State Of Knowledge Report: Sweet Potato - Uganda

Kampala, Uganda, 15/11/2018

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1. SWEET POTATO/FOOD SCIENCE IN UGANDA

Key findings

- Sweet potato is sold fresh and commonly consumed in steamed, boiled, fried or roasted form.
- Pale (white/yellow) fleshed cultivars such as Dimbuka, Sukai, Tanzania and Kawogo, are the most widely cultivated due to their sweet taste, high dry matter content and durability. Orange Fleshed Sweet Potato is not highly regarded due to purported 'inferior sweet taste', low dry matter content and perishability.
- Farmer and consumer preferences for the crop include: sweet taste, high dry matter content, no or low fibre, large size roots, sweet taste, colour, shape, cleanliness and absence of disease symptoms.
- Processing boiled, steamed and fried sweet potato starts with peeling, chopping (if the root is large) and washing the root. Quality characteristics for these steps are having a uniform, smooth surface without ridges and crevices for easy peeling and washing. Medium size roots are easier to peel, and having no brown colour after washing.
- Boiled sweet potato involves boiling, preferably ready in 30 minutes, not soggy and retention of the flavour. Mashing is optional, and the preferences are that it is soft but not soggy or fibrous.
- Steamed sweet potato involves wrapping a preferably medium sized root in banana leaves after washing, then steaming. It should be ready in 45 minutes and retain flavour.
- Fried sweet potato involves slicing and deep frying, after washing. The root should be easy to slice in a uniform thickness and not brittle. Frying should be no longer than 5 minutes, not absorb oil and steadily develop to light brown colour without darkening.
- A good, cooked sweet potato should be firm, not mushy and have a characteristic sweet potato flavour.
- Sensory attributes preferred by consumers of fried sweet potato include; light brown colour, crispy crust, soft and slightly dry interior, mealy texture/mouth feel, a little crunchy and not fibrous.

Introduction

Sweet potato is the fourth most important crop in Uganda in terms of production volumes (1.8 million MT) after maize, cassava and bananas (UBOS, 2016). Sweet potatoes are highly regarded in Uganda with a reported per capita consumption 73kg/person/annum (FAOSTAT 2013). In addition to food, sweet potato is an important commercial crop contributing to incomes of farmers in Uganda.

Sweet potato is grown in all regions of Uganda on 55% of root and tuber arable land (MAAIF, 2015). Total production of sweet potato stood at 1.8million MT with the leading Eastern region accounting for 47%. The major producing districts by region, in descending order include; Iganga (Eastern), Nakasongola (Central), Gulu (Northern) and Kyenjojo (Western).

Sweet potatoes in Uganda are marketed principally as fresh roots and consumed in steamed, boiled, fried or roasted form (Ingabire and Vasanthakaalam, 2011; odora et al., 2000). Several other products are made from sweet potato including; dried chips and chunks (amukeke/inginyo), flour (kasande, amukeke/inginyo flour), pastries and confectionery products (Engoru et al., 2005; Nakanyike 2014; odora et al., 2000; Abong et al., 2016). In parts of Eastern Uganda, roots are sliced (amokeke) or crushed (inginyo) before drying (Hall et al., 1998).

The research questions for the food science State of Knowledge (SOK) report are:

1. What are the characteristics of the raw material that will give a good quality product noting differences between processing methods, regions, ethnicity etc.?
2. What are the key steps in processing and preparation that will give a good quality product noting differences between processing methods, regions, ethnicity etc.?

3. What are the known quality characteristics of the raw material associated with each stage of processing and preparation, to the final product?
4. What are the known quality characteristics of the final product?

1.1. Methodology

Key informant interviews were conducted to obtain primary information. Six respondents (2 male and 4 female) were purposively selected for the interviews. Interviews were conducted among staff of National Agricultural Research Laboratories (NARL) and a catering service provider in Kawanda. These were targeted for their experience as sweet potato consumers, researchers and processors. Secondary information was obtained through review of relevant literature.

1.2. Results

1.2.1. Raw material characteristics

Three major classes of sweet potato are grown in Uganda; white, yellow and Orange Flesh Sweet Potato (OFSP) with variability across agro-ecological zones. Farmer preferences that guide varietal selection include; good taste (sweet) and high dry matter content with no fibre (Kilimo Trust, 2013b). Sweet potato peels and flesh colour varies depending on the cultivar (Ingabire and Vasanthakaalam, 2011). Production is dominated by pale (white/yellow) fleshed cultivars such as Dimbuka, Sukai, Tanzania and Kawogo with over 86% of sweet potato farmers cultivating them. They are characterised by sweet taste, high dry matter content and being hardy with regard to harsh environmental conditions. On the other hand, OFSP is not highly regarded due to purported 'inferior sweet taste', low dry matter content and perishability. Nonetheless it is cultivated for its nutritional and monetary value (Nakanyike 2014). However, sweet potato varieties that combine both qualities termed OFSP dry and starchy have recently been bred as described by Tumwegamire et al (2011). These conform to consumer preferences especially among adults in SSA. There are OFSP with both high β-carotene and dry matter content.

Over the years, a series of sweet potato cultivars with varying characteristics have been bred and released in Uganda. In 2007, five cultivars namely, NASPOT7, NASPOT8, NASPOT9 O, NASPOT 10 O and Dimbuka-Bukulula were released with the former four being orange and the latter cream-fleshed landrace. The skin colour was purple red and cream for NASPOTs and landrace cultivar respectively. They were characterised by a high dry matter content (26.9 – 36.1%) (Mwanga et al., 2009). The cultivars were also reported to have acceptable root shape described as obovate and long irregular or curved. More so, the NASPOT cultivars had moderate to high beta-carotene content 44.3 – 460.3 (μg^{-1}DM).

Prior to 2007 releases, another series of sweet potato cultivars were released: New Kawogo, Tanzania, Bwanjule, Sowola and Wagabolige (Mwanga et al., 2001); NASPOT 1-6 (Mwanga et al., 2003); and Kakamega (SPKOO4) and Ejumula (Mwanga et al., 2007c). Some of the attributes were: high dry matter content (29 – 35%); flesh colour was white, pale yellow, cream and orange; root shapes were obovate, round elliptical and long irregular or curved; skin colour was cream, purple-red, brownish orange, red, yellow and purple. SPK004 and Ejumula were OFSP rich in beta-carotene (376– 27698 µg/100g). Flesh colour of sweet potato roots is strongly correlated with β-carotene content whereby orange fleshed roots have significant amounts of β-carotene content compared to pale fleshed ones (Burgos et al., 2009; Low et al., 2007; Adeyemi et al., 2015).

Root size has been reported to be a good maturity indicator used by sweet potato farmers in Uganda to inform the decision of piecemeal harvest (Bashaasha et al., 1995). Women are mostly involved in this mode of harvest (refer to the Gender module for more information). From a market perspective, sweet potato attributes considered key by institutional consumers include; high dry matter content associated with a hard texture, low fibre content, large size roots, sweet taste, colour, shape, cleanliness and absence of disease symptoms such as spots (Kilimo Trust, 2013a). Desirable characteristics of fresh/raw sweet potato from KIIs are summarised in Table 1: Generally, there was unanimity in preferred sweet potato characteristics among the key informants.

Table 1: Description of desirable characteristics of fresh/raw sweet potato from KII.

Characteristic	Description
Root form	A good sweet potato root should have a uniform, smooth skin surface and wholesome without any wrinkles or ridges or signs of physical defect. A fresh root also exudes sap when the tip is broken.
Root size	A medium size root is most preferred because it is easy to peel and easier to cook whole without need for excessive chopping/size reduction. More so, big sized roots are often infested with pests or diseased and thus not preferred. On the contrary those who preferred big sized roots stated that big roots were indicative of maturity and were ideal for bigger families as well as traders who earn more from their sale.
Colour	The most preferred skin colours are cream and purple-red whereas flesh colour are yellow and white-cream. These are associated with adequate sweetness, firm texture when cooked and mealiness when eaten.
Texture	A good root should be turgid/firm when pressed with a finger. A soft texture is a sign of loss of freshness. The raw root is also slightly chewy but not fibrous
Taste	The raw potato has a characteristic sweet taste and slight astringency from the sap which is produced.

1.2.2. Processing characteristics

Boiled/Steamed Sweet Potato

At household level, sweet potatoes are mainly prepared in two ways; steaming in banana leaf wrapping and boiling in water till soft. Furthermore, ready sweet potatoes maybe mashed with beans into a paste referred to as mugoyo. Steaming is widely preferred because it results in sweet potatoes which are rich in flavour and not soggy. Mashed sweet potato (mugoyo) is usually prepared for children. This is because it is easy to prepare, convenient (can be carried as a snack to school), nutritious and is considered to have a high satiety value.

