	31,428

People can source roots in two ways: by growing them or by buying them. Even though Maputo City is an urban, high population density area, 44% of the households have access to some land: either a

garden, or a field within the district or even outside the city. Sweetpotato is relatively widely cultivated: an estimated 24% of the population grows sweetpotato. Assuming that those who grow it do in general not buy it, estimated market demand would be roughly three quarters of the estimated total demand, or something between 11,000 and 24,000 tonnes, the equivalent of 32 to 65 tonnes per day. As mentioned earlier production in Maputo (province and city) can be estimated at about 54,000 tonnes, suggesting that one to two fifths of the province's production is commercialized and sold into the city. This is not dissimilar to the estimated percentage of production commercialized in Manica (Figure 2.6).

The figures in Table 3.7 and Table 3.8 can also be used to estimate the size of the demand of OFSP. About two-thirds of the population consumes OFSP in less than one-third of its sweetpotato meals. This group is responsible for about 9400 tonnes of OFSP per year. Thus out of these 9400 tonnes of SP about 1600 tonnes is OFSP. About one-sixth of the population eats OFSP in more than one third but less than two thirds of its SP meals. This group contributes 1500 tonnes to annual OFSP consumption in the city. Fourteen percent each OFSP in more than two thirds of its SP meals. This group contributes 3400 tonnes. The last group, who eats exclusively OFSP contributes 38 tonnes to Maputo City's annual OFSP production. The sum of these values is 6600 tonnes, which means that OFSP represents about 42% of total SP consumption in the city. The estimated annual OFSP production of 6600 tonnes is again more or less consistent with the estimated percentage of land for sweetpotato covered by orange-fleshed varieties in Maputo (Province and City): according to Table 3.3, 1,600 hectares is under OFSP and 2100 hectares under WFSP, so that the share of OFSP is 43% of the total area under SP. The April 2014 survey suggests that out of the total population only 13% produce OFSP. Following the same reasoning as for sweetpotato in general the proportion acquired through the market can be estimated at 87% of total consumption or 5700 tonnes.

3.3.3. SP retailing

The last step in the value/commodity chain is the retail market. SIMA covers sweetpotato consumer prices and publishes them weekly in its bulletin together with the information on other crops. The results for the period May 2014 to May 2015 are presented below (Figure 3.7). The prices for Chimoio oscillate between 5 and 25 Meticais per kilo and for Maputo between 9 and 33 Meticais per kilo with averages of 14.55 and 15.02 Meticais per kilo respectively.

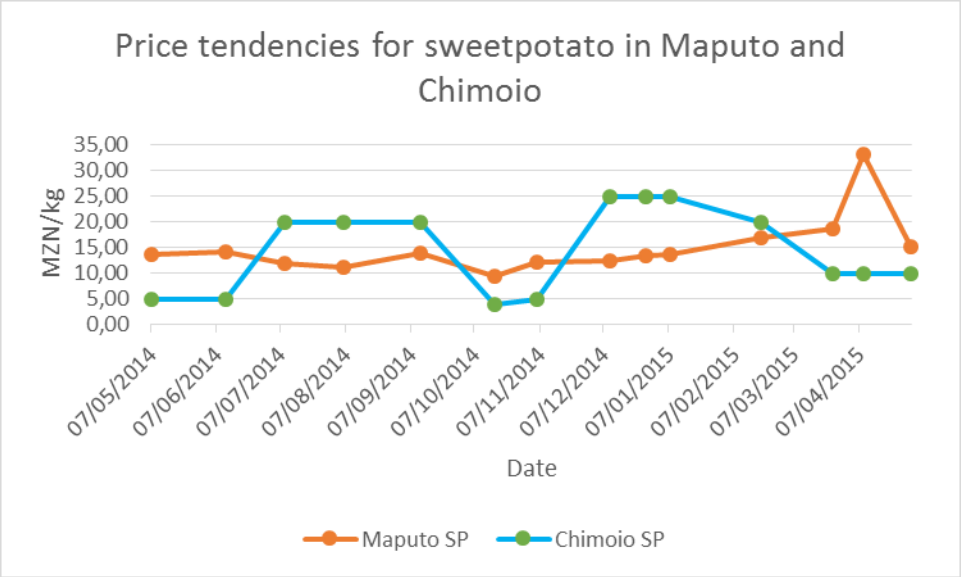


Figure 3.7. SIMA retail prices for Chimoio and Maputo (May 2014 - May 2015, meticais per kg)

CIP has monitored, together with SIMA, three markets in Chimoio and six in Maputo (Figure 3.8). In Maputo CIP alone has also monitored less intensively some other markets and roadside sellers.

The data collected for CIP by SIMA differ dramatically from those published in SIMA's weekly bulletin and show a huge difference in price between Chimoio and Maputo: Sweetpotato in Chimoio averages 5.29 Meticais (about US$ 0.16) and in Maputo 15.91 Meticais (about US$ 0.50). The prices SIMA collected for CIP tally with observations during the field visit. This second set of data also show that the markets in Chimoio and Maputo differ with regard to OFSP: in Maputo there appears to be a bonus for OFSP in Maputo of about 45%. In Chimoio there is no bonus.

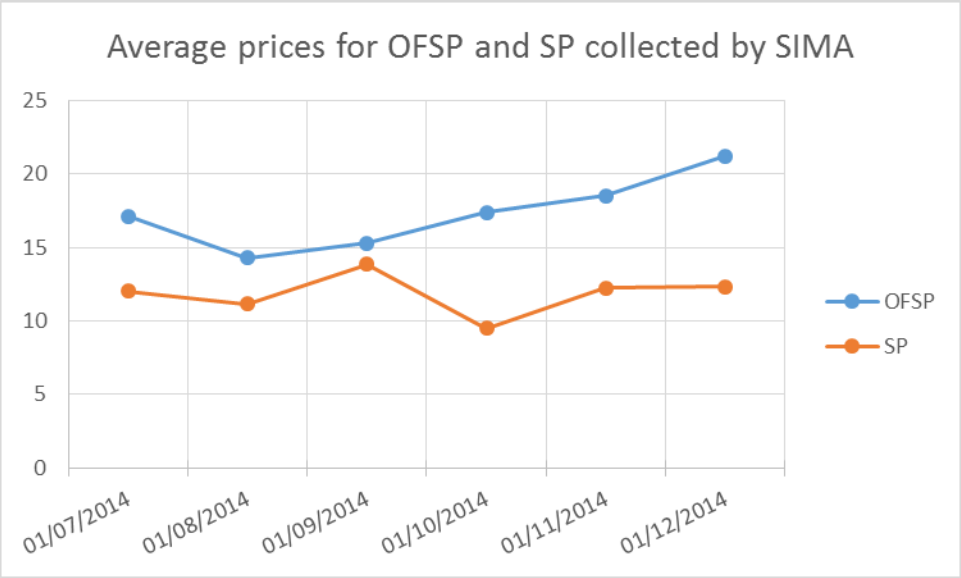


Figure 3.8: Average monthly prices for OFSP and SP in Maputo between July and December 2014

Monitoring by CIP itself entails buying piles of roots at different markets and at street corners, weighing the piles and counting the roots, and asking the sellers questions about the origin of the roots. The commodity chain starts obviously in the production areas. These are locations such as Albazine (on the outskirts of Maputo City), Boane, Bobole in the district of Marracuene, and Manhiça in Maputo Province and Chókwè, Macia and Xai-Xai in Gaza province. The most important source area is Manhiça: In 41% of the 104 samples the roots came from this district; in 31% of the 61 samples from urban markets and 56% of the samples from peri-urban markets. Retailers at urban markets obtain their roots not only straight from the production areas but also from traders at peri-urban markets such as Fajardo, Xiquelene and Zimpeto: 20% of the urban samples sourced their roots from these markets (Table 3.9).

Table 3.9: Origin of roots on Maputo's urban and peri-urban markets (data collected by CIP)

Area of origin	Type of market where sample was taken (count)			Type of market where sample was taken (percentage)		
	Urban	Peri-urban	All	Urban	Peri-urban	All
Albazine	1		1	2%	0%	1%
Boane	2	1	3	3%	2%	3%
Bobole	6		6	10%	0%	6%
Chokwe	1		1	2%	0%	1%
Unknown	12	5	17	20%	12%	16%
Gaza	1	1	2	2%	2%	2%
Inhambane	1		1	2%	0%	1%
M. Fajardo	5		5	8%	0%	5%
M. Xiquelene	1		1	2%	0%	1%
M. Zimpeto	6		6	10%	0%	6%
Macia	1	6	7	2%	14%	7%
Manhica	19	24	43	31%	56%	41%
Maputo	1		1	2%	0%	1%
Marracuene	3	2	5	5%	5%	5%
Xai-xai	1	4	5	2%	9%	5%
Total	61	43	104	100%	100%	100%

The retailers on the urban markets such as Mercado Central and Mercade Janete use the peri-urban markets because there is a significant difference in price: the average per kg price in the markets in the city centre is almost double (35 Meticais) of that in the peri-urban areas (18 Meticais).
In March to May the person buying the roots was asked to register at the markets the total number of retailers selling SP and also the proportion of those selling OFSP. The data show that Xiquelene and Central are the markets with the highest numbers of SP traders but that Zimpeto and Central are the markers with the highest number of traders selling OFSP (Table 3.10).

Table 3.10: Number of retailers selling SP and OFSP on selected markets (source: CIP data)

Market	# selling SP	# selling OFSP	% OFSP retailers	Data count
Xiquelene	17	1	6%	05/05/2015
Central	13	7	54%	10/04/2015
Central	12	6	50%	01/05/2015
Fajardo	8	2	25%	??
Zimpeto	8	4	50%	06/05/2015
Zimpeto	7	5	71%	26/03/2015
Fajardo	6	2	33%	28/03/2015
Janete	6	3	50%	31/03/2015
Janete	5	2	40%	04/05/2015
Xiquelene	4	1	25%	31/03/2015

More details on the value chains in the two provinces can be found in the next chapters.

4. Sweetpotato commodity chain in Maputo

4.1.Production activities and producers

4.1.1. Manhiça district

Production in Manica is concentrated in the valley of the Incomati River. One of the key production areas is Calanga. This is a *posto administrativo* 7 km to the East of Manhiça town. As part of the research a group discussion was held with members and leaders of one of the local farmers associations, the Associação dos Camponeses de Munhangue in Calanga. Numerous farmers were present (approximately 20), most of them were women.

The association has under its control a total area of 570 ha. Around 70 ha is used for grazing so that the total farming area about 500 ha. A small plot is farmed collectively; most is farmed individually. On the average, each member has access to about 2 ha. Individual areas are divided into scattered parcels. This makes it difficult for the farmers to estimate the amount of land cultivated under different crops and their yields.

Maize and peanut are the main food crops consumed at household level and they also have the largest cultivation areas. Sweetpotato represents the most important commercial crop for the area. It is not considered a staple food. Sweetpotato has two production cycles per year. Due to staggered planting it is possible to find the crop during most of the year. WFSP vines are sourced locally; OFSP vines are obtained from CIP. The main challenge is retention from one year to the next. In most years the floodplain where the crop is grown is inundated during the rainy season. When this happens people hurry to save the maize and peanut but they normally let the sweetpotato drown. This issue affects mainly OFSP varieties as the stock is small and easily destroyed completely. The white-fleshed varieties are more common and hence can be more easily acquired from farmers with land outside the floodplain.

The main harvesting season for SP is in July-August for the cycle planted just after the rains, i.e. in February-March. A second cycle may be planted in July-August with harvests in November-December. If the river does not flood it may even be possible to plant a third cycle. However, staggered planting makes it possible to harvest roots between these peak periods.

Inundation is not the only threat to the crop. Unseasonal heavy rainfall in April 2015 caused damage to material that had been planted earlier.

The farmers harvest the fresh roots three times a week during the entire season that can last up to three months. They bring almost all the fresh SP roots into the market in Manhiça with a truck or a tractor. There is a market on Monday, Wednesday and Friday close to the Red Cross building where crops are sold to traders from Maputo. The trip from Calanga to town can take more than 30 minutes, as the farming area is about 7 km in a straight line but almost 24 km by road from the town and the access road is not paved. A small amount of fresh SP roots and leaves is exported to South Africa where it apparently is mainly bought by the Mozambican community. These roots are left at a street corner after an agreement is made with the trader.

As illustrated in Table 4.1, the high supply season lasts from June to December and, during this time, a bag of fresh SP roots is sold at 150 MZN. The price is the same regardless of the buyers who are, in general, traders/retailers from Maputo and Gaza, or retailers from local markets. People normally use the 50 kg rice bags for packaging their roots. The actual weight of a fully packed bag can be more than 70 kg. At the beginning of the season and when the SP supply is low, the price per bag can reach 350 MZN. Assuming an average weight of 70 kg per bag, the per kilo price can be estimate to range between 2.2 and 5.0 meticais/kg.

Farmers selling on the market in Manhiça face several additional expenditures. The transport to the market costs 25 MZN/bag; on the market they pay a daily amount of 20 MZN as a municipality fee

and an extra 6.5 MZN per bag market fee for cleaning every time they go to the market. Hence total costs 51.5 MZN per bag (about 0.7 MZN/kg).

The farmers separate the fresh roots by root size and, especially when requested by costumers, by colour of the flesh. While the price of the white/yellow and OFSP varieties are the same, a bags with bigger roots fetch 2 to 3 times the price of bags with smaller roots. On the basis of the amount of roots commercialized, and assuming an average yield of 10 tonnes/ha, the land planted with SP roots by the farmers of the association can be estimated to be around 100-150 ha, which is one fifth to one quarter of the total available area per cycle[7].

Table 4.1: Variation in availability of SP roots and marketing price in Calanga through the year (approx.) (data obtained from interviews)

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
SP root supply	***	*	*	*	*	*	**	***	***	***	***	***
SP big root price (MZN/bag)	150	150/ 350	350	350	350	350	350	150/ 350	150	150	150	150
SP small root price (MZN/bag)	50	150/ 200	150/ 200	150/ 200	150/ 200	150/ 200	150/ 200	50	50	50	50	50

High supply: ***; Medium supply: **; Low supply: *

Source: Field visits interviews

The Associação Eduardo Mondlane was interviewed in October 2014. The association has 47 members and manages 60 ha of land close to Manhiça town, although only 20 ha are currently under cultivation. The members produce cassava, sweetpotato, carrots, and onions. The OFSP crop is cultivated in a shared portion of land of 30-40 m^2, yielding 4 bags of fresh roots per cycle. They also produce on individual plots of similar sizes. Due to the presence of irrigation, the farmers are able to have three OFSP production cycles per year. They have received three different varieties of vines from CIP but currently only one survives (probably Ester).The cooperative does not pay any land or water fee costs. Ideally, the farmers would like to sell a bag of fresh OFSP roots at 500 MZN to the retailers but often their bargaining power is impaired by internal and external constraints and, as a consequence, they may get only 250 MZN per bag. This happens, for example, when one of the cooperative members would like to sell a bag quickly to have available cash, decreasing, as a consequence, the price per bag for all the farmers involved. The farmers pay 50 MZN to bring the bag to the road, and then a minibus brings the bags to the Maputo markets. The cooperative members share the profits among each other, and their common costs are represented only by the rent of a tractor. Each member also has individual plots where they produce OFSP crop, mainly for their own consumption of roots and leaves. The OFSP production is currently very limited due to low consumer demand and profitability; they claim that transportation costs are too high and they do not have any vehicles to bring their bags directly to the urban area. The farmers are planning to increase the OFSP production as they perceive that the consumers' demand is increasing. Due to the consumer perception of OFSP as a "food for poor", during the holidays they are not able to sell any fresh roots.

[7] The land planted with SP has been estimated using the information about the total quantity of fresh roots commercialized by the farmers. The farmers send to the market 4 trucks filled with SP bag per day, for 3 days a week; and each truck can contain between 100-150 bags. They sell fresh SP roots for approximately 12 weeks per cycle. Considering an approximate yield of 10 tonnes/ha, and the weight per bag at 70 kg, the estimate hectares are 100-150.

4.1.2. Namaacha district

Two commercial farmers[8] cultivating fresh OFSP roots and vines were interviewed in Namaacha district, in the localities of Mafuiane and Mahelane (their details are shown in the Tables below). They provided information about general trends in the region and their own activities.

In general, the white fleshed sweetpotato root is the most popular type and is cultivated by the farmers mainly for their own use in all the district. The OFSP is not so widespread and those who grow it mostly commercialize the roots.

In Mafuiane, maize is the main staple crop, followed by cassava and white fleshed sweetpotato varieties; the latter is consumed especially for breakfast. The farmers are not well informed about OFSP cultivation and trade. A few years ago, its consumption was higher but then it decreased due to decreasing quality of the fresh roots, possibly due to over utilized vines or to the fact that the varieties were less adapted to consumer preferences. Since 2013, new, tastier and less watery varieties have become available. Today, people are looking for fresh OFSP roots but supply remains small. The average farming area in Mafuiane is estimated at around 0.8 ha, for a total amount of plots of ~150. The plots are irrigated and 75% of the farmers are women. The area devoted to SP varieties is larger than other agricultural commodities but it is quite difficult to estimate their yields and profitability because the farmers are not used to keeping track of revenues and costs, and most of the production factors are common to several crops.

In Mahelane, there is a long tradition of cultivating white fleshed SP varieties, especially in lowland areas and along rivers. Here the farmers plant in Feb-March to harvest in June-July. They harvest few roots each time for home consumption and the average parcel cultivated under SP is quite small (around 200 m^2). White fleshed SP root is considered a staple crop second to maize, while cassava is not a daily food.

The interviewed farmers have operated as vine multipliers (DVM). The basic material was supplied by CIP for free in 2012 and 2014. Table 4.2 reports some information about farmers who produce SP for the market.

Table 4.2: Summary of the OFSP production by two farmers in Namaacha district, Maputo Province

Province		Farmer A	Farmer B
Maputo	**Varieties**	OFSP: Irene, Gloria, Bela, Namanga	OFSP: Ininda, Gloria, Melinda
District/Localities:	**Avg yields for OFSP (tonnes per ha):**	10	18
Mafuiane (Namachaa), Mahelane	**Avg yield for vines (tonnes per ha):**		5
	Avg selling price of SP roots (MZN/kg):	50 MZN for most of the roots, 25 MZN for the roots sold to Terramar (limited quantity)	10 MZN for roots sold to big traders and 15 MZN for roots sold to other customers
	Avg selling price of SP vines (MZN/kg):	free	4
	No. of cycles per year:	Continuous	Two

Source: Field visits interviews

[8] We refer to them as commercial farmers as the following requirements are met: the farm is set up for the main purpose to sell the produce to the market; the farm is larger than a regular family farm, the farmers regularly hire labour from outside the family (family members can also be involved, but a key factor is the hired help used); the farmers tend to make use of new technologies in order to increase output and create competitive advantages where possible.

