Introducing a Pro-Vitamin A Rich Staple Crop: Analysis of Decision Making along the Orange Fleshed Sweetpotato Value Chain in Uganda

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Dedication

To my parents, *Papa* John Philemon Francis Xavier Oliso-Emosingoit (RIP) and *Toto* Janet Mary Akiteng Oliso; my dear wife, Immaculate and lovely Children: Ingrid, Ian, Ivan and Isabella.

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Abstract

This thesis critically examines the determinants of uptake of pro vitamin A-rich sweetpotato along the value chain in Uganda and examines the role of a marketing component in a food biofortification intervention. It is conceptualised within the value chain and adoption decision theory. Using both qualitative and quantitative methods of social investigation, this thesis: i) evaluates the factors that influence producers to grow Orange Fleshed Sweetpotato (OFSP) for sale, ii) assesses the factors influencing trader decisions to sell OFSP, iii) analyses factors determining acceptability and repeat purchase of OFSP by consumers, and iv) evaluates the role of marketing in a biofortification intervention.

The thesis identifies both generic and specific factors influencing uptake of OFSP. Generic factors include: access to productive resources; previous experiences in marketing other crops; and importance of the crop. The specific factors were the role of the Reaching End Users (REU) project; the attributes of OFSP; price and profitability; the possibility of selling OFSP vines; and availability of OFSP roots. Six possible roles for marketing in a biofortification programme have been identified. These are: changing the perception of the crop, increasing uptake and adoption, exploring alternative uses, stimulating rural entrepreneurship, increasing availability and creating awareness and demand for the crop. It is recommended that biofortification interventions should have a marketing component, there is need to target mothers and children. Initial market development should focus on small market outlets. It is important to increase availability of OFSP and awareness of its benefits to human health along the value chain. Further research could focus on marketing of other types of biofortified crops, understanding variety specific drivers of OFSP and options for their promotion to specific end-users, developing and dissemination OFSP varieties with longer in-ground storage traits, and understanding the role of informal trade in driving uptake of biofortified crops.

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List of Acronyms and Abbreviations

ACMVD	African Cassava Mosaic Virus Disease
AIDS	Acquired Immune Deficiency Syndrome
ANOVA	Analysis of Variance
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AT-U	Appropriate Technology, Uganda
AVRDC	The World Vegetable Centre
BBW	Banana Bacterial Wilt
BDDP	Bukedea District Development Plan
BSFS	Busoga Sub-Farming System
BUWOSA	Bukedea Women's Strugglers Association
CAADP	Comprehensive African Agricultural Plan
CBO	Community Based Organization
CDC	Centre for Disease Control
CDO	Cotton Development Organization
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
CLUSA	Cooperative League of the United States of America
CPP	Crop Protection Programme
CRS	Catholic Relief Services
DALYS	Disability Adjusted Life Years
DC	Demand Creation
DCS	Demand Creation Specialist
DFID	Department for International Development
EPI	Expanded Programme on Immunisation
FADEP-EU	Farming for Food and Development Program, Eastern Uganda
FAL	Functional Adult Literacy
FFI	Food Fortification Initiative
FFMHH	Female Farmer in Male Headed Household
FGs	Farmer Groups
FHHH	Female Headed Household
FOs	Farmers Organizations
FAO	Food and Agricultural Organization
GCC	Global Commodity Chains
GDP	Gross Domestic Product
GMO	Genetically Modified Organisms
GoU	Government of Uganda
GPN	Global Production Networks
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit

Ha	Hectares
HIV	Human Immunodeficiency Virus
HKI	Helen Keller International
HP	HarvestPlus
HYV	High Yielding Varieties
IDP	Internally Displaced Persons
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
IU	International Units
KDDP	Kamuli District Development Plan
LCs	Local Councils
LVCAEZ	Lake Victoria Crescent Agro-Ecological Zone
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MDG	Millennium Development Goals
MDDP	Mukono District Development Plan
MI	Micronutrient Initiative
MLF	Market Link Farmer
MPD	Marketing and Product Development
MPDS	Marketing and Product Development Specialist
MoH	Ministry of Health
MoES	Ministry of Education and Sports
NAADs	National Agricultural Advisory Services
NARO	National Agricultural Research Organisation
NGO	Non-Governmental Organisation
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development
NIE	New Institutional Economics
NRI	Natural Resources Institute
OFSP	Orange Fleshed Sweetpotato
OR	Operations Research
PD	Project Director
Pg	Page number
PMCA	Participatory Market Chain Analysis
PMG	Produce Marketing Groups
PPM	Parts Per Million
PRAPACE	Regional Network for Improvement of Potato and Sweetpotato in Eastern and Central Africa
RAE	Retinol Activity Equivalent
RDA	Recommended Daily Allowance
RDI	Recommended Daily Intake
REU	Reaching End Users
SERENUT	Serere Groundnuts
SOSPPA	Soroti Sweetpotato Producers and Processors Association

SOCADIDO	Soroti Catholic Diocese Development Organization
SPSS	Statistical Package for Social Scientists
SPVD	Sweetpotato Virus Disease
SSA	Sub-Saharan Africa
SS	Seed Systems
SSS	Seed Systems Specialist
TFS	Teso Farming System
TSNI	Towards Sustainable Nutrition Improvement Project
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic and Household Survey
UGX	Uganda Shillings
UGX/kg	Uganda Shillings per kilogramme
UK	United Kingdom
UNBS	Uganda National Bureau of Standards
UNCST	Uganda National Council for Science and Technology
UNFFE	Uganda National Farmers Federation
UNICEF	United Nations International Children's Emergency Fund
UoG	University of Greenwich
US	Uganda Standards
US$	United States Dollars
USA	United States of America
USAID	United States Agency for International Development
VAD	Vitamin A Deficiency
VC	Value Chain
VCA	Value Chain Analysis
VEDCO	Volunteer Efforts for Development Concerns
VITAA	Vitamin A Initiative for Africa
WB	World Bank
WDR	World Development Report
WFP	World Food Programme
WFSP	White Fleshed Sweetpotato
WHO	World Health Organization
YFSP	Yellow Fleshed Sweetpotato
YLD	Years Lived with Disability
YLL	Years of Life Lost

Chapter One: Background and Introduction

1.1 Background to the study

Vitamin A Deficiency (VAD) is a serious public health problem, affecting nearly one-third of the population and 127 million pre-school children in Africa (West *et al.* 2002). Children and women, particularly pregnant mothers, are the highest-at-risk segments of the population due to their high demand for vitamin A rich food and different physiological requirements. Globally, about 350,000 children go blind annually due to VAD (Black *et al.* 2008), half of them dying within 12 months of losing their sight (WHO, 2009).

In Uganda, 20% of children and 19% of women are considered to be deficient in vitamin A (UDHS, 2006). VAD results from consumption of a mainly carbohydrate-based diet, often containing inadequate quantities of the required essential micronutrients. According to the World Bank, dysfunctional food systems highly contribute to inadequate access to foods containing sufficient quantities of vitamin A by at-risk populations (World Bank, 2007b), which are correlated with poverty (Mwanika, 2007; Welch and Graham 2013).

Attempts at solving VAD have included micronutrient supplementation, food fortification and biofortification. Micronutrient supplementation entails bi-annual administration of high potency supplements to at-risk populations (UNICEF, 2007). Food fortification entails adding vitamin A to food such as oil or flour (Dary and Mora, 2002). However, coverage of such programmes is often low and sustainability is dependent on donor support (HarvestPlus, 2010). Biofortification on the other hand involves increasing the micronutrient levels of staple crops that the poor already eat through plant breeding (Bouis, 2002a). Compared to micronutrient supplementation and food fortification, biofortification is considered to be a low cost, and more sustainable rural-based intervention (Nestel *et al.* 2006). The crops that have been bred and disseminated with the aim of addressing VAD include cassava, maize and sweetpotato. The biofortified sweetpotato is known as the Orange Fleshed Sweetpotato (OFSP). Other sweetpotato types grown, marketed and consumed in Africa in general and Uganda in particular are the white and yellow varieties.

Plate 1: Types of sweetpotato, distinguished by their flesh colour, grown, sold and consumed in Uganda: white (left), yellow (centre) and orange (right).

This thesis makes an original contribution to knowledge by investigating two interrelated themes: the factors influencing adoption of OFSP along the value chain and the relevance of a marketing component toad food biofortification intervention. It seeks to critically analyse the nature and determinants of decision-making along the OFSP value chain, with regard to production, marketing and consumption of OFSP. This is the first study on the factors influencing the uptake of a biofortified agricultural commodity using a combination of quantitative and qualitative investigations along a value chain.

1.2 The link between this thesis and the Reaching End Users project

This research was set within the context of a research and development project in Uganda and Mozambique, the Reaching End-Users (REU) with biofortified crops project that piloted an integrated food-based approach (biofortification) as a solution to the problem of VAD. The project promoted production, marketing and consumption of four pro-vitamin A rich sweetpotato varieties in Uganda, namely: *Ejumula, Vita, Kabode* and *Kakamega*. Pictures of the four varieties are presented in plate 2, followed by their characteristics in Table 1.1.

Plate 2: Harvested roots of the four OFSP varieties promoted in Uganda by the REU project. L-R *Ejumula, Vita, Kabode* and *Kakamega*

Table 1.1: Mean yield (tons/Ha), dry matter content (%) and beta carotene content on a fresh weight and dry matter basis in the four OFSP varieties promoted in Uganda. Data were computed from results of random OFSP yield trials among project farmers in Bukedea, Kamuli and Mukono in 2007

Variety	Mean yield (tons/Ha)	Dry matter content (%)	BC*/100g fresh weight	All trans BC*/g fresh weight	All trans BC*/g dry matter
Ejumula	6.0	34.6	9062	91	261.9
Vita	10.4	30.7	9655	97	314.5
Kabode	8.5	30.3	7460	75	246.2
Kakamega	9.5	35.0	4071	41	116.3

*BC: Beta-carotene

Source: HarvestPlus, 2010.

The objectives of the REU project and my role as a researcher in that project are presented in Box 1.1. Although the primary data used in this thesis was collected as part of project activities, the thesis addressed specific research objectives and research questions, which necessitated more in-depth and critically analysis. This thesis focussed on the following: a) understanding household-level constraints and opportunities for the production and marketing of OFSP, b) research among traders on their perceptions towards, and factors likely to influence their decision to trade in OFSP, c) preferences and perceptions of consumers towards OFSP and other staple food, and d) the role of marketing in a biofortification project. Results of the specific research areas of this thesis were presented and discussed in national and international project meetings and workshops.

Box 1.1 Overview of the Reaching End-Users Project and my role in it

The Reaching End-Users (REU) project was implemented in Uganda and Mozambique by a consortium of partners led by HarvestPlus. The goal was to identify cost-effective and sustainable strategies for farmer adoption and consumer acceptance of biofortified crops. The specific objectives were to:

- Disseminate OFSP in Uganda and Mozambique, reaching over 10,000 farming households in each country, by integrating seed systems, demand creation and market and product development;
- Examine whether such an integrated agriculture-nutrition-marketing intervention results in improved vitamin A intakes among young children and their female/mother care givers;
- Analyse alternative dissemination strategies for cost-effectiveness; and
- Outline factors key to success of not only this effort, but to similar endeavours in future, including in seed systems, markets and product development and demand creation.

The project consisted of an operations research (OR) and an implementation component. The Implementation component, undertaken by local NGOs, was responsible for the day to day management of the programme. The OR component was responsible for developing intervention strategies, monitoring progress in implementation and drawing lessons that could be applied in future scaling-up of such interventions. The Natural Resources Institute (NRI) of the University of Greenwich (UoG) was responsible for operations research of the Market and Product Development (MPD) component. As a researcher and NRI PhD student in the project, my specific roles included:

a) Designing and conducting the marketing diagnostic study, and using the results to develop a marketing strategy for the project
b) Understanding household-level constraints and opportunities for the production and marketing of OFSP
c) Advising on aspects of marketing implementation such as designing and managing a trader data base, content and form of trader training and market facilitation activities
d) Designing and undertaking research among traders on their perceptions towards, and factors likely to influence their decision to trade in OFSP
e) Analysing preferences and perceptions of various consumer segments towards OFSP and other staple food
f) Assessing options for and viability of semi-commercial processing and value addition of OFSP
g) Designing, testing and managing a system for price data collection for OFSP and other staple crops in the markets of importance to the project
h) Participating in periodic review, monitoring, evaluation and knowledge sharing events
i) Writing and disseminating research reports, and periodic progress reports, including contributing towards the end of project donor report and best practices manual
j) Maintaining a data base of key market research data and information.