Boiled and steamed sweet potato

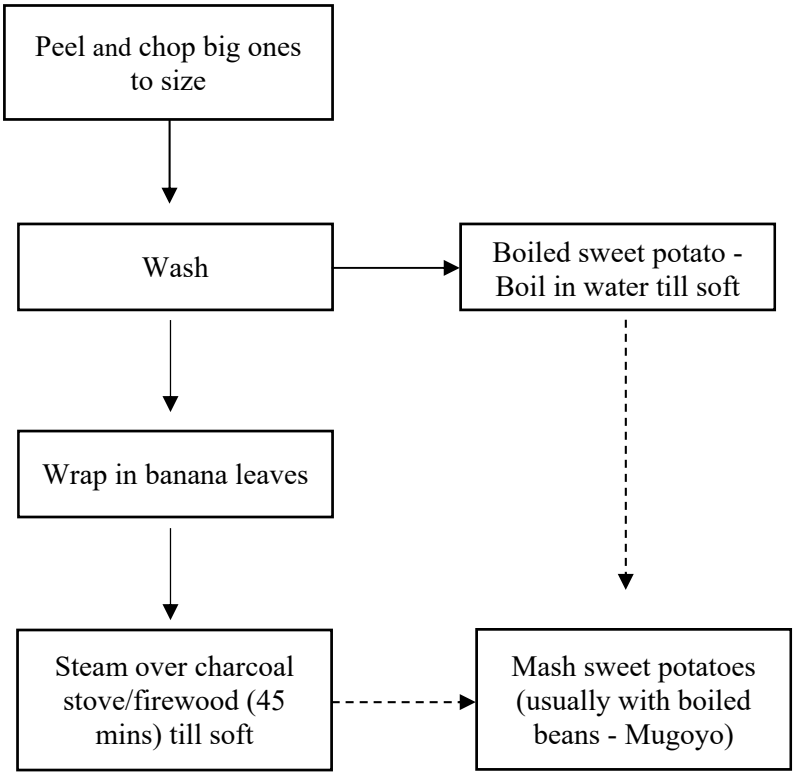

Figure 1: Processing steps for boiled and steamed sweet potato

Fried sweet potato

Fried sweet potato is the third most popular form of consumption after boiled/steamed and roasted. It is mainly consumed by urban folk as well as medium income earners in the rural areas (Kilimo Trust, 2013a). The major processing steps according to Owori et al., (2007) include;

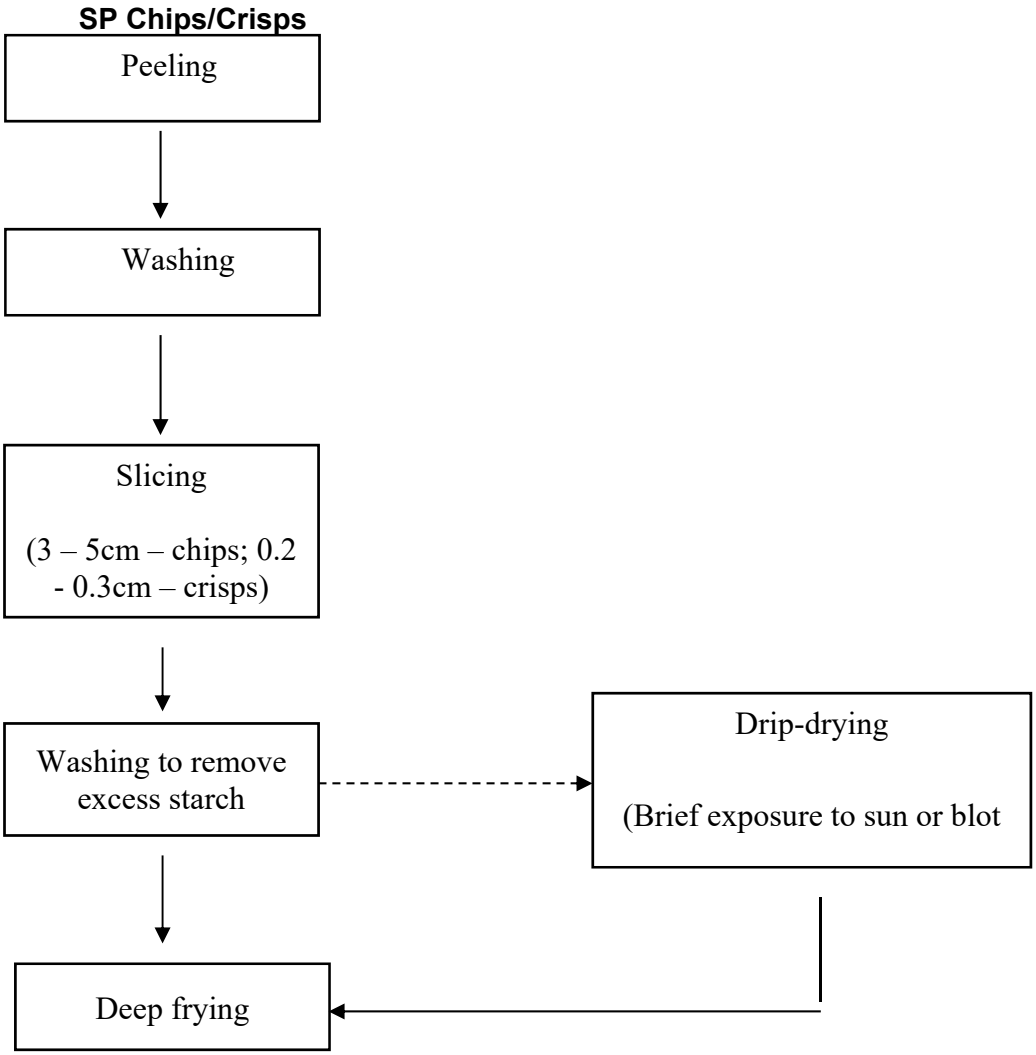

Figure 2: Processing steps for fried sweet potato

At each processing step, the important quality characteristics based on KII are summarised Table 2;

Table 2: Description of quality characteristics of boiled/steamed and fried sweet potato at each processing step

Preparation method	Processing step	Quality characteristics
• Boil in water • Steam cooking • Deep frying	Peel and chop big sized roots	• Uniform, smooth surface without ridges for easy peeling • Medium size roots (approximately 300g) are easier to peel and can be prepared whole
	Washing	• easy to wash without crevices that hold soil • no brown colour after washing
• Steam cooking	Wrapping in banana leaves	• Medium size roots are easy to wrap whole
	Steaming	• Ready within 45 minutes • Retain sweet potato flavour
• Boil in water	Boiling	• Ready within 30 minutes • Retain sweet potato flavour • Not soggy
• Boil in water • Steam cooking	Mashing (optional)	• Soft but not soggy • Not fibrous
• Deep frying	Slicing	• Easy to slice to uniform thickness • Not brittle
	Deep frying	• Short frying time (5 minutes) • Does not absorb cooking oil • Steady development of light brown colour without darkening

1.2.3. Final product characteristics

Boiled/Steamed Sweet Potato

Several authors have reported on the sensory attributes of orange and pale-fleshed sweet potato varieties (Tomlins et al., 2004, 2007, 2012). Generally, consumer studies in Africa have shown that consumers prefer high dry matter SP associated with pale-fleshed varieties compared to low dry matter SP linked to OFSP (Kapinga and Carey, 2003).

Five orange fleshed and landrace sweet potato cultivars (NASPOT 7, 8, 9 O, 10 O and Dimbuka-Bukulula), when subjected to sensory evaluation, were reported to have a slightly dry texture and moderate sweetness. Generally, they had good to excellent overall acceptance especially among children under six years and women (Mwanga et al., 2009). Low et al (2009) reported that in sub-Saharan Africa, young children preferred OFSP with low dry matter content (20-24%) whereas adults preferred relatively higher (>27%). Nonetheless, consumer preference for OFSP remains high (Birol et al., 2015). Previously released varieties (NASPOT 1 – 6; SPK004 and Ejumula) were reported to have dry or somewhat dry texture and sweet or moderately sweet taste when cooked (Mwanga et al., 2001; Mwanga et al., 2003; Mwanga et al., 2007).

In a study by Tomlins et al., 2012, eleven sweet potato varieties were evaluated for sensory attributes. These were orange fleshed (Ejumula, Kakamega, SPK004/1, SPK004/6/6 and SPK004/1/1), yellow-fleshed (Tanzania and Naspot 1) and white-fleshed (Dimbuka, Nakakande, New Kawogo and Ndikirya N'omwami). Dry matter content was in the range 26.8-39.4% while total carotenoids varied between 0.4 and 72.5 µg/g fresh weight. The OFSP varieties were associated with pumpkin flavour, watery texture while the white had a sweet potato flavour and crumbly texture. As such, the high carotenoid OFSP had an inclination towards having low dry matter with a 1.2% reduction in dry matter content for each doubling of carotenoid content. In addition, changes in dry matter content and sensory attributes such as taste, texture, appearance and odour were genetically linked with variation of β-carotene content of OFSP. According to Hagenimana et al. (1998b), the association between dry matter content and flesh colour of sweet potatoes is minimal despite the general observation of higher DM content for pale/white fleshed compared to orange-fleshed roots. Tumwegamire et al 2007, assessed seven cooked sweet potato varieties, namely Ejumula, SPK 004, Kala, Sowola 6, Sudan, 4-4, and Naspot 5, for attributes namely; taste, flavour, appearance, starchiness, fibrousnesses and general acceptability among children and adults. Overall, the orange-fleshed Ejumula variety was most preferred by both categories however the squash-like flavour associated with OFSP was not liked by adults. Appearance of the cooked root stood out as key attribute for the children. Key informants had varied preference of boiled/steamed sweet potato (**Table 3**). However, there was general consensus that a good boiled/steamed sweet potato should be firm, not mushy and have a characteristic sweet potato flavour.