Farmer A owns 7.5 ha of land; she uses only 2 ha for cultivating all the crops because she has not enough financial resources to work her total area. Labour is basically hired. Due to the continuous water availability through pumped irrigation, she can cultivate her crops all year round. She plants the SP vines once they are available, usually in May, and after ~3-4 months she starts harvesting the roots, depending also on the rains and maturation period of the varieties. The OFSP variety Namanga, for example, has a maturity period of three months while Irene and Ininda take four and Glória even five months. She weeds twice during the production cycle. After harvesting, she plants the vines in another piece of land alternating bigger and small parcels. She first harvests the bigger roots to let the smaller ones grow more. She usually harvests sweetpotato when she wants to sell; in one hour, she is able to harvest ~20 kg of fresh sweetpotato roots. Having experienced in-ground losses in the past, she now treats the land with chili spray to keep away weevils and nematodes; moreover, she has cats around the farm for the rodents. She noted that the OFSP variety Delvia is more prone to weevil contamination. She does not know exactly the OFSP yields but estimates, based on previous harvesting, the harvest to be about 250 kg of fresh OFSP roots from 250 m^2, i.e. ~ 10 tonnes/ha. She sells a limited quantity of fresh OFSP roots to a local supermarket at 25 MZN/kg and the rest at fairs, local events and directly to private consumers[9] at 50 MZN/kg. She grades and packs the fresh roots. She distributes the vines for free to her neighbours. Sweetpotato (only orange-fleshed varieties) is almost totally for the market. She does not eat much of it herself. When she eats it, she consumes the roots boiled, fried, with caril. She also uses them for preparation of sweet pastries and occasionally she makes an OFSP juice mixed with beetroot, carrot and other fruits to sell[10]. Farmer A is a person who wants to specialize in quality horticulture crops: she cultivates broccoli, cauliflowers, spinach, carrots, beetroots, mushrooms. She opts for OFSP because she believes in its added value.

Farmer B has 6 ha of irrigated land. So far, he has cultivated only 0.5 ha with OFSP. He has operated as a vine multiplier (DVM) to CIP under the OFDA project and more recently under SUSTAIN. SUSTAIN has bought most of the vines but also sells the OFSP vines to other farmers at 4 MZN/kg. Now he has started selling roots and is confident that the market will absorb his produce. That is why he is planning to increase the area under sweetpotato to up to 1 ha for the next cycle. He starts land preparation for sweetpotato in November and he plants the vines in late December. He weeds four times per cycle between January and February and then harvests in April, i.e. four months after planting. He has a tractor to plough and to make the ridges. The harvesting is manual with a hoe. He experiences some in-ground losses from weevil attacks, mostly when the roots are not deeply planted. He rotates OFSP with maize and beans. He sells the fresh OFSP roots to big traders at 10 MZN/kg, and at fairs, local events and to private consumers at 15 MZN/kg. He uses the Goba-Maputo railways to transport the fresh roots bags to Maputo. The transport costs are 150 MZN per tonne.

Details on farmers' accounts for SP production and markets are reported in Table 4.3. The revenues take into account all the production of orange-fleshed sweetpotato and vines at farm level, including what is used for home consumption. The latter is recorded at the price per kg sold by the same farmer. The labour is both hired and provided by family members; for family labour the same wage recorded for hired labour is used (and two different gross margins calculated, with and without family labour cost). The gross margins per ha and per kg are calculated.

[9] Two other two female OFSP producers having a similar strategy were interviewed in October 2014: they had their own clients who more or less guaranteed demand and were willing to pay between 30 and 50 meticais per kg of OFSP. This strategy seems to work only for OFSP as this kind of roots has its own market. See section 4.1.3.

[10] Farmer A's plot is not too far from the main road connecting Maputo to the Swazi border. She would like to open a road-side stall to exploit the opportunities of traffic passing through Mafuiane similar to what farmer D is doing in Umbeluzi but thinks that this is only viable if she could do this together with other farmers.

Table 4.3: Farmers' gross margins for OFSP production per cycle

	Farmer A: 0.5 ha of OFSP cultivation			Farmer B: 0.5 ha of OFSP cultivation and 0.5 ha of vines		
	Unit	Quantity per plot/cycle	Total Value per plot/cycle	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)
Revenues *(a)*			**225,000**			**122,500**
*Orange-fleshed Sweetpotato (q1)**	tonnes	10	225,000	tonnes	9	112,500
Vines	kg	N.A.		kg		10,000
Costs *(b)*			**13,325**			**15,325**
Water	monthly fee	4	1,000	monthly fee		500
Hoe	unit		50	unit		50
Bags (for roots)	unit			unit		
Fertilizer	litre			litre		
Land preparation	tractor		875	tractor		500
Mounding/ridging	man/day	4	400	tractor		1,000
Planting	man/day	4	400	man/day	18	1,800
Weeding	man/day	16	1,600	man/day	48	4,800
Applying fertilizers						
Harvesting	man/month	1.25	4,000	man/month	2	6,000
Transporting			5,000			675
Selling						
Gross margin *(a-b)*			**211,675**			**107,175**
excluding family labour			215,675			107,175
Gross margin per kg *[(a-b)/q1]*			**42**			**10.80**
Gross margin per ha *[(a-b)/q2]*			**423,350**			**214,350**
Farmer total land (ha)	2			6		
Total ha unders OFSP *q2*	0.5			0.5		
OFSP acreage						
% Total	25%			8%		
Vines production acreage						
% Total						
OFSP Price (MZN/kg)	**45**				**12.5**	
Vines price (MZN/kg)	free				4	
Home consumption (% total prod)	few				few	
In-ground losses	very few				few	
Other losses	none				none	
Labour	Hired + self				Hired+ family	
Irrigation (Y/N)	Y				Y	
Use of tractor (Y/N)	Y				Y	

Note: In the calculation of gross margins per kg, q1 is expressed in kg. For farmer A, family (own) labour is accounted for the harvesting activities. Farmer B also makes use of family (own) labour but detailed information are not available (and so not accounted in the table). Source: Field visits

4.1.3. Moamba and Boane districts

In October 2014 two farmers cultivating OFSP in Moamba and Boane districts were interviewed. Their details are shown in the Tables below.

Table 4.4: Summary of the OFSP production by two farmers in Moamba and Boane districts, Maputo Province

Province		Farmer C	Farmer D
Maputo	**Varieties**	OFSP: Irene, Tio Joe	OFSP: Irene, Tio Joe, Sumaia, Namanga
District/Localities:	**Avg yields for OFSP (tonnes per ha):**	13	30
Moamba, Boane	**Avg yield for vines (tonnes per ha):**		11
	Avg selling price of SP roots (MZN/kg):	20 MZN	25 MZN for grade A roots (35% of the quantity), 20 MZN for grade B roots (35% of the quantity), 10 for grade 10 (30% of the quantity)
	Avg selling price of SP vines (MZN/kg):	free	10
	No. of cycles per year:	Continuous (except from November to February)	Continuous

Source: Field visits interviews

Farmer C owns 2.5 ha of land in Moamba district, and cultivates OFSP in small parcels. She harvests OFSP all year round, except from November to February. The estimated yields amount to 13 tonnes/ha. After the harvesting, the fresh OFSP roots are almost immediately sold: the farmer does not wash or cure the roots that are kept stored for less than one week. She cultivates different OFSP varieties: Irene (sold at 20 metical/kg) and Tio-Joe (sold at 20 to 25 metical/kg) are the most appreciated among the consumers. She sells the roots at the Fajardo market in Maputo, and directly to consumers whom she reaches by car. She has given vines for free to her neighbours and one is now also producing. She thinks that OFSP has a high market potential and that current supply is lower than demand. In her area, there is only one other farmer cultivating OFSP.
In her opinion, the key weakness of the crop is the long production cycle. Another weakness is the little awareness of the farmers about the crop itself, its potential and the cultivation method. The most important advantage is that growing OFSP requires much less supervision than other vegetables such as cucumber and tomato. She is positive about the possibility to have access to a storage facility, humidity is a big problem and forces her to sell the fresh roots immediately after harvest.

Farmer D is a large farmer who owns 170 ha in Umbeluzi in Boane district. He has two other farms in Central and Northern Mozambique of 500 ha and 750 ha, respectively. He produces the OFSP crop only in Maputo on 6 ha. The roots are used for human and animal consumption. He classifies the roots (by size) in grade A and B for human consumption, and grade C for animal feed. He also supplies farmers with OFSP vines in the provinces of Gaza, Inhambane and Maputo.

He harvests the OFSP crop at a rate of one hectare per month, identifying his own profits at up to 14,000 USD/ha. He operates a road side stall along the Boane-Maputo road where he sells roots, roasted pork meat of the pigs he feeds grade C OFSP as well as other crops. Neighbours sell in his vicinity. The stall is well marked with a huge sign. It is his main outlet.

Starting from August 2014, he has been expanding his OFSP acreage from 6 to 12 hectares to sell the fresh roots to a big trader from South Africa who will export to the UK[11]. To be able to meet the quantity required by the client (500 tonne), he contracted with 10 to 20 out-growers. He has an entrepreneurial vision about the market: he thinks that once the awareness of the consumers about the nutritional aspects of OFSP varieties grow, the production will follow. His main activities are, however, seed production (hybrid maize, soybeans, etc.) and pig breeding.

[11] Recent field visits do not confirm these statements so most likely he has maintained his original business model.

Table 4.5: Farmers' gross margins for OFSP production per cycle

	Farmer C: 1 ha of OFSP cultivation			Farmer D: 6 ha of OFSP cultivation and vines		
	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)
Revenues *(a)*			**260,000**			**4,035,000**
*Orange-fleshed Sweetpotato (q1)**	tonnes	13	260,000	tonnes	30	3,375,000
Vines	kg	N.A.		tonnes	11	660,000
Costs *(b)*			**20,200**			**402,000**
Water	monthly fee	4	7,000	monthly fee		74,400
Enrgy costs for irrigation						57,000
Hoe	unit		50	unit		
Bags (for roots)	unit			unit		
Fertilizer	litre			litre		30,600
Land preparation	man/day		1,000	tractor		12,000
Mounding/ridging	man/day	4	650	tractor		30,000
Planting	man/day	4	1,000	man/day	18	18,000
Weeding	man/day	16	3,000	man/day	48	60,000
Applying fertilizers						18,000
Harvesting	man/month	1.25	2,500	man/month	2	48,000
Transporting			5,000			
Other costs (extra labour and maintenance)						54,000
Selling						
Gross margin *(a-b)*			**239,800**			**3,633,000**
excluding family labour			179,800			3,633,000
Gross margin per kg *[(a-b)/q1]*			**18**			**18.75**
Gross margin per ha *[(a-b)/q2]*			**239,800**			**605,500**
Farmer total land (ha)	2.5			170		
Total ha unders OFSP *q2*	1			6		
OFSP acreage as % Total	40%			4%		
Vines production acreage as % Total						
OFSP Price (MZN/kg)	**20**				**25 (Grade A), 20 (Grade B), 10 (Grade C)**	
Vines price (MZN/kg)	free				10	
Home consumption (% total prod)	few				few	
In-ground losses	very few				few	
Other losses	none				none	
Labour	Hired				Hired	
Irrigation (Y/N)	Y				Y	
Use of tractor (Y/N)	Y				Y	

Note: In the calculation of gross margins per kg, q1 is expressed in kg.
Source: Field visits

In the case of the four individual commercial farmers interviewed in Maputo province, the profitability of OFSP varieties (including the selling of vine) is estimated at 214,000/605,000 MZN per ha/annum. The upper bound is driven by the considerably higher productivity of farmer D (in term of OFSP roots and vines). The gross margin per kg amounts to 12-18 MZN for farmers B, C and D; the calculations of the gross margin per kg for farmer A, instead, lead to 42 MZN per kg, considering that she is able sell her fresh OFSP roots to a higher price.

The gross margin achieved by these farmers is more than three times the farm-gate sales price in Manhiça and a strong indication of the current economic potential of OFSP in the Maputo area. Comparing the smallholders who sell SP (and some OFSP) in Manhiça with the interviewed individual farmers in Namaacha, Moamba and Boane one is immediately struck by the difference in price. The farmers in Manhiça report a maximum price of about 5 meticiais per kg, whereas their counterparts in Namaacha and Boane fetch five to ten times this value, mainly because they are able to sell directly to consumers who are willing to pay a bonus for orange-fleshed varieties.

4.2.Retailers

4.2.1. Mercado Central, Maputo

Two female retailers were interviewed in Mercado Central (Central Market). Mercado Central is located in downtown Maputo and is the marketplace for medium to high income consumers. The

retailers sell different kinds of vegetables and fruits on their stands. One of the interviewed retailers buys the fresh SP roots in bags[12] from the producing areas of Manhiça and Marracuene. She says that she buys the bags from a middleman that collects the roots at farm level and brings them to the village, but his/her presence has not been confirmed by other interviews or direct field visits The second retailer buys the fresh SP roots in buckets from Mercado Xiquelene and Mercado Zimpeto on the outskirts of Maputo City and from Calanga in Manhiça district.

The price at which they buy SP roots changes during the year: the variation is entirely attributed to the different supply availability within the year. As a consequence, the sale price also varies from 10% to more than 60% during the year. The retailers sell SP roots in kg, having a scale at their stand. It is difficult for them to speculate about the exact profits coming only from the SP retailing, as they sell various commodities; an estimation of average margin per bag is provided in the Table 4.6 below.

Table 4.6: Fresh OFSP root trading prices and supply in Mercado Central

SP root supply season	Peak (May-Dec)	Low (Jan-Apr)
Retailer 1 SP buying price (MZN)	1,500 per bag*	1,650 per bag *
Retailer 2 SP buying price (MZN)	200 per bucket*	300 per bucket *
Retailer 1 SP selling price (MZN/kg)	45	50
Retailer 2 SP selling price (MZN/kg)	30	50
Retailer 1 Average margins per bag (MZN)	650-1,750	750-1,850
Retailer 2 Average margins per bucket (MZN)	400	700

Source: Field visit interviews

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg. The prices collected during the interviews refer to the OFSP, as these varieties were sold on their stand when the interview took place. The average margins includes an estimation of the costs per bag (Table below).

The weekly costs of selling fresh SP roots for a single retailer may amount to 100-110 MZN, and include bringing the bags to Maputo, then carrying them into the stand, and paying city council taxes (the market spot costs about 6 MZN/meter of stand per day) (see Table 4.7). The ticket for the person accompanying the bags may add other 50 MZN. Transporting a bucket from local markets is cheaper

Table 4.7: SP main retailing costs for Retailer 1 in Mercado Central

Transport to bring the bags from the village to the bus in Manhiça and Marracuene	30 MZN/bag
Transport to arrive to the Maputo from Manhiça and Marracuene	40-50 MZN/bag
Trolley carrier to the market spot	20-30 MZN/bag
Spot in the market/City Council taxes	9 MZN per day (**for all the fruits stand**)
Total costs per week for only SP (excluding buying the 50 kg rice bags used for bulk packaging)	100-120 MZN/bag

Note: The exact costs for the market spot attributable to SP cannot be calculated because the retailer sells different fruits and vegetables on her stand. An approximate cost of 10 MZN per week has been added to total costs per week for only SP to detect.

Both retailers think that during the last 10 years their business has lost profitability, and that the competition among the retailers has increased. Moreover, fewer customers are currently carrying out their shopping at Mercado Central buying, instead, fruits and vegetables at street retailing points and/or at farm level as they are more easily accessed by car and the prices are cheaper. Selling fresh

[12] The bags are referred to the 50 kg rice bags. Their real weight of a SP bag at around 65-80 kg. This weight is estimated, not measured.

SP roots seems to be even less profitable than selling other vegetables. The main problem with SP is that the demand is not high enough and the retailers may be not able to sell the fresh roots on time and, as consequence, they have to further reduce the prices when the roots lose their freshness.

The retailers perceive their customers as a heterogeneous group that like and consume all the SP varieties, especially during the cold weather. The consumers prefer the medium to large size roots. Orange-fleshed varieties are consumed mostly for their vitamin A content, frequently following doctors' recommendations; consumers prefer the white/yellow varieties because apparently they can be stored for a longer period without losing their freshness.

4.2.2. Mercado Janete, Maputo

As for Mercado Central, two retailers (women) have been interviewed in Mercado Janete and they were selling a range of different vegetables and fruits on their stands, in addition to OFSP roots. They buy the fresh SP roots from other retailers in Mercado Fajardo and Zimpeto; the roots come from farmers in Marracuene and Bobole, sometimes even from Beira. They both sell on average 15 kg of fresh SP roots per week, with a variation of ±50% between peak and low supply season. As Table 4.8 shows, the price at which they buy SP roots can vary by more than 100% between the peak and low supply season due to the crop seasonality and rains pattern. The selling price may also change by between 25% and 100% during the year. The price of the OFSP variety can be 50% higher than the white/yellow varieties. The retailers have a scale and sell SP roots in kg or fraction of it. It is difficult for them to speculate about the SP profits, as they sell various commodities on their stand. The fresh SP roots are, however, among the less profitable commodities and the margins per bag or per bucket may not vary so much between the two supply seasons.

Table 4.8: Fresh SP root trading prices and supply in Mercado Janete

SP root supply season	Peak (July/Aug-Nov/Dec)	Medium (April-June)	Low (Dec/Jan-April
Retailer 1 SP buying price (MZN)	250 per bucket*	300 per bucket*	300 per bucket*
Retailer 2 SP buying price (MZN) bucket/bag	150 per bucket*/ 350 per bag*	150 per bucket*/ 350 per bag*	350 per bucket*/ 1,000 per bag*
Retailer 1 SP selling price (MZN/kg)	40	50	50
Retailer 2 SP selling price (MZN/kg)	25-30	40	50
Volumes (kg/week)	15-20		10
Retailer 1 Average margins per bucket (MZN)	230-350	300-450	300-450
Retailer 2 Avg margins per bag *(MZN)*	750-1,650	750-2,500	650-2,500

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg. The average margins includes an estimation of the costs per bag (Table below).