Source: Adapted from HarvestPlus, 2010

The rest of this chapter sets the context of this research by describing the importance of agriculture in the economy of Uganda, followed by an examination of the notion of food and

nutrition security and the various connotations of nutrition security. It then proceeds with an analysis of the role of vitamin A in human health and its sources. This then leads to a discussion of the manifestations of VAD and an analysis of the VAD situation in Uganda. The three main approaches to the control of VAD are then discussed, building the case for OFSP as an ideal vehicle for biofortification. Gaps in knowledge and approaches to the use of OFSP as a solution to VAD are also examined. The problem statement relating to this research, the objectives of the research and the key questions that this research seeks to answer are then presented. The last part of this chapter examines the significance of this study, a definition of the key concepts used, and summarises the structure of the entire thesis.

1.3 Agriculture in the economy of Uganda

Agriculture continues to play a pivotal role in the economy of Uganda and will remain a key determinant of the country's efforts to reduce poverty (MAAIF, 2010). Besides being the primary source of food and raw materials for agro-based industries, that account for 40% of the manufacturing sector, it contributes nearly 20% of Gross Domestic Product (GDP), accounts for 48% of exports (may even be much higher when combined with the value and volume of informal trade) and employs 73% of the population, with a higher percentage of women 83% than men 71% (UBOS, 2009).

The agricultural sector is dominated by about 4.5 million smallholder farmers, of whom 80% own less than two hectares of land. These smallholder farmers produce nearly all the food crops, coffee, cotton, tobacco, and about 25% of grade dairy cattle (MAAIF, 2010). Only tea and sugarcane are grown on large estates, which total about 40,000 hectares (UBOS, 2006). It is hoped that the predominance of smallholder farming could imply equitable distribution of benefits from sectoral growth.

Measured in terms of contribution towards agricultural gross domestic product, the food crops sub-sector is the most important, accounting for about 70%. The livestock sector contributes 17%, fisheries and export crops each contribute 5%, while forestry accounts for 4% (UBOS, 2006). However, only about one-third of food crop production is marketed, compared to two-thirds of livestock production and almost all of the export crop output.

The main staple food crops in Uganda are plantain (bananas), cassava, maize and sweetpotato. Analysis by region indicates that while the eastern region of Uganda is the main producer of sweetpotato, accounting for almost one-half of the sweetpotato produced in the country, even in this region, sweetpotato is still the third most important food, after maize and cassava (Table 1.2). Although these data are relatively old, it is the most recent source that disaggregates crop production in Uganda by region. The September 2013 national census did not include a module on crops because they considered this data to still be relevant. It is also the data set that provides contextual analysis for the *National Development Plan* 2010/11-2014/15 and the *Uganda Vision 2040*. Other data sources such as FAOSTAT report higher crop production figures and are not disaggregated by region. However, the trend reported in both data sets in terms of the relative national importance of the crops is consistent.

Table 1.2: Total production (M/T) of plantain, maize, sweetpotato and cassava, four of the most important staple crops in Uganda, by region as reported in the most recent Uganda Census of Agriculture of 2009

	Plantain	Maize	Sweetpotato	Cassava
Central	1,039,834	449,859	312,405	409,810
Eastern	342,236	1,108,556	847,139	1,061,185
Northern	31,626	305,796	292,932	983,124
Western	2,883,653	497,774	366,297	440,190
Total	**4,297,349**	**2,361,985**	**1,818,773**	**2,894,309**

Source: MAAIF, 2010

Overall, the performance of the agricultural sector in the recent past has recorded a mixed record. Between 1987 and 2005, the agricultural sector recorded an annual average growth rate of 3.8%, above the population growth rate at that time (UBOS, 2006). Recent data, however, reveals that the performance of the sector has stagnated, registering a decline from 7.9% in 2000/01 to 2.6% in 2008/9, below the population growth rate of 3.2% (UBOS, 2009), and much lower than the 6% growth target (CAADP, 2008) set by African governments under the Comprehensive African Agricultural Development Plan (CAADP) of the New Partnership for Africa's Development (NEPAD). This rate of growth is insufficient to meet the agricultural needs of a rapidly growing population. As a result, an increasing number of people are unable to meet their basic needs and are at a greater risk of food insecurity and malnutrition (IFPRI, 2010).

1.4 Agriculture and nutrition

Agriculture is of fundamental importance to human nutrition, both as a direct determinant of household food consumption and through its role in livelihoods and food systems (FAO, 2013). Yet FAO's latest estimates indicate that nutrition status of 868 million people in terms of energy consumption is still poor and an estimated two billion people suffer from one or more micronutrient deficiencies (FAO, IFAD and WFP, 2012). About 26% of all children under the age of five are stunted, 31% suffer from vitamin A deficiency, while an estimated 1.4 billion people are overweight, of whom 500 million are obese (WHO, 2013[1]). Malnutrition is now recognised as a broader problem than just insufficient intake of dietary energy and protein popularly known as under nourishment but it also encompasses micronutrient deficiencies, and overweight and obesity. This broader view is now referred to as the triple burden of malnutrition (Pinstrup-Andersen, 2007).

These global health and nutrition situation suggests agriculture can make an even greater contribution to health and nutrition (Fan *et al.* 2012), since the primary cause of malnutrition is inadequate quantity (total calorific intake) and quality (variety, diversity, nutrient content and safety) of dietary intake (Gomez, *et al* 2013). Yet, agriculture, health and nutrition have long occupied separate realms. Analyses of agricultural production seldom recognize that agricultural goods and processes have health consequences on producers, traders and consumers. At the policy and programmatic levels, agriculture and health operate in separate silos, seldom considering the consequences of their actions on sectors outside their own (Hoddinott, 2012).

However, there is increased recognition and concerted effort towards interventions and approaches that leverage agriculture for improved nutrition and health. The Food and Agriculture Organisation (FAO) in its 2013 edition of *The State of Food and Agriculture* (FAO, 2013) makes the case that food systems– from agricultural inputs and production; through processing, marketing and retailing, to consumption – can promote more nutritious and sustainable diets for everyone. Similarly, the International Food Policy Research Institute asserts that leveraging agriculture for health and nutrition has the potential to speed progress towards meeting all the eight Millennium Development Goals (IFPRI 2012).

[1] www.who.int/nutrition/challenges/en/

Radical changes to a food production system, as exemplified by the Green Revolution, demonstrated that food systems can successfully reduce malnutrition (Evenson and Collin, 2003). However, this was mainly protein-energy malnutrition and associated under nourishment since the emphasis at that time was on higher agricultural productivity of staple grains.

Developing country food systems have also undergone dramatic changes since the Green Revolution era. These changes are driven by rapid urbanisation and increasing incomes in developing countries, emergence of domestic and global commercial food value chains, efforts by some governments to establish safety nets for the food insecure, and advances in research that targets traits other than yields (Pinstrup-Andersen, 2012). Given the changes in the food systems and a broader understanding and complexity of malnutrition, the challenge then is how to sustainably harness the potential of agriculture to address the nutrition and health challenges.

Hoddinott (2012) identifies five key pathways through which levers affecting agricultural production and markets can affect health and nutrition: changes in crops, farm practices, and markets; changes to production methods; changes to incomes; changes to the use of time; and changes in intra-household resource allocation.

Changes in agricultural production can result in the introduction of new foods into diets. At the farm level, the introduction of new crops as a result of innovations in crop breeding (for example, biofortified foods) has the potential to improve both health and nutrition. At the level of local, regional, or national food markets, actions by the private sector, governments, or other actors can make existing foods produced within a country available to new markets. Changes in processing can also affect foods consumed. This can be beneficial, for example, where foods are fortified with micronutrients, or harmful, as in cases where processing introduces excessive levels of sodium.

Changes in production processes may make agricultural work either more or less physically intensive. For example, mechanization can reduce the physical demands of agricultural labour, whereas crops that require greater manual weeding may increase it. They will also change exposure to pesticides, zoonosis, and work-related accidents.

When changes in agricultural production lead to increases in household income, the income can be used to purchase goods that improve health status.

Where changes increase the returns to time spent in agriculture, households may increase the amount of labour they devote to agricultural production. If this labour does not come from outside the household and if it does not come from reduced leisure, then some other household activity will be affected. Households might reduce time spent on other income-generating activities, make greater use of child labour, or reduce time spent on the production of health or nutrition.

Changes in agricultural production may result in changes in the allocation of resources within the household. If this change results in women earning greater income, it may affect how households spend money, how food is allocated, and what types of assets are accumulated.

However, while agriculture has the potential to contribute towards addressing the triple burden of malnutrition, it is important to note that nutritional outcomes also depend on many factors, most of which are outside the direct realm of agriculture. For example, although agriculture can lead into an increase in income, the incomes can be used for purposes that do not necessarily result into improved nutritional outcomes. Similarly, since more food is now accessed through modern food value chains as opposed to own production and local market chains, agricultural systems may have little control over the quality of food available through these chains and the purchase decisions of the consumers. Other causes of malnutrition, outside the direct realm of agriculture, include access to health services particularly adequate care practices for children and mothers, the nature of the environment (physical and political), gender equity and economic resources.

Within the broad framework of agriculture and nutrition, this thesis makes a contribution towards understanding how: *Changes in crops, farm practices, and markets* can affect health and nutrition with a specific focus on vitamin-A rich sweetpotato and vitamin A deficiency.

1.5 Food and nutrition security

The Food and Agricultural Organisation (FAO) of the United Nations (FAO, 2009) defines food and nutrition security as the access by all people at all times, physically and economically, to sufficient, safe and nutritious food for a healthy active life. Current estimates suggest that close

to one billion people in the world, nearly one in every seven people, suffer from hunger and food insecurity (FAO, 2010). Whereas food security reflects adequate availability and accessibility to food, nutrition security connotes effective utilisation, which encompasses dietary adequacy and balance (Kennedy and Bouis, 1993; Gross *et al*. 2000).

The key determinants of food and nutrition security are availability, accessibility and utilisation of food. Availability refers to sufficient food for all people which can be achieved through production, storage and imports (Rosengrant, 2005). Accessibility can be achieved through access to and use of productive resources and purchasing power (Kennedy and Haddad, 1992; Pangaribowo *et al*. 2013). However, disparities in access to resources makes the poor more vulnerable to both food and nutrition insecurity (Mazur *et al.*2007). Utilisation is the ability to derive sufficient nutritional value from a particular food in a given period. It is a function of the cooking process, feeding patterns, sanitation and health status (Hamelin *et al.* 1999) .

In deconstructing the notion of nutrition security, four categories of nutrition security have been delineated (Weingarthner, 2005): over-nutrition resulting from over consumption of calories; secondary malnutrition resulting from illness that inhibit proper digestion or absorption of food; protein calorie malnutrition and micro-nutrient malnutrition or "hidden hunger" resulting from diets lacking sufficient amounts of essential micronutrients. This thesis addresses some aspects of the last category of nutrition security: micro-nutrient malnutrition.

Up until the early 1980s[2], food security has been concerned with calorific under-nutrition and less with micro-nutrient malnutrition since its effects take long to be noticed (Zimmerman and Qaim, 2004). In spite of this, there is increasing recognition of the fact that micronutrient malnutrition affects a sizeable portion of world population especially in the developing world. The World Bank estimates that 35% of the world's population lack adequate intake of iodine; 40% suffer from iron deficiency, while more than 40% of children world-wide are deficient in vitamin A (World Bank, 2006). These deficiencies arise from heavy dependence on carbohydrate-based food resulting in lack of diversity in diets, especially among the poor (Ruel, 2001).

[2]When the Consultative Group on International Agricultural Research (CGIAR) recognized the need to use rice as a vehicle to address micronutrient deficiencies.

However, while the ability of the poor to access a diverse diet comprising nutritious foods is critical in addressing micronutrient malnutrition (Ecker *et al.* 2011), nutritional outcomes are affected by a multiplicity of factors such as caring practices, health, sanitation, and empowerment of women. Within this access to food is critical and there is need for investments to boost agriculture, prevent escalation of food prices and boost farm incomes (Ruel *et al*. 2013). The next sub-section focuses specifically on Vitamin A Deficiency (VAD).

1.6 Role and availability of vitamin A

Vitamin A is an essential nutrient required for maintaining the functioning of the body's immune system, playing an important role in the regulation of cell-mediated immunity and in humoral antibody response (Shankar, 2001; Villamor and Fawzi, 2005). Among pregnant and breastfeeding women, vitamin A is important in the healthy development of the foetus and new born, especially with lung development and maturation (Strobel *et al.* 2007).