Table 3: Description of characteristic requirements for bolied/steamed sweet potato

Characteristic	Requirement/specifications
Colour	• uniform yellow • off-white
Texture	• Soft texture (preferred by children) • Mealy texture/mouth feel (preferred by adults – makes one full faster) • Not watery (muwuta) • Moderately soft and mashable (for mugoyo) • No fibres
Taste	• Characteristic sweet potato sweet
Aroma	• Cooked sweet potato aroma

Fried Sweet Potato

Tumuhimbise et al., (2013) evaluated the sensory quality of crisps from two OFSP varieties (ejumula and kakamega). A semi-trained panel and a 9-point hedonic scale were used to assess mouthfeel, crispiness, colour, taste and overall acceptability. Ejumula crisps scored higher than Kakamega for colour and crispness linked to deeper orange colour and higher dry matter content respectively. Pre-treatment of sweet potato crisps with 2% salt enhanced the overall acceptability for both varieties. Hagenimana et al., (1998a) conducted a study on oil content in fried sweet potato products. They assessed the effect of oil type on sensory acceptability of crisps comparing the cultivars Kemb 10 (sweet potato) and Dutch Robyjin (potato). Texture, flavour, color, crispiness and overall acceptability were evaluated on a 7-point hedonic scale. Sweet potato crisps scored in the range good to very good for all attributes albeit being less preferred compared to potato. The type of oil used for frying did not significantly impact crisp quality. The study also showed that there was an inverse linear relationship between dry matter and oil content of crisps from ninety four sweet potato cultivars assessed. Preference of deep fried sweet potato based on KII is summarised in **Table 4**;

Table 4: Description of characteristic requirements for fried sweet potato

Characteristic	Requirement/specifications
Colour	• Light brown
Texture	• Crispy surface • Soft and slightly dry interior • Mealy texture/mouth feel • Not fibrous • A little crunchy
Taste	• Characteristic sweet potato sweet
Aroma	• Fried sweet potato aroma

1.3. Conclusion

The findings from this study indicate a glaring knowledge gap with regard to disaggregation of data on preferences for sweet potato characteristics by gender, ethnicity, region and processing method. The KII revealed some processing methods and consumption pattern which might be specific to certain regions e.g mugoyo (mashed sweet potato) in parts of Eastern and Central Uganda. It is envisaged that the RTB Foods project will go a long way in validating anecdotal information and ultimately bridge the existing knowledge gaps.

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UBOS, 2016. Statistical abstract

APPENDICES

Appendix A: Key informant interview table

Institution	Years of experience	Role	Gender
NARL - Kawanda	>20	Research scientist	M
NARL - Kawanda	>10	Research scientist	F
NARL - Kawanda	>5	Research scientist	M
Gomago Catering Service	20	Cook	F
Gomago Catering Service	8	Cook	F
Gomago Catering Service	5	Cook	F

Appendix B: Overview table of quality characteristics

Boiled/steamed sweet potato

	Quality Characteristics (and range, if possible) to achieve a good product ** specify variation with process/region/user group – complete multiple tables if necessary*	***Mean ranges for the quality characteristics*** *(from literature if available)*	***Evidence to substantiate*** *(refer interviews and/or add citation sources)*	***Your confidence in the information*** *(low, med, high) + reason*
Raw material	Root shape and form • Uniform and wholesome surface without physical defects • obovate, round elliptical and long irregular or curved		KII Mwanga et al., 2009	High (Usual practice) High (Peer reviewed publication)
	Root size • Medium		KII	Medium (variability depending on vc node – trade or consumption)
	• High dry matter content	• (>30%)	Mwanga et al., 2009	High (Peer reviewed publication)
	Flesh colour • white, pale yellow, cream and orange		KII	Medium
	Skin colour • Cream, purple-red, brownish orange, red, yellow and purple.		KII	Medium

	Quality Characteristics (and range, if possible) to achieve a good product ** specify variation with process/region/user group – complete multiple tables if necessary*	***Mean ranges for the quality characteristics*** *(from literature if available)*	***Evidence to substantiate*** *(refer interviews and/or add citation sources)*	***Your confidence in the information*** *(low, med, high) + reason*
	Texture • Turgid/firm • Slightly chewy but not fibrous		KII	Medium (Requires larger sample size)
	Taste • Characteristic sweet taste • Slight astringency		KII	Medium (Requires larger sample size)
Processing/Preparation steps				
1. Peel and chop big sized roots	• uniform, smooth surface without ridges for easy peeling • Medium size roots are easier to peel and can be prepared whole		KII	Medium (Requires larger sample size)
2. Washing	• easy to wash without crevices that hold soil • no brown colour after washing		KII	Medium (Requires larger sample size)
3. Wrapping in banana leaves	• Medium size roots are easy to wrap whole		KII	Medium (Requires larger sample size)
4. Steaming	• Ready within 45 minutes • Retain sweet potato flavour		KII	Medium (Requires larger sample)
5. Boiling	• Ready within 30 minutes • Retain sweet potato flavour • Not soggy		KII	Medium (Requires larger sample)
6. Mashing (optional)	• Soft but not soggy • Not fibrous		KII	Medium (Requires larger sample)

	Quality Characteristics (and range, if possible) to achieve a good product ******* *specify variation with process/region/user group – complete multiple tables if necessary*	***Mean ranges for the quality characteristics*** *(from literature if available)*	***Evidence to substantiate*** *(refer interviews and/or add citation sources)*	***Your confidence in the information*** *(low, med, high) + reason*
End product				
	Colour • uniform yellow • off-white		KII	Medium (Requires larger sample)
	Texture • Soft texture (preferred by children) • Mealy texture/mouth feel (preferred by adults – makes one full faster) • Not watery (muwuta) • Moderately soft and mashable (for mugoyo) • No fibres		KII	Medium (Requires larger sample)
	Taste • Characteristic sweet potato 'mild sweetness'		KII	Medium (Requires larger sample)
	Aroma • Cooked sweet potato aroma		KII	Medium (Requires larger sample)

Deep fried sweet potato

	Quality Characteristics (and range, if possible) to achieve a good product * specify variation with process/region/user group – complete multiple tables if necessary	**Mean ranges for the quality characteristics** (from literature if available)	**Evidence to substantiate** (refer interviews and/or add citation sources)	**Your confidence in the information** (low, med, high) + reason
Raw material (characteristics similar to boiled documented previously)				
Processing/Preparation steps				
1. Peel and chop big sized roots	• uniform, smooth surface without ridges for easy peeling • Medium size roots are easier to peel and can be prepared whole		KII	Medium (Requires larger sample size)
2. Washing	• easy to wash without crevices that hold soil • no brown colour after washing		KII	Medium (Requires larger sample size)
3. Slicing	• Easy to slice to uniform thickness • Not brittle		KII	Medium (Requires larger sample size)
4. Deep frying	• Short frying time (5 minutes) • Does not absorb cooking oil • Steady development of light brown colour without darkening		KII	Medium (requires further data)
End product				
	Colour • Light brown		KII	Medium (requires further data)

	Quality Characteristics (and range, if possible) to achieve a good product * specify variation with process/region/user group – complete multiple tables if necessary	**Mean ranges for the quality characteristics** (from literature if available)	**Evidence to substantiate** (refer interviews and/or add citation sources)	**Your confidence in the information** (low, med, high) + reason
	Texture • Crispy crust • Soft and slightly dry interior • Mealy texture/mouth feel • Not fibrous • A little crunchy		KII	Medium (requires further data)
	Taste • Characteristic sweet potato mild sweetness		KII	Medium (requires further data)
	Aroma • Fried sweet potato aroma		KII	Medium (requires further data)

Appendix C: Document citation log

1.1 Citation	1.2 Country and region of focus
Ingabire M. R. and Vasanthakaalam H., Comparison of the Nutrient Composition of four sweetpotatoes varieties cultivated in Rwanda. American Journal of Food and Nutrition, 1(1): 34-38: (2011).	Rwanda, East Africa
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Owori C., Lemaga B., Mwanga R. O. M., Namutebi A. and Kapinga R. (2007). Sweet potato Recipe Book: Sweetpotato Processed Products from Eastern and Central Africa. Kampala-Uganda 93pp.	East and Central Africa
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Hagenimana V., Karuri E.G., and Oyunga M.A. (1998a). Oil Content in Fried Processed Sweet potato Products. Journal of Food Processing and Preservation 22, 123-137	Kenya, East Africa

Appendix D: Document review summary table characteristics

Source (first author, year)	**Methodology**					**Raw material characteristics**	**Note any differences in the preferences for the characteristic by region, processing method, ethnicity, gender etc.**	**Food processing and preparation (disaggregated by gender and other factors of difference wherever possible, if recorded in document)**			**Comment on your level of confidence in the paper**
	Consultation: • **Focus groups** Sex disaggregated data presented (y/n): number, gender, region, user group • **Individual interviews** Sex disaggregated data presented (y/n). number, gender, region,	**Sensory evaluation** e.g. QDA, Panel, Number panellist + number of products	**Consumer testing** (Hedonic test – or specify other consumer test, Number of consumers, by gender, region, user group, Number of products	**Processing steps to make the product**	**Other methods of note**	**Characteristics (and range, if possible) of the raw material that make a good product that the authors identify (disaggregated by gender/user group if recorded in document)** Appearance, Age, Odour, Texture when touching, Taste or texture when biting		**Processing & / or preparation steps to make the product**	**<u>Physical and chemical, quality</u> characteristics of the raw material (and range, if possible) at each step of the process and preparation to the final product**	**<u>Physical, chemical, nutritional, sensory qualities</u> characteristics of the final product** Regarding its appearance, odour, texture between fingers, taste, texture in mouth, aroma	

	user group										
Mwanga, 2009			• **aggregate pairwise comparison**			• **Dry matter (26.9 – 36.1)** • **Skin colour; purple-red, cream** • **Flesh colour; pale/intermediate/dark orange, yellow, cream** • **Root shape; obovate, long irregular or curved**				**Sensory** • **Texture; somewhat dry** • **Taste; moderate sweetness**	**High**
Tomlins (2012)		• **semi-trained sensory panel** • **modified quantitative descriptive analysis (QDA)** • **100mm unstructured**		• **Sort** • **Boil**	**Readiness to eat determined using a fork**	• **Total carotenoids (0.4-72.5 lg/g fresh weight)** • **Dry matter (26.8-39.4%)**		• **Sort** • **Boil**	**Sort** • **Disease free** • **No insect damage**	**Sensory** • **Appearance (smooth)** • **Odour (pumpkin, sweet potato)** • **Colour (orange, yellow, white, uniform)** • **Texture (crumby-brittle and flaky**	**High**

		scale for intensity of sensory attributes • 10 sensory panellists • 13 sensory attributes • 11 sweet potato varieties								when compressed by the fingers, watery) • Taste (sweet, pumpkin)	
Bashaasha et al; 1995	•Individual interviews (structured questionnaires) •216 respondents •4 agroecological zones of Uganda	•		•Peel, Steam or boil •Unpeel, boil or steam •Mash with other food		• Size • Shape • Colour •		•Peel, Steam or boil •Unpeel, boil or steam •Mash with other food		•Sweet •Palatable	High