The SP selling costs for a single retailer amount to 20-30 MZN per week, considering the limited amount of SP roots sold (i.e. a fraction of a bag) and the SP share of the total market costs among other commodities. These costs include carrying the bags to the market spot (1 bag every 3-4 weeks), individual transportation, and market council taxes (a stand of 2 metres cost 12.5 MZN per day) (see Table ***4.9***).

Table 4.9: SP main retailing costs for Retailer 2 in Mercado Janete

Daily commuting costs to the market	7 MZN
Transport to arrive to the Janete from Fajardo or Zimpeto markets (per bag)	50 MZN/bag
Transport two-ways to/from the Janete from/to Fajardo or Zimpeto markets (herself)	28 MZN
Annual market fee	150 MZN
Spot in the market/City Council taxes	25 MZN per day (for all the fruits stand)
Total costs per week for only SP (excluding buying the SP roots bags)	20-30 MZN

The retailers think that there are some differences in their business compared to a few years ago. In general, there are fewer customers, less money available and the products take a longer time to be sold. Retailers' suppliers may not always have a large amount of fresh SP roots. As a consequence, the buying and selling prices have increased, and the presence of fresh SP roots presence in the market has decreased.
They sell the white/yellow fleshed SP varieties more easily due to their taste and lower water content. However, there are consumers that ask specifically for OFSP because of their nutritional value. In general, SP are eaten boiled with tea for breakfast, or with fish for lunch or dinner. The consumers prefer to buy maize, cassava, and Irish potatoes.

4.2.3. Mercado Fajardo, Maputo

Mercado Fajardo is a market on the outskirts of the city centre and used by wholesalers and retailers alike. The two retailers (women) interviewed at Mercado Fajardo were selling only fresh SP roots. They usually buy their fresh roots from farmers located in Manhiça (at Xigowene market) and Bobole. During the cold months, they notice that the quality of fresh SP roots from these localities may decrease and, when possible, they prefer to buy the bags from a trader from Chimoio at a higher price. They had only white fleshed varieties but they trade OFSP when available. The share of OFSP is, however, smaller than of white fleshed varieties. The traders at Fajardo sell to final consumers and to retailers (i.e. from Mercado Central, Janete). As illustrated in Table 4.10, during the peak season the retailers buy a bag at 250 MZN and sell the fresh roots in piles at 10, 20 or 30 MZN (small to larger SP roots), in buckets at 150 MZN or as whole bag at 600 MZN. During the low supply season the buying price for one bag can double; the selling price of buckets and bags seems less volatile so that the traders' profit margins decrease. The response to variation in supply and price is to lower the number of roots in a pile.

Table 4.10: Fresh SP root trading prices and supply in Mercado Fajardo

SP root supply season	Peak (July-Dec)	Low (Jan-June)
Retailer SP buying price (MZN)	250 per bag*	450-500 up to 700 per bag*
Retailer SP selling price (MZN)		
Piles (small/medium/big roots)	10/20/30 MZN	10/20/30 MZN (with less roots than peak season)
Buckets* (MZN)	150	250
Bags* (MZN)	600	800
Volumes (bags/week)	15-20	3-4
Retailer OFSP buying price (MZN)	600-650	N.A.
Retailer OFSP selling price (MZN)		
Piles (small/medium/big roots) (MZN/pile)	20/40/50 MZN	20/40/50 MZN
Buckets* (MZN/bucket)	300	
Retailer Average margins per bag (MZN)	200-650	500-800

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg. The price per bag of 700 MZN refers to the bag from Chimoio.

The costs for a single retailer may amount to 480-1,160 MZN per week (Table 4.11).

Table 4.11: SP main average retailing costs for the retailers in Mercado Fajardo

Transport to arrive to Maputo from Bobole or Manhiça	30 or 50 MZN/bag
Trolley carrier to the market spot	10 MZN/bag
Daily commuting costs to the market	50 MZN/day
Spot in the market/City Council taxes	3 MZN per day
Cleaning fee	5 MZN per day
Watchman	25 MZN/week
Total costs per week for only SP (excluding buying the SP bags)	480-1,160 MZN

They include the transport of the fresh SP roots from Manhiça or Bobole (respectively at 50 MZN and 30 MZN per bag), a trolley carrier to bring the roots from the street to their spot at 10 MZN/ bag, market taxes and cleaning fee for a total of 8 MZN/ day, 25 MZN per week for a watchman to protect the stock from theft, 50 MZN for transport of the retailer herself to and from Fajardo.
The consumers favour the white fleshed SP variety and medium-sized roots. The SP can be eaten boiled or fried and it is mainly for breakfast. In general the consumers consider the OFSP varieties too watery, and cassava is preferred over SP. The medium roots cook faster than the bigger roots saving firewood. The retailers report that the small roots are usually mixed with *mafura* and, when there is no *mafura* in the market, the people tend to eat more cassava[13]. The retailing business is considered quite remunerative and they think to have a good relationships with the farmers. The retailers, however, would like to increase the selling volumes especially during the low supply season, for example when *mafura* fruits (*Trichilia emetica*) are matured as they are often eaten with sweetpotato during the holiday season.

4.2.4. Mercado Xiquelene, Maputo

Mercado Xiquelene is a market in the peri-urban areas of Maputo City. At this market one retailer was interviewed. This retailer sells mainly white fleshed SP varieties, as she finds the OFSP varieties hard to get. She thinks that this is due to low production. She sells some herbs along with SP roots. She buys fresh SP roots from farmers/traders who come to Xiquelene every day from Manhiça. She buys a few bags each week depending on how the business is going and the money available. During the high supply season, she buys one bag at 500 to 550 MZN, selling the small, medium and big roots piles at 10, 20 and 30 MZN, respectively. The prices during the low supply season increase by 50-60% on average (Table 4.12). She buys a bucket of OFSP at 400 MZN and she sells OFSP roots from 30 to 50 MZN per pile with different roots size.

Table 4.12: Fresh SP root trading prices and supply in Mercado Xiquelene

SP root supply season	Peak (July-Oct)	Medium (Nov-Dec/ April-June)	Low (Jan-Apr)
Retailer SP buying price (MZN)	500-550 bag*	550-800 bag*	800-850 bag*
Retailer SP selling price Piles (small/medium/big roots)	10/20/30		20/30/50
Volumes (bags/week)	3-4	2	1-2
Retailer OFSP buying price per bucket (MZN)	400		
Retailer OFSP selling price per pile of small/big roots (MZN)	30/50		
Retailer Average margins per SP bag (MZN)	250-400	150-200	450-850

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg. The average margins include an estimation of the costs per bag (Table below). The retailer average margins per bag are calculated considering an amount of 40-50 piles (of ~1.5 kg each) per bag

Her costs to sell fresh SP roots amount to 60-90 MZN per week, and include a trolley carrier to bring the bags from the parking place in Xiquelene to her spot, the market fees and the costs of the watchman for her to leave the SP bags on her spot during the night (Table 4.13).

Table 4.13: SP main retailing costs for the retailer in Mercado Xiquelene

Trolley carrier to the market spot	10 MZN/bag
Spot in the market/City Council taxes	3 MZN/ day
Watchman	5 MZN/ day/bag
Total costs per week for only SP (excluding buying the SP roots bags)	60-90 MZN

[13] This statement, however, needs to be confirmed as mafura season is short (December to April) and does not coincide with the SP peak, although it has been detected that the presence of small SP roots in the market increases during the low supply season.

When the bags are light enough, she carries them to a neighbour whom she pay less than a watchman. She lives nearby and walks to work. She is satisfied with her business with SP as she can support the family, buy food and send her children to school. She gives part of her profits (30 MZN/day) for a *xitique,* which is a rotating saving and credit association (ROSCA) scheme. Her *xitique* has five members who deposit on a daily basis and receive the entire amount each fifth day. In this way each member has periodically a relatively large sum which helps them to restock.
According to this informant most of the consumers like the small roots as they get the impression that they buy more product for a lower price. The medium and larger SP roots are bought mostly for quality. The consumers also like OFSP varieties, mostly eaten for health reasons following medical recommendation.

4.2.5. Mercado Zimpeto, Maputo

Mercado Zimpeto is on the road to Marracuene. It is one of the main wholesale markets in the Maputo area. One SP retailer (woman) was interviewed at this market. This woman sells white/yellow fleshed and OFSP varieties, cassava, and Irish potatoes. She comes from Macia, in Gaza Province, where she buys the fresh roots directly from the producers. As shown in Table 4.14, during the high supply season, she buys a bag of fresh roots at 200 MZN or a bucket at 20-30 MZN and she sells the roots in the market in piles or in buckets. A pile of small roots (approx. 20 roots) is sold at 10 MZN and a pile with bigger roots (7 or 8 roots) at 20 MZN; the bucket full of fresh SP roots is sold instead at 150 MZN. During the low supply season, the buying and the selling price increase on average by 40%, or up to 100% when very few roots are present in the market.

Table 4.14: Fresh SP root trading prices and supply in Mercado Zimpeto

SP root supply season	Peak (May-Dec)	Low (Jan-Apr)
Retailer SP *buying* price (MZN)		
Bag*	200	250
Buckets*	20-30 up to 100	200
Retailer SP *selling* price		
Piles (small (20 roots)/ big roots (7-8 roots))	10/20	10/20 (with less roots than peak season)
Bucket*	150	250
Volumes (bags/week)	10	2
Retailer Average margins per bag (MZN)	350-500	300-450
Retailer Average margins per bucket (MZN)	30-120	50

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg. The average margins includes an estimation of the costs per bag (Table below). The retailer average margins per bag are calculated considering an amount of 40-50 piles (of ~1.5 kg each) per bag and an amount of 12-15 piles (of ~1.5 kg each) per bucket and the retailing costs.

The total costs for SP business per week amount to 800-900 MZN, and are mostly due to the high transport costs the retailer faces for herself and the bags carried from Gaza Province (Table 4.15). To write off expenses and watch the unsold bags on her spot, she sleeps in the market until she sells her stock completely. Although she has quite a tough job, she seems satisfied with her business with the fresh SP roots.

Table 4.15: SP main retailing costs for the retailer in Mercado Zimpeto

Transport to bring the bags from Macia to Zimpeto	50 MZN/bag
Transport to arrive to the Maputo and back (herself)	100 MZN/bag
Spot in the market/City Council taxes	15 MZN per day
Food and other	40 MZN per day
Total costs per week for only SP (excluding buying the SP roots bags)	800-900 MZN

She thinks that the consumers prefer the OFSP varieties to the white fleshed ones and that they are aware of the vitamin A content. They eat the roots boiled, or mixed with *mafura* during the mafura season.

4.2.6. Aerodromo area, Manhiça

One SP street vendor (woman) has been interviewed near to the Aerodromo in Manhiça. She buys bags of fresh SP roots from the farmers/sellers from Calanga and other low land areas in Manhiça that come to the nearest market on Monday, Wednesday and Friday. She is also a farmer, planting sugarcane and sweetpotato. She estimated that she gets 9 bags (50kg rice bags) from 500-1,000 square meters of land (~8-15 tonnes per ha). She does not sell the fresh SP roots that she grows. During the high supply season, she buys one bag at the market at 150-200 MZN, selling a small bag filled with SP at 50 MZN. The buying prices during the low supply season increases by 25-60% on average (Table 4.16) but, when roots are very scarce, the price can go up more. She also buys in buckets, especially during the low supply season, but it is not economically convenient. She sells the small bag at the same price but the bag would contain less and smaller roots. There is no price difference among the different SP varieties but fresh OFSP roots are less available on the market.

Table 4.16: Fresh SP root trading prices and supply in Aerodromo area, Manhiça

SP root supply season	Peak (Aug-Dec)	Low (Jan-July)
Retailer SP buying price (MZN)		
Bag*	150-200	250
Buckets*	150	200-350 up to 700
Retailer SP selling price of small bags (MZN)	50	50 (less and smaller roots)
Volumes (bags/week)	9	1-2

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 15-20 kg (3 or 4 buckets make a bag). The retailer does not know how many small bags she makes out of one bag. For this reason, it is difficult to estimate the gross margin per bag.

Table 4.17 lists the cost of selling SP roots per week. She pays 5 MZN/day for the spot on the street. She pays for a trolley to bring the roots from the market to the market spot at 10 MZN/bag. She buys 3 times a week and she stores the roots in her house during the night.

Table 4.17: SP main retailing costs for Retailer in Aerodromo

Trolley to bring the bags to the spot	10 MZN/bag
Spot in the market/City Council taxes	5 MZN per day
Total costs per week for only SP (excluding buying the SP roots bags)	40-50 MZN

She thinks that her business is profitable also due to her location and her proactivity in selling the roots in the street. She would like to have a higher supply all-year long. She notices that her clients ask the fresh OFSP roots following a medical prescription. She mixes the roots in the bag or sells them separately, depending on what the customers want. She personally prefers the SP from the river valley close to Manhiça town over those from Calanga, as she thinks that the farmers in Calanga use fertilizers on their land.

4.2.7. Supermarkets

Two managers from two different supermarket chains have been interviewed. In their shops, they sell white SP from South Africa. The most popular variety sold the white fleshed root with the red skin (probably Blesbok). The orange-fleshed varieties are not sold by either supermarket. The supermarkets also receive some fresh SP roots from farmers located in Maputo Province but, in terms of volumes, the Mozambican production is quite low compared to the South African. The SA roots are bigger and of better quality; moreover, the national production is not always available and

the local roots may come to the shops unwashed, making it difficult for the supermarkets to sell them due to hygienic regulations. The SA and local roots generally have the same price[14]. Even when the local products are cheaper, the consumers of these two supermarkets prefer to buy South African SP roots because they perceive a higher quality. In SA, the sweetpotato VC structure seems more organized and includes also the presence of intermediaries, while both managers think that in Mozambique the farmers do not invest or add value to their products as they have been poorly exposed to the market issues. Details of the volumes marketed in the two supermarket are reported in Table 4.18. Supermarket 1 sells a smaller amount of SP and at cheaper price (on average) than supermarket 2; the latter is more popular among the high income Maputo residents.
Supermarket 2 sells 500-600 kg of fresh SP roots imported from SA per month and ~70 kg of fresh roots bought from local producers. The SP local varieties cost on average 1-3 MZN less per kg than the SA roots. The manager would like to start selling the orange fleshed variety and switch to more national products if the local farmers would provide more quality products and bigger roots.

Table 4.18: Fresh SP root prices in two supermarket in Maputo

SP root supply season	Peak (May/June-Oct/Nov)	Low (Dec- April)
Supermarket 1 SP buying price (MZN/kg)	20	30-32
Supermarket 2 SP buying price (MZN/kg)	20-25	27-30
Supermarket 1 SP selling price (MZN/kg)	34-35	49
Supermarket 2 SP selling price (MZN/kg)	55	65-75
Supermarket 1 Volumes (kg/week)	40	
Supermarket 2 Volumes (kg/month)	600-650	
Supermarket 1 Average margins (in %)	50-70	
Supermarket 2 Average margins (in %)	N.A.	

4.3.Consumers

To complement the information about consumption given by SP producers and retailers, two consumers have been interviewed in order to learn about how frequently they consume SP roots, how they prepare them, what their main root selection criteria are, how much they spend on SP roots and what they knew about SP nutritional benefits.
During our visits to the markets, we met very few consumers buying fresh SP roots. The consumers interviewed were met at the stands of the retailers located in Mercado Fajardo (see above) and they were basically the only ones available to answer questions. They explained that they eat the OFSP roots boiled for breakfast with tea, fried or cooked with fish for the main meals. They can eat the roots weekly or twice a month.
One consumer prefers the small roots as they are tastier and sweeter, the other one chooses the bigger roots because they are easy to cut after been peeled. The consumers prefer unwashed roots bought at local market. They think that the OFSP are difficult to find, and they can cost 40% to 50% more than the white fleshed varieties. The two consumers appreciate the OFSP and know about their vitamin A content.

4.4.Supply and price seasonality

In much of Maputo Province, fresh SP roots are harvested mostly during the winter, with farmers typically planting the crop once or twice per year. Those months where fresh SP root supply peaks and those where supply is low are shown in Table 4.19, based on information from farmer focus group discussions and individual case studies, and different retailers. The supply is quite low from January to April and it starts to increase from May until the end of the year. The farmers that have access to irrigation plant the vines all year round.

[14] The fresh roots from SA cost – at the place of origin – less the Mozambican roots, then the supermarket pay 20% of duties plus the transport costs that together add ~70% to the SA farm gate price.

Table 4.19: Peak and low supply seasons of fresh SP roots in Maputo Province (based on the different agents interviewed)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calanga production	*	*	*	*	*	**	***	***	***	***	***	***
Manhica retailing	*	*	*	*	*	*	**	***	***	***	***	***
Maputo retailing												
Central	*	*	*	*	**	***	***	***	***	***	***	***
Janet	*	*	*	*	**	**	***	***	***	***	***	**
Fajardo	*	*	*	*	*	**	***	***	***	***	***	***
Xiquilene	*	*	*	**	**	**	***	***	***	***	**	**
Zimpeto	*	*	*	*	***	***	***	***	***	***	***	***

High supply: ***; Medium supply: **; Low supply: * *Source: Field visits*

From the data above gathered mostly from the interviews with retailers, it appears that the volumes of SP trade are not very high even during the peak season. The purchase and sales prices reported by the agents interviewed are summarized in Table 4.20. The trading system uses bags, buckets, piles and kg as units of measure. The average selling price variation of bags and buckets during the peak and low supply seasons is reported to be between 25% and 66% in Maputo markets; the highest variation with increases of 85% and 100% is registered for the prices of fresh SP roots per kg in Mercado Janete and the price of small roots piles in Mercado Xiquilene. The retailers report that the buying prices tend to vary more than the selling price, suggesting that they may bear the cost within their business of the 'price variability due to seasonality'.