Vitamin A is available in its true form, retinol, which can easily and directly be used by the body from animal sources such as fish, oils, milk and eggs (Gonzalelez de Urqueta de Lorza, 2006). However, intake of animal protein is often limited due its high cost and limited availability in developing countries (Harvey *et al.* 1999). Plants, particularly fruits (mangoes, apricots and papaya) and vegetables, both leafy green vegetables (spinach and amaranth) and yellow vegetables (pumpkins, carrots and squash) have retinol esters, in the form of pro-vitamin A carotenoids (Ruel, 2001), which are potentially more easily accessible.

VAD affects nearly one-third of the population and over 127 million pre-school children in Africa (West *et al.* 2002). Meenakshi, (2007) estimates that 3% of the mortality of young children, 20% of corneal scarring and measles, and all night blindness among both children and pregnant and lactating mothers is due to VAD. Other documented consequences of VAD include compromised immune response (Ross, 1996) and hence increased risk of death from HIV/AIDS (McLaren, 2001; Andargachew *et al.* 2011) and increased severity of respiratory and gastrointestinal infections (Usha and Mortorell, 1998; Brenchley and Dovek, 2008).

1.7 Manifestations of vitamin A deficiency in Uganda

Uganda produces a wide range of crops and animal products and is favoured by two planting seasons a year in the most populated areas; yet problems of malnutrition, famine and hunger persist (Iannotti *et al.* 1998; MoH and MAAIF, 2003; MAAIF, 2010). This mainly results from dysfunctional food systems that partly arise from a mismatch between demand for and supply of food (World Bank, 2007b). Other contributing factors include high rates of morbidity, particularly due to malaria and HIV/AIDS; inadequate maternal and child care including lack of knowledge of good dietary practices, poor water, sanitation, and health services and low levels of income in urban areas (Samkange, 2009).

The earliest formal study on VAD prevalence in Uganda was carried out in Kamuli district in Eastern Uganda in 1991 (Bauchou and Labadarios, 2003). The results of which confirmed the prevalence of both sub-clinical (serum retinol < 0.7 μ mmoL/1 or 20 μg/dL) and clinical (< 0.35 μ mmoL/I) VAD, according to the World Health Organisation's classification (Kawuma and Serunjogi, 1991). Thirteen years' later, the World Bank linked VAD to 11,000 cases of blindness and approximately 8,000 deaths in Uganda (World Bank, 2004). In 2006, 20% and 19% of Ugandan children and women respectively were found to be deficient in vitamin A (UDHS, 2006).

Economic losses due to VAD are large. Estimates suggest that between 2004 and 2014, VAD will have cost Uganda US$ 2.5 billion due to untreated illness and US$ 382 million due to lost productivity amongst women with anaemia (MoH, 2010). Similarly, the Disability Adjusted Life years (DALY) analysis for Uganda estimates that the economic impact in terms of lost human productivity is in the range of US$ 306 to US$ 613 million per year (Yaggen, 2005). This does not include the intangible effect on the loss in quality of life. Given its magnitude both globally and in Uganda, the next sub-section analyses the various responses to VAD.

1.8 Combating vitamin A deficiency

Attempts at combating VAD both in Uganda and globally have focussed on fortification (Dary and Mora, 2002; Bukusuba, 2005); supplementation (Beaton, 1993; WHO, 1999; UNICEF,

2007); food-based approaches (Ruel, 2001) including diet diversification; (Gibson and Hotz, 2001); home gardening (HKI/AVRDC, 1993; CARE/NEPAL, 1995; Chakravarty, 2000; Ruel, 2001; Ianotti, *et al*. 2009) and use of biofortified foods (Bouis, 2003; HarvestPlus, 2005; Nestel, 2006; Meenakshi *et al.* 2007). Each of these approaches is discussed below.

1.8.1 Micronutrient supplementation

Micronutrient supplementation or supplementation, the periodic delivery of high potency supplements to at-risk populations remains the most widely practised, direct means by governments throughout the world to prevent VAD (UNICEF, 2007). It entails bi-annual delivery of supplements containing 200 000 International Units (IU) of vitamin A to pre-school children (< 5 years old), with 50%of this dose given to infants 6-11 months of age and a 200 000 IU oral dose of vitamin A given to mothers within six weeks after giving birth to enrich their breast milk (WHO, 1999).

There may be a greater requirement for vitamin A supplementation in regions affected by periodic drought, chronic poverty, and food shortages as well as refugees and other populations cut off from their usual sources of food (WHO, 1999). However, evidence from UNICEF's multiple cluster indicator surveys suggests that children living in poorer, rural areas, who are likely to be at the greatest risk, may be disproportionately missed out by this intervention as few countries have been able to establish the dedicated delivery strategies for sustained effective coverage (UNICEF, 2007).

For long term sustainability of supplementation there is need to change the perception of this intervention from a quick short-term measure to an integral part of government preventive measures (Houston, 2003) and to limit over dependence on external support and resources. The basic premise of supplementation is that VAD is a health challenge, yet a medical approach on its own may not sustainably address VAD. Nonetheless, increased appreciation of the fact that VAD is both a medical and nutritional challenge has led to the emergence of other approaches, particularly food fortification.

1.8.2 Food fortification

Food fortification or fortification is the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population group(WHO and FAO, 2006). Fortification is generally considered socially acceptable, requires minimum changes in the eating habits, usually costs < 2% of the cost of the unfortified food, its delivery system is already in place and it can become sustainable (Lofti *et al.* 1996; Gomez-Galera *et al*. 2010). The foods that are commonly fortified include oils, and margarine; cereals; flours; and sugars (Begin *et al.* 2001; Dary and Mora, 2002).

Several conditions have been identified as central to the success of food fortification: nutritional surveillance to assess the prevalence of malnutrition and shortfall of the individual nutrients in the food supply; a suitable food vehicle that is widely consumed by the population groups most at risk; centralized food processing infrastructure and technical expertise; availability of appropriate fortificants (Haas and Miller, 2006). Fortification also requires appropriate control legislation and adherence mechanisms to ensure that levels of micronutrients are controlled within safe and acceptable limits (WHO and FAO, 2006; Gomez-Galera *et al*. 2010).

In reality, countries with significant VAD are also countries with significant limitations in dietary diversity, use of processed food, availability of centrally milled staple food suitable for fortification and appropriate control legislation and adherence mechanisms (Houston, 2003). Therefore, conditions necessary for the success of fortification are less likely to be common in many developing countries where its uses have been infrequent and has often been discontinued after successful, often donor funded, pilot trials have ended (Dary and Mora, 2002). Limitations in these two approaches have given weight to the rise of food-based approaches.

1.8.3 Food-based approaches

Food-based approaches (Ruel, 2009) encompass interventions that aim to: a) increase production and availability of food rich in vitamin A; b) increase consumption of foods rich in these micronutrients, and c) increase bioavailability of vitamin A in the diet; that is, the amount of vitamin A that can be absorbed and utilised by the body.

Home gardening has been the most popular food-based strategy for increasing consumption of vitamin A rich foods (Ruel, 2001). The rationale behind this strategy is to increase production of fruits and vegetables as a way of supplementing the largely starch and carbohydrate diets of rural agricultural households (Chakravarty, 2000; Gabre-Madhin, 2000; Iannotti, *et al* 2009). Some of the home gardening projects specifically aimed at increasing availability of micro-nutrient rich vegetables and fruits throughout the year, while others complemented home gardening with livestock-based interventions (Marsh, 1998). While Ruel (2001) noted that home gardening had increased consumption of vitamin A and iron rich vegetables among children, significant improvements in their nutritional levels (measured through anthropometry indicators) could not be ascertained due to insufficient scientific rigour of the studies involved. In spite of this, home gardening interventions that in cooperated nutrition education, behaviour change and social marketing were more successful (Marsh, 1998; Gabre-Madhin, 2000; Mulokozi *et al.* 2000), as opposed to those that focussed solely on home gardening (Ruel, 2009).

Biofortification, the development of micronutrient dense crops, through either conventional breeding or modern biotechnology, is one of the most technically feasible food-based approaches (Nestel *et al.* 2006). Since staple crops, the main target of biofortification, are the only foods eaten in large quantities by the poor, biofortification is directed at poorer families whose low incomes preclude consumption of desired levels of non-staples (Bouis, 2002a). In addition, it may be more feasible for some farmers who may be either reluctant or unable to replace their staple crops with horticultural crops as may be the requirement under home gardening (Meenakshi *et al.* 2010). Biofortification is considered to be a rural-based intervention that, by design, initially reaches the more rural-based households, who comprise the majority of the undernourished in many countries, penetrating the urban populations as production surpluses are increasingly marketed (Welch, 2002).

A comparative evaluation of what an investment of US$ 80 million could achieve concluded that (Bouis, 2002b:15):

> *"It could provide vitamin A supplements (capsules) to 80 million children and women in South Asia for two-years (1 in 15 persons in the population, at a cost of 25 cents for delivery of each pill, effective for 6 months); it could provide iron fortification to one-third of the population of South Asia for two years; or it might be possible with this funding to develop six nutrient-dense crops for dissemination to all the world population for many years".*

HarvestPlus and biofortification

In recognition of the potential discussed above, the Consultative Group on International Agricultural Research (CGIAR) formed HarvestPlus, an initiative coordinated by the International Centre for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI) (HarvestPlus, 2005). HarvestPlus seeks to reduce the effects of micronutrient malnutrition, especially vitamin A and zinc, by harnessing plant breeding to develop staple food crops (beans, cassava, rice, sweetpotato, wheat in the first phase) that are rich in micronutrients. It is believed that introduction of these biofortified crop varieties will complement existing approaches by offering a sustainable, low-cost method for reaching people with poor access to health care systems or formal markets. Additionally, it is thought that their introduction will provide recurring benefits throughout the developing world at a fraction of the recurring costs of either supplementation or post production fortification (McClafferty and Russell, 2002; HarvestPlus, 2010). One of the pioneer crops to be bred and disseminated under the HarvestPlus initiative is the orange fleshed sweetpotato.

1.9 Orange fleshed sweetpotato and vitamin A deficiency

Sweetpotato is one of the most important crops in the densely populated Eastern Africa. Uganda is the leading producer of sweetpotato in Africa, where the crop is the second most important root crop after cassava. Although sweetpotato is grown throughout the country as a subsistence crop, the major producing areas are the north-eastern and south-western regions (Hakiza *et al.* 2001; Gibson *et al*.2008).

The main types of sweetpotato grown and consumed in Africa in general, and Uganda in particular, are the yellow and white-fleshed types (Scott *et al.* 1998; Gibson *et al*.2008). Although

relatively new in a sense that it is not grown, traded and eaten in significant quantities (Yanggen and Nagujja, 2006), OFSP is a particularly promising food for combating VAD because it has relatively high levels of ß-carotene (100-1600 Retinol Activity Equivalent (RAE/100grams) in varieties found in Africa) and is generally well accepted by children (Low *et al.* 2007; Tomlins *et al.* 2007). It is also a good source of energy (293 to 460 kJ/100grams[3]); easy to cultivate; vegetatively propagated; fairly drought resistant once established; is less labour intensive than most staple crops and can be planted over a broad range of time without significant yield losses (Bashasha *et al.*1995; Low *et al.* 2007).It has been documented that successful dissemination of OFSP could eliminate between 40% and 60% of the VAD burden compared to 3% - 30% for cassava and 1% - 32% for maize (Meenakshi *et al.* 2007).

OFSP can, therefore, in theory provide a source of vitamin A that is accessible to isolated, small rural communities, and most important, has the potential to be self-sustaining over time if the varieties are incorporated into the farmers' production systems (Mwanga *et al.* 2004).

An impact assessment of a food-based intervention that introduced OFSP in Mozambique (Low *et al.*2007) revealed that "intervention children" were more likely to have eaten OFSP on three or more days in the last week (55% v 8%; $p < 0.001$) and their vitamin A intakes were much higher than those of control children (median 426 v 56 µg retinol activity equivalent, $p < 0.001$). Controlling for inflammation/infection and other confounders, mean serum retinol increased by 0.100 µmol/L (SEM 0.024; $p < 0.001$) in intervention children and did not increase significantly in control children. Based on these results, this study concluded that the integrated promotion of OFSP can complement other approaches and contribute to increases in vitamin A intake and serum retinol concentrations in young children in rural Mozambique and elsewhere in sub-Saharan Africa (SSA).