	• More female respondents (average 57%)										
Tomlins et al; 2007	• Individual interviews (structured questionnaires)	• Semi trained sensory panel • 12 assessors • QDA • 100 mm unstructured scale for attribute intensity • 4 sweet potato cultivars	• Central location testing • Modified category scale (text and pictures) • 153 respondents • School children • Mothers with preschool children	• Sort • Peel • Cut/chop • Boil				• Sort • Peel • Cut/chop • Boil	Sort • Disease free • No insect damage	• Colour; orange, creamy, yellow • Flavour; pumpkin • Texture; watery, hard, coarse, fibrous • Starchiness • Sweet	High
Tomlins et al; 2004	• Individual interviews (structured questionnaires)	• QDA • 100 mm unstructured scale for attribute intensi	• Central location testing • 600 respondents • 51% female,	• Peel • Cut/chop • Boil				• Peel • Cut/chop • Boil		• Colour; internal and external • Chewiness • Odour • Sweetness • Starch • Appearance • Fibre • Stickiness	High

		ty rating • trained sensory panel • 21 panelists	49% male • 14 sweet potato cultivars • Ranking consumer test • Most preferred consumer test							• texture	
Tumwegamire et al., 2007			• hedonic testing • pairwise ranking • 3 agroecological zones • Children (7-10 years) • Adults (women and men) • Seven sweet potato varieties	• Peel • Cook		• Size • Shape • Colour; flesh – deep orange, orange, light orange; skin – cream, red • Root skin appearance • Flesh appearance • Dry matter				• Taste • Flavour • Appearance • Fibrousness • Starchiness	High

Tumuhimbise et al., 2013		• semi-trained sensory panel • 28 panelists • 9 point hedonic scale	•	•		• Colour; deep orange • Dry matter (37.24, 39.91) • B-carotene (181.21, 254.19)				• Crispiness • Colour; Deep orange • Taste • Mouthfeel	High
Hagenimana et al., 1998a		• 7-point hedonic scale of 1 =very poor and 7 =excellent • Untrained sensory panel • 25 panelists	•	• Hand peel • Slice • Wash • Surface dry with towel • Deep fry		• Flesh colour; dark yellow • Dry matter (33.6)		• Hand peel • Slice • Wash • Surface dry with towel • Deep fry	Slice • Thickness (1.5mm)	• Crispiness • Not oily	High

2. GENDER AND SOCIO-CULTURAL CONTEXT REPORT FOR BOILED AND FRIED SWEETPOTATO

Key findings

- The importance of sweet potato for food security and income is increasing, particularly due to pest and disease problems with alternative staples such as cassava and banana.
- There has been a significant push to promote Orange Fleshed Sweetpotato (OFSP) in the county to target vitamin A deficiency; however, consumers have reported to dislike the taste and smell of the crop, its low dry matter content and perceptions that the crop is genetically modified.
- Promotional activities focusing on the nutritional benefits of OFSP positively impact on the adoption of new OFSP varieties. Children are attracted to the orange colour varieties.
- Ejumula and NASPOT varieties of OFSP are particularly popular, due to their nutritional benefits, sweet taste and greater yield – which is linked to higher income-generation potential.
- However, farmers tend to view that local sweet potato varieties are more drought tolerant.
- Planting material is most often obtained through social networks, and not purchased.
- Sweetpotato is commonly planted on large mounds with five to six vines on land demarcated for food security, and rotated with maize, beans and groundnuts. Women tend to intercrop with beans, but not men.
- Women also perform most of the labour activities regarding production, harvesting, washing and peeling, and packaging for sale. Men will participate in selling if there is a surplus.
- Women are reported to have most of the knowledge on production activities and varieties. Women play an activity role with decision making regarding sweet potato and sweet potato fields. But men also influence decisions.
- Freshly harvested sweetpotato is commonly steamed in a pot with its skin, and with other foods, but wrapped in banana leaves. Mature roots are peeled and steamed individually. It can also be roasted. In some areas, fresh roots are sliced and dired I the sun for 2-3 days, then boiled before consumption.
- Fried sweet potato is rare in rural areas; however, it is common among the Muslim community who eat it during Ramadan. There is growing demand for fried sweet potato in urban and peri-urban areas as a snack.
- Constraints reported for women are drudgery in making ridges/mounds, weeding, harvesting, Post- slicing and drying SP, low bargaining power, prices, untrustworthy buyers, and chronic back ache. Men report limited access to mechanization (animal traction), quality herbicides, low prices, untrustworthy buyers

Introduction

The importance of sweetpotato in Uganda as a food crop can hardly be overemphasized. Uganda is Africa's leading sweetpotato producer and globally is second to China (Mwanga and Ssemakula, 2011). Sweet potato is a primary staple in Uganda and comes third after cooking banana and cassava in order of importance (Bashaasha et al; 1998, Thiele et al., 2009,). The crop has become increasingly popular given the major threats to banana (banana bacterial wilt) and cassava (cassava mosaic virus) that have ravaged productivity of these staples. Given its potential to bridge the hunger gap, sweetpotato is increasingly becoming an income generating crop as farmers have realized its business potential especially immediately after the dry seasons (Gibson et al, 2007).

Aside from this, there has been a drive to promote Orange Fleshed Sweetpotato (OFSP) in Uganda as a way to address hidden hunger among vulnerable groups such as women and children (Low et al, 2007). The nutritional approach to OFSP promotion is due to the fact that Ugandan children, just like in many other countries in Sub Saharan Africa (SSA), suffer from

Vitamin A deficiency (Mwanga and Ssemakula, 2011). Women are targeted in particular for OFSP adoption due to their role in determining household nutrition (Gilligan et al 2014). Recently, however, the approach has shifted to value chain development in a bid to increase visibility of the crop in rural and urban households. Despite these initiatives, OFSP is a rare item in Ugandan markets. One of the challenges that has been highlighted by consumers is it's taste and smell. A recent market study in Tanzania for example revealed that consumers do not like OFSP because of its low dry matter content which render it 'watery' after cooking (Mayanja et al, 2017). Other studies have revealed that consumers have a negative perception about the crop due to negative propaganda indicating that it is genetically modified.

Sweetpotato breeders have thus taken a new stance, and now focus on delivering varieties with traits preferred by the end users. To this end, participatory varietal selection, among other strategies, has taken root in Uganda and other countries in sub-Saharan Africa (SSA) (Mwanga et al 2011; Amele and Mudege; 2015). To support this effort, the RTBFoods Project aims to develop a gender responsive product profile for the most popular OFSP products in Uganda: boiled and fried sweetpotato. This output is under Work package one (WP 1) and is hereafter referred to as the WP1 Product profile.

The WP1 Product profile is defined as 'a set of quality characteristics of the product (in this case, boiled and fried sweetpotato) that meet consumer demand. The Product Profile will contain information on (i) characteristics of the product (ii) stakeholder group and demand segment (ii) optimal range of acceptability of the characteristics and (iv) Priority – relative importance of the characteristic(s) to the stakeholder group (Forsythe et al, 2018). Amongst the activities designed to develop the product profile, is this State of Knowledge (SoK) report.

The report aims to address the following research questions:

- What are the agronomic norms and practices of sweetpotato in Uganda?

- Have new varieties of the crop associated with the product been introduced in Uganda and is there expertise or evidence on the factors influencing adoption in this context?
- What are the different uses and products of the sweetpotato?
- What are the gender dimensions of the sweetpotato value chain and the main alternative uses?
- Are there trade-offs between different uses of sweetpotato? Does this affect different groups of people's participation, workload and benefit from boiled or fried sweetpotato?

2.1. Theoretical underpinnings

The gender dimensions framework – GDF (Rubin, 2011) was used to obtain a deeper understanding of the gender and socio-cultural-economic perspectives underlying utilization of boiled and fried sweetpotato. The GDF offers a structured approach to analysing gender relations pertaining to a selected value chain within a household, firm, community and broader economy. As such, it enables application of a gender lens on existing: (i) practices and patterns of participation (such as time, mobility, labour participation (ii) patterns of access to productive assets (iii) social beliefs and perceptions and (iv) law, policies and institutions that shape the chain of focus. The framework allows to factor in dynamism inherent in gender relations as well as in the market.