Table 4.20: Farmers and Retailers prices and volumes for fresh SP roots in Maputo Province (based on the different agents interviewed)

		Price (MZN)	Volumes (per week)	Price variation from peak to low season
Farmer in Calanga		bag: 150 (peak) - 350 (low)	N.A.	130%
Farmer in Mafuiane		kg: 10 and 15 all year round	N.A.	
Farmer in Mahalane		kg: 26 and 50 all year round	N.A.	
Farmer in Moamba		kg: 20 all year round	N.A.	
Farmer in Boane		kg: 25, 20 and 10 all year rouns	N.A.	
Mercado Central	*Buying price*	bag: 1,500 (peak) - 1,650 (low); bucket: 200 (peak) - 300 (low)	N.A.	10%-50%
	Selling price	kg: 30-45 (peak) - 50 (low)		~25%
Mercado Janet	*Buying price*	bag: 350 (peak) - 1,000 (low); bucket: 150 (peak) - 350 (low)	kg: 15-20 (peak) - 10 (low)	130%-180%
	Selling price	kg: 25-30 (peak) - 50 (low)		~85%
Mercado Fajardo	*Buying price*	bag: 250 (peak) - 500 (low)	bags: 15-20 (peak) - 3-4 (low)	100%
	Selling price	bag: 600 (peak) - 800 (low); bucket: 150 (peak) - 250 (low)		30%-65%
Mercado Xiquilene	*Buying price*	bag: 500-550 (peak) - 800-850 (low)	bags: 3-4 (peak) - 1-2 (low)	57%
	Selling price	piles (different roots size): 10/20/30 (peak) - 20/30/50 (low)		50%-100%
Mercado Zimpeto	*Buying price*	bag: 200 (peak) - 250 (low); bucket: 20-100 (peak) - 200 (low)	bags: 10 (peak) - 2 (low)	25%->200%
	Selling price	bucket: 150 (peak) - 250 (low)		66%
Supermarket	*Buying price*	kg: 20-25 (peak) - 27-32 (low)	bags: 9 (peak) -2 (low)	~30%
	Selling price	kg: 34-55 (peak) - 49-75 (low)		~40%
Aerodromo, Manhica	*Buying price*	bag: 150-200 (peak) - 250 (low); bucket: 150 (peak) - 350 (low)	N.A.	40%-130%
	Selling price	small bags: 50 (all year)		

Source: Field visits

Note: The calculations of the price variation from peak to low supply season considers the average price per supply season and it is calculated as a growth rate from low to high price (i.e. from peak to low supply season).

4.5.Main findings

- Sweetpotato is not an important staple in Maputo province when compared to maize and cassava- One to two-fifths of the production is sold on the market. Most sweetpotato is produced by smallholders and white varieties are predominant. In the key sweetpotato production area Manhiça orange-fleshed varieties are not common. Much of the OFSP on offer is produced by commercial farmers in larger plots;
- Sweetpotato has two production cycles per year following the rainfall pattern but the presence of irrigation may allow the crop to be planted continuously. Most SP varieties grown mature by 3 or 4 months after planting but some OFSP varieties take up to five months;
- The SP crop is typically cultivated by men and women; the women's involvement in farming activities appear to be higher but, as the crop becomes more commercial, the men may step in and hire labour to help scale activities;
- A few years ago, the OSFP consumption was higher but then it decreased due to the quality of the fresh roots. This may point to less tasty and more watery varieties. Production appears to have declined due to the loss of planting material as a result of floods and droughts. Since 2013, new, tastier and less watery OFSP varieties have become available to farmers in Maputo Province. The most popular ones are Delvia (more prone to weevil attacks), Irene (probably the favourite one),Ininda, Gloria, Melinda. The promotion of OFSP, including the vine distribution and propagation, is on-going. Due to high the high market price of in particular orange-fleshed varieties processing is restricted to high-end and small scale such as juices and pastry;
- From our interviews with selected commercial farmers it appears that the profitability of OFSP varieties (including the selling of vine) varies between 214,000/605,000 MZN per ha/annum while the gross margin per kg amounts to 12-42 MZN;
- Interviews with smallholders in Manhiça producing mainly WFSP indicate margins that are below 5 MZN/kg; these farmers do not obtain a premium for OFSP but for larger roots.
- In the SP value chain, intermediation activities are not very defined. Small-scale SP producers in Manhiça sell to traders who might either sell on to retailers in Maputo or act as wholesalers. The larger farmers sell directly to consumers at roadside stalls, fairs and festivals, or through home delivery. They sell also a limited amount to supermarkets. During fieldwork middlemen and wholesalers have not been detected: the farmers sell directly to consumers and retailers located in rural or urban markets close to the production areas while the traders in the larger markets sell to both final consumers and retailers from other markets;
- SP retailing activities are dominated by women in urban markets. The fresh SP roots are traded in bags (the volumetric measure is the 50 kg rice bag, while the real weight of a bag packed with sweetpotato is estimated around 65-80 kg), buckets (which weigh about 20 kg), per kg (when the retailers have a scale) and in piles with different root size compositions and weights;
- Buying and selling prices are lowest during the peak season (May-Nov/Dec) and highest in the low season (Dec/Jan-April), with price variation up to 100% when there is great scarcity of fresh roots in the market. The trade volumes mentioned by the interviewed traders range from 10 kg of fresh SP roots weekly sold in Mercado Janete during the low supply season to 20 bags (about 1400 kg) per week in Mercado Fajardo during the peak supply season;
- From our visits to different markets it emerges that the retailers' margin per bag is likely to be higher during the lower SP supply season than during the peak season as consumer prices appear to fluctuate less than the farm-gate and retail prices. The retailers located in the urban market of Maputo (Mercado Central and Janete) registered the highest margins (650-1,650 MZN/bag during the peak supply season and 650-2,500 during the low supply season), mostly led by the higher price of fresh SP roots per kg. The margins of the other retailers are

on average 250-550 MZN/bag during the peak supply season and 350-700 during the low supply season;

- In the main supermarket chains in Maputo, the largest volumes of fresh SP roots are imported from South Africa due to their better quality at almost the same price of the national fresh roots, and consumer preference. Moreover, the local production is not always available and does often not meet quality standards;
- The SP root production and trade happen within Maputo Province borders, even though the occasional presence of traders from Chimoio in Mercado Fajardo and a retailer coming from Gaza Province in Mercado Zimpeto have been detected;
- Net consumer preference for certain varieties of fresh SP roots is not detected, but the trade of OFSP roots appears to be at a lower scale than the one of white fleshed SP roots. OFSP fetches a premium price on the Maputo markets.

Figure 4.1: (clockwise from top left) OFSP field in Mafuiane; women of the Associação dos Camponeses de Munhangue in Calanga; Mercado Janete; Mercado Central; 50-kg rice bag filled with fresh SP roots in Mercado Fajardo; retailer in Mercado Xiquilene; Bags and buckets in Mercado Zimpeto; retailer with scale in Mercado Janete; retailer at her stand in Mercado Central; retailer on her spot in Mercado Fajardo (Photos: Ilaria Tedesco)

5. Sweetpotato commodity chain in Manica

5.1.Production activities and producers

5.1.1. Macate district

Sections 2.2 and 3.3.1 contain some general references to the production of sweetpotato and the acreage of white and orange-fleshed varieties in Manica Province. This section presents more detailed information about individual farmer strategies in Macate district. Together with Gondola, Macate district represents the main SP crop producing area of Manica province. A focus group with 11 farmers (7 men and 4 women) was held in the locality Chissassa, Macate district.

According to the interviewed farmers, sweetpotato is not a primary crop for the area, mostly because it has a longer production cycle than other crops. The main staple crops for daily consumption are maize, beans, and sorghum. The area of a single farm may vary from 0.5 to 10 hectares. The size of the land allocated to sweetpotato depends on farmers' production targets: roots intended for home consumption are grown on small parcels while commercial farmers may plant 1 or 2 hectares with the crop. The yields are estimated at ~50 bags/ha, for an approximate amount of ~4 tonnes/ha[15]; the yield of fresh roots per ha is the same for the different SP varieties.

The sweetpotato is a dry land crop which is generally planted once a year on non- irrigated land. In lowland areas, the SP vines are planted in September (i.e. right at the start of the rainy season) and harvested in January rapidly because the land gets flooded afterwards. In highland areas the farmers, instead, plant the vines from December to March, harvesting from April to September before the planting of maize in November. On irrigated land, however, production cycles may be different.

The white fleshed SP varieties are more commonly cultivated than the orange-fleshed; WFSP vines are easily available for planting. The most widespread WFSP varieties in the area are Tomanze and Secai, the latter appreciated for its taste. Mabuadara is indicated as the most watery SP root variety and tends to rot easily, while Tambarare is not widely planted as it requires more water. Orange fleshed varieties are less available. A variety called Africare seems to be well received by the market and it is sold at a higher price than the white fleshed varieties. The fresh OFPS roots are present in the market from June to September and, when the peak is particularly high, they can represent even up to 50% of the total fresh SP roots supply.

The seasonality and the price per bag are illustrated in Table 5.1. The lowest price is 90 MZN/bag registered from April to July while it can reach up 450 MZN for a 50 kg bag or 300-350 MNZ for a 25 kg bag when the planting season has been delayed. The farmers explained that the price is very volatile and it may change even during the same day, greatly affecting the farmers' income. The profits from SP are not well known by the producers as SP seems to be a new crop for business with potentials still to be explored.

Table 5.1: Chissassa SP root availability and selling price during the year (approx.)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SP root supply	*	*	**	**	***	***	***	***	**	**	**	*
SP price in Macate (MZN/bag)	200/ 250	200/ 250	200/ 250	90- 250	90- 250	90- 250	90- 250	200- 450	200- 450	200- 450	200- 450	200- 450

High supply: ***; Medium supply: **; Low supply: *

Note: The bags refer to a volumetric measure of 50 kg that, expanded for another 20-30%, brings the real weight to ~65-80 kg

[15] The volumetric measure of the bag is 50 kg bag (used for rice) but the real weight can be ~65-80 kg per bag. The estimated production would hence be about 4 tonnes which is low compared to other estimates (see section 3.3.1)

Men and women work in different fields or on the same field on diverse tasks. Commercial production is mostly carried out by men, often with the help of casual or regular workers paid at 100 MZN per day, while the women are more engaged in producing SP roots for home consumption (i.e. a production of 4 to 6 bags) or in selling activities. One of the men engaged in commercial production of vines and roots explained that he would not hire female workers to avoid gossiping. The harvesting is done manually and piecemeal based on consumption needs or selling opportunities. The SP roots that do not last well in the soil suffer from damage by weevils; rats and pests cause post-harvest losses. Other limitations to SP productivity are constraints in the supply of vines and the lack of water for irrigation.
The farmers grade the fresh roots before selling them in the markets: they do not sell damaged roots or the ones smaller than 15 cm, as the retailers and consumers prefer bigger roots. The farmers transport the roots in bags to the market in Chimoio by bicycle or by carrying the bags on their heads; they may also share a truck for larger quantities. The price per bag is influenced also by the transporter costs. Occasionally a buyer comes to the fields to buy the fresh roots. As they tend to overload the bags and squeezing the roots to gain quantity and choose only bigger roots this frequently results in lower profits for the farmers.
Three farmers have been individually interviewed in Macate and in Gondola districts. Details are presented in Table 5.2.

Table 5.2: Summary of the SP crop cultivated by the three farmers, Manica Province

Province		Farmer A	Farmer B	Farmer C
Manica	**Varieties**	OFSP (just planted): Sumaia, Amelia,	OFSP (just planted): Ininda, Sumaia, Delvia, Amelia	N.A.
Sub-county/Localities:	**Avg yields for SP/OFSP (bags or tonnes per ha):**	100 bags	~180 bags	11
Chissassa (Macate), Gondola	**Avg yields for vines (tonnes per ha):**	N.A.	N.A.	8
	Avg price of SP roots (MZN/kg or MZN/bag):	250-300 MZN/bag	250 MNZ/bag	11.5 MZN/kg
	Avg price of SP vines (MZN/kg):		4	4 or 5
	No. of cycles per year:	1	3	2

Source: Field visits

Farmer A owns 10 ha of land in Chisassa that are cultivated with SP, peanuts, beans, maize, and banana; 0.5 ha are under white/yellow fleshed SP varieties and 0.1 ha under OFSP. After preparing the land in October, he plants the vines in November and harvests from February to June. The rains heavily affect his harvest: in case of a low precipitation, he may experience losses up to 30% of his total production, harvesting around 30-35 bags of fresh roots instead of 50 bags with normal rains. He keeps 10%-20% of his fresh SP roots for family consumption, selling the rest in Chisassa, Macate and Chimoio (Mercado 38). He reaches the markets in Macate and Chimoio by bus paying 25-30 MZN for his own transport and 10-15 MZN for each bag. He does not pay any transport to go to Chissassa. In Chissassa, the selling price varies from 150 MZN per bag in April-June to 350 MZN/bag in July and August while in Chimoio and Macate the selling price per bag is 50 MZN higher during both seasons. In Chimoio, he sells 10-20 bags per month, paying municipality fees (20 MZN/bag) and transport from the road to the market (5-15 MZN/bag). His clients are mostly local but some come as far as from Beira and Tete. In Chissassa, he also sells fresh SP roots in piles.
Farmer B has 4.5 ha of land in Chisassa, irrigated using a gravity system. He cultivated 0.75 ha with white/yellow fleshed SP varieties and he also started planting OFSP in November. He sells the vines at 4 MZN/kg and the fresh SP roots in the local market, for a price that varies from 120 MZN/bag to 350 MZN/bag. He also cultivates cabbage, and carrots.
Farmer C is a commercial farmer located in Gondola district. He has more than 100 ha and uses 1 ha for OFSP root production and 0.5 ha for OFSP vine propagation. The land is irrigated using a pumping system. He sells a quantity of 50 kg of fresh OFSP roots per week to a supermarket chain in Chimoio

for 10 to 15 MZN/kg[16]; the highest price is registered from December to January and the lowest from May to July. He also sells OFSP directly to consumers and other traders at 10 MZN/kg. He sells the vines to CIP (4 MZN/kg), to other organizations and neighbouring farmers at 5 MZN/kg. He starts land preparation for the SP crop in December, plants the vines in January and, for the other cycle, in April. He has fresh OFSP roots almost 9 months a year, except from September to November. In July and August, the consumer demand decreases and he prefers to leave the roots in the ground sometimes experiencing substantial losses from weevil attacks. He cultivates a wide range of horticultural crops, including lettuce, cabbage, tomatoes and spinach that he also sells to the supermarket.

Details on farmers' accounts for SP production and markets are reported in Table 5.3. The calculations include all production of sweetpotato and vines at farm level, including that for home consumption. The latter is recorded at the same farmer's selling price (MZN per kg). Labour is hired and/or provided by family members. In the calculations for family labour, it is accounted the same wage used for hired labour (and two different gross margins calculated, with and without family labour cost). The gross margins per ha and per kg are calculated.

Table 5.3: Farmers' gross margins for SP and OFSP production (per cycle)

	Farmer A: 0.5 acres of SP and 0.1 of OFSP			Farmer B: 0.25 ha of SP plus vines			Farmer C: 1 ha of OFSP and 0.5 ha of vines		
	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)	Unit	Quantity per plot/cycle	Total Value per plot/cycle (MZN)
Revenues *(a)*			**18,000**			**19,250**			**144,500**
*Sweetpotato (q1)**	bag	50	15,000	bag	45	11,250			
*Orange-fleshed Sweetpotato (q1)**	bag	10	3,000	bag			tonnes	11	126,500
Vines	bag			kg	2,000	8,000	tonnes	4	18,000
Costs *(b)*			**12,550**			**14,700**			**18,550**
Water	fee			fee		N.A.	fee		N.A.
Hoe	unit		50	unit			unit		50
Bags (for roots)	unit			unit			unit		
Fertilizer	liter			liter			liter		
Land rent	acre			acre			acre		
Land preparation	man/day	5	2,500	man/day		1,500	tractor		3,000
Mounding/ridging	man/day	10	2,000	man/day	9	900	man/day	10	1,000
Planting	man/day	10	2,000	man/day	12	1,200	man/day	30	3,000
Weeding	man/day	7	1,500	man/day	36	3,600	man/day	40	4,000
Pesticides and application	man/day			man/day			man/day	30	3,000
Harvesting	man/month		3,000	man/month	2	6,000	man/month	1.5	4,500
Transporting	bus		1,500	bus		1,500	motorbike		
Selling	market spot			market spot			market spot		
Gross margin *(a-b)*			**5,450**			**4,550**			**125,950**
excluding family labour			**16,500**			11,900			125,950
Gross margin per ha *[(a-b)/Σq2]*			**24,750**			**13,685**			**107,950**
Gross margin per bag or per kg *[(a-b)/Σq1]*	bag (mixed WFSP and OFSP)		**109**	bag		**91**			**10**
Gross margin per year	1 cycle		5,450	3 cycles		13,650	2 cycles		251,900
Farmer total land (ha)	10			4.5			>100		
SP ha *q2*	1			0.25					
OFSP ha *q2*	**0.1**			**N.A.**			**1**		
% Total	11%						1%		
Vines production ha				**N.A.**			**0.5**		
% Total							0.5%		
OFSP Price (MZN/kg or MZN/bag)	300			250			11.5		
Vines price (MZN/kg)				4			4.5		
Home consumption	10% to 20%			10%			300 kg per harvesting		
In-ground losses	up to 30% with few rains						very few		
Other losses							very few		
Labour	Self +family			Hired+self			Hired		
Irrigation (Y/N)	N			Y			Y		
Use of tractor (Y/N)	N						Y		

Source: Field visits

Note: The calculations of the gross margins are expressed in per bag for farmer A and B (as well as the sweetpotato and orange-fleshed sweetpotato quantities *q1* and the price) while are in per kg for farmer C (as well as the sweetpotato and orange-fleshed sweetpotato quantities *q1* and the price). For farmer C an average vine price of 4.5 MZN/kg is accounted.

[16] After interviewing the shop manager of the supermarket in Chimoio, we discovered that the quantity sold is lower (20-30 kg of SP per week). He mentioned also that he rejects some of the roots supplied by Farmer C because of quality issues. See section 5.2.3.

Considering the three individual farmers interviewed in Manica province, the profitability of WFSP and OFSP varieties (including the selling of vines) is estimated at 13,600/108,000 MZN per ha/annum. The upper bound is driven by the ability of farmer C to sell the fresh roots to a supermarket chain and, possibly, by the premium price for OFSP varieties. The gross margin per bag amounts, instead, to 250-300 MZN or about 3.3 to 4.1 MZN per kg for 2 farmers in Macate and in 11.5 per kg for farmer C. The difference between farmers A and B on the one and C on the other is also probably due to their location in Macate whereas C is close to the N6 connecting Beira and Chimoio and the fact that C has his own clientele for OFSP and can deliver directly to the supermarket.