A similar study among school children in the KwaZulu Natal province of South Africa that used the modified-dose-response test (Van Jaarsveld *et al.*2005) reported greater improvement in the vitamin A liver stores in the treatment group than in the control group resulting from consumption of OFSP. The proportion of children with normal vitamin A status (DR: $R<0.0060$) in the treatment group tended to increase from 78% to 87% ($p=0.096$) and did not change

[3] 70 to 110 kcal/100 grams (1kcal=4.184kj).

significantly (from 86% to 82%) in the control group (p=0.267). The treatment group consisted of children who were fed on OFSP as part of the intervention, while the control group were not fed on OFSP as part of this intervention.

In spite of the potential of OFSP discussed in the preceding paragraphs, there are a number of factors that inhibit its full exploitation as a vehicle for biofortification. These include:

Low status food: sweetpotato in general is regarded as a low status food staple signalling the need for behaviour change to help break stereo-typical views against low status but nutrient-dense foods like OFSP (Bonnard, 1999). Similarly, a study among urban consumers in Kampala and Soroti districts of Uganda(Oburu, 2006) revealed that the share of budget allocated to sweetpotato declined as per capita food expenditure and income increases. This implies that, if incomes increase, then the share allocated to sweetpotato is likely to decrease or that among the high income clusters, the share of expenditure allocated to sweetpotato is relatively low. In addition, nutritional benefits have not been important in the choice of a sweetpotato variety by farmers (Yaggen and Nagujja, 2006) as well as urban consumers (Oburu, 2006). This is partly because staple crops have not been traditionally promoted as a source of micronutrients, such as minerals and vitamins (Rees, 2003).

A focus on crop breeding and dissemination: most biofortification strategies have focussed mainly on breeding and dissemination with little focus on marketing, nutrition education and behaviour change. However, studies in Uganda (Gonzalelez de Urqueta de Lorza, 2006; Yaggen and Nagujja, 2006) identified lack of consistent markets for roots as a major constraint to farmer uptake of new OFSP varieties. Few studies, as well as interventions promoting OFSP, have included market development, which may be essential to ensuring sustained adoption of a food-based approach (Low *et al.* 2007). Similarly, nutrition education and behaviour change have been proved to be pivotal in the success of a biofortification initiative, especially when the micronutrient trait is visible, as is the case with colour changes resulting from a high pro-vitamin A content in sweetpotato (Nestel, 2006; de Groote and Kemenju, 2008).

Weak policy and institutional linkages: OFSP has largely been promoted by the ministries responsible for agriculture with minimal linkages with the other relevant ministries such as health and education, yet sustainable solutions to malnutrition are likely to be realised if the

intervention strategy entails closer collaboration among the relevant ministries and agencies, and by formulating policies and intervention strategies that reflect this need (Meenakshi et al. 2007; World Bank, 2007b).

Few Varieties: promotion of OFSP in Uganda started only in 2003 and has concentrated on two varieties, *Ejumula* and *Kakamega* (Mwanga *et al.*2007). Both of these varieties have drawbacks that limit their acceptability and adoption. In comparison to the existing yellow and white sweetpotato types, most OFSP varieties, including *Ejumula* and *Kakamega*, tend to have low dry matter content, yet most African consumers tend to prefer sweetpotato types with high dry matter content (Kapinga *et al.* 2006; Nestel *et al.* 2006). While the *Kakamega* variety has good all-round agronomic characteristics, it has relatively lower levels of beta-carotene and thus may contribute negligible amounts of pro-vitamin A. The *Ejumula* variety is highly susceptible to virus and disease attack which limits its uptake and geographical area of cultivation (Tumwegamire *et al.* 2007). In spite of the foregoing, two more varieties, *Kabode* and *Vita* were released in 2007, and were promoted by the REU project. It is anticipated that more varieties, with improved all-round attributes will be released soon, as breeding work continues.

Vitamin A losses in stored products: in the main growing areas of northern and eastern Uganda, sweetpotato is mainly consumed in the fresh form (boiled, roasted or raw), and as a reconstituted dish made from dried and stored sweetpotato slices. Pro vitamin A retention studies (Bechoff, 2008) concluded that while OFSP immediately after drying contains significant amounts of pro-Vitamin A, high losses occur during storage for longer than four months, reducing pro-Vitamin A availability in the dishes made from dried and stored products. Thus the need for cooking and storage methods that optimise pro-vitamin A retention.

Preference for yellow and white types: previous studies on sweetpotato marketing (Fowler and Stabrawa, 1993; Hall *et al.* 1998; Scott *et al*. 1998; Wanda *et al*. 2003; Coote *et al*. 2007) reported that white and yellow varieties remained popular in most households and among purchasers. While the predominant market for OFSP remained fresh roots, there was reluctance by traders to accept OFSP. Indeed many would mix them with the market preferred varieties in order to sell (Oburu, 2006a; Coote *et al*. 2007). Other authors (Oburu, 2006a; Yaggen and Nagujja, 2006) reported a dearth of OFSP in the main Kampala markets suggesting a need for

sustained awareness campaign run in parallel with production increases and the development of market linkages. However, when OFSP appeared in the urban markets, it was quickly bought up mainly by educated people aware of its health benefits. Therefore, the key challenge for promoters of OFSP is how to ensure sustainable uptake in a sweetpotato value chain dominated by preferred yellow and white sweetpotato types.

With the above challenges to the use of OFSP as a means of combating VAD in mind, the subsequent sub-sections of this chapter curves out the niche of this thesis: the information and knowledge gaps that it seeks to address.

1.10 Problem statement

Biofortification has emerged as a complementary approach to solving the problem of VAD. Staple crops, the main target of biofortification are the only foods eaten in large quantities by the poor on a regular basis(Bouis *et al.* 2009). However, while biofortification is considered to offer a more sustainable type of intervention they require considerable inputs into production, marketing and nutrition education. There is lack of data and information on the factors that will influence the uptake of OFSP along the value chain.

This study addresses a gap in examining the factors that influence the decision of producers and traders to sell OFSP, and consumers to purchase it. It also assesses the role that a marketing component can play in a biofortification intervention. This is novel in the sense that previous attempts to develop value chains have focussed on enhancing economic benefits of food production (Hawkes and Ruel, 2011). The target crop, OFSP, has a visual orange trait, is relatively new in Uganda in the sense that it is not produced, traded and consumed in any significant quantities, and little is known about the factors that will influence the decision of the key actors to respond to its introduction as a marketable commodity.

In order to address this research problem, this study critically examines the factors influencing the decision by producers and traders to sell OFSP and of consumers to purchase it. It will also analyse the role of marketing in a biofortification intervention. This will be done by addressing four research objectives and answering the research questions relevant to each research objectives, which are presented in the next sub-section.

1.11 Objectives and research questions

1.11.1 Overall objective

To critically examine the factors influencing the decision by producers and traders to sell OFSP; consumers to purchase it; and the role of a marketing component in biofortification intervention that seeks to alleviate VAD.

1.11.2 Specific objectives

1. To examine the factors that influence the decision by producers to grow OFSP for sale;
2. To explore the factors influence the decision of traders to sell OFSP either alongside or in place of other sweetpotato types and food staples;
3. To evaluate factors determining acceptability and repeat purchase of OFSP among urban consumers; and
4. To assess the role of marketing in a biofortification intervention.

Each of these specific research objectives has a set of research questions that they seek to answer.

1.11.3 Research questions

Objective 1: To examine the factors that influence the decision by producers to grow OFSP for sale.

Research questions:

1. What are the priority crops that producers grow?
2. What is the nature and characteristics of OFSP marketing among producers?
3. What factors influence the decision of producers to sell OFSP?

Objective 2: To explore the factors influencing trader decisions to sell OFSP either alongside or in place of other food staples.

Research questions

1. What are the characteristics of the market intermediaries involved in OFSP trade?
2. How does trade in OFSP compare to trade in non-OFSP?
3. What factors influence the decision of traders to sell OFSP?

Objective 3: To evaluate factors determining acceptability and repeat purchase of OFSP among urban consumers.

Research questions

1. How acceptable are OFSP roots in terms of appearance, heap weight, size and price?
2. What are the main characteristics of OFSP consumers?
3. How do consumer purchase decisions of OFSP compare to those of non-OFSP?
4. What factors determine acceptability and repeat purchase of OFSP?

Objective 4: To assess the role of marketing in a biofortification intervention

Research question

1. Does marketing have a role to play in a biofortification intervention?

1.12 Significance of the study

This study is significant in a number of ways. First, it makes a contribution to a better understanding of the factors that determine the response of the various actors along the value chain to the introduction of a biofortified staple crop. At the producer level, it identifies key issues that need to be addressed for successful uptake of OFSP for both home consumption and sale. This is particularly important since the marketing component is not solely concerned with increasing incomes, but rather is a means of ensuring availability of OFSP for consumption. At the market level, it provides a clear understanding of the factors that underpin traders' decision to invest in marketing a new product, with perhaps uncertain market prospects. It further provides an understanding of the key drivers of consumer acceptability and likely repeat purchase of the

new product. Understanding consumer preferences for a nutrient-enhanced crop, not a target for most crop improvement interventions, is critically important for sustained uptake.

The role of a marketing component in a biofortification intervention has not been previously investigated. This study is therefore significant in the sense that it is the first time that such insights are researched and made available. For planners, policy makers and future biofortification interventions, results from this study could provide a useful resource material on the critical factors for the success of a similar endeavour.

1.13 Definition of key concepts

Below are definitions of the key concepts that underpin this study and how they are used in this thesis.

Decision Making: is how people make choices among desirable alternatives (Edwards, 1954) . In this thesis, it refers to the choice by producers and traders to sell OFSP, and consumers to purchase OFSP for home consumption.

Adoption: is the process through which an individual or other decision making unit passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision (Rogers, 2003).

Innovation: is the use of new ideas, new technologies or new ways of doing things in a place or by people where they have not been used before (Bernett, 2004). In this case the decision to sell OFSP by traders and producers, and the decision to purchase OFSP by consumers constitutes an innovation.

Value chain: describes a full range of activities which are required to bring a product or service from conception through the different phases of production, delivery to final consumers and final disposal after use (Kaplinsky and Morris, 2000). Producers, traders and consumers are the key nodes in the OFSP value chain.

The last sub-section outlines how this thesis is organised and summarises the contents of each of its nine chapters.

1.14 Structure of this thesis

This thesis is organised into nine chapters:

Chapter one presents the introduction and context of the study. The problem statement, research objectives and research questions are examined. It concludes by illustrating the significance of the study, defining the key concepts underpinning the study and an overview of the structure of the thesis. The second chapter is a review of the literature that formed a basis for this study. The literature reviewed falls into two interrelated strands: agricultural marketing and poverty eradication; and agricultural technology adoption. The theoretical and conceptual framework that directed the study is contained in chapter three. Chapter four discusses the methodology. This includes a description of the study areas from which information and data were collected; the research approach; and the methods used for collecting and analysing information and data from the producers, traders and consumers. Chapter five is the first results chapter. It is an interpretation and analysis of the information and data collected from the producers, as the first node in the OFSP value chain. Results from the investigations of the market intermediaries (traders) are presented in chapter six. Chapter seven presents results from the consumers, the last node in the OFSP value chain. Building on results presented chapters 5, 6 and 7; chapter eight examines the role of marketing in a food biofortification intervention. In chapter nine, the main conclusions, recommendations and suggested areas for further work are presented.

Chapter Two: Literature Review

2.1 Introduction

The key themes that underpin this study are: i) the value chain, ii) agricultural marketing and poverty reduction, ii) smallholder farmer market inclusion, iv) adoption of improved agricultural technology, and v) adoption and acceptability of biofortified staple crops. Each of these themes is analysed in order to identify findings from previous work undertaken, gaps that remain and provide a departing point for this study. This chapter concludes with a reflection on the key issues emanating from the analysis of this literature and starts with an overview of agricultural marketing theory.

2.2 Overview of agricultural marketing theory

Agricultural marketing theory originated as a discipline dealing with the process of getting agricultural commodities from the farmer to the consumer (Bartels, 1970). Marketing discourse prior to 1950 was shaped by three dominant schools: commodity, functional and institutional schools of thought (Meulenberg, 1986). The commodity school focused on the nature of the product as the basis of marketing, highlighting the importance of the terms necessary to bridge the gap in place, time and product form between the producer and consumer. The functional school was concerned with the three functions of exchange including buying, selling and negotiating a contract, physical functions such as transport, storage, and processing and the facilitating function which involved trade financing and market information. The institutional function looked at how institutions such as cooperatives, commodity exchanges, weights, measures and standards either facilitated or hindered the movement of the product from producer to consumer.