A desk study was conducted to obtain information on the gender and social cultural context of boiled and fried sweetpotato in Uganda. Content analysis was done on 15 documents categorized as below:

- Technical reports (available on RTB-MEL)
- Journal articles
- Guides for sweetpotato agronomy

Key Informant interviews were held with six R&D professionals (4M, 2F) to obtain a general perception on the themes of the research questions. However, there was a paucity of data related to fried sweetpotato specifically.

2.2. Findings

2.2.1. Sweetpotato agronomic practices and adoption of improved varieties suitable for boiled and fried products

The National Sweetpotato program has released a number of new sweetpotato varieties in the past decade (Mwanga et al 2007, 2008, 2011). These include both white and orange fleshed varieties (WFSP and OFSP). According to KII, in cases where projects undertake promotion activities, farmers have adopted new varieties, especially those that are nutritious (OFSP) and high yielders e.g. NASPOT 11. This is because of the output is high and benefits are greater. So where there is promotion, adoption is high but this goes hand in hand with high yield and importantly, good eating attributes (e.g. high dry matter, sweetness).

In Nakasongola, Ejumula and the NASPOT series are popular with the farmers. The farmers have the interest to adopt because the improved varieties have Vitamin A and when you talk about Vitamin A, children and old people are obviously targeted. Children like it because of the colour – it attracts them. They pick the orange coloured ones first. Adults like Vitamin A because of prevention of diseases because when you are adult sometimes you are told you are like a baby, so you need to take care of yourself. Similarly, improved varieties have been adopted in central and eastern Uganda (the Naspot series).

Despite this interest, farmers in Nakasongola were of the view that the local varieties are more resilient to drought as compared to improved varieties. So, when it comes to sourcing seed, their priority is for the local varieties because they know they will survive the adverse weather conditions. The improved varieties are liked because they are high yielding and so have high income generating potential – there is a market for improved varieties so farmers will grow the improved ones mainly for the market. The local varieties would then be used for household consumption, for food security.

Most households obtain planting material for sweet potato through interaction with other households, which raises questions about the role of social interaction, intrahousehold division of labour, and gender in adoption and diffusion (Gilligan et al 2014).

In eastern and central Uganda, sweetpotato is planted on large mounds, and a bundle comprising five to six vines is planted on each mound. In areas that have access to animal traction, sweetpotato is planted on ridges, but this is mostly practiced by people who have access to oxen plough. Sweetpotato is rotated with maize, beans and groundnuts. The crop is planted as a single stand, rarely intercropped with maize but there are usually volunteer crops from previous seasons that may sprout here and there. These findings are in line with Bashaasha et al (1995).

Men and women farm on shared plots in eastern Uganda; however the roles and responsibilities may vary depending on whether the crop is grown solely for food or the market. Given the importance of the crop for food in the region, it is accorded sizeable acreage for which women are solely in charge of especially where the crop is meant for food. The size of a family's sweetpotato garden is thus an indicator of its food security and wellbeing. In the central region especially around Lake Victoria, sweetpotato is also planted as a single crop. Women sometimes intercrop with beans but men rarely practice intercropping. In Mpigi area, men revealed that the family plants one big plot of sweetpotato, after which a portion is demarcated for food. The food plot is used to assess the level of productivity and also for indications of weevil infestation. The woman has control over the food plot, while the husband manages the income plot.

In Eastern Uganda, sweetpotato is a family crop and is in most cases planted by women: it is the women's initiative and they perform all the related activities. If they are lucky, the man will make the mounds. Women source vines, weed twice in a growing season and start harvesting at three months (piece meal).

According to the KII from Nakasongola, planting in this region commences in May. Sweetpotato is not a priority crop in the first season, because farmers believe that if you plant it early it is easily affected by pests and crops. It is planted as a sole crop, though a few farmers intercrop it with beans. It is mostly women who grow sweetpotato and so the gardens mostly belong to women. It is rare to find a garden that belongs to men.

2.2.2. Uses of the crop and corresponding products

In Eastern Uganda, the initial root harvests are steamed in jackets. This could be attributed to tenderness of the young roots. Freshly harvested sweetpotato is not steamed individually; all other foods are steamed together in one pot and it is placed on the top of all the other foods. As the roots mature, they are peeled and steamed individually. In Nakasongola, fresh roots are also steamed and eaten at all meals: breakfast, lunch and supper. The sweetpotato is wrapped and steamed in banana leaves.

Another form of consumption is locally known as '*mugoyo*[1]' – i.e. steamed sweetpotato and bean mash. This is a delicacy that is eaten as a main meal. In central region, it is wrapped in banana leaves and placed in the dying embers of the fireplace (in the middle of the cooking stones) to keep warm. It is then served in the morning as breakfast or packed as a lunch snack for school children.

Sweetpotato roots are also roasted in a similar manner and commonly referred to as *lumonde/emboli omuvumbike*. In the north, east and Nakasongola, fresh roots are sliced and dried in the sun. The sweetpotato slices which normally take about two to three days to dry are stored for use during lean times; or sold for income. In Nakasongola, the dried slices (also locally known as *Kasedde or ebitere bya byata*) are a delicacy. They are immersed in boiling water with a pinch of salt and skilfully mingled into a mash. The mash can be served with sauce or eaten on its own as a complete meal.

In northern Uganda where sweetpotato is cultivated for both food and income, the women usually have to compromise with their spouses on the quantity and quality to reserve for making sweetpotato chips. This usually happens when the market for fresh roots is good (i.e. fair/high prices); and the men want to sell off the food and income designated plots. In such

[1] In Buganda, omugoyo has been associated with aging women because it is assumed only old women have the patience to prepare it due to the straining process. The common myth about omugoyo in Buganda is that two lovers are not supposed to serve each other omugoyo. It is believed that such an act would extinguish the fire and may even result in a failed relationship.

circumstances; women negotiate for a few lines in the garden, since they role of ensuring food availability will fall squarely on their shoulders in lean times.

Fried sweetpotato is a rare product in rural areas. However, it is most common amongst the Muslim community who eat it during breaking the fast (futr) during Ramathan. The common method of preparation is peeling and slicing the root in fairly big chunks, boiling it for a short time and then deep frying it. However, the product is fast becoming popular in urban and peri-urban markets where it is prepared and sold as a snack.

DECISION MAKING

Decision making regarding crop decisions is gendered, and therefore likely to which sweet potato varieties are planted, and how much. Gilligan et al. (2014) found that men play a leading role in crop-choice decisions within the household, but survey data show that women also play an active role in crop selection, particularly for food crops for household consumption, and that women commonly supply labor on household farms.

2.2.3. Gender dimensions in the sweetpotato value chain

Boiled/steamed and fried sweetpotato (SP)	**Practices and Participation** SP is mainly produced by women. They are responsible for all the production activities right from sourcing vines for planting through to harvesting and processing dry chips and cooking (Hall et al, 1998). According to a Key Informant, women are lucky if the husband assists in making mounds. Women practice piece meal harvesting over an extended period of time (Heyd & Qaim, 2008). In eastern Uganda, the first harvests are steamed in their jackets alongside other foods. As the roots mature, they are peeled and steamed on their own. Fried SP is rare in the communities. However, it is a major component of the futr meal during Ramadan. Men participate in selling, if there is a surplus. Even then, women harvest and package the SP for sale. SP is chipped and dried and this practice is common in Eastern, Northern and Lake Kyoga areas. Dried SP (*mutere, maboya, kasedde*) is an important food security product. Depending on the region, it can be reconstituted and mashed with beans (mugoyo). In Teso region, it is cooked for breakfast during lean times. In Kamuli, it is milled into flour and substituted for wheat and cassava flour in local snacks.	**Resources** • **Knowledge (who knows what)** women are believed to be the custodians of knowledge regarding SP production. Mudege et al (2016) found that men in Eastern Uganda attested to this fact. They relied on women on identifying 'sweet varieties' and knowing when best to plant, weed and harvest. Both men and women participate in capacity building activities. However, women are mostly targeted by nutrition programs whereas technical trainings are attended by men (Mudege et al, 2017). • **Natural and Productive Resources** Land, vines and tools are the major resources required. Land is mostly owned by men in Uganda and they allocate land amongst the various crops. However, studies have shown that SP being a food crop, it is not usually grown on 'prime' area (Mudege et. al; 2016). Women source vines from own fields, neighbours and relatives for free. Buying vines is rare and mostly for improved varieties.	**Beliefs and Perceptions** Sweetpotato is a woman's crop, it is a way of life for communities in Eastern Uganda. All homes in Busoga grow SP – it should not be sold unless in very dire circumstances Sweetpotato vines are not for sale – you give some to your neighbour of good variety, and next time she can return the favour.

	Women and children are the ones responsible for peeling and drying and preparation. However, the entire family benefits from dried SP.	Chowdhury et al (2009, 2011) showed that farmers in Uganda are willing to pay more for biofortified products, but only when they have information about its benefits. In Tanzania, farmers were willing to pay a higher price for vines of improved local varieties (Mwiti, 2015). This implies that investment in high yielding varieties is on the trend, for as long as the taste is right (KII). • **Income** Men usually have a greater say over income from bulk sales of SP. In this case men grow SP specifically for the market on larger plots. As observed by Okonya (2014), women headed household have very limited access to off-farm income and credit. • Services • There is limited access to extension and BDS services for SP for both men and women (Mudege et al 2016). **Employment** • Women have to offer free labour to the commercial plot before attending to their own (Kyalo et al, 2014).	