5.2.Retailers

5.2.1. Mercado 38, Chimoio

Mercado 38 is the largest fruit and vegetable market in Chimoio. The market is visited by consumers and by retailers from other markets. Consumers will buy piles for consumption at home whereas the retailers buy bags to sell them on. The traders located in Mercado 38 buy directly from the farmers, or they can be farmers themselves. There are no real wholesalers or middlemen. During the high supply season, the market looks quite busy in terms of SP selling and buying, while during the low season very few SP traders (3 or 4) are detected. The majority of SP traders that are present on the market are women.

The SP roots are brought to the market on trucks and on motorbike and bicycles. To transport the fresh SP roots from the production area to the market, the traders rent space on a truck. The transport costs from Macate to Mercado 38 are 70-80 MZN/bag while from Gondola to Mercado 38 it is 30 MZN/bag. The municipality fee to sell at Mercado 38 amounts to 20 MZN per day.

A former MINAG officer involved in data collection for the market information system (SIMA) provided information about the variation in supply and price at Mercado 38 (Table 5.4).

From January to March, the availability is low as well as the price due to the poor quality of the roots sold (in general quite small). In April, the fresh SP roots availability increases, reaching the peak from May to August. In September the fresh SP roots availability decreases and the price starts to increase from October to December reaching 35 MZN/pile containing a lower amount of roots.

Table 5.4: General SP root trading prices and supply in Mercado 38

Supply season	Prices (avg)	Notes
Low (Jan-March)	20 MZN/pile	price is low due to the scarce roots quality
Medium (Apr)	20 MZN/pile	
Peak (May-Sept)	20-30 MZN per pile	
Medium (Sept)	30-35 MZN/pile	
Low (Oct-Dec)	35 MZN	the number of roots per pile decrease

Additionally, two SP retailers have been interviewed. They come to the market every day and sell on average 1-3 bags per week (Table 5.5). Retailer 1[17] sells the SP roots in bags to other retailers who have their business at Mercado Catanga while Retailer 2 buys the bags at Mercado 38 (or in Macate) and sells the fresh roots in piles: from one bag she puts together 10 small roots piles (sold at 10 MZN/pile) and 13 big roots piles (sold at 20 MZN/pile).

During the peak season retailer 2 pays 250 MZN for a bag with WFSP roots while a bag with OFSP costs 400 MZN. She thinks that her business is profitable, as she provides for 4 children, contributes to family expenses and also keeps some money for herself. Net of all the expenses, she estimates to have profits of ~50 MZN per bag.

[17] Due to time constraints, the interview of the retailer 1 has been very short, and therefore the information provided are not complete.

Table 5.5: Fresh SP root trading prices and supply in Mercado 38

SP root supply season	Peak (Apr-Sept)	Low (Oct-March)
Retailer 1 SP buying price (MZN)	200	~300
Retailer 2 SP buying price (MZN)	250 (white fleshed) 400 (OFSP)	up to 500
Retailer 1 SP selling price (MZN/bag)	300	400-450
Retailer 1 SP selling price per pile (small and big roots (MZN)	10/20	20/30
Average volumes (bags/week)	2	
Retailer 2 Average margins per bag (MZN)	100	

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg).

5.2.2. Mercado Catanga, Chimoio

One retailer (man) has been interviewed at Mercado Catanga where he was selling fresh SP roots along with other fruits and vegetables, such as Irish potatoes, banana, yam and sugar. His business operate at different locations on the market, with the Irish potato and other fruits and vegetables being inside the market itself and the sweetpotato on the roadside outside the market. He comes every day to the market, except on Sunday when it closes and focuses his attention on the business inside the market. His wife is mainly taking care of the daily retailing of SP. He buys the fresh SP roots bags in Macate from relatives and other farmers in the area, or he buys in Mercado 38 when he does not have enough roots and does not find it convenient to go to Macate. Sometimes he is able to source more roots than he can sell in Chimoio. In those cases he transports the surplus to Beira and sells it there. The different supply season and the price variation for his retailing activities are reported in Table 5.6. He grades the roots to sell the SP in piles and tries to get an average revenue per bag of 500-550 MZN, gross of the bag and the retailing costs.
He says that about 75% of the SP retailers are women in the market, even though the men are probably engaged in larger business activities. During the low supply season, there is less competition and fewer retailers in the market, and they agree certain piles sizes and prices.

Table 5.6: Fresh SP root trading prices and supply in Mercado Catanga

SP root supply season	Peak (May-Sept)	Medium (Mar-April)	Low (Oct-Feb)
Retailer 1 SP buying price per bag (MZN)	250-300	300-400	150-300
Retailer 1 SP selling price in small/medium/big roots piles (MZN)	10/20/40/50	10/20/30	10/20/30
Volumes (bag/week)		3-4	
Average margins per bag (MZN)	550-850		550-850

Note:* The volumetric measure of the bag is 50kg (real weight 65-80 kg); the bucket contains 25-20 kg. The average margins includes an estimation of the costs per bag (Table below). The retailer average margins per bag are calculated considering an amount of 40-50 piles (of ~1.5 kg each) per bag and an amount of 12-15 piles (of ~1.5 kg each) per bucket

The transport from Macate costs 20-30 MZN per bag.
The bus arrives here at Catanga and he can either bring the bags to the spot himself or hire a trolley that costs 20 MZN per 10 bags.
The unsold bags stay at the market in a sort of storage room that costs 10 MZN per day, independently of the number of bag stored (Table 5.7).

Table 5.7: SP main retailing costs for Retailer 2 in Mercado Catanga

Transport to the Mercado Catanga from Macate for himself	25 MZN
Transport to arrive to the Mercado Catanga from Macate	20-30 MZN/bag
Trolley	2 MZN/bag
Storage room	10 MZN/day
Spot in the market/City Council taxes	12 MZN/day
Total costs per week for only SP (excluding buying the SP roots bags)	220-250 MZN

Maize and Irish potatoes are the most favourite staple crops but SP is preferred over cassava. SP is considered a smaller business than for other fruits and vegetables. Some retailers may survive and support the family selling SP roots but it is not really profitable. SP is in general eaten for breakfast. As income increases, people prefer to substitute the roots with bread. If this tendency continues SP is a declining business. Consumers prefer the bigger roots and the red skin, white fleshed sweetpotato varieties. Only one-third of the clients, mostly wealthier people and foreigners, ask specifically for OFSP varieties.

5.2.3. Supermarkets

One manager from a supermarket chain has been interviewed in Chimoio. The shop sells both white fleshed and OFSP roots buying the crop from a local supplier or importing it from South Africa. Price and quantities are reported in Table 5.8.
The local supplier is a farmer from Gondola (see previous section) that provides the supermarket with 20-30 kg of SP per week when he has roots available in the field.
The manager judges general SP business at supermarket level as quite poor. The local SP suffers from lack of continuous supply and low quality and, for this reason, the supermarket also buys fresh SP roots from SA. The manager would like to have a continuous supply of local SP but it needs to have certain quality standards that often the local supplier is not able to meet.
To be accepted by the consumers, the fresh SP roots should have skin with no spots and be of medium size (4-5 roots for kg) as the customers do not buy smaller roots. Most of the customers would value the local products more than the products from SA due the use of fertilizers that characterize the South African SP production.

Table 5.8: Fresh SP root prices in two supermarket in Maputo

SP root supply season	Peak (Apr-July)	Medium(Aug-Dec, Jan-Apr)	Low (Dec)
Supermarket SP buying price (MZN/kg)		10	
Supermarket 1 SP selling price (MZN/kg)		24 (local variety), up to 49 SA variety*	
Supermarket 1 Avg Volumes (kg/week)		20-50	
Supermarket Average margins (in MZN/kg)		14-20	

* When the SP price arrives at 49 MZN per kg, few customers buy the fresh roots. To ensure that the customers would buy all the products in the supermarket, the price of SP has to be lower than 30 MZN.

5.3.Processor

Zebra Farm/SoSoja is a combination of two enterprises producing and processing soy (SoSoja) and orange-fleshed sweetpotato (ZebraFarm) in Manica Province.
The processor started his small business producing milk and yogurt from soybeans. Soy milk and yoghurt have been marketed on a small scale in Chimoio; GAIN and AgDevCo have supported the upscaling of the business through certifications, new equipment and production facility. For his business, the processor works also with the Universidade Católica de Moçambique (UCM), and the Ministry of Science and Technology (Department of Entrepreneurship).

OFSP juice and OFSP/soy biscuits will be new products: at the moment, they are in the trial phase with CIP piloting them in its laboratory in Maputo. **Error! Reference source not found.** shows the processing technical coefficient for juice and biscuits, and their costs.

Table 5.9 Formula and costs for juice and biscuits production

		Quantity (gram)	Unit price (MZN/gram)	Total cost (MZN)	Technical coefficient ratio (single ingredient: final product)	Cost (%)
Ingredients (for 21 kg or 21,000 grams of juice)	*OFSP*	25,652	0.025	641.3	1.22:1	58%
	ascorbic acid	192	1.72242	330.70	0.009:1	30%
	sugar	2,898	0.038	110.12	0.138:1	10%
	xhantham gum	40	0.57	22.74	0.002:1	2%
Total Costs (MNZ)	**for 21 kg of juice**			**1,104.87**		
	per gram			**0.05**		
	per bottle (200 grams)			**10.52**		
Ingredients (for 950 kg of biscuits, efficiency rate ~73%)	*Flour*	500	0.026	13	0.55:1	11.5%
	Sweetpotato	150	0.025	3.75	0.16:1	3.3%
	Soy	150	0	0	0.16:1	0.0%
	Butter	250	0.316	79	0.26:1	70.2%
	Eggs (number)	1	5	5	0.06:1	4.4%
	Sugar	250	0.042	10.5	0.26:1	9.3%
	Salt	5	0.088	0.44	0.005:1	0.4%
	Baking powder	3	0.3	0.9	0.003:1	0.8%
Total Costs (MZN)	**for 950 grams of biscuits**			**112.59**		
	per gram			**0.12**		

Source: Mujuju L. & Brouwer, R. (2015). SUSTAIN Mozambique & ZEBRA FARM integrate two value chains in juice and biscuits. Presentation at the Community of Practice (CoP), Sweetpotato Marketing, Processing and Utilization Meeting, Nairobi, Kenya, May 20 -21, 2015

Raw material (soybeans, fresh OFSP roots) are sourced from own farm and from outgrowers in Vanduzi district: to have the necessary amount of fresh OFSP roots to produce biscuits and juice, the processor is planning to be supplied by 10 out growers (~5 ha) planting mostly Tio Joe OFSP variety, as more watery and apt for producing juice. The agreed price with the farmers is 25 MZN/kg.

The production of OFSP juice and biscuits has not yet started delaying, as consequence, the flow of the planned activities for the four-year period 2015-2018. Neverthless we report the production volumes (of final and raw products) and the business planned as initially designed, as a forthcoming starting of the activities could not impede to reach the given targets during the next years.

Table 5.10 shows the estimated production volumes for the juice (18,000 litres in 2015 up to almost 29,000 litres in 2018) and the biscuits (41,000 kg in 2015 up to 65,600 in 2018). The relative requirements of fresh OFSP roots are estimated at 22,500 kg in 2015 up to 36,000 kg in 2018.

Table 5.10. Production volumes and OFSP requirements

	Annual volumes (240 days)			
Year	**2015**	**2016**	**2017**	**2018**
Juice (litres)	18,000	28,800	28,800	28,800
Biscuits (kg)	41,018	65,629	65,629	65,629
OFSP (kg)	22,500	36,000	36,000	36,000

Source: Mujuju L. & Brouwer, R. (2015)

Table 5.11 illustrates the business plan for 2015-2018, reporting the estimations and the calculations for the revenues for single activities, the common costs to run the business (mainly labour, energy and rental costs). This Scenario describes the business requirements to achieve the SUSTAIN targets.

The daily production should have started in the first quarter of 2015 with 30 kg of juice and ~68 kg of biscuits per day, to increase fourfold by the end of 2015 and for the next three years. Once the business is at its full capacity, the total net revenues for both juice and biscuits are planned to reach almost 100,000 USD per year.

Table 5.11. Business plan for juice and biscuits production 2015-2018

Product	Year	2015				2016	2017	2018	Notes
		I Quarter	II Quarter	III Quarter	IV Quarter	Annual	Annual	Annual	
Juice	Daily production (kg)	30.00	60.00	90.00	120.00	120	120	120	*Planned*
	Unit cost of production (MZN/gr)	0.05	0.05	0.05	0.05				*Experimental results*
	Total cost for packaging (MZN)	17.52	17.52	17.52	17.52				*Calculated*
	Selling cost for packing (200ml) (MZN)	22.00	22.00	22.00	22.00				*Estimated*
	Net revenue per package (MZN)	4.48	4.48	4.48	4.48				*Calculated*
	Net revenue per day (MZN)	671.61	1,343.22	2,014.84	2,686.45				*Calculated*
	Revenues (USD)	**1,343**	**2,686**	**4,030**	**5,373**	**21,492**	**21,492**	**21,492**	*Calculated*
Biscuits	Daily production (kg)	68.36	136.73	205.09	273.46	273.46	273.46	273.46	*Calculated*
	Unit cost of production	0.12	0.12	0.12	0.12				*Experimental results*
	Total cost for packaging (MZN/50 gr)	8.00	9.00	10.00	11.00				*Calculated*
	Selling cost for packing	10.00	11.00	12.00	13.00				*Estimated*
	Net revenue per package (MZN)	2.00	2.00	2.00	2.00				*Calculated*
	Net revenue per day (MZN)	2734.56	5469.12	8203.68	10938.24				*Calculated*
	Revenues (USD)	**5,469**	**10,938**	**16,407**	**21,876**	**87,506**	**87,506**	**87,506**	*Calculated*
Total revenues (juice + biscuits) (USD)		**6,812**	**13,625**	**20,437**	**27,249**	**108,998**	**108,998**	**108,998**	
Production costs (common to juice + biscuits) (USD)	**Total costs**	**2,840**	**2,949**	**3,059**	**3,168**	**11,358**	**11,358**	**11,358**	*Calculated*
	Total peeling costs (USD, 60 days)	110	219	329	438	438	438	438	*Calculada*
	*Wage for fixed labour (3*8000 MZN/month)*	2,400	2,400	2,400	2,400	9,600	9,600	9,600	*Estimated*
	Rent (80 USD monthly)	240	240	240	240	960	960	960	*Estimated*
	Energy costs (1500 MZN/month=30 USD/month)	90	90	90	90	360	360	360	*Estimated*
Total net revenue (juice + biscuits) (USD)		**3,973**	**10,676**	**17,378**	**24,081**	**97,639**	**97,639**	**97,639**	*Calculated*

Source: Mujuju L. & Brouwer, R. (2015)

This moderately optimistic scenario indicates that the business will be profitable and can recover the investments in equipment and infrastructures, not included in the calculations. The largest profit is expected from the sales of biscuits that represent ~80% of the total net revenues.
The results of a (very) limited sample tasting[18] show that juice and biscuits seem to be marketable: from a comparison with Santal fruit juice, the OFSP juice formula is well appreciated and minor negative point is represented by the aftertaste, while the biscuits need improvement on 'crunchiness'. Juice and biscuits score well on nutrition parameters (Fe, Vit A) but more tests are needed.

5.4.Supply and price seasonality

Macate district represents one of the largest SP production areas in Manica Province. Here, the SP roots are harvested mostly once a year in non-irrigated land. A summary of the months where fresh SP root supply peaks and those where supply is low are shown in Table 5.12, based on information from farmer focus group discussions and individual case studies, and different retailers. The peak supply goes from April to September due to the fresh roots coming from the highland area. The roots from the lowland area mostly supply the market from January to March, depending on the rainfall pattern.

Table 5.12: Peak and low supply seasons of fresh SP roots in Manica Province (based on the different agents interviewed)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Macate production	*	*	**	**	***	***	***	***	**	**	**	*
Chimoio retailing												
Mercado 38	*	*	*	**	***	***	***	***	***	*	*	*
Catanga	*	*	**	**	***	***	***	***	***	*	*	*

High supply: ***; Medium supply: **; Low supply: *

[18] The sample is constituted by 10 male students between 20 and 25 years old.

Source: Field visits

The purchase and sales prices reported by the agents interviewed are summarized in Table 5.13. From the above data gathered from farmers and retailers, the trading system uses bags, piles and kg as units of measure. The average buying price variation of bags during the peak and low supply seasons is reported to be between 44% and 60% in Chimoio markets; a variation of from 80% to above 100% is registered for the selling prices of fresh SP roots from farmers and retailers. The selling price tends to vary more than the buying price as, even explicitly said during the interview, the vendors tend to gather higher margins during the low supply season.

Table 5.13: Prices and volumes for SP fresh SP roots in Manica Province (based on the different agents interviewed)

		Price (MZN)	Volumes	Price variation from peak to low season
Farmers in Macate		bags: 90-250 (peak) - 250-450 (low)	N.A.	~105%
Farmer in Gondola		kg: 8 (peak) - 15 (low)	10-12 tonnes/ha per cycle	87%
Mercado 38	*Buying price*	bag: 200-250 (peak) - 300-350 (low); 400 (OFSP)	2 bags per week (avg)	44%
	Selling price	bags: 300 (peak) - 400-450 (low); piles: 10-20 (peak) - 20-30 (low)		50%-100%
Mercado Catanga	*Buying price*	bag: 250 (peak) - 400 (low)	4 bags per week (avg)	60%
	Selling price	piles: same price but changes the number of roots		N.A.

Source: Field visits

Note: The calculations of the price variation from peak to low supply season considers the average price per supply season and it is calculated as a growth rate from low to high price (i.e. from peak to low supply season).