From the 1950s, the management approach took a central role in influencing agricultural marketing with behavioural and quantitative sciences as key concepts (Webster Jr and Fredrick, 2009). The key premise of this approach is that companies should hold a deep understanding of

the wants and needs of their customers (Drucker 1958). To illustrate, a farmer producing OFSP is not just in the business of growing this sweetpotato, but rather in the business of providing solutions to the food and nutritional needs of their customers. Research studied the optimal use of marketing instruments such as the four 'Ps'[4] (Products, Prices, Place and Promotion), that intended to push products through distribution channels meanwhile creating a pull on consumer markets through promotion and price actions (Ingenbleek, 2012). The management approach was particularly unique in that it was informed by behavioural and decision sciences, giving it a multi-disciplinary outlook.

Other theoretical foundations that shaped current marketing discourse include market structure analysis (Bain, 1959), market efficiency studies (Samuelson, 1965), regional and spatial analysis (Takyama and Judge, 1971) and price analysis (Fox, 1953; Tomek, 1983). Recent influences in marketing theory and practice coalesced into the value chain approach (VCA), among others, which is reviewed in detail in the next sub-section due to its relevance to this work.

2.3 The Value Chain

The value chain (VC) describes a full range of activities which are required to bring a product or service from conception through the different phases of production, delivery to final consumers and final disposal after use (Kaplinsky and Morris, 2000; Humphrey and Schmitz, 2001). It provides a means of understanding relationships between businesses, methods for increasing efficiency, and ways to enable businesses to increase productivity and add value (Webber, 2000). Within the definition of VC, two elements are intertwined: chain and value. Chain originates from the supply chain literature and connotes the processes and actors that take a product from its conception to its disposal after end use or the life cycle of the product. Value signifies what is added to a product as it moves from one stage in the cycle to the next.

[4]These were later extended to '7Ps' to include People, Process and Physical evidence
http://www.cim.co.uk/files/7ps.pdf

2.3.1 Origins of the value chain

The VC has its theoretical underpinnings in the business management paradigm (Porter, 1985; Porter, 1996); world systems theory (Wallerstein, 1974; Hopkins and Wallerstein, 1986); and the political economy of food and agriculture (Bair, 2009).

The Business Management Paradigm: the origin of the concept of VC as an analytical framework is attributed to Porter's exposition of competitive strategies which provided a tool that enabled firms to look beyond their own boundaries, to examining linkages with other organisations and to identify ways of creating and sustaining better value (Porter 1985; Kaplinksky, 2005). According to proponents of the business management paradigm, VCA describes the activities within and around an organisation, and relates them to an analysis of the competitive strength of the organization, evaluating which activity adds to the products and services of the organization and bringing to the fore the value of the consumer. It stresses the insight that an organization is more than a random compilation of machinery, equipment, people and money. Only if these things are arranged into systems and systematic activates will it become possible to produce something for which customers are willing to pay a price. Porter argues that the ability to perform particular activities and to manage the linkages between these activities is a source of competitive advantage.

Porter's contribution to value chain discourse provided a framework for strategic analysis of organisations from a business perspective which helps assess whether such organisations have sustainable competitive advantage as well as potential sources of differentiation and grouping of activities. However, while providing useful generic insights that have shaped the current VC discourse, the business management paradigm appears to be more relevant to the manufacturing sector compared to the agricultural and food sectors. To be more appropriate to the current use of the VC, the apparent emphasis of this paradigm on quantitative approaches may need to be complemented with qualitative methodologies.

World Systems Theory: this theory provided the historical antecedents of the GVC literature. Wallerstein (1974) developed a core–periphery model, in which northern industrialised nations located in the central core are linked with developing southern nations in the periphery through global commodity chains (GCCs). As the GCC literature developed, it shifted the discourse of

the world systems theory from the macro to the micro level, through its focus on the organisation of industry and firms within a more integrated global economy (Gereffi, 1999; Gereffi and Korzeniewicz, 1990; Gereffi and Fernandez-Stark, 2011). The GCC literature subsequently evolved into GVC analysis with a focus on how local economic processes are conditioned by global arrangements (Gereffi and Christian, 2010). The approach consists of understanding how producers at upstream nodes of production are linked with their end markets, including retailers at downstream nodes (Keane, 2012). These studies explored how changes in the organisation and coordination of global trade and production – characterised by the splitting up of production processes between countries and the deepening of trade and investment linkages affected firms and labourers in periphery countries, their relative returns, and development of productive capabilities (Gereffi and Korzeniewicz, 1990; Nadvi and Thoburn, 2004). A criticism of the world systems theory is that its apparent focus on linking downstream producers to upstream consumers often in developed countries ignores the fact that for smallholder producers it is the local markets that they are most linked to and depend on for their livelihoods. This is more pertinent when dealing with low-value bulky and perishable staple crops such as the orange fleshed sweetpotato. Therefore, it may be more relevant to producers who are already able to produce for and supply to high-end markets.

Political Economy of Food and Agriculture: the new political economy of food and agriculture was influenced by commodity systems analysis and systems of provision (Bair, 2009), from the sociology of agriculture. Commodity systems analysis (Friedland, 1984) focuses on analysing the organisation of agricultural production and the relationship between production and consumption in food chains. Systems of provision (Fine, 1994; Fine, 2002), is an integrated production and consumption framework, which rather than beginning with production, as is common with most work on the new political economy of agriculture, considers the specificities of the consumption – production relationship. The cornerstone of this paradigm is that commodities are distinctly structured by the chain or system of provision that unites a particular pattern of production with a particular pattern of consumption (Fine and Leopold, 1993).

The other concept related to this strand of literature is the French "*Filiere* Concept" (Raikes *et al.* 2000), which literally translates into a thread/chain/network in English. This concept, also referred to as the sub-sector approach was developed in the 1960s at the Institut National de la

Recherche Agronomique (INRA) and the Centre Internationale en Recherche Agronomique pour le Development (CIRAD) as an analytical tool for empirical agricultural research. The approach was influenced by the needs of the colonial and post-colonial French state, since state (agricultural) development was commodity specific and needed a matching analytical framework. It was used to gain a more structured understanding of economic processes within production and distribution systems for agricultural commodities (Raikes *et al.* 2000) and has been applied to domestic chains ending at national boundaries (Kaplinsky and Morris, 2000). It provides insights into the sequential nature of interconnected activities through the spatial mapping of commodity chains, thus the chains are analysed from a rather linear technical and managerial perspective (Reud, 2006). As a system of agents for producing and distributing goods and services, the *Fliere* concept focuses on empirical assessment of input-output relationships, prices and value-added distribution along commodity chains (Raikes *et al.* 2000).

The main theoretical foundations of the current VC and the key authors are synthesized in Table 2.1.

Table 2.1: Characterization of the conceptual frameworks informing the current value chain discourse in terms theoretical foundations, main objectives, underlying concepts, key features and leading authors

	French Filiere approach (1960S)	**Commodity Chain (1974)**	**Value Chain (1980s)**	**Global Commodity Chain (1990s)**	**World economic Triangle (2000s)**	**Global Value Chain (2001)**
Theoretical foundation	-No unified theoretical approach	-World systems theory derived from dependency theory	- Business management paradigm	-World systems theory -Organisational sociology	-World systems theory Organisational sociology	-Global commodity chains
Objectives	-Physical inputs and outputs, prices and value added in marketing chains -Focus on agricultural commodities	-Explanation of the world capitalist economy	-Focus on industrial firms -Competitive advantage by breaking down its activities into the value added	-power relations of globally linked production systems (meso and micro level) -focus on industrial goods	-upgrade of regions or clusters -linking cluster development and value chains	-Governance and regulation systems -linking horizontal and vertical approaches
Underlying concepts	-No underlying concept	-International division of labour -core-periphery-semi periphery	-in-house value added	-governance (consumer-driven/buyer driven) -organisational learning/upgrading	-Governance -upgrading of clusters	-Governance -Transaction costs -Upgrading
Features	-Static models National boundaries	-Holistic point of view -Micro-oriented -Qualitative analysis	-Production processes at firm level -No attention to international territorial arrangements	-Focus on governance	-Qualitative analysis	-Composition of commodity chain -World economic triangle
Key authors	Raikes *et al.* 2000	Wallerstein (1974)	Porter (1985)	Gereffi (1994, 1999, 2005)	Messener (2002)	Humphrey & Scmitz (2001) Gereffi & Kaplinsky (2000)

Source: Adapted from Fabe *et al.* (2009)

The convergence of these threads in the last decade resulted into the emergence of value chains as one of the dominant discourses in research in agricultural marketing in developing countries by many governments, international donors NGOs and research bodies (Humphrey, 2005). It is also promoted as an approach for linking smallholder farmers to remunerative markets.

2.3.2 Key value chain concepts

From the review of the VC theories, two concepts emerge that are relevant to this thesis: upgrading and governance.

Upgrading

VC upgrading has been defined as:

> *"Increasing the competitiveness of the value chain by moving it in a new direction-towards a new market, market segment or customer; towards increased efficiency within the value chain; or towards adding operations within the value chain" (Webber and Labaste, 2010: 69).*

Riisgaard *et al.* 2010, brings in the concept of risk mitigation as one of the key tenets of VC upgrading and delineates the following five types of VC upgrading: process, product, volume, functional and coordination.

Process upgrading: improving processes, such as increasing the efficiency of internal processes, improving client management or reducing waste.

Product upgrading: introducing new products or improving old products to give them greater unit value, complying with standards of those products, or shifting away from high value markets to gain value from bulk markets.

Volume upgrading: producing more of a product.

Functional upgrading: changing the mix of activities conducted to gain more value from the chain, such as taking on a new function in the chain (for example farmers taking on processing in addition to growing) or offloading such a function.

Improving value chain coordination: this relates to improving coordination in the chain to order to enhance overall performance.

Smallholder farmer upgrading is at the core of inclusive value chain development because it improves efficiency (process upgrading) and or quality (product upgrading) measured in terms of uptake/adoption and continued use of new production technologies such as seed, fertilizer and soil and crop health management practices (Dun, 2014) and better marketing approaches. Overall, upgrading, therefore, is value addition in a chain that results from interventions and initiatives, chain functions, actors' capabilities and empowerment (Poole, 2013).

Governance

Global value chain analysis defines chain governance as the process of specifying, communicating and enforcing compliance with key product and process parameters along the value chain (Humphrey and Schmitz 2001). Governance occurs when one firm follows parameters set and enforced (through monitoring and sanctions) by another. At any point in a value chain, the three key parameters to be specified are: i) what is to be produced: product design and specifications, ii) how it is to be produced, process specifications, and iii) how much is to be produced, and when: production scheduling and logistics (Humphrey, 2005). Gereffi *et al.* (2005) argue that governance structures in value chains are determined by three factors: (i) the amount of information that needs to flow along the chain in order to coordinate the various activities within it; (ii) the extent to which this information can be codified (i.e. turned from tacit, hard to-communicate knowledge into codified information that can be pressed easily from one agent to another); and (iii) the extent to which suppliers are competent to meet the requirements placed upon them.

2.3.3 Food Value chains

A recent application of value chain concepts to food and nutrition has resulted in the emergence of the concept of food value chains (FVCs), which comprise activities necessary to bring farm products to consumers, including agricultural production, processing, storage, marketing, distribution and consumption (Gomez *et al.* 2011). FVC analysis considers linkages between participating actors (e.g. farmers, manufacturers, retailers and consumers) and examines the flow of food from farmers to distributors and to retailers (Burch and Lawrence, 2007; Webber and

Labaste 2010).This concept was later expanded to include the people and institutions that initiate or inhibit change in the system as well as the socio-political, economic and technological environment in which these activities take place (FAO *et al.* 2012). In the 2013 edition of *The State of Food and Agriculture*, FAO makes the case that FVCs or food systems from agricultural inputs and production; through processing, marketing and retailing, to consumption can promote more nutritious and sustainable diets for everyone (FAO, 2013).

Table 2.2 highlights the different types of FVC, the key actors in each, and the implications for food access and availability (Gomez and Ricketts, 2013).