		Information • Access to agricultural information related to SP production is very limited for both men and women (Okonya & Kroschel, 2014) **Benefits** SP is an important crop that bridges the hunger gap (Gibson 2007), both in fresh and dried form. It is increasingly becoming an important income generating crop, mostly for men – for vine and root sales (Namanda et al 2011)	
	Laws, Legal Rights, Policies, and Institutions Until recently, SP has been considered an 'orphan' crop and rarely accorded national resources. Crop improvement thus is not a priority and mostly done with donor support (Bashasha et al, 1995). This is changing with initiatives supporting OFSP, however. In Nakasongola, a byelaw was passed that requires all households to grow at minimum of quarter an acre of SP.	**Power** The common perception is that women don't have control of decision making/power. Mudege et al (2016) in a study using the adapted WEAI showed that women and men perceived similar levels of decision making power on production related decisions. However, women felt they had less power than men to make marketing related decisions. This was the same for asset ownership and for control over use of income from sale of SP. Elsewhere, studies have shown that sole female ownership of assets such as land may not lead to great benefits. Rather, joint asset ownership has been shown to lead to better resource utilization (Gilligan et al, 2014).	**Gender-based constraints and opportunities (GBC + GBOs)** Findings from a study in central and eastern Uganda using the gender-based constraints analysis tool revealed the following GBC's (Mudege et al, 2016) **Women:** <u>Production:</u> Drudgery in making ridges/mounds, weeding, harvesting <u>Post-harvest:</u> slicing and drying SP Marketing: low bargaining power, prices, untrustworthy buyers <u>Health implications</u>: chronic back ache

			Men: Production: limited access to mechanization (animal traction), quality herbicides Marketing: low prices, untrustworthy buyers

Key findings from a Gilligan et al (2014) study on the impact of OFSP information and dissemination programme, from a gender perspective

Adoption rates of OFSP in the study were found to be very high (90%) in the first season of the project, when free planting material was distributed . However, average adoption rates declined in the next three seasons due to vines drying up, and lack of labour to grow the crop.

The study found a complex relationship between female bargaining power (measured by control over household assets) and the impact of the biofortification program on OFSP adoption and diffusion and dietary intakes of vitamin A.

Female bargaining power, measured by the share of land and nonland assets exclusively controlled by female household members, does not unambiguously increase the probability that a household adopts OSP in response to the project. Also, land parcels over which women have sole control are not those most likely to contain OSP.

Rather, the probability of adoption of OSP is highest on parcels over which there is joint control but where women take the lead in deciding which crops are grown. However, the probability of adopting OSP is lowest on parcels exclusively controlled by men.

As expected, we find evidence that crop-choice decisions are correlated across parcels.

In examining adoption decisions within households, plots of land exclusively controlled by women are not more likely to contain OSP, but plots under joint control of men and women, in which a woman has primary control over decision making are significantly more likely to contain OSP. Plots exclusively controlled by men are the least likely to contain OSP.

Evidence indicates that women play an important role, and often a leading role, in the decision to adopt OFSP, but that this decision is often jointly made with their husbands. Because of the jointness of these decisions, the current strategy of targeting only women with nutritional training may be missing an opportunity to create an awareness of the benefits of OSP among men.

While the evaluation of the REU project found no evidence of impact of fathers' knowledge of child feeding practices in Uganda (de Brauw et al. 2010), but the contribution of nutrition messages received by women on the impact of the project on OSP adoption and dietary intakes of vitamin A appears to be relatively small (de Brauw et al. 2012). Nonetheless, in this setting, our results suggest that engaging with adult household members of both genders might be the best strategy to promote adoption.

The share of nonland assets controlled by women increases dietary intakes of vitamin A, but this measure of female bargaining power does not increase the impact of the OSP project on vitamin A, suggesting that the project had similar impacts across households with different levels of female bargaining power.

2.3. Discussion and conclusions

From the foregoing, considerable knowledge has been generated on the agronomy and utilization of boiled (or steamed) sweetpotato. Key Informants had a wealth of information regarding sweetpotato in production and livelihood systems, as well as on consumer preferred characteristics/traits. However, most of this information was not analysed from a gender perspective, hence the need for additional research. There was a paucity of data on fried sweetpotato, which could be attributed to the fact that most communities in Uganda consume boiled/sweetpotato. Thus, there is a need for more research in this area, to be able to contribute to breeding sweetpotato varieties that meet the end user's needs. It is envisioned that the RTBfoods project will help address this gap in knowledge. It is believed that once this is achieved, there will be more uptake of the nutritious sweetpotato and hence improved utilization in Uganda and the Great Lakes Region as a whole.

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3. DEMAND STATE OF KNOWLEDGE REPORT FOR BOILED AND FRIED SWEETPOTATO IN UGANDA

Key findings

- Uganda is the third largest producer of sweet potato in Africa.
- Important food security crop due to it drought tolerance, nutrition, early maturity and flexible growing season. Piecemeal harvesting is widely practiced and an attribute particularly valued by women.
- Demand and income-generation potential for sweet potato and products is growing in the country. The high season occurs during Ramadan.
- Demand segments are urban and rural consumers consume boiled sweet potato prepared at home. In urban areas, people commonly consume boiled or fried sweet potato purchased from hotels or from road-side vendors. There is some indication that fried sweet potato is preferred by men and in urban areas as a snack.
- Sweetpotato is very popular in eastern Uganda.
- Varietal preferences are Kampala, Boy, Socadido, Soroti and Tanzania varieties - the latter two are particularly valued by traders due to their longer shelf-life. The variety
- In the central region (Buganda), sweetpotato with high dry mater content and high sugar content is preferred. Varieties that have deep roots because they can be piece-meal harvested with little damage by the weevils are also preferred.
- Traded informally, particularly by women. Wholesale is an activity conducted by men. However, there is a lack of information on the scale of activities.
- Marketing constraints include the crops bulkiness, high perishability, high transport costs, minimal storage facilities, limited market information services and absence of processing.
- Not commonly stored as it is mainly harvested on a piecemeal basis, however improved storage techniques are being increasingly used, such as pit stores (favoured by women) and clamp stores (favoured by men).

Introduction

Sweetpotato is a major staple crop in the Ugandan economy, ranking third after cooking banana and cassava (Mwanga et al, 2011). Though mostly grown for food, the crop is increasingly becoming a significant income earner. Sweetpotato is mostly traded informally where rural aggregators play a major role in bulking the crop for sale in peri-urban markets. According to Bashaasha et al (1995); trading is mostly done by women producers who sell small volumes to women in rural markets, though urban trading is becoming increasingly significant. Recent findings show that men are increasingly becoming involved in wholesale trade, but retail is still dominated by women (Kyalo et al, 2014; Mayanja et al, 2016). However, it is mainly regarded as a woman's crop and mostly held in low regard; which exacerbates its trade development. This could be attributed to the limitations in access to and control over resources women face; which curtails their ability to increase investment in the sweetpotato value chain. Sweetpotato marketing is constrained by a number of factors including bulkiness, high perishability, high transport costs, minimal storage facilities, limited market information services and absence of processing (Bashaasha and Mwanga, 1995). In fact, the bulky and perishable nature of the crop especially hinders its entry into lucrative markets *(ibid)*.

However, the crop has many benefits for farmers especially those living in marginal areas given that it is drought resistant, nutritious (especially the orange fleshed varieties which contain beta carotene) and matures earlier than most other root and tuber crops (Namanda et al, 2011). Sweet potato also has a flexible growing season allowing for piecemeal harvesting over a three to ten month period, which is important for food security (Ewell, 2010). It is mainly consumed in fresh form, either boiled or roasted.

According to Ewell and Mutuura (1994), sweetpotato is an efficient provider of cash income over unit of land and time for farmers. Even with low external input, the profitability of the crop is high with great potential to double when improved technologies are applied (Bashaasha & Mwanga, 1995). Considering the aforementioned benefits, it is important that efforts to improve its marketing are stepped up in the region.

Most households in Uganda consume sweetpotato at least once a week, especially in rural areas. In urban and peri-urban areas, the crop is mostly purchased by women, just like in other East African countries. The general perception is that demand for sweetpotato is increasing in the country (Ewell, 2010). In a market study conducted in 14 markets in Tanzania, Mayanja et al (2017) found out that demand for sweetpotato is highest during Ramadan. About 61% of the consumers interfaced with in this study had attained primary education, and 75% were women, while purchase patterns were 2-3 times a week by 45% of the respondents.

This State of Knowledge seeks to further explore the demand status of boiled and fried sweetpotato in Uganda. Specifically, it seeks to address the research questions below:

1. What is the demand and trends in demand for the product, from people who pay for the product and make and consume it themselves?
    a. What are the different demand segments associated with the product?
    b. What are the size of the different demand segments and what are the trends for the product?
    c. What are the geographical and demographic characteristics of the demand segments for the product?
2. How do the demand segments correspond to preferred characteristics for the product?
3. How the product is transported, stored and sold, and by who (e.g. gender, socio-economic status, age, region etc.)?

3.1. Methodology

A desk study was conducted where close to five documents were reviewed for content relevant to the research questions mentioned in section one above. Six key informants were interviewed to obtain their expert opinion about demand and trends for boiled and fried as well as fresh sweetpotato roots. Data were analysed using content analysis. As with the gender SoK, there was a paucity of data specifically on fried sweetpotato.

3.2. Results

3.2.1. Sweetpotato scale of production

2016 figures from FAOSTAT find that Uganda is the third largest producer of sweet potato in Africa (2.1 million tonnes), behind Nigeria (3.9 million tonnes) and Tanzania (3.8 million tonnes).