5.5.Main findings

- SP is not a priority crop in Manica Province, as a result of its long production cycle and because of food preference of the population. The white fleshed varieties are predominant than OFSP in terms of quantity produced;
- SP is typically grown once per year; in Macate district, lowland and highland areas have different, and mostly sequential, planting and harvesting seasons but the presence of irrigation may allow the SP crop to be planted continuously;
- SP is typically produced by men and women in different plots and/or carrying out different tasks in the same plot. As the crop becomes commercialised, the men are more involved in SP activities;
- From our individual farmers interviews, the profitability of SP varieties (white- and orange-fleshed, plus the vines) is estimated at 13,600/108,000 MZN per ha/annum. The upper limit is controlled by the ability of farmer C to sell the fresh OFSP roots to a supermarket chain that may have a premium price. The gross margin per bag amounts, instead, to 250-300 MZN for 2 farmers in Macate and in 11.5 per kg for farmer C;
- OFSP varieties are still not well-known. The promotion of OFSP, including the vine distribution and propagation, is on-going and the processing activities are starting with the production of biscuits with OFSP and soybeans, and of OFSP juice;
- In the SP value chain, wholesaling and intermediation activities appear limited. The farmers sell directly to the consumers and to the traders located in the urban markets or at markets close to the production areas. Traders in the larger markets (i.e. Mercado 38) sell to both final consumers and retailers from the same or other markets;

- Most of the SP retailing activities are carried out by women. SP is traded in bags (volumetric measure of ~50 kg, with a real weight of 65-80 kg), kg (i.e. in supermarkets) and piles of different roots size composition;
- Buying and selling prices are lowest during the peak season (May-Nov/Dec) and highest in the low season (Dec/Jan-April) with a price variation estimated on average of between 50%-100%;
- The SP production and trade happen within Manica Province borders, even though the presence of buyers from Beira and Tete Provinces have been observed and traders have reported selling on to Beira;
- The supermarket chain in Chimoio sells a very limited amount of fresh SP roots. Most is WFSP imported from South Africa. It has a contract for OFSP from a local producer but often rejects the roots because they do not meet minimum quality standards. Irregularity of supply is another weakness of local production that is not affecting imports from South Africa;
- Trade of OFSP roots appears to be smaller than that of the white fleshed roots. The fresh OFSP roots are mostly chosen by wealthier people or foreigners.

Figure 5.1: (clockwise from top left) SP field and vines in Chissassa; farmers focus group in Chissassa; fresh SP roots bag in Mercado 38; Transportation of fresh SP bags from Chissassa to Macate and Chimoio; retailers in Mercado 38 *(Photos: Ilaria Tedesco)*

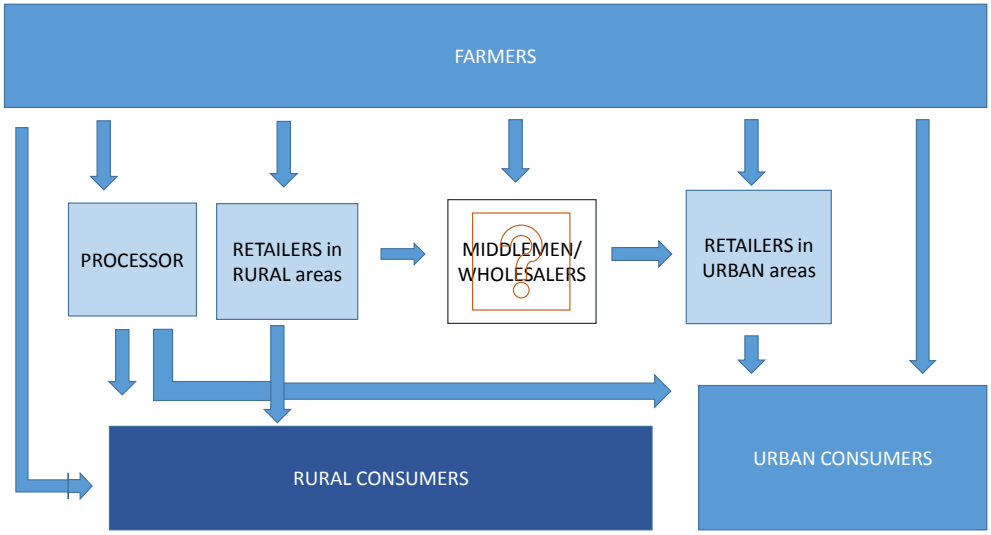
6. Opportunities and limitations for sweetpotato curing and storage

6.1. General Structure of the sweetpotato value chain, volumes and opportunities for its expansion

From the discussions with farmers, retailers, processor, and consumers interviewed during the field visits in Maputo and Manica provinces, the following structure of the sweetpotato value chain has been observed (see Figure 6.1). It is interesting to note that most of the fresh SP root production is traded and consumed within the border of each province. A few exceptions have been detected from our interviews, such as some traders from Chimoio that sell the bags filled with fresh SP roots from April to July at Mercado Fajardo (Maputo), a few retailers coming from Beira and Tete provinces to buy the fresh SP roots from farmers located in Chissassa (in Macate district) and a retailer in Mercado Zimpeto that brings the fresh SP roots from Gaza Province. It should be noted that he study covers a small area and a small number of informants so that more interprovincial trade may exist but has remained undetected.

The farmers located in the areas surrounding Maputo and Chimoio provide the rural and urban areas with fresh SP roots through different channels. The farmers may sell the SP crop to the retailers of rural and urban markets that come to the farms to collect the bags/buckets using trucks/buses, may themselves become traders/retailers in the local markets, or deal directly with the consumers without intermediation. The presence of middlemen, SP roots transporters and wholesalers as specialized agents in the value chain appears to be very limited, and virtually not existent.

Figure 6.1: Structure of the sweetpotato value chain in Maputo and Manica provinces



Source: Own elaboration

The SP crop is cultivated once or twice a year following the rain patterns in non-irrigated lands. In Manica province, the harvesting of fresh SP roots starts in March and ends in October. In Maputo, the season starts and ends two months later (Table 6.2). The white fleshed sweetpotato varieties are the most common. They are cultivated by the farmers for their own consumption and, to a lesser

extent, for trade. The OFSP varieties are less common and more generally produced for the market by the relatively small number of farmers that are growing them.

Table 6.1: Peak and low supply seasons of fresh SP roots in the two Provinces (based on the different agents interviewed)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maputo	*	*	*	*	**	**	***	***	***	***	***	**
Manica	*	*	**	**	***	***	***	***	**	**	*	*

High supply: ***; Medium supply: **; Low supply: *
Source: Field visits

Plots intended for home consumption are small and scattered while SP fields for the market are on average 0.5-1 ha.

Combining different data sources (PES, TIA) with the information gathered during the field visits, we estimate an annual production of SP crop between 104,000 and 150,000 tonnes in Manica province[19]. For Maputo we do not have direct observations, and we can only calculate the volumes based on information of the land under SP crop (TIA), and of the average yields provided by MINAG/TIA and collected during our interviews[20].

The yields obtained during the field visits amount to 10 tonnes/ha: this value represents an approximate average between all the observations collected in Manica and Maputo, and the value includes assumptions on the amount of roots (kg) per bag, considering the latest as unit of measure for the yields in Manica[21].

Table 6.2: Volumes of fresh SP roots in the two Provinces (tonnes)

		Maputo	Manica
Annual SP production (2010-2012) in tonnes *Source: PES*		N.A.	126,456
Land under SP (2012) in hectares *Source: TIA*			
Orange-fleshed varieties	*a1*	1,588	3,354
White-fleshed varieties	*a2*	2,188	7,033
Avg yields in tonnes/hectares (2015) *Sources: MINAG/TIA*	*b1*	14.4	14.4
Avg yields in tonnes/hectares (2015) *Sources: Field visits*	*b2*	10	10
Own calculations on Annual SP production (2012) in tonnes using data from *TIA, MINAG/TIA*	*(a1+a2)*b1*	54,374	149,573
Own calculation on Annual SP production (2012) in tonnes using data from *TIA, Field visit*	*(a1+a2)*b2*	37,760	103,870

Combining these two information sources, the volumes of SP produced in Maputo province should be from 37,000 tonnes to 54,000 tonne per year (Table 6.2).

To verify the reliability of SP production estimates in Maputo, we can also take into account the amount of fresh SP roots consumed in the area, as our study detected that the main proportion of SP crop is traded and consumed within each province. Using data from Brouwer and Low (2014)[22], Table 3.8 report that, in Maputo city area, the consumption of SP is between 15,714 and 31,428

[19] In this case most of the data refers to 2012.
[20] It is worth noting that the production information cannot be considered entirely reliable, as the acreage data provided by TIA looks very inaccurate (standard error at 44%).
[21] We combine the information collected in Manica and Maputo because it does not seem that there are significant variations in the yields amount for the two provinces.
[22] Brouwer and Low, 2014. Orange-fleshed Sweetpotato: Promoting technical and behavioural change in volatile contexts, CIP paper.

tonnes per year. Assuming that those who grow SP crop in general do not buy fresh roots, the estimated market demand would be roughly three quarters, i.e. between 11,000 and 24,000 tonnes, the equivalent of 32 to 65 tonnes per day. As mentioned earlier production in Maputo (province and city) can be estimated at about 54,000 tonnes, suggesting that one to two fifths of the province's production is commercialized and sold into the city[23]. This quantity is quite near to that estimated for the production data in Maputo province; we can therefore say that the SP crop production in Maputo area is confirmed to be about one third of the amount of annual SP production in Manica province. The proportion of OFSP acquired through the market can be, instead, estimated at 5,700 tonnes (details in section 3.3.2).

Considering the ***price variation*** of fresh SP roots during the year, Table 6.3 summarizes information gathered from different data sources and agents.
In particular, the data from field visits reports the average differences in buying prices of the retailers, as broader and more comparable information; the prices refer to quantity of fresh SP roots bought in bags, in buckets and per kilo. Considering all the markets (i.e. rural and urban), the average buying price between the peak and low supply season varies between 44% in Chimoio and 130% in Maputo. However, it is worth noting that Table 6.3 excludes information of farmers that act also as retailers; the commercial farmers able to cultivate OFSP crop on irrigated land, for example, do not vary their selling price during the year. For details on the prices and variation by different location, see Table 4.20 and Table 5.13 in each value chain section.

From our field visits, it emerged a slightly different peak and low SP supply seasons in Maputo and in Manica, and a higher price of fresh orange-fleshed roots (45%-50%) with respect to the white-fleshed SP varieties.

Table 6.3: SP price variation at retailing/consumers level (different data sources)

		Maputo	Manica
Field visits	Peak / Low SP supply (months)	June-Oct (peak) / Jan-April (low)	May-Aug (peak) / Dec-Feb (low)
	OFSP price difference with respect to WFSP	~50%	~45%*
	Price Variation from peak to low supply season	50%-130%	44%-87%
SIMA^	Peak / Low SP based on low and high prices (months)	Aug-Oct (peak) /March-April (low)	May-June (peak) /Dec-Feb (low)
	OFSP price increase with respect to WFSP *Source: SIMA for CIP*	~40%	not detected
	Price Variation from peak to low supply season	~2.5 times (from 9 MZN to 33 MZN)	4 times (from 5 MZN to 25 MZN)
CIP^^	Peak / Low SP based on low and high prices (months)	Aug (peak) / Mar (low)	N.A.
	OFSP price difference with respect to WFSP	N.A	N.A.
	Price Variation from peak to low supply season	~70% (from 21.06 to 35.88 MZN/kg)	N.A.

Source: Field visits; SIMA and SIMA for CIP (see section 3.3.3); Brouwer (2015)
Note: The calculations of the price variation from peak to low supply season considers the average price per supply season and it is calculated as a growth rate from low to high prices (i.e. from peak to low supply season). information received by only one retailer at Mercado 38; ^ for details, see section 3.3.3; ^^data from* Market Monitoring 2014 (Brouwer, 2015).

[23] If we extend the same SP eating behaviour observed in Maputo City (described in section 3.3.2) for Maputo province, considering the number of households in Maputo province equal to 234,433 (Table 2.1) and assuming that the SP consumption by household is ~1 kg per meal (as described by the consumers interviewed), (very) rough calculations estimates ~40,000 tonnes of fresh SP roots consumed per year.

Considering that our field observations are limited to few agents interviewed, we also report the price variations calculated from data collected by the Ministry of Agriculture (Market Monitoring System, SIMA and SIMA for CIP, see section 3.3.3) and by CIP in Maputo province. The information collected by these two sources refer to the price per kilo, calculated weighting the piles sold in different markets, and are summarized in the report Market Monitoring 2014 (Brouwer, 2015).
SIMA covers sweetpotato consumer prices and publishes them weekly in its bulletin together with the information on other crops. The results 2015 presented in Table 6.3 are for the period May 2014 to May: the prices for Chimoio oscillate between 5 and 25 Meticais per kilo and for Maputo between 9 and 33 Meticais per kilo with averages of 14.55 and 15.02 Meticais per kilo respectively.
SIMA/SIMA for CIP dataalso confirmed some findings about our SP value chain study such as: sweetpotato in Maputo is more expensive than in Chimoio, no wholesalers have been identified, the fresh SP roots are typically sold in piles and not in kg (SIMA, however, does not include observations from Mercado Janet where the retailers have the scale), the supply of OFSP is only one quarter to one third the supply of WFSP, the fresh SP roots are sold at different prices in different Maputo markets.
CIP collected, instead, about 110 samples from urban and peri-urban markets and informal sellers in Maputo City between August 2014 and May 2015. CIP targets and collects only sample for OFSP; however, the retailers often sell piles of white fleshed sweetpotatoes roots as piles of orange fleshed varieties and this confusion may pollute the information collected, making consequently difficult to detect also any significant difference in price between these varieties. The price in Maputo markets increases by ~70% from the high supply/low price season (Aug) to low supply/high price season (March), and the price changes substantially from a market to another (see section 3.3.3) Other conclusions reached by CIP are: the price difference between peri-urban and urban markets, the small volumes (20 to 50 kg a week) sold by retailers and peri-urban and urban selling fresh SP roots cultivated in Manhiça.

Here follows a ***list of opportunities identified for developing the sweetpotato value*** chain at different agents' levels:

- Considering the importance of SP as a commercial crop, especially in Manhiça and Macate districts, stabilizing farmers' access to OFSP vines may lead to an increasing production of OFSP roots in the area, following an extension of the land allocated to the crop. The farmers in Calanga (Manhiça district) report, for example, losses of in particular OFSP planting material when the river inundates their land during the rainy season, and the consequent inability to plant for the next season. The farmers, however, should consider growing, multiplying and propagating their own vines in their plots, in highland areas or within elevated greenhouses, and be encouraged to consider the vines as a commercial input, not only as goods subsidized by external institutions[24];
- The cultivation of fresh OFSP roots can be boosted, considering an increasing demand from urban consumers for their nutritional value. In this way, the farmers that thus far sell all the SP varieties at the same price (i.e. the farmers in Calanga) may ask for a premium price for the bags filled with OFSP varieties and improve therefore their livelihood;
- One market segment where farmers may fetch a high price is the supermarkets. If production and post-harvest activities at farm level would improve, in the short-term commercial farmers in Boane, Namaacha and Gondola districts could provide larger, stable and improved quality supplies of fresh SP roots to the local supermarket chains, especially of orange fleshed SP varieties. This would contribute to adding value to the sweetpotato chain and lower the comparative advantage of the imported SP roots from South Africa. So far, the supermarkets still prefer to buy South African sweetpotatoes as their supply is regular,

[24] In distributing OFSP for free to women in Calanga, CIP staff observed people buying WFSP vines from a local producer. This suggests that there are opportunities for sustainable commercial vine production in the area, in particular if one would successfully boost the OFSP root market.

prices are low, and quality is better (the South African roots are bigger, undamaged and clean). Local supply is still irregular, dirty and its quality not guaranteed. The supermarket chains' preference for imports reflects a general concern about the weak competitiveness of Mozambique's agricultural production[25];

- Considering different data sources, consumer price variation from peak to low supply season is estimated to be around 40%-60% on average, but according to some interviewed retailers it can reach more than 100% when there is extreme scarcity of fresh roots in the market. The volumes traded, although larger during the high supply season, do not seem to be really substantial compared to other staples and even Irish potato and the consumers' demand appears also modest from most of the retailers' point of view. The development of the chain depends not only on a push from production to consumption. It is also necessary to create a pull from consumption toward production promoting fresh SP roots in fairs, markets and road shows. During these activities OFSP nutrition benefits could be highlighted to raise the public image of the commodity. These activities would stimulate de demand and encourage production without leading to a depression of the producer price at the medium run;
- A similar stimulus can be created through the promotion of processing activities, especially for OFSP-based processed products. An NRI study of the value chain in Kenya has shown that consumers may prefer the white/yellow fleshed SP to the OFSP varieties but argues that the demand for OFSP may increase due to the successful marketing of OFSP-based commodities such as bakery products (Tedesco and Stathers, 2015; EIL, CIP and Tuskys, 2014)[26,27]. A survey in Maputo suggests that OFSP is not widely rejected. To the contrary, it fetches premium prices in comparison to white varieties and Brouwer and Low (2014) argue that "marketing OFSP as a product separated and distinct from conventional sweetpotato for the better-off may be instruments to remove the negative stigma and turn it into a food item that poor people can eat with pride". The high price paid for fresh roots in Maputo renders virtually economically unviable. In Manica/Chimoio, however, independently of their colour, fresh root prices are much lower, which makes processing an attractive option;
- In the SP value chain, wholesaling and intermediation activities appear very limited. The farmers mostly sell directly to the consumers and retailers located in the urban markets close to the production areas.These direct linkages, reported also as quite weak, are perceived as one of the reasons why the trade of fresh SP roots is small and localized, and the sweetpotato value chain relatively poorly developed. Leveraging linkages with other crops for wholesaling activities should be stimulated. This can be through exploring commercial opportunities with Companhia de Vanduzi (Chimoio) or Hortifructicola (Maputo). These companies are trading horticultural products in general[28], and own their storage facilities. At the moment, Companhia de Vanduzi seems open to the possibility of trading fresh SP roots, and estimates the formal market of fresh SP roots for Central-North Mozambique at 2-3 tonnes per week. Until now, Hortifructicola is not interested in wholesaling sweetpotato, considering it as an expensive and unavailable crop in the market, and mentioning in particular quality and post-harvest issues as important obstacles to market development. The gap in the chain due the current absence of buyers/middlemen

[25] http://www.speed-program.com/blogs/by-author/carrie-davies/agriculture-exports-drop-23-why-should-we-care

[26] Tedesco, I., Stathers, T., (2015). Sweetpotato value chains in Kenya: a business opportunity for puree processing and the potential role for commercial fresh root storage. NRI report, February 2015, University of Greenwich, Chatham: UK. 117pp117pp; EIL, CIP and Tuskys (2014). Consumer Acceptance and Willingness to Pay for Orange Flesh Sweetpotato Bakery Products in Tuskys Supermarket, Nairobi

[27] It should be noted that a consumer survey in Maputo did not confirm a generalized rejection of OFSP for reasons of taste (see Brouwer & Low, 2014).

[28] Mozfood/Vanduzi trades and export baby corn, chili peppers, carrots and cabbages.

could be instead filled if/when the production will increase and the consequent value chain will better develop;

- According to the interviews with NGOs staff operating in Manica province, the SP crop is becoming a more important source for food security at national level. Currently, the SP crop does not represent a priority crop for the Ministry of Agriculture. The NGOs staff think that more attention from the Government would lead to an increasing number of actions in support of SP crop;
- Interest of donors and/or international organizations to participate in the development of the sweetpotato crop could be enhanced through projects that promote conservational agriculture techniques. Among the OSFP varieties, Tio Joe has been suggested as the most appropriate variety due to its long leaves that allow the cover of the land.