Table 2.2: Food value chain typologies, key actors, implications for food access and their hypothesized influences on nutrition adapted from Gomez & Ricketts, 2013

FVC Type	Key actors	Implications for food access	Hypothesized nutritional impacts
Traditional	Traditional traders buy primarily from smallholder farmers, and sell to consumers and traders in wet, mostly local markets	**Affordability**: a local products with flexible process, product volumes and quality standards **Availability**: food 'hub' for consumers and local traders to access directly from traders and smallholder farmers. Availability is highly dependent on production seasonality	• Help reduce micronutrient deficiencies by offering low-priced fruits, vegetables, livestock products, and staples, particularly in rural areas and in poor neighbourhood of urban areas • Production seasonality combined with lack of post-harvest and distribution infrastructure, increase FVC intermediation costs and limit the ability of these chains to reduce micronutrient deficiencies and under nourishment
Modern	Domestic and multi-national food manufacturers procure primarily from commercial farms and sell through modern supermarket outlets	**Affordability**: economies of scale enable the production, marketing and distribution of packaged/processed food at low per-unit prices **Availability**: provide year-round, variety of products, primarily in urban areas, successfully expanding the market for these products	• May contribute to alleviate micronutrient deficiencies by offering a wide assortment of products year round; but their physical location and quality standards may imply higher retail process, missing the poor • May contribute to obesity/overweight malnutrition by expanding the reach of inexpensive, calorie-dense processed/packaged foods, primarily in urban areas
Modern-to-traditional	Domestic and multinational food manufacturers sell through the network of traditional traders and retailers	**Affordability**: benefit from economies of scale to connect with traditional distributors and retailers, offering low-priced processed foods to reach low income consumers **Availability**: by linking up with traditional retailers, food manufacturers develop intense distribution strategies in urban areas and in rural isolated markets	• Expansion of processed/packaged foods to rural, isolated areas may alleviate under nourishment, but may result in over-nutrition among urban consumers • Food fortification initiatives focusing on this chain may contribute to reduce micronutrient malnutrition
Modern-to-traditional	Supermarkets and food manufacturers source food from smallholder farmers	**Affordability**: increased income opportunities in high value crop and livestock production for smallholder farmers and traders can expand food budgets because most are net-food buyers **Availability**: increased production and crop diversification may increase food available for local consumption	• May reduce micronutrient deficiencies and under nourishment for smallholder farmers and traders through higher income leading to diversification • Opportunities for smallholder farmers and traders to benefit directly from participation appear limited and may miss asset-poor farmers; substantial benefits may result from off-farm employment opportunities.

2.3.4 Value Chain and Agricultural Marketing

Although originating in the manufacturing sector, the VC has been widely used in agricultural research and development. Several donors and development agencies have utilised VC as a pathway out of poverty by linking producers to remunerative markets both domestic and international. Examples include IFAD, FAO, USAID, KIT, GTZ and DFID. These organisations have developed various resource materials to guide value chain analysts and field practitioners. The rationale behind the VC is that poor farmers will benefit if they can appropriate a greater amount of the returns accruing from the chain, particularly in light of the differentiation strategies pursued by global agribusiness (Nangole *et al.* 2011).

Value chain analysis has also been used for a comparative assessment of the competitiveness of a country's key agricultural commodities and enterprises as a basis of identifying and prioritizing intervention areas. For example, in Uganda, Action Against Hunger International recently commissioned a comparative assessment of the maize, groundnuts, sesame, sunflower and rice value chains in northern Uganda in order to identify interventions that are likely to spur pro-poor growth (Dilipagic and Elepu, 2014). A similar study was commissioned by USAID in collaboration with EAC, COMESA and the EAGC under its Competitiveness and Trade Expansion Program (COMPETE) targeting six staple crops: maize, wheat, rice, groundnuts, finger millet and sorghum (Chemonics 2010). Tchale and Keyser (2010) mapped the composition of supply chain costs for Malawi's key staple crops, examining how these costs affected the competitiveness of each commodity and finally, whether Malawi has cost and competitive advantage in these different crops.

2.3.5 Weaknesses of the value chain approach

Within the VC literature, a proliferation of different terminologies which discuss similar concepts or ideas is evident. While the key authors are keen to highlight differences, most of these concepts have a lot in common relative to the professed differences. Similarly, there are many well documented case studies on the use of value chains, which do not add much conceptual clarity. The VC is therefore becoming more of a fashionable concept with very little concerns for some of its basic tenets. Most practitioners focus on particular aspects of the VC such as the producer node without taking into consideration the chain and value concepts that are

the real difference that this approach makes. In reality, such applications may not be different from the earlier approaches to marketing such as the commodity studies and sub-sector approaches.

Most of the literature of GVC examines products from developing countries consumed in the industrialised world. In essence focusing on producers who are able to consistently supply the needs of sophisticated consumers in the developed world since they are already competitive. Rarely does it focus on the evolution of smallholder producers and the stages that preceded their integration into GVCs. The literature may, therefore, be of limited value to practitioners who want to upgrade producers in developing countries. VCs in the agricultural sector have been successfully applied to high value products such as horticultural products, and dairy. Among staple crops, it has mainly been used on the hard grains, typically rice, wheat, maize and oil crops. There is, therefore, limited application on the relatively low-value, bulky and perishable staples such as sweetpotato and cassava on which a majority of the poor demand on.

2.4 Agricultural marketing and poverty eradication among smallholder farmers

Agriculture has been identified as a pathway out of poverty, particularly in Sub-Saharan Africa (SSA), where three out of four people depend on it, directly or indirectly, for their livelihood (World Bank, 2008; Fischer and Qaim, 2010). This partly results from the realisation that,: without development in agriculture, reaching the Millennium Development Goal on poverty and hunger will remain elusive: growth in demand for food is outstripping supply and that if agriculture is to provide food, feed and fuel, then renewed investment in agriculture is required (World Bank, 2007). However, in today's more integrated world economy, success in productivity-based agricultural growth critically depends on the expansion of market opportunities (Asfaw *et al.* 2010). The WDR is emphatic on this:

> *'Getting agriculture moving requires improving access to markets and developing modern market chains. It requires a small holder based productivity revolution' (World Bank 2007: 20).*

Therefore, a review of the findings from the relevant literature in the area of agricultural marketing, agricultural development and poverty eradication is imperative in order to assess the

role of agricultural marketing in agricultural development and poverty eradication. This will set the context of understanding the role of agricultural marketing in a biofortification intervention.

Numerous studies have identified the intricate relationship between well-functioning product markets and technology adoption in poverty eradication. There is, thus, increasing recognition, although not universal acceptance (World Bank, 2005; Maryanne, 2007), that improving access to markets for small producers in low-income countries is a route to poverty reduction and achievement of many of the Millennium Development Goals (MDG)[5]. This recognition dates back to the work of Schultz (1964) who opined that smallholder farmers are poor but efficient or that the input-output relationship among smallholder farmers is similar to that for larger producers. Therefore, within more favoured agricultural areas and for a range of commodities, African agricultural smallholders can be internationally competitive (Poole *et al.* 2013). On his part, Lipton (2005) postulates that there is virtually no example of mass poverty reduction in modern history that did not start with sharp increases in employment and self-employment income due to increased productivity among small family farms. Better input and output market integration is therefore required to help move smallholder farmers into higher input-output levels, which would help break the vicious cycle that keeps them in their smallholder situation (Huylenbroeck *et al.* 2012).

Improved market systems are considered critical to both the development of agriculture and the way it contributes to growth (Dorward and Kydd, 2004). These authors identify three broad mechanisms through which agricultural growth and generation of surpluses in poor rural areas can drive poverty reduction, all underlying the pertinent role that markets play: i) the direct impacts that increased agricultural productivity and incomes have on the rural poor, who derive significant parts of their incomes as farmers or farm labourers; ii) the benefit of cheaper food for both the urban and rural poor; and iii) agriculture's contribution to growth and generation of economic opportunity in the non-farm sector. The WDR (World Bank, 2008), asserts that better markets for food staples have broad implications for agricultural growth because they raise farm-gate prices, build the confidence of farmers in their reliability and allow farmers to diversify into higher value products.

[5] MDG 3 is particularly relevant: End extreme poverty and hunger.

On its part, the International Fund for Agricultural Development's (IFAD's) strategic framework (2011-2015) affirms that insufficient integration into agricultural markets and value chains is one of the key factors that keep rural households in poverty (with close to 1.4 billion people living on less than US$1.25 a day: a significant decline from 1.8 billion in 1990, but still unacceptably high[6]), leave them ill-equipped to face new risks and opportunities, and undermined rural food security and nutrition (IFAD, 2011).Yet better input and output market integration could break the vicious cycle of poverty as better economic and physical access to higher value markets would increase income, result in possibilities to improve technology, increase input mix resulting in higher indifference curves (Huylenbroeck, 2010).

Market availability and access are considered key to adoption and sustained use of an improved technology (CIP, 2006). A farming household is unlikely to adopt a production technology, even if it is otherwise considered best, unless a well-functioning market for the product exists to make the technology viable and give an adequate return (Rashid, 2002).

Poorly functioning markets, weak domestic demand and lack of export possibilities are considered major constraints to Africa's agricultural growth prospects (Diao and Hazell, 2004). For poor farmers to thrive in a globalised economy, it will be necessary to create an entrepreneurial culture in rural economies (Barham and Chitimi, 2008), where farmers produce for the market, rather than try to market what they have produced (Lunday *et al.* 2005), as well as better understanding the role of traders (Fafchamps and Hill, 2005). As it is, there appears to be little evidence that agricultural marketing interventions have resulted in reduction in poverty and hunger in many situations partly because of the failure to understand the decision-making behaviour of small-scale farmers in the African context and the tendency to generalise without specific attention to the local context as well as the consequences that result from market integration (Poole, 2012). Therefore, while marketing aims at increasing profits, income etc. from improved market access, these may be secondary goals to some smallholder farmers.

In conclusion, therefore, although improved market access is considered a critical driver of sustained and broad-based poverty-reducing development, on its own, it is neither a magic bullet

[6]United Nations 2010, United Nations Research Institute for Social Development (UNRISD) 2010. Combating Poverty and Inequality, structural Change, Social Policy and Politics.

nor a sufficient condition for such development: other social, political and technical processes of change are also vital. In the agricultural sector, poverty is a result of poorly functioning markets confounded by low and unsustainable production and productivity.

2.5 Smallholder market inclusion in Eastern Africa

This thesis is about uptake of OFSP as a tradable commodity along the value chain. Since OFSP is almost exclusively produced by smallholder farmers, an analysis of the literature on smallholder market inclusion is pertinent.

Most of the literature and work undertaken on smallholder market inclusion in eastern Africa concerns high value cash crops, livestock or animal products. These include coffee in Uganda (Fafchamps and Hill, 2005); coffee in East Africa (Ponte, 2002); cotton in Uganda and Tanzania (Poulton *et al.* 2004); potato in Kenya (Hoeffler, 2006); fresh fruits and vegetables in Kenya (Dolan and Humphrey, 2000; Humphrey *et al.* 2004; Minot and Ngigi, 2004; Fafchamps and Hill, 2005); and livestock in Ethiopia, Kenya or both (McPeak, 2004; Bellamare and Barrett, 2006). Few scholars have addressed smallholder participation in staple crops. These include chickpea in Ethiopia (Asfaw *et al.* 2010) and bananas in Uganda (Komarek, 2010).There is also a growing body of literature examining smallholder market participation in modern marketing chains epitomised by supermarkets (Weatherspoon and Reardon, 2003; Reardon and Timmer, 2006; Naveen *et al.* 2007). Even then, it may not be reasonable to consider farmers who are able to produce high value cash crops, livestock or animal products as well as those who are capable of meeting the stringent requirements of supplying to modern marketing chains to be smallholder, particularly within the context of African agriculture.

In spite of the preceding criticism, Barrett, (2008), discerns three themes on smallholder market participation in eastern and southern Africa. Firstly, although many smallholder farmers are engaged in staple crop production, a relatively small proportion of these farmers sell some amount of the staples that they produce. Secondly, better endowed farmers, in terms of access to resources and those living in favourable agro-climatic zones, are the ones more likely to be engaged in staple crop marketing, and, finally, transaction costs are a significant barrier to market participation by smallholder farmers.

Regarding the first theme, a recent synopsis of smallholder market participation in Eastern and Southern Africa demonstrated that the fraction selling staple grains is typically between one quarter and one third of smallholders (Wiggins and Keats, 2013). In Kenya, 10% of the farmers accounted for about 75% of all the maize sold by Kenyan smallholder farmers in 1997 and 2000 (Nyoro *et al.*1999; Jayne *et al.* 2006). Data from the Uganda Bureau of Statistics (UBOS) show that, while all the staple crops produced are grown by smallholder producers, levels of market participation are It is estimated that 75% of the households sell less than 25% of their produce (UBOS, 2002; MAAIF, 2010). However, there is a likelihood that this data may not include informal cross border trade and the value of crops that are exchanged either for labour or for other commodities under reciprocal barter arrangements. In summary, staple crops are produced almost exclusively for home consumption, but who are these few smallholder farmers who sell and under what conditions do they produce staples for sale? This is the focus of the second theme.