Sweetpotato is grown by almost every household, and mostly on small plots of about 0.25 acres for home consumption. A few households, especially those with access to swamp land, grow the crop commercially, mainly during the dry season when prices are very high. According to a key informant, on average each household produces five sacks averaging 100-130kg.

3.2.2. Demand segments for boiled and fried sweetpotato

Boiled sweetpotato is mostly eaten while steamed at home, in hotels and road side food vendors in the evenings in trading centers. The deep fried sweetpotato is very popular as a breakfast snack to accompany morning tea in urban areas, but not in rural areas. It's mainly sold in kiosks along the roads, at schools and in busy trading centers. Another form is the bean-sweetpotato mash.

Types of demand segments

According to key informants; urban and rural consumers consume boiled sweet potato that is prepared at home, purchased in hotels or from road-side vendors as stated above. Urban consumers purchase deep fried sweet potato as a breakfast snack from road-side vendors, schools and trading centres. The demand for purchased sweetpotato is increasing among institutions (e.g. schools) because of an increase in the number of boarding schools which have it on its menu.

Demand segments by demographics (age, gender, marital status)

Sweetpotato is enjoyed mostly by children and women who always ensure that enough of this food crop is present in the garden to ensure household food security. According to a key informant, men and youths tend to prefer fried sweetpotato while women and children prefer boiled roots. Another view was that fried sweetpotato is preferred in urban areas and eaten as a snack. Yet another view fronted was that the youth don't like sweetpotato and would rather opt for products like chappatti.

Size and trends

The demand is relatively small for sweetpotato because of its bulkiness or amount of starch. Not a lot of sweetpotato can be eaten in a single sitting. Another key informant was of the view that a small restaurant can host 20-30 clients a day who eat sweetpotato. This would amount to less than 50 kg of sweetpotato

Variation of demand segments by geography, AEZones

Sweetpotato is very popular in eastern Uganda, in particular in urban areas such as Soroti where they slice and dry it for storage.

Orange flesh sweet potato

There has been considerable promotion of Orange-flesh sweet potato in the country which is considered to potentially reduce vitamin A deficiency. A study by Chowdhury et al (2011) found that the willingness to pay for this variety was the same for non-bio fortified 'traditional' varieties – however, when consumers are supplied with information on the nutritional value of the variety, consumers are willing to pay a premium (Chowdhury et al 2011). Actions have been taken to build a market for the variety in the country, at the farmer, trader and consumer levels as part of projects such as HarvestPlus (Coote et al. , 2011).

3.2.3. Demand segments in relation to preferred characteristics of boiled and fried sweet potato

In the central region (Buganda), sweetpotato with high dry mater content and very sweet (high sugar content) is preferred. According to a key informant, varieties that have deep roots because they can be piece-meal harvested with little damage by the weevils are also preferred.

3.2.4. Supply chain of sweet potato (gender lens)

If sweetpotato is grown for sale, the traders/buyers come to the field and buy it before harvesting. Its then bagged and transported to the urban markets by a vehicle and sold to consumers.

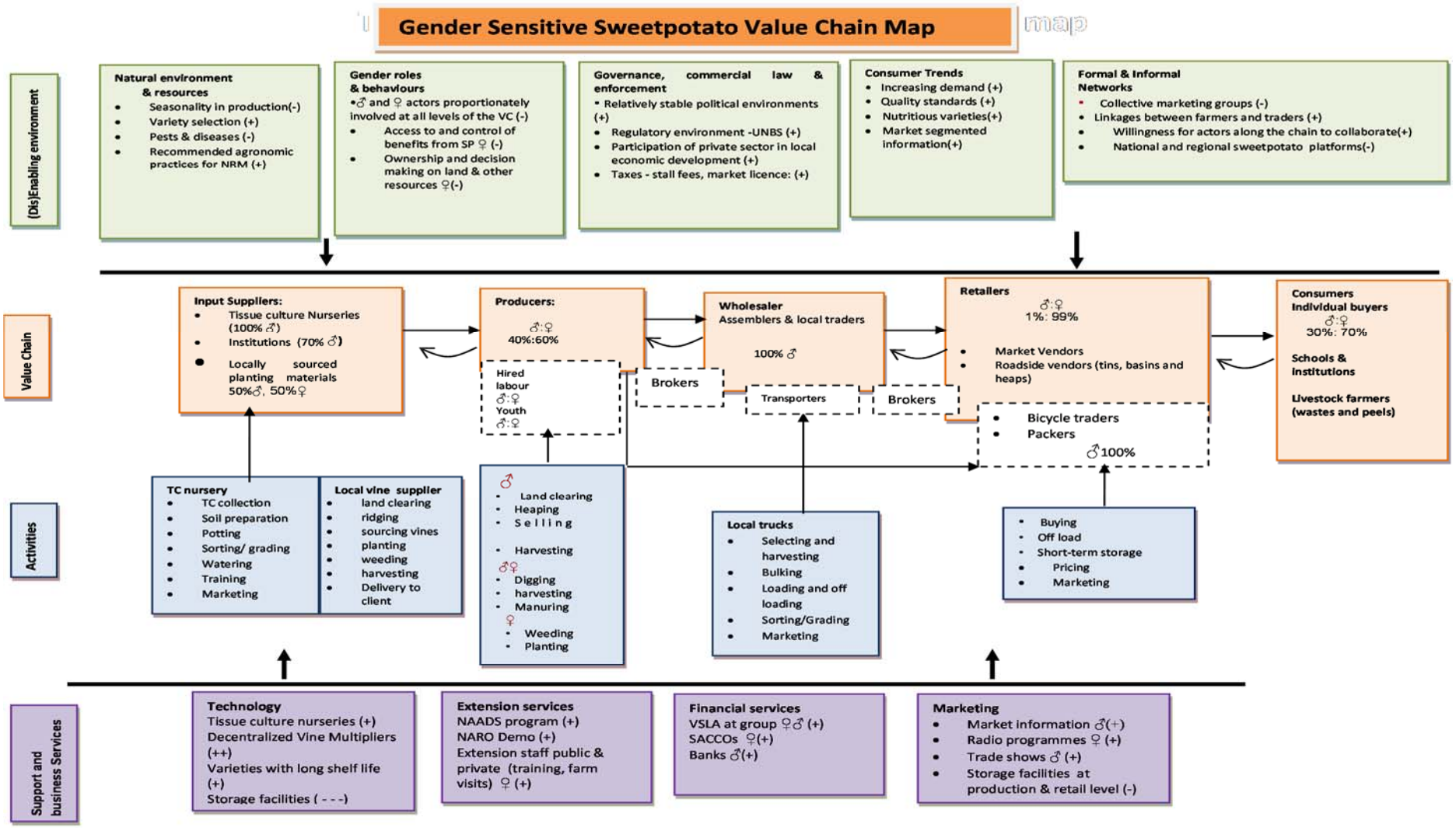
Sweet potato used for home consumption, is typically harvested by women in batches of roots for 1-2 days, carried in bags or baskets by women on their heads and prepared for cooking.

Results from a scoping study conducted in eastern Uganda in which 68 farmers were interview (38F) by Mayanja et al (2016) revealed that female actors were highly concentrated in subsistence production and retailing nodes. Men dominated commercial sweetpotato production as well as wholesale, brokerage and transportation (Fig. 1). In addition, male farmers reported up to 60% higher productivity (6.7 MT/Ha) and 33% more acreage than female farmers. Men perceived minimal contribution of women and youth to labour for commercial sweetpotato production (Fig 2). All farmers acknowledged men's high participation in marketing (Fig 2).