6.2. Stakeholder perspectives of the potential advantages and problems of a fresh SP root storage facility

During the SP value chain field study, the potential usefulness of a sweetpotato fresh root storage facility and its location has been discussed with sweetpotato stakeholders (farmers, extensionists, NGOs, traders and processor). It was assumed that such a facility might help smooth SP root supply and prices during the year, and improve the quality of the roots. Stakeholders were asked to suggest what advantages and problems might occur as a result of having a fresh root storage facility, which location would be most appropriate, and what price farmers might be willing to pay to store their SP roots for a period of a day or a week.

SP root supply trends in different locations: In the Maputo and Manica provinces, SP is typically grown once or twice per year, and the SP roots are less available in the period that goes from December/January until March/April.

Perceived advantages of a fresh SP root storage facility: Stakeholders felt that a fresh root storage facility could bring diverse range of advantages into their SP value chains, such as:

- allowing producers currently constrained by seasonal rainfall to have fresh SP roots available for sale and consumption all year round;
- allowing producers to receive a better price from selling fresh SP roots, as they are not forced to sell immediately after the harvest;
- avoiding the need to keep the SP stored long in the field where they are prone to attack by weevils, nematodes and other pests;
- avoiding rodent or weevil damage, and root quality deterioration which occurs when mature SP roots are left for more than two days outside the ground;
- allowing the farmers to increase the production as they can distribute their supply during the year;
- improving postharvest handling (with washing, curing, grading, packing) of SP roots to avoid losses during storage and help access more rewarding retailing markets, such as supermarkets located in urban areas that need a regular supply and demand better quality roots;
- empowering farmers in bargaining with various customers;
- helping retailers to manage SP quantity and price fluctuations;
- creating a safe place for retailers to store the unsold bags;
- helping the processor to have a constant supply of roots.

Perceived problems for a fresh SP root storage facility: Stakeholders also described possible disadvantages, such as:

- difficulties to manage a storage facility that collects the SP roots from few farmers or from a farmers' association, as the community must agree, discuss, and take decisions about the costs and these may not be straightforward processes;
- the additional storage costs make the roots too expensive;
- the current amount of SP production, trade and consumption is not sufficiently high to justify storage facility investments;
- the general lack of interest about the SP crop may make it difficult to find the financial resources needed to build a storage facility;
- if financial resources are available, they would be better spent on irrigation than on storage facilities to have a year-round SP crop production;
- the farmers, in general, prefer to sell the SP roots immediately and do not wait too long to get their revenues;
- the consumers prefer freshly harvested and unwashed SP roots;
- Mozambican farmers do not have the required attitude to invest time and money in value added activities to improve the SP produce;
- SP fresh roots may lose quality during the storage period while the consumers would like to buy a product that looks fresh.

Willingness to pay for storage: Some stakeholders found it difficult to suggest how much the root storage should cost while others, taking into account the costs of current storage, paying a watchmen in the markets, sales price and profit margins, have been able to estimate how much they would be willing to pay weekly or daily, per bag or per kg. If the warehouse was installed, the farmers in Macate think that the price should be lower than what they currently pay to store in Mercado 38, i.e. lower than 5 MZN per bag/day. This means that their maximum willingness to pay is about 2.1 MZN/kg per month. In Namaacha district the two farmers indicated that they could pay a monthly price of 4-5 MZN/kg (for an average quantity of 100 kg for a maximum of three months) and of 3 MZN/kg, respectively. In Maputo markets, some retailers suggested they were willing to pay between 5 MZN to 20 MZN per bag per day (between 2.1 MZN and 8.9 MZN per kilo per day. The latest price was proposed by the retailer in Zimpeto coming from Gaza province who sleeps on her market spot to watch her bags.
Strategic location for a fresh SP root storage facility: Stakeholders felt that the choice of a location for a fresh root storage facility needed to take into account the characteristics of the bulking area, such as altitude in relation to flood waters and soil quality, proximity to farming area and/or main retailing hubs, access and transport, public participation exercise (inter- and intra- agents groups, including farmers, processors, retailers). Some felt it may be necessary to have one storage facility for the whole famers' association or just for a few farmers, such as in Calanga and Macate districts, and in Namaacha, respectively. The potential quantities of SP roots transported would be limited so that the location would not really exacerbate farmers' transport costs. A few retailers in Maputo felt that a fresh root store would need to be located, for example, in Mercado Fajardo and Mercado Zimpeto to be of use to them when the roots are needed and are not available in other markets, as well as to store the any unsold bags from one day to another.

6.3. Feasibility assessment of different scenarios for SP fresh root storage facilities

Storage facilities for agricultural commodities may help to guarantee a smooth food supply during the year, to keep surplus crops safe and to retain their quality for several months; moreover, there are also financial incentives to keeping the crop stored due to transportation, price fluctuation or demand issues.
In this paragraph, we explore the opportunities and limitations for storage facilities for sweetpotatoes in Maputo and Manica provinces. In particular, we analyse the possibility to install

curing and storage structures for a group of commercial farmers in Namaacha district (Maputo Province) and for a processor of OFSP-based products located in Chimoio (Manica Province).

The agents' types and locations for storage facilities have been chosen among a range of other options taking the following into account:

- their current and foreseen business opportunities;
- the feasibility to set up root storage in a relatively short time;
- their strategic location, as they are quite near to the main urban centres;
- the relatively small investments involved that would not burden business with a large financial load for the investor(s) and the recipients;
- the commitment shown by the agents interested.

Exploring these two possibilities will help also to identify different purposes for curing and storing the fresh SP roots. Moreover, they can be seen also as pilot examples as, once run at full capacity, they may convey information and feedback useful for future storage opportunities that may involve more agents and different business opportunities. The alternative locations in the key production areas (Calanga or Manhiça town, Macate) are not investigated because the interviewed informants in these area were not really decided about the usefulness of the storage, its most appropriate location and its management model.

A range of different storage systems which could be implemented at the farmers' and processor's level are reported in Table 6.4. This table considers the type of storage system (if it is a triple S type, plenum chamber or an insulated tunnel), the range of storage capacities, the initial capital costs (CapEx), the maximum storage period for SP roots, their expected weight losses during the maximum storage period and the operational costs by storage period (OpEx) that includes power costs, repair and maintenance costs and labour. The CapEx figures are for the larger tonnage in the target group. The OpEx figures refer to the storage period of 4 months. The costs are expressed in USD[29]. It is worth noting that each cost refers to the maximum storage capacity in each storage system.

Table 6.4: Characteristics of potential small to large scale sweetpotato storage system

Storage system	Storage capacity	CapEx (in USD)	Storage period months	Losses by weight	OpEx (in USD per storage period)
Triple S type with additional controlled cooling	Small scale - <1000kg	400	4	8%	40
Plenum chamber type with cooling	Medium - 1 to 5 tonnes	8,000	4	6%	250
Plenum chamber type with cooling	Large - 5 - 10 tonnes	13,000	4	6%	280
Plenum chamber type with cooling	Large - 10 - 50 tonnes	40,000	4	6%	450
Insulated tunnel type with plenum	Large - 10 - 50 tonnes	15,000	4	6%	750

Source: A. Marchant, NRI, pers. comms. , Jan 2015

Table 6.5 reports, instead, the cost of the type of storage facilities that, due to its capacity, is more likely to be of interest to the farmers and the processor. The lifespan is assumed to be 15 years and the interest rate is set at 18.5%[30]. The annualised capital costs and operation costs per storage period are reported in USD and MZN (Exchange rate: 33.38 MZN=1 USD, Official exchange rate April 2015). To ease the comparison with other types of costs, both the capital and operational costs are calculated per week. It is assumed that the storage period of 4 months is 17 weeks.

[29] Energy options and related prices are not analysed in detail due lack of information. However, the storage facilities mainly need electricity, which may come from different sources (i.e. generator, solar photovoltaic (PV), hydro sources, etc.). As a rule of thumb, the electricity price is estimated to be 3.5/10 times the oil price, i.e. 35c / kWh (est. Andrew Marchant).

[30] AgriDevCo has the interest rate at 15% while the bank interest rates on loans are higher (up to 22%). We have set the interest at 18.5% as an average between the two values.

Table 6.5: Storage facility costs

	Plenum chamber type with cooling	Plenum chamber type with cooling	Plenum chamber type with cooling	Insulated tunnel type with plenum
Storage capacity	Medium: 1 to 5 tonnes	Large: 5 to 10 tonnes	Large: 10 to 50 tonnes	Large: 10 to 50 tonnes
Equipment (in USD)	8,000	13,000	40,000	15,000
Interest costs	18.5%	18.5%	18.5%	18.5%
Life span (years)	15	15	15	15
Annualised capital cost (in USD)	1,606	2,610	8,029	3,011
Capital cost *per storage period* (in USD considering 3 storage periods per year)	535	870	2,676	1,004
Operation cost *per storage period* (in USD)	250	280	450	750
Capital + Operation costs *per storage period* (in USD considering the max storage capacity)	785	1,150	3,126	1,754
Capital + Operation costs *per week period* (in USD considering the max storage capacity and 17 weeks per storage period)	46.19	67.64	183.91	103.16
Capital + Operation costs *per week period* (in MZN)	**1,542**	**2,258**	**6,139**	**3,443**
Capital + Operation costs *per week per tonne* (in MZN considering the max storage capacity)	**308**	**226**	**123**	**69**

Source: NRI and own elaboration

Error! Reference source not found. shows instead some transport costs that can be paid by the farmers or the processor to bring the fresh SP roots to potential storage facilities based on information collected during the field visits.

Table 6.6: Cost of fresh SP roots transport

From	to	Distance	Cost (MZN/kg)	Cost (MZN/bag)
Namachaa	Maputo	~60 km	1.2 MZN/kg	
Boane	Maputo	~35 km	1 MZN/kg	
Manhiça	Maputo	~90 km		50 MNZ/bag
Bobole	Maputo	~50 km		30 MNZ/bag
Calanga	Manhiça	25 km		25 MNZ/bag
Gaza Province (Xia Xia district)	Maputo	>200 km		50 MZN/bag
Chissassa	Chimoio	~60 km		15 MZN/bag
Chissassa	Macate	~10 km		5 MZN/bag

Source: Own elaboration

The average cost within Maputo province is then around 1 metical/kg, or 30-50 MZN/bag, depending also on the means of transportation[31].

6.3.1. Storage opportunity for commercial farmers in Namaacha district (Maputo Province)

In Namaacha district, two farmers have been interviewed who have indicated an interest in curing and storing the sweetpotato crop, OFSP varieties in particular. Their main aim is achieve smoother supply and raise the quality of the roots they place on the market; a limited amount[32] of this supply can be delivered to local supermarket chains. The farmers interviewed indicate that another 5

[31] Considering 70 kg as the average weight of a bag filled with fresh SP roots, the transport costs per kg are estimated at 0.42-0.71 MZN. In the next paragraph, however, we fix a standard cost of transportation at 1 MZN/kg as middle-upper bound of the all the transportation costs observed; the amount of 1 MZN/kg, in this way, can be seen also including other not accounted costs as, for example, the opportunity costs for the farmers transporting the roots/the hiring of a driver.

[32] This business option is currently under exploration by CIP. Based on the information gathered from the managers of the supermarkets, this amount of fresh can be around 100-600 kg per month at one supermarket. Together all supermarkets may probably absorb four times this amount. The upper bound limit will occur in the unlikely case that all the WFSP supply from South Africa would be replaced by domestic (OFSP) varieties.

farmers located in this area could be potentially interested to be included and use common storage facilities. Their involvement, however, has to be confirmed.

An option for an on-farm structure probably would start with a smaller structure. Additional storage structures may be necessary as the farmers expanding their SP production. It is worth noting that the farmers interviewed have irrigated land, harvest few parcels each time and run a quite successful business.

The current advantages of building the storage facilities in Namaacha districts are mainly related to the increased ability to extend the annual availability and quality of SP roots; harvesting the roots at the optimum time and in larger parcels; the maintenance and the expansion of their markets with a continuity of supply, keeping out the competition; buffering mechanism against low prices, targeting their sales during periods of low supply/high price. Moreover, other foreseen advantages attain the increasing production and acreage of other farmers, and a larger number of SP varieties that can be planted. Storage profitability, however, is highly dependent on achieving the quality demands of the higher end market. This implies washing, grading and curing.

The limitations of the storage facilities in Namaacha are related to the focus in supporting the production side of the value chain and not necessarily to smooth the price for the urban consumers in the short-term, the initial low quantity of SP roots to be stored, possible coordination and management problems among the farmers for whom the degree to which they are willing to cooperate still needs to be assessed. The exact location still needs to be identified but the farmers interviewed have few hectares near to the cultivated plot that are currently unused.

The analysis of the convenience of a storage facility at producer level is illustrated in Table 6.7. Three scenarios have been considered: Scenario 1 considers the storage facilities used by 2 farmers (i.e. the ones that have already stated their interest) while Scenario 2 and Scenario 3 include 5 farmers and 10 farmers, respectively, to illustrate if some of the other potentially interested farmers would join and if more farmers would be included in this enterprise. To estimate the storage capacity needed, it is assumed that the harvesting of SP roots is carried out by farmers in small parcels, once a week for 1 month (i.e., 4 weeks) and the yields per farmer is at 10 tonnes/ha. The maximum storage need is estimated, therefore, at 2.5 tonnes per week per farmer[33]. The average selling price of fresh OFSP roots is assumed at 25 MZN/kg.

Table 6.7 gives an overview of the costs for the three scenarios considering the data of Table 6.5. The storage costs per week depend on the type of storage facility: the costs for the plenum chamber with cooling are calculated at 226 and 123 MZN per tonne/week depending on the capacity and stored volumes, while the costs for the insulated tunnel with plenum are calculated at 69 MZN per tonne/week (Scenarios 2 and 3)[34]. The latter is not available for Scenario 1 as the information available concern only a storage capacity between 10 to 50 tonnes. It is, however, reasonable to think that the monthly cost per tonne for an insulated tunnel with plenum (with max capacity of 5 tonnes) are lower than 69 MZN. It is worth noting that the costs per week refers to the maximum storage capacity (5 tonnes for the Scenario 1, and 50 tonnes for the Scenarios 2 and 3, respectively) and are based on the assumption of a 17 week (~4 month) storage period. Considering that the

[33] The data represent a sort of compromise, as the yields can be higher and the quantity stored per week can be lower.

[34] Please note that the costs for Scenario 2 and 3 do not change because they both refers to the max capacity of 50 tonnes. We currently do not have the necessary information to scale down these costs up to 12.5 tonnes and 25 tonnes (scenario 2 and 3, respectively): building a facility with a lower storage capacity (i.e. less than 50 tonnes) would cost less but we do not know, for example, if the cost will halve for half of the max storage capacity or the economy of scale gained by the largest dimension (50 tonnes).

foreseen quantity to be stored will have smaller tonnage than 50 tonnes in Scenario 2 and 3, the capital costs per week are likely to be lower, if the costs for building a smaller storage facility (less than 50 tonnes) are lower than the economy of scale gained, instead, by the largest dimension (50 tonnes).
The final cost for storage facilities (expressed in MZN/kg per month) may, however, require calculation adjustments once the storage facility dimension, the flows and the timing of harvesting the fresh SP roots are better defined.

Table 6.7: Cost analysis of storage facilities for different scenarios

		Scenario 1	Scenario 2	Scenario 3
SP stored	Fresh SP roots to store per week (tonnes) (max foreseen quantity)	5	12.5	25
	Price per kg (in MZN)	25	25	25
	Transport Costs per week/tonne (in MZN) (max quantity)	5,000	12,500	25,000
Storage facility costs	Plenum chamber type with cooling per week/tonne (in MZN, considering maximum capacity apt for the scenario) *(a)*	226	123	123
	Insulated tunnel type with plenum per week/tonne (in MZN, considering the maximum capacity of 50 tonnes) *(b)*	N.A.	69	69
	Monthly cost to store SP in a plenum chamber (MZN/kg) *(a/1000)*4*	**0.90**	**0.49**	**0.49**
	Monthly cost to store SP in an insulated tunnel type with plenum (MZN/kg) *(b/1000)*4*	**N.A.**	**0.28**	**0.28**
	Losses per storage period*	6%	6%	6%
Price variation range	Increase of 50% of the weekly cost during low supply (MZN/kg)	37.5	37.5	37.5
	Increase of 130% of the weekly cost during low supply (MZN/kg) (very low supply period)^	58	58	58
Cost per farmer	Transport cost (MZN/kg)	1	1	1
	Montly storage cost for a plenum chamber plus SP roots transport (MZN/kg)	1.90	1.49	1.49
	Montly storage cost for an insulated tunnel plus SP roots transport (MZN/kg)	N.A.	1.28	1.28
Willingness to pay per farmer	Montly willingeness to pay (MZN/kg)	4	4	4

Source: Own elaboration
*Note: * the losses refer to the loss of weight of fresh SP roots stored for 4 months. They are not taken into account in the calculation of storage cost as it is unlikely that the fresh SP will be stored for 4 month, representing therefore very limited losses in term if MZN/kg. They are reported only for information completeness. ^The price increase from peak to very low supply season of 130% is reported by farmers in Calanga, at Mercado Janete and at Aerodromo in Manhiça.*

In the Table 6.7, the cost per farmer are calculated: (only) storing one kg of SP roots per month will cost from 0.28 MZN (insulated tunnel with plenum for Scenario 2 and 3) and 0.90 MZN for the plenum chamber for Scenario 1. If we add the approximate costs of transporting the fresh SP roots to the facility location within Maputo (1 MZN/kg), transporting and storing one kg of fresh SP roots will cost 1.28-1.90 MZN per month to the farmers. This cost represents one third to half of the costs that the farmers have indicated that they were willing to pay to store the fresh SP roots.
However, it is worth noting that extra costs for washing, grading and curing have not been taken into account and they need to be included for running of a proper storage facility and providing quality roots to access the premium market. The sum of these costs, however, should be lower than 2-2.5 MZN/kg to meet the willingness to pay of the farmers. If the costs for washing, grading and curing are higher than 2-2.5 MZN/kg, the farmers' profitability will lower and, consequently, they could increase the selling price of fresh SP roots per kg to compensate the extra costs incurred, and this will affect negatively the whole business.