The second theme posits that there is a relationship between asset ownership (wealth), favourable geography and market participation. It posits that poorer households often meet their household staple food crop requirements by purchasing rather than own production. The best endowed quartile of farmers exhibit a probability greater than 50% of selling to the market (Barrett, *op.cit*). Studies in Kenya on market participation (Nyoro *et al.*1999) report that the only region where over 50% of surveyed households were net maize sellers was the high potential zone for maize production which is also the more affluent area. Another aspect of favourable geography is proximity to markets or an all-weather road. Households closer to markets have a higher likelihood of being net sellers, and generating larger sales volumes (Komarek, 2010). Similar observations were made in Mozambique (Heltberg and Tarp, 2002) and Madagascar (Jayne *et al.* 2006). In the same token, a recent study on asset endowments and smallholder coffee farmer participation in higher value chains concluded that improved market access alone, even under relatively favourable market conditions, and with considerable external support, will have uncertain impacts on rural poverty if the underlying constraints on household assets and investments are not addressed concurrently (Donovan and Poole, 2014).

The third theme underscores the importance of transaction costs as a significant barrier to market participation, especially after the withdrawal of government subsidies in the form of pan

territorial pricing (Kahkonen and Leathers, 1999). Transaction costs are the non-price costs of making a commercial exchange; they are the basis of the organisation of all economic activity and can explain much of the behaviour of households (Coase, 1937).They include the costs of arranging a contract, monitoring and enforcing it (Mathews, 1986). Transaction costs associated with transport are of particular interest Barrett, (op.cit). Ownership of a means of transport, either motorized or bicycle, was reported to enhance food grain market participation and the quantity that can be sold (Heltberg and Tarp, 2002). Transaction costs have been demonstrated to have an influence on banana sales per acre in Uganda (Komarek, 2010). In Kenya, most farmers who were involved in inefficient production of low-return food crops did so as a rational food import substitution decision in response to high transport costs in product markets (Omamo, 1998). Work in Tanzania and Zambia concluded that smallholder farmer participation can be encouraged if marketing costs (mainly transaction costs) can be reduced (Kahkonen and Leathers, 1999). In spite of the importance of transaction costs, they are not the only variable likely to have an impact on smallholder marketing.

Studies on other markets, particularly external inputs and financial services, studies report an even lower level of smallholder market participation. As a case in point, fertiliser use in Africa is low, with most estimates reporting an average of 12kg per hectare applied or less, compared to more than 100kg per hectare for other parts of the developing world (Crawford *et al*. 2006, Minot, 2009). Application rates vary considerably by country, by region within countries, and by crop. Higher rates of fertiliser use are mainly attributed to the higher potential areas where intensive cultivation takes place, such as the central highlands of Kenya, and among farmers engaged in cash crop farming, such as cotton or those who are part of out-grower schemes where there are well established means to distribute fertiliser (Wiggins and Keats, 2013). Overall, therefore, it can be reasonably confidently said that the majority of smallholders use very little, if any, manufactured fertiliser. Even less participation takes place with financial services. Farm surveys often report less than one in ten small-scale farmers getting a formal loan from a bank or other financial agency for agricultural purposes (Jessop *et al.* 2012) Agricultural insurance schemes particularly for staples are relatively in their infancy explaining partly why it is rare for farm households to be able to insure formally through an insurance policy against the risks in farming, or more generally, yet these are becoming more complex in light of climate change and outbreak of severe and new crop pests and diseases.

2.6 Challenges to market access by smallholder farmers

Marketing is often cited as one of the key challenges to agricultural development, especially in developing countries, yet building the production capacity of smallholder farmers and improving their access to markets are key to poverty reduction and rural development (Fischer. and Qaim, 2011). Smallholder farmer inclusion in markets is severely impeded by multiple market failures (Jayne *et al.* 2010). Since most of them live in poor remote areas, poor infrastructure results in high transaction costs that reduce their incentives for participation in both input and output markets (Kleih, 2004; Barrett, 2008). The highly diversified nature of smallholder agricultural activities creates a structure where production is largely geared towards family consumption needs and not so responsive to market requirements (Deninger and Okidi, 2001). Moreover, by generating small and scattered surpluses, such production patterns contribute significantly to high transaction costs and risks, especially in the context of poorly developed road and telecommunication infrastructure (Marter and Wandschneider, 2002). Long distances from markets rules out the production of higher-value perishable crops and reduces the linkages between these producers and more specialized markets (Kindness and Gordon, 2001).

Smallholder market access is also hampered by limited access to, and use of, services including effective extension and rural credit (Halloway and Ehui, 2002; Reardon *et al.* 2009; Wiggins *et al*. 2010), which are important preconditions in upgrading productions systems. This partly results from a bias among organisations providing marketing extension support in which they focus on large scale farmers who are considered to be easy to reach and more likely to heed the messages and bring about impact (Benin, 2004). However, it could be a result of the emphasis on most agricultural service providers on production extension support compared to marketing. Even among agricultural economists, the focus has been on how to increase production and productivity assuming that whatever is produced is demanded by consumers and will reach consumers at an affordable price. Other limiting factors include, lack of market information and market asymmetry (Ferris, 2004), liquidity constraints that make it difficult to optimise time of sale (Coote and Wandschnieder, 2001); low output prices relative to input prices (Kiiza *et al.* 2004); low productivity and hence low marketable surplus (Kleih, 2004; Nyapindi, 2004). Significant taxation, official and unofficial, of agricultural products in transit further exacerbates marketing costs and risks (Ellis and Bahigwa, 2001). Insecure land tenure is characteristic of

small producers and severely hampers their ability to get access to credit and get involved in markets (Maryanne*et al*, 2007).

Producer organisations, farmer groups, associations and cooperatives, as institutions for collective action, are often viewed as an important mechanism for enhancing the market inclusion of smallholder farmers (Kariuki, 2005; Markelova, *et al*.2010), through facilitating economies of scale, improving bargaining power of farmers, access to market information and linking farmers directly to final consumers These institutions can be oriented towards increasing production, marketing and or livelihoods in general, sometimes serving more than one purpose (Gabre-Madhin 2007; Bernard *et al.* 2009; Francesconi and Heerink 2011). Experiences with collective action suggest that it has been more successful in reducing transaction costs and supporting smallholder farmer inclusion in high value markets. Okello *et al.* (2007) report how smallholder farmer groups in Kenya, Ethiopia and Zambia were able to deliver their green beans to European markets. Similarly, positive benefits have been recorded with cooperative marketing among smallholder fruit and vegetable farmers in Tanzania (Barham and Chitemi, 2009). In Uganda, success with collective marketing was reported in the potato sector, where smallholder farmers in Kabale district have successfully supplied potatoes to Nandos, an upscale market outlet in Kampala (Kaganzi *et al*. 2009) and smallholder farmers supplying the commercial beer breweries with sorghum (Elepu and Nalukenge, 2009).

In contrast, some reviews criticise particular donors for having focused too much on the high-value export markets through collective action and other linkage mechanisms, arguing that the cost of certification and risks involved have often been too high, to the detriment of smallholder farmers (Jaffee *et al.* 2011). That high value markets such as supermarkets will source their supplies from small farmers, but only when they cannot get supplies from larger farms, sometimes when farmers have already invested in essential assets such as cooling tanks for milk, and often when farmers are organised in groups. A study by Vorley *et al.* (2011) questions the basis of a strategy that aims at enhancing smallholder market participation in more sophisticated chains of exporters and processors as it may cause policy makers to ignore the importance of informal markets that a majority of the smallholder farmers are linked to and depend on. There is also the bigger issue that probably the priorities and interventions for the vulnerable smallholders could focus on other fields: in stimulating the demand for labour, in building their assets, in

improving their health and education and in providing social protection, especially for those unable to work, as opposed to market inclusion (Wiggins and Keats, 2013).

However, novel as it may be, there are few examples of successful collective action with respect to staple crops especially the non-dry grain high value staples. Also, many collective action initiatives, including some of those reported in the preceding section, are externally supported or based on externally-driven criteria, which may not resonate locally. Therefore, it is important that such initiatives address a felt need, are internally-driven and have agreed entry and other requirements.

The next sub-section reviews the literature on agricultural technology adoption. It is premised on the fact that OFSP, as well as the decision to adopt it as a tradable commodity constitutes an agricultural innovation. In this particular case, the focus is on adopting it for the market, and along the value chain.

2.7 Agricultural technology adoption

Agriculture remains the main source of livelihoods especially for the rural poor (MAAIF, 2010) and the options for improving the output of smallholder agriculture through area expansion are often limited. Adoption of technological innovations is considered one of the most viable options for unlocking the potential of the agricultural sector (Doss *et al.* 2003; Asfaw *et al.* 2010). Some studies have demonstrated a robust and positive effect of agricultural crop adoption on farm household well-being through increasing incomes from sale of the crops. This suggests that there is a large scope for enhancing the role of agricultural technology in directly contributing to poverty alleviation.

In spite of the potential discussed above, results of most adoption studies have revealed varying but, often dismal rates of adoption of innovations. For example studies by the International Wheat and Maize Improvement Centre (CIMMYT) on the impact of maize research and extension work on smallholder farmers throughout Tanzania between 1975 and 1995 report adoption rates of between 0.08 and 0.52 for improved maize seed and between 0.1 and 0.33 for improved fertilizer use in maize (Mafuru *et al.* 1999). Similarly, one of the most comprehensive reviews of the impact of agricultural innovations, a meta evaluation of more than 700 case studies, commissioned by IFPRI, concluded that while average rates of return to agricultural

research and development were 48%, there was a wide range from zero to 636% (Alston *et al.* 2000). This underscores the need to understand the constraints and opportunities to technology adoption, especially at farm level, as a prerequisite for designing effective technological innovations, including those promoting biofortified crops. The next sub-section reviews findings from relevant studies on staple crop technology adoption.

2.7.1. Empirical studies on technology adoption

Drawing on insights from the adoption of innovations paradigm as well as other adoption concepts, a number of empirical studies have been conducted aimed at understanding the nature and determinants of the adoption decision process. Due to the large number of adoption studies, particularly at the producer (farm) level, this review focuses on relevant adoption studies from the developing world, mainly Africa and with a focus of staple crops. The literature review did not find any documented work on adoption and acceptability of staple crops, in general, and biofortified crops in particular by traders. Similarly, with the possible exception of results reported as part of this project, no studies were found that investigated factors influencing adoption of a biofortified crop by producers for the market. With these caveats in mind, this sub-section starts with a review of literature on adoption of staple crops followed by a review of literature on adoption and acceptability of biofortified crops by producers and consumers.

Adoption of staple crops

Studies on staple crop technology adoption in the developing world gained prominence after the Green Revolution in Asia. One of the influential studies is a synthesis of earlier studies on the adoption of the High Yielding Varieties (HYVs) of wheat and rice that culminated in the Green Revolution. It highlighted the importance of land tenure system and varietal characteristics in the adoption decisions of Asian Farmers (Ruttan, 1977). Other findings were that the HYVs were rapidly adopted in areas where they were economically and technically superior to existing varieties and that land owners tended to gain more than tenants and labourers from adoption of the HYVs. However, farm size was initially not a serious constraint to adoption as the performance of the HYVs was similar in both small and large farmers' fields.

Between 1996 and 1999, the International Maize and Wheat Improvement Centre (CIMMYT) commissioned 22 micro-level studies on the adoption of improved wheat and maize technologies

in Ethiopia, Kenya, Tanzania and Uganda. A synthesis of results from these studies (Doss *et al.* 2003) opined that access to extension services was highly correlated with technology adoption as this played a pivotal role in disseminating information on new technologies and how to manage them. Other important determinants of technology adoption were classified into attributes associated with the farmer and farm, characteristics of the technology, and objectives of the farmer. Factors that accounted for poor technology adoption were lack of awareness, including misconception about the technology; limited profitability; and unavailability of technology. These studies focussed on farm-level adoption whereas this thesis uptake along the value chain, that is, at producer, trader and consumer levels.