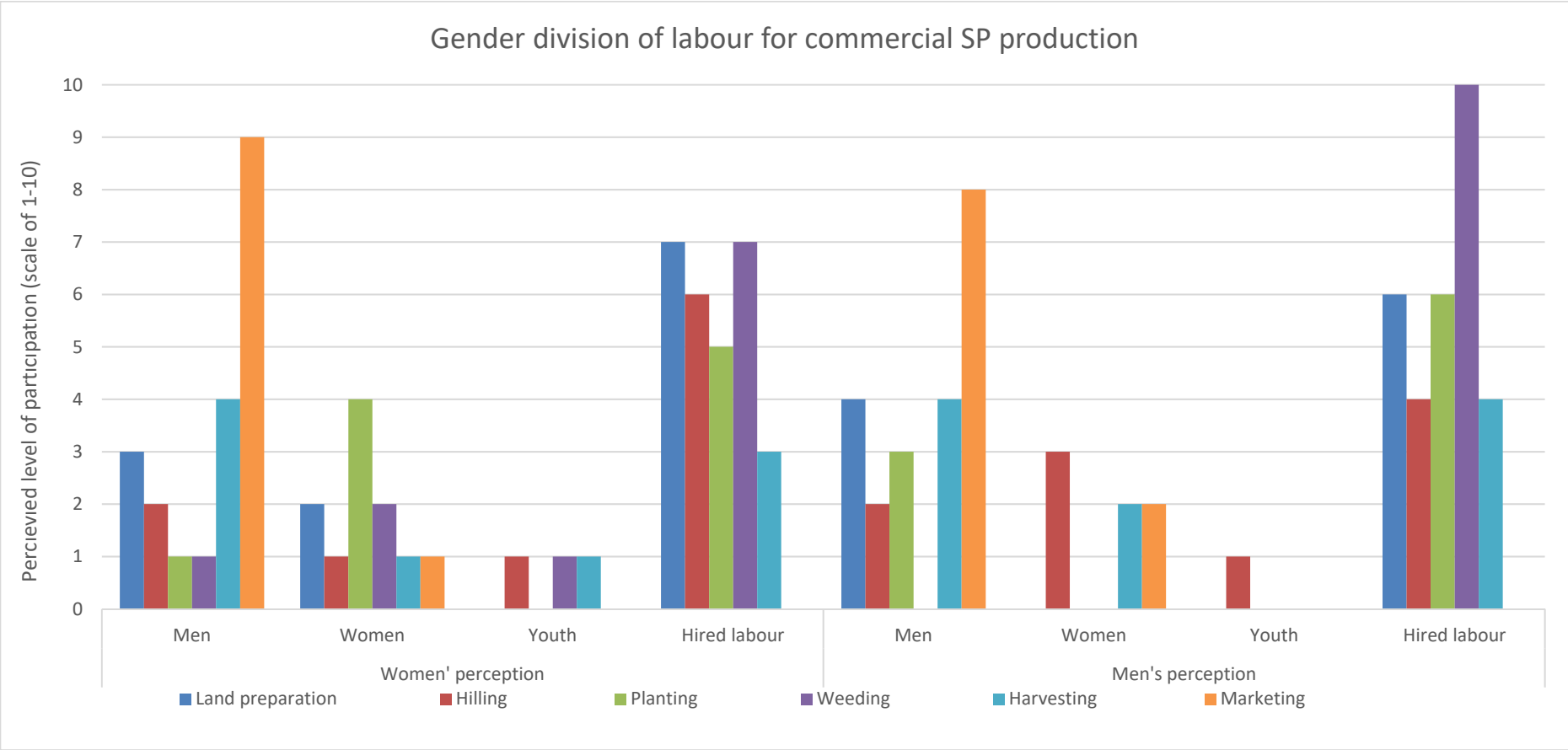
Varietal preferences: According to Mayanja et al (2006) scoping study, farmers' varietal preferences for sweet potato were Kampala, Boy, Socadido, Soroti and Tanzania varieties; the last two of which were highly demanded in the market because of longer shelf-life. Traders preferred varieties with longer shelf-life and are not willing to invest in storage. The type of variety, along with location, was found to affect dry matter, beta-caroteene and sugar content of sweet potato (Namutebi et al (2004).

Constraints: Female farmers cited limited access to market information, markets and postharvest technologies as major challenges. Men cited inability to meet buyers' demands in low seasons as a major challenge.

Storage: In much of Uganda, storage of sweet potatoes is not practised, as it is often harvested on a piecemeal basis and subsequently stored in the ground (Hall et al. 2000). Improved storage methods that have been promoted in the country, which include pit storage -dug pits in the ground 1mx1m approx. lined with grass, and clamp storage - flattened mounds lined with dry grass and wrapping roots with more grass and soil, however storage conditions vary by location (Namutebi et al 2004). In the Mayanja et al (2006) study, it was found that female farmers preferred pit stores while men preferred clamp stores with higher storage capacity to be promoted.



Source: Mayanja et.al. 2016



Source: Kyalo et .al. 2014

3.2.5. Profitability of the Sweetpotato by demand segment

During and at the end of the rainy season, almost every home has sweetpotato and the price is low (about 60,000 per 100kg bag). However, the price more than doubles during the dry season and at the start of the rainy season, because at that time sweet potato can only be grown on swamp land, which is usually accessed by wealthier farmers in the community.

Steamed sweetpotato vending is estimated to provide low to medium profits due to the relatively small scale of operation (Table 1). However, sweetpotato is consumed alongside other foods such as cooking banana, and in that respect the food vendor has a daily income which is higher than just from sweetpotato. The daily income of the food vendor from sweetpotato is USh 4000(approximately 1USD).

Table 5: Profitability of steamed sweetpotato (in USh)

Description	Number	Unit	Unit price	Amount
Cost of preparation				
Fresh sweet potato roots	1	heap	5,000	5,000
Charcoal	2	Tins	2,000	2,000
Banana leaves	2	Pieces	500	1,000
Labour	1	Person	2000	2,000
Transport	1	Trip	1,000	1,000
Total cost				**11,000**
Revenue				
1 heap of sweet potato root gives 15 servings costed at 1000 each	15	Boiled cassava	1000	15,000
Gross margin				**4,000**
Gross margin %				**27**

Source: Estimates by the key informant

1. *Document citation log*

Add as many rows as necessary.

1.1 Citation	1.2 Country and region of focus
Mayanja, S; Kyalo, G; Babirye, G, Namanda, S and Ssekyewa, H. 2016. Understanding gender dynamics and their contribution to designing winning sweetpotato postharvest interventions	Uganda, Eastern Uganda
Mayanja, S; Grant, F; Kakuhenzire, R and Okuku, H. 2017. Rapid market assessment: Viable Sweetpotato Technologies in Africa – Tanzania. International Potato Center (CIP).	Tanzania, Mbeya, Iringa and Morogoro regions
Bashaasha, B, Mwanga, R.O.M	Uganda, entire country
Chowdhury, S; Meenakshi, V; Tomlins, K and Owori, C. 2011. Are consumers in developing countries willing to pay more for micronutrient dense biofortified foods? Evidence from a field experiment in Uganda	Uganda, Kamuli, Luwero, Kampala
Coote, Tomlins, Massingue, Okwadi and Westby. Farmer, Trader and Consumer decision making	Uganda, Mozambique
http://www.sweetpotatoknowledge.org/wp-content/uploads/2016/04/Sweetpotato-Production-in-Sub-Saharan-Africa-Patterns-and-Key-Issues.pdf	
ASHYAMAL CHOWDHURY, J. V. MEENAKSHI, KEITH I. TOMLINS, AND CONSTANCE OWORI Are consumers in developing countries willing to pay more for micronutrient-dense biofortified foods. Evidence from a field experiment in Uganda. American journal of agricultural economics, Jan 2011	Uganda
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Hall and Devaraux. 2000. Low cost storage of sweetpotatoes in Uganda: lessons from participatory and on station approaches to technology choice and adaptive testing. Outlook on Agriculture	Uganda

2. Document review

Note: always disaggregate data by gender and other factors of social difference where available

	Methodology			Product		Demand segments of product						
Source (first author, year)	**Focus groups, interviews, stakeholder analysis, market analysis etc**	**Description of sample (indicate men/women)**	**Region**	**Scale of production of the crop associated with the product**	**Variations of the product**	**Demand segments and (size) of the product (add rows for each demand segment)**	**Trends**	**Location**	**Demographics of the demand segment**	**Preferred characteristics for the demand segment**	**Description of the product chain including Transportation, storage and sale of product (e.g. gender, socio-economic status, age, region etc.)**	**Profitability of the product, by demand segment**
Mayanja, 2016	FGD, interviews, market analysis	65 (35 F) sex disaggregated FGD 17 KII	Eastern Uganda	Low to medium	Raw SP roots	Institutions	increasing	Eastern Uganda	Schools & other	Not mentioned	See map above	Not given
						Individual buyers (hh)	"	"	30%M, 70% W	High dry matter, sweet in taste	"	"
					Peels and small roots	Livestock farmers	"	"	Not mentioned	Not mentioned	"	"
					Roots	Retailers	"	"	99% Women	Long shelf life	"	"
					Roots	Wholesalers	"	"	100% Men	Long shelf life	"	"
Mayanja, 2017	Interviews, Rapid market analysis	149 traders (114 W) 162 consumers (114 W) 1 male processor 16 KII (3W)	Iringa, Morogoro, Mbeya in Tanzania	Low to high	Raw white fleshed SP Roots	Producers	Increasing	Tanzania	Not given	Local varieties (HDM)	See report (very detailed) Source: Iringa, transport – pickups for men, public vehicle and head for women, storage: rare, men traded higher volumes than women	"
				Low to medium	White, Yellow fleshed	Traders	increasing	"	149 (114 W)	Large roots, red skin color, yellow flesh,		"
				Low	White, yellow, OFSP	Consumers	increasing	"	162 (114 W), 61% had basic education, bought 2-3 time @ week. 34% were farmers, 47% retailers	Tasty, mealy Nutritive, large roots, red skin color, yellow flesh, HDM (W), sweet taste (M)		"
Source (first author, year)	**Focus groups, interviews, stakeholder analysis, market analysis etc**	**Description of sample (indicate men/women)**	**Region**	**Scale of production of the crop associated with the product**	**Variations of the product**	**Demand segments and (size) of the product (add rows for each demand segment)**	**Trends**	**Location**	**Demographics of the demand segment**	**Preferred characteristics for the demand segment**	**Description of the product chain including Transportation, storage and sale of product**	**Profitability of the product, by demand segment**

	Methodology			Product		Demand segments of product						
											(e.g. gender, socio-economic status, age, region etc.)	
Chowdhury, 2011	Field experiment, WTP, survey	121 (First) 115 (2nd) 118 (3rd) 113 (4th) Total: 467	Kamuli, Luweero, Kampala		WFSP YFSP Orange Deep orange	Consumers, Producers	Increasing with nutritional info	Kamuli, Luweero, Kampala	69% were house hold heads 31% spouses. Average number of people per household: 6 pp/hh; 6 years of school, 83,000/ income p.a.;	Taste, appearance, nutritional value		Not given
Coote (u.d)	Market development	50				Producers						
		400				Traders						
		474 (Uganda)				Consumers			Nurses, teachers, foreigners Sweetpotatophile (59%) Orangephiles (23%) Light orangephobes (11%) Orangephobes(7%)	Carotenoid content, nutritional value, HDM	Market linkages between producers, traders and consumers	

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