About the consumers' demand, the storage facility in Namaacha district will increase the availability of fresh SP roots and, possibly, lower their price during the low supply season[35]: considering the price observed, the farmers could, in fact, sell the fresh SP root at a price that would include the cost of storage and still get extra-profits during the low supply season. If the scope of the storage facilities is to lower the urban price for higher quantities, this can be a successful strategy that may keep the price lower without affecting too much farmers' profits.
However, washing, grading and curing should be necessary at this purpose, especially for the farmers that wish to get a better access to premium market, i.e. supermarket chains.

Considering the commercial nature of the farmers interested, their level of management of their activities (higher than the other farmers interviewed), and their closeness to market, the establishment of storage facilities in Namaacha district could provide a pilot case in short term. After being tested, it may help to provide information and feedback for the possible establishment of larger storage facilities for a larger number of farmers, for example in Calanga or in Macate. As said, these two locations are not yet investigated because the interviewed agents in these area have not clear idea about the usefulness of the storage, its most appropriate location and its management model.

6.3.2. Storage opportunity for processor in Chimoio (Manica Province)

A processor located in Chimoio has been interviewed. He already produces soymilk and soy yoghurt and is planning to start producing OFSP juice and biscuits made of the residues of the juice and soymilk and yoghurt production as soon as the equipment arrives. Raw material will be sourced from his own farm and from outgrowers in the Vanduzi district. From the point of view of the processor of fresh SP roots, the storage offers various advantages, such as: reliable and timely supply of raw material for the processing activities; improved root quality; timely planning of the processing activities; access to a supply of fresh SP roots during periods of the year when the amounts of SP harvested is low; a buffering mechanism when the roots purchasing price is high in case he needs to buy extra quantities from the market.
The processor has space to build a storage facility next to his factory. Due to this availability, no transport costs are accounted in the costs assessment.

The initial need of the processor is 37.50 kg of OFSP per day (Scenario 1) to produce 30 kg of juice and 68.36 kg of biscuits per day[36] while, once the processing activities run at their full capacity, he will need 150 kg of OFSP per day (Scenario 2). The annual number of business days is 240, and the weekly requirement are calculated at 187.5 kg and 750 kg for the Scenario 1 and 2, respectively, considering 5 working days per week.
To achieve the OFSP requirements for Scenarios 1 and 2, the store realistically needs to be able to hold between a minimum of 1 week to 1 month of root demand. Given the early stages of the enterprise and the need to ensure that the processor is not let down during this critical period, it would be advisable to ensure the storage facility can hold at least to 1 month's root demand.

[35] In Maputo, however, we confront a sort of 'supply paradox'. Although CIP found that there is unsatisfied demand during the low supply season, some retailers located Mercado Central and Mercado Janete have highlighted that the demand is often quite low and they have to further reduce the prices when the SP roots are not bought within few days because the roots lose their freshness. This issue has to be further investigated, especially in which locations the two phenomena occur.
[36] To produce the biscuits and the juice other ingredients are needed, as water, sugar, etc. for juice and flour, soybeans, butter, eggs and sugar for the biscuits. Details on section 5.3.

The calculations of root storage requirement for the different scenarios is reported in Table ***6.8***. To meet the appropriate storage capacity, the 'plenum chamber with cooling' with storage capacity of ~1-5 tonnes seems to be sufficient. The plenum chamber with the maximum storage capacity of 5 tonnes is, in fact, able to store a supply of fresh SP roots for 26 weeks for Scenario 1 (~ 6 months), and for 6.6 weeks for Scenario 2 (~1.5 month).

Considering that the Scenario 1 is provisional, as it is planned only for the first quarter of the processing activities, the maximum storage capacity of 5 tonnes can be necessary for running the business at its full capacity.

Table 6.8: Different root storage requirement scenarios

		Scenario 1	Scenario 2
Fresh OFSP roots (daily requirements in kg)	*a*	37.5	150
Fresh OFSP roots (weekly requirements in kg)	*b=a*5*	187.5	750
Storage time with a plenum chamber type with cooling (medium: 1 to 5 tonnes) (considering the max storage capacity of 5 tonnes)	*(c=5,000/b)*	26 week/supply	6.6 week/supply

Source: NRI and own elaboration

The analysis of the convenience of the storage facility at processor level is illustrated in Table 6.9[37]. The capital and the operational costs for the plenum chamber with cooling apt for the processor are 308 MNZ/per tonne stored, as illustrated in Table 6.5**: Storage facility costs**. It is worth noting that the cost per week refers to the maximum storage capacity of 5 tonnes and is based on the assumption of a 17 week (~4 month) storage period. If the processor builds a storage facility of a smaller tonnage than 5 tonnes, the capital costs, and therefore the capital and operational costs per week, are likely to be different. For example, considering a foreseen quantity to be stored lower than 5 tonnes, the capital costs per week are likely to be lower if the costs for building a smaller storage facility (less than 5 tonnes) are less than the economy of scale gained, instead, by the largest dimension (5 tonnes). In Table 6.9, we scale down the costs for the lower amount of fresh SP roots (i.e., less than 5 tonne) proportionally (we refer to it as potential costs), but this condition should be better verified.

Given the price at which the processor is buying fresh OFSP roots (25 MNZ/kg), Table 6.9 shows the increasing costs per week of buying fresh SP roots if the unit price per kg increases of 44% and 87%. Even with a minimum price increase of 44%, it seems that it is worth the investment in storage facilities, as the weekly cost to buy fresh roots in low supply season are higher than the weekly storage costs for both types of facility.

[37] We currently consider only the plenum chamber as we do not have the necessary information to scale down the insulated tunnel with plenum to 5 tonnes. Building a facility with a lower storage capacity (i.e. less than 10-50 tonnes) would cost less but we do not know the cost function with respect to cost storage capacity or the economy of scale gained by the largest dimension (50 tonnes).

Table 6.9: Cost analysis of storage facilities for different scenarios

		Scenario 1	Scenario 2
SP stored	Fresh SP to store per week (kg) (foreseen quantity) *a*	187.5	750
	Fresh SP to store per year (tonne) (foreseen quantity) *a1=(a*51)/1,000*	9.56	38.25
	Price per kg (MZN) *b*	25	25
Storage facility costs	Cost of plenum chamber type with cooling per tonne/week (in MZN considering maximum capacity apt for the scenario) *c*	308	308
	Potential weekly cost to store SP in a plenum chamber (for the foreseen quantity *a* in MZN) *d=(c/1,000)*a*	58	231
	Losses per storage period*	6%	6%
Price variation range	Increase of 44% of fresh SP roots during low supply (MZN/kg)	36	36
	Increase of 87% of fresh SP roots during very low supply (MZN/kg)	46.8	46.8
	Extra weekly cost during low supply season in MZN/kg^	11-21.8	11-21.8
Increasing price during low supply	Weekly cost increase with +44% of price of fresh SP roots during low supply (MZN) *(11*a)*	2,063	8,250
	Weekly cost increase with +87% of price of fresh SP roots during low supply (MZN) *(21.8*a)*	4,088	16,350

Source: Own elaboration

*Note: * the losses refer to the loss of weight of fresh SP roots stored for 4 months. They are not taken into account in the calculation of storage cost as it is unlikely that the fresh SP will be stored for 4 month, representing therefore very limited losses in term if MZN/kg. They are reported only for information completeness. ^The price increase from peak to very low supply season of 87% is reported by farmers in Gondola. The low supply season last about 5 months, from November to March in Manica province. The potential weekly cost is calculated scaling down the cost proportionally.*

However, we need to prove that this investment is worth considering the costs of storage that the processor has to face during both supply seasons.

Considering a price increase of 44% for 5 months per year (i.e. 21 weeks), the cost of the plenum chamber with cooling for the maximum storage capacity of 5 tonnes is no longer an economically viable investment for Scenario 1: the annual cost to maintain a storage facility of 5 tonnes capacity (78,540 MZN) overcome the extra costs of facing the higher price (+44%) for 21 weeks while it can be convenient if the price will rise by 87% (upper bound). In the Scenario 1, however, the processor will have to store a lower amount of fresh SP roots (<5 tonnes): scaling down the costs of the facility proportionally (considering the SP roots stored for 1 month, i.e. a 4 weeks supply) shows that storing is cheaper than the increasing costs of the SP supply during the low season within the all range of price increase. For the Scenario 2, Table 6.10 shows that the extra costs of buying SP during the low supply season (assuming that lasts 21 weeks) are higher that the full costs and the potential cost of the plenum chamber.

Table 6.10 Cost analysis of storage facilities and price variation for different scenarios per year

Annual storage facility costs	Full costs for Plenum chamber type with cooling per year (in MZN considering maximum capacity apt for the scenario and the foreseen quantity *a*) *e=(5*c)*51*	78,540	78,540
	Potential costs for Plenum chamber type with cooling per year (in MZN considering the costs to store the foreseen quantity *a*) *f=d*51*4*	11,781	47,124
Total extra costs during low supply	Total extra cost during low supply season considering an increase of 44% (in MZN)	43,313	173,250
	Total extra cost during low supply season considering an increase of 87% (in MZN)	85,838	343,350

Source: Own elaboration

Note: The low supply season last about 5 months, from November to March in Manica province, for a duration calculated at 21 weeks. The potential costs per year are calculated scaling down the cost of the storage facility (at its maximum capacity) proportionally.

Considering the calculations for the storage facility at processors' level, it can be reasonable to think that the costs for a storage facility for <5 tonnes could be lower than the seasonal price increase of the fresh SP roots. The extra costs of curing the fresh SP roots need, however, to be included, as well as it should be verified the effective price increase of fresh SP roots during the low supply season considering that the processor may not be affected for all the quantity of roots he needs if he has formal contract with out-growers.

Also in this case, the establishment of storage facilities in Chimoio could provide a pilot case study in the short-term that, after being tested, may help to provide information and feedback for the establishment of larger storage facilities in Chimoio.

7. Conclusions and recommendations

The sweetpotato (SP) value chains have been investigated in two important sweetpotato production and consumption areas of Mozambique: the provinces of Manica and Maputo. The fresh SP root production, availability, and trading have been explored, providing insights into the opportunities for further developing the chain and establishing fresh SP root storage facilities.

From the discussions with farmers, retailers, processor, and consumers interviewed during field visits, it emerges that the structure of the VC is similar in the two provinces considered. The farmers provide their rural and urban areas with fresh SP roots through three different channels: i) selling the SP crop to the retailers operating in rural and urban markets; ii) acting themselves as traders/retailers in the local markets; iii) selling directly to the consumers without intermediation. The presence of middlemen, SP roots transporters and wholesalers as specialized agents was not observed and this lack was reported as one of the weaknesses for the whole SP value chain. Differences between the two focal SP producing areas are due to a few different climatic features; the volume and scale of SP fresh root trading; whether the farmers cultivate OFSP or not. OFSP appears more widespread in Maputo province than in Manica province. Combining different data sources with the information gathered during the field visits, it emerged that the annual SP production volumes are 104,000- 150,000 tonnes in Manica and 37,000 -54,000 tonnes in Maputo; in Maputo, the upper bound seems to be a more reliable data. It is likely that the consumption of SP occurs in the same province as production.

The SP crop is cultivated once or twice a year following the rainfall patterns in non-irrigated lands. In Manica province, the harvesting of fresh SP roots starts in mid/late March after the end of the rainy season that starts a few weeks before that of Maputo province. The white fleshed SP varieties are cultivated in small parcels by farmers mainly for their own consumption and, to a lesser extent, for trade. The OFSP varieties are less widespread and mostly commercialized by the farmers who grow them. The farmers have access to SP planting materials from one of their own or a neighbour's plot, buying or receiving the vines for free. The SP crop is typically cultivated by men and women in different plots and/or carrying out different tasks in the same plot; the women's involvement in farming activities appear to be higher but, as the crop becomes more commercial, the men may step in and hire labour to help scale activities.

The largest quantities of white- and orange-fleshed SP roots are traded from the main producing areas of Manhiça and Macate to the urban centre of Maputo and Chimoio, respectively. Farmers may harvest and deliver their SP roots to the main market area by bicycle, trucks or bus. The farmers are mainly paid on a per sack basis with a lower price paid for the small or cut roots than for the medium and large-sized roots.

The profitability of SP varieties at farm level changes depends on the farmers' business orientation, irrigation access, and location. In Maputo Province, the calculations for farmers who produce OFSP for the market and who have access to irrigation (and tractors for some of them) report a profitability of OFSP varieties at 214,000/605,000 MZN per ha/annum. The upper bound may be attributed to the overestimation of the yields by a large farmer that needs to be verified (30 tonnes/ha). The profits for the farmers interviewed in Manica province are, instead, at 13,600/108,000 MZN per ha/annum. This lower profitability compared to Maputo province may be attributed to the underestimation of the yields by two farmers (that reported the yields in bags), to the fact that the farmers interview cultivated WFSP varieties that may have a lower selling price than

the OFSP varieties (although information on the premium price of OFSP are scarce and controversial), and to the selling SP prices in Manica province that are lower than Maputo province.

The fresh SP roots are traded in bags (the volumetric measure is the 50 kg rice bag, while the real weight of a bag packed with sweetpotato is estimated to be around 65-80 kg), buckets (weight is about 20 kg), kg (when the retailers have a scale) and piles with different root size composition. Retailing activities are dominated by women in rural, peri-urban and urban markets. Retailing appears to be the most profitable in urban markets but the retailing volumes are higher in the peri-urban and rural markets. The retailers located in the urban market of Maputo (Mercado Central and Janete) registered the highest profit margins (650-1,650 MZN/bag during the peak supply season and 650-2,500 during the low supply season) while the margins of the retailers from the peri-urban market in Maputo registered an average 250-550 MZN/bag during the peak supply season and 350-700 MZN/bag during the low supply season. In Chimoio, the calculations for a retailer put the profit margin per bag at 550-850 MZN/bag. In some supermarket chains in Maputo and Chimoio, the largest volumes of fresh SP roots are imported from South Africa due to their better quality at almost the same price of the national fresh roots, the year-round availability, and consumers' preference.

Data collected during the field visits indicate that the price variation between the peak and low supply season changes by agent and province. The average buying price of the retailers increases by 40%-60% in Chimoio and 30%-130% in Maputo from the peak to the low supply seasons. While it was difficult to understand if the price variation differs by fresh SP root varieties, a premium price was observed for orange-fleshed SP roots that is 40%-50% higher than the price of the white-fleshed SP varieties in the Maputo area. It is worth noting that these price values and growth percentages are related to our small sample size and retailers met in different markets; the commercial farmers able to cultivate SP crop on irrigated land, instead, do not vary their selling price during the year. Our information has been complemented with other data sources, such as the Market Monitoring System (SIMA) and data collected from CIP that, however, capture an existing but lower price variation between the peak and low supply season.

The consumers met and interviewed were very few and a net consumers' preference for WFSP or OFSP varieties cannot be assessed. However, the consumers interviewed in one of the Maputo urban markets bought and appreciated the fresh OFSP roots and were aware of their vitamin A content. The rural, peri-urban and urban markets sell the local SP varieties to heterogeneous types of consumers while urban supermarkets sell the South African (imported) white-fleshed SP varieties that are preferred by wealthier consumers that appreciate their bigger size and the washed skin, and are willing to pay a higher price for these qualities.

From the study of the two provinces, a list of opportunities/recommendations for developing the sweetpotato value chain has been identified. This list includes: stabilizing farmers' access to (OF)SP vines; raising demand for OFSP by urban consumers as a result of their awareness of their nutritional value as a means to pull off an expansion of the production of OFSP; improving production and post-harvest activities at farm level to take advantage of business opportunities with local supermarkets that require a larger, more stable and better quality supply of fresh SP roots to substitute the roots imported from South Africa; promoting fresh (OF)SP roots in fairs, markets and road shows to push the consumption side of the chain; exploring linkages with other crops for wholesaling activities to enlarge the scale of the SP trade; stimulating the interest of donors and/or international organizations through projects that develop the (OF)SP value chain, including the one promoting conservation farming.

Our analysis from field work identified the possibility to install curing and storage structures for a group of commercial farmers in Namaacha district (Maputo Province) and for a processor of OFSP-based products located in Chimoio (Manica Province). The agents' types and locations for storage facilities have been chosen from a range of options mainly due to: their current and foreseen business opportunities; the feasibility to set up root storage in a relatively shorter time than the other option available; their strategic location, as they are quite near to the main urban centres and located near to accessible roads; the relatively smaller investments involved that would not burden business with a large financial load for the investor(s) and the recipients; the commitment shown by the agents interested. Detecting and developing these two possibilities will also help to identify other opportunities for curing and storing the fresh SP roots in other areas.

A computation of the weekly costs of various SP fresh root store types, of transport from farm location to the potential storage facility, of estimated higher priced SP roots, and willingness to pay for storing fresh roots showed the economic feasibility of having a storage facility at farmers' level in Namaacha district. Storing and transporting one kg of fresh SP roots would cost at 1.28-1.90 MZN per month that is about half the costs that the farmers indicated to be willing to pay to store the SP roots. However, extra costs of curing, grading and ensure quality roots need still to be taken into account, especially for the farmers that wish to get a better access to premium market (i.e. supermarket chains). The storage facility in Namaacha district could increase the availability of fresh SP roots and, possibly, lower their price during the low supply season: if the scope of the storage facilities is to lower the urban price for higher quantities, this can be a successful strategy that may keep the price lower without affecting too much farmers' profits. The limitations of the storage facilities in Namaacha are related to the extra efforts necessary to supporting the production side and value added activities (curing, grading and ensure quality roots), the initial low quantity of SP roots to be stored, possible coordination and management problems among the farmers for which cooperation behaviour still needs to be assessed.

Considering the building of storage facilities at processor' level in Chimoio, calculations showed the economic convenience of having a storage facility with a tonnage of 5 tonnes, even with a minimum price increase of fresh OFSP roots at times of low supply of 44% once the business will run at its full capacity . While the location and the dimension of the storage facility may be almost clear, further steps are still needed for his overall business, to get started and enter into a full capacity modality.

At the moment, to our knowledge no commercial SP fresh root stores yet exist in the focal provinces of the study, or elsewhere in Mozambique. Detecting and developing these two possibilities will help also to identify other opportunities for curing and storing the fresh SP roots in other areas. They can be seen, in fact, as pilot examples that, once run at full capacity, may convey information and feedback useful for future storage opportunities that may involve more agents and different business opportunities.

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