The adoption of improved cassava varieties in Uganda (Abele *et al.* 2007) was found to be positively correlated with the following technological attributes: disease resistance, maturity period, taste and dry matter content. That farmers chose varieties that were resistant to diseases, matured early, with high dry matter content and sweet taste. This study further established that older farmers and bigger households were more likely to adopt improved cassava varieties compared to younger farmers and smaller households, since it is a key food crop. Earlier work by the National Cassava Research Programme in Uganda (Akullo, Undated) revealed that variety adoption was highly dependent on the characteristics of a particular variety, including: high yield, sweet taste and marketing prospects. Varietal preferences varied across the country according to prevalent local food and farming systems.

Similar work undertaken on cassava in the Lake Zone of Tanzania (Kavia *et al.* 2007) revealed that lack of information on the improved cassava varieties; susceptibility to CMVD; and low starch levels significantly affected the adoption of cassava varieties. Other determinants of adoption were age, formal education, farmer experience in farming and the amount of land available and farmed. However, this study noted that for farmers who had sold cassava in the past, the area allocated to improved varieties declined. This was attributed to the fact that the improved varieties were not as acceptable as the local ones by urban consumers, due to their unpleasant taste. This work differs from the adoption studies reviewed in the preceding paragraphs in that it highlighted the importance of consumer-preferred attributes in variety adoption. Nonetheless, like the other studies, results were based on data from a farm-level

survey. Little work has been done to link consumer perceptions with farmer adoption studies, yet consumer perceptions may be more important in the adoption of biofortified crops.

An analysis of farmer preferences in sweetpotato varieties in Uganda by the International Potato Centre (CIP), identified high yield, sweet taste and early maturity as the most sought after characteristics in a variety (Yanggen and Nagujja, 2006). Although marketability was not explicitly stated as a preferred attribute by producers, sweet taste is more of a consumer characteristic that may have a bearing on marketability. Similarly, since most sweetpotato farmers are subsistence, high yield may generate a marketable surplus. Furthermore, this piece of literature, like the Uganda study on adoption of improved cassava varieties, highlights the fact that sweetpotato preferences have a regional dimension. Farmers and consumers from the centre and East (Busoga region) of the country prefer WFSP compared to their counterparts in the north and north- east who prefer YFSP. Regional preferences were later confirmed by other studies (Low *et al.* 2009). It is therefore reasonable to expect that uptake of OFSP may have regional dimensions, stemming in part from differences in consumer preferences.

An *ex-ante* assessment of the economic viability of adopting dual-purpose (for feed and food) sweetpotato in a mixed crop-livestock system in Western Kenya (Claessens *et al.* 2009) identified yield of the dual purpose sweetpotato and harvest index (the ratio between tuber and fodder yields) as the most important determinants of adoption. Other important factors affecting uptake were the price of milk and the nutritional value of fodder. This study also found strong regional differences in the preference by consumers for a particular sweetpotato type.

The adoption studies reviewed above looked at the general factors affecting technology adoption. Other studies have analysed the role of a particular variable in the technology adoption process. Meredia and Minde (2002) studied the role of profitability (higher gross margins) of a technological innovation in determining adoption. They identified three types of agricultural technological innovations. First, technologies that are profitable under researcher-controlled environments and on-farm trials and demonstration plots such as wheat and hybrid maize in Ethiopia; and use of inorganic fertilizer on maize in Kenya. Second, technologies that are profitable on farmers' fields but under specific circumstances, the use of drought animal power technology for weeding on farms less than two hectares is a case in point; and, third, those

profitable and highly adopted, such as coffee and cassava in Kenya and Uganda respectively. This study offers two valuable insights. Firstly, it underscores the need for suppliers of technological innovations to offer relevant and profitable options and, secondly, technology adoption may vary in different ways depending on the context in which they are applied.

Linking technology adoption and commercialisation of chick-pea, Asfaw *et al.* (2010) found that farmers in Ethiopia who adopted improved chick-pea technologies were able to market their output since higher productivity from improved technologies translated into higher output market integration. They observed that promotion of improved technologies is a vital stimulus in encouraging smallholder market participation. These authors identified knowledge of improved varieties, household wealth (livestock and land) and availability of active family labour force as significant drivers of chick-pea technology adoption.

A number of adoption studies have examined the role of social networks in the adoption process. Experience from the Indian Green Revolution suggests that farmers learn how to cultivate a new crop from the choices of others also cultivating the same crop (Munshi, 2004). In contrast, an examination of the role of social networks in the adoption of improved sunflower technologies in Northern Mozambique (Bandiera and Rasul, 2006) revealed that adoption decisions are positive when there are few adopters in the network and negative when there are many adopters. Adoption is more highly correlated within networks of family and friends than other network types. Furthermore, adoption decisions of farmers who have better information on a technology are less influenced by adoption choices of others. In Uganda work on diffusion of green manure technologies (Isabirye, 2009) identified extension workers as well as farmer-to-farmer networks as the main channels through which the technology was disseminated.

In conclusion, many studies have been undertaken on adoption of improved staple crop technologies by farmers in the developing world. A majority of these studies focussed on the general factors influencing or affecting technology adoption, but a growing body of work explores the role of specific factors, such as social networks and marketing in technology adoption. While the key factors affecting technology adoption vary from one technology to another, they can be grouped into: i) nature, attributes and availability of the technology, ii) access to and quality of extension support, and iii) characteristics of the farm and farmer.

Specific factors in the adoption process that have been of interest to scholars include role of social networks and marketing opportunities. This work departs from these earlier ones in that it focuses on uptake and adoption along the value chain, that is, by producers, consumers and traders. The next sub-section focuses on adoption and acceptability of biofortified crops.

Adoption and acceptability of pro-vitamin A containing biofortified crops

The previous sub-section analysed the factors affecting the adoption of staple crops in Africa. This sub-section focuses on the adoption of staple crops biofortified with pro-vitamin A. Maize (yellow and orange types) and sweetpotato (orange) are the two staple crops that have been bred and disseminated in Africa as a means of overcoming VAD. This section reviews literature on the adoption and acceptability of biofortified maize and OFSP in Africa.

Adoption and acceptability of biofortified maize

Three types of maize, according to colour, can be discerned. White maize, which has no carotenoids; yellow maize with little carotenoids; and orange maize which has significant amounts of carotenoids (Menkir *et al.* 2008). With the exception of two studies on orange maize; one in Maputo, Mozambique (Stevens and Winter-Nelson, 2008)and the other in rural Zambia (Meenakshi *et al.* 2010), most of the other adoption and acceptability studies on biofortified maize in Africa have been conducted on yellow maize.

Biofortified yellow maize has been promoted in East and Central Africa where white maize is a key staple crop. A study on consumers' willingness-to-pay for yellow maize in Nairobi, Kenya revealed a strong preference for white maize (De- Groote. and Kemenju, 2008) in spite of the nutritional benefits of yellow maize. Only a few consumers would buy biofortified yellow maize at the same price as white maize, and actually most consumers would need a 37% price discount to buy yellow maize. It revealed that socio-economic factors such as gender, education, income and ethnic background influence consumer preference. These findings corroborate earlier research by FAO and the CIMMYT in Kenya that concluded that the price of white maize was consistently higher than the price of yellow biofortified maize in the local markets(FAO. and CIMMYT, 1997). High consumer preference for white maize over yellow maize is attributed to the fact that consumers consider yellow maize to be inferior since most of it had been distributed as relief food and considered more suitable for animal feed (Rubey *et al.*1997).

Results similar to those in the Kenya study above were obtained from a study conducted in South Africa, where consumers initially selected white maize meal instead of the biofortified yellow maize meal. However, provision of nutrition information resulted in an increase in acceptability of yellow maize from 23% to 90% in one area and zero to 85% in the other study area (Vermeulen, 2005).

In Zimbabwe, a study was undertaken to analyse consumers' awareness of, and attitudes towards, consumption of biofortified yellow maize (Muzhingi *et al.* 2008). Findings revealed that while most consumers were aware of yellow maize, few knew about its nutritional value and few were consuming it. Yellow maize was perceived to be inferior to white maize and considered unfit for human consumption. The study recommended nutritional education targeted at low income households as a means of increasing acceptability and consumption of yellow maize.

Using "taste test and a trading experiment", the acceptability of biofortified orange maize was evaluated in Maputo, Mozambique (Stevens and Winter-Nelson, 2008). The taste, texture and appearance of the local white maize were considered to be better than the biofortified orange maize. Household size, presence of small children, dietary diversity and perceived taste were significant determinants of acceptability of orange maize.

In contrast, work on consumer acceptance of biofortified orange maize in rural Zambia concluded that, in spite of the negative attitudes towards yellow maize, orange maize is likely to be accepted and that provision of nutrition information translated into a price premium (Meenakshi *et al.* 2010). This work was conducted in the Central and Southern Provinces of Zambia, which are two of the provinces with the highest production and consumption of maize coupled with a high percentage of the poor. Indeed all respondents reported that maize is their primary staple and that they consume it daily. Muzhingi*et al*. (2008) contend that nutrition information is the single most important factor in determining a household's decision to purchase nutritionally enhanced maize. They concluded that in Zimbabwe, a nutrition campaign can significantly alter consumers' perceptions and lead to a much higher probability that non-white maize would be consumed.

Three conclusions emerge from the review of literature on adoption and acceptability of biofortified maize. Firstly, all the studies reported were on consumer acceptability. No work has been done on farmer and trader adoption and uptake. This emphasis on end-user (consumer) acceptability contrasts with work done on adoption of staple crops in general, which, as earlier noted, is mainly based on farm-level studies or the producer node of the value chain. Secondly, while most of the studies conclude that white maize is more preferred to yellow and orange maize types, and commands a price premium, provision of nutrition information has the potential of creating a positive impact on acceptability of biofortified yellow and orange maize types. Finally, one of the key barriers to acceptability of yellow and orange maize types is the negative attitude towards it, which signals the importance of awareness creation of nutritional benefits in driving acceptability.

Adoption and acceptability of biofortified sweetpotato

Three types of sweetpotato are grown and consumed in Africa: white, yellow and orange. OFSP is grown in smaller quantities and rarely sold in most markets, and in spite of its nutritional value, it is the least preferred (Low *et al.* 2009). This review focuses on OFSP adoption and acceptability studies conducted in Kenya, Mozambique and Uganda, since these are the countries in which most of the precursor work to the REU project on promotion and dissemination of OFSP in Africa has been undertaken.

One of the first acceptability and adoption studies of OFSP in Africa was conducted in Kenya in 1999. It evaluated the impact of a two-year (1995-1997) collaborative research project that introduced OFSP to women farmers in Western Kenya by integrating nutrition education and production support. The findings indicate that producers and consumers of OFSP found the root appearance, taste and texture to be as acceptable as non-OFSP (Hagenimana *et al.* 1999). However, OFSP varieties were more likely to be adopted by farmers if they were relatively high in starch levels, low in fibre, high yielding, pest and disease tolerant and were introduced through community-level education with focus on the health benefits to young children (Hagenimana *et al.*op.cit). This mirrors findings by West (2002`) who observed that food-based innovations implemented with active participation of women and community engagement, through social

marketing[7], were more likely to introduce changes in food preparation and consumption, improve pro-vitamin A intake and eventually enhance the vitamin A status of the target beneficiaries.

An adoption study of OFSP by farmers in Mozambique (Mazuze, 2004) identified three factors influencing uptake: sweetpotato area cultivated, number of times the farmers received OFSP vines and participated in field days and demonstrations of processed products. Farmers who already devoted a large area of land to sweetpotato were more likely to plant OFSP. Thus, farmers who attach importance to sweetpotato as a staple crop by allocating more land to it were more likely to adopt OFSP. It should be noted that in Mozambique, sweetpotato is a minor staple, that is, they are consumed as a snack or breakfast dish, rather than as a main meal, as in Uganda. The number of times a farmer received vines was important in adoption decisions given the erratic nature of rainfall in the area as well as the fragile nature of OFSP vines. Although this work did not identify marketability as a key constraint to adoption of OFSP, it recommended a series of marketing interventions such as appropriate processing and storage techniques and identifying market opportunities for OFSP roots and processed products as ways of spurring adoption of OFSP.

Experiences from the "Towards Sustainable Nutrition Improvement Project" (TSNI) in the Zambezia province of Mozambique, which aimed at increasing intake of pro-vitamin A and to increase serum retinol among young children through integrated agricultural extension, nutrition and marketing, reported high adoption rates (90%) among the treatment households producing OFSP by end of year two of the project (Low *et al.* 2007). Analysis of results obtained indicated the importance of a marketing component in promoting adoption.

OFSP promotion in Uganda started in the late 1990s and was spearheaded by the National Agricultural Research Organisation (NARO) with support from the International Potato Center (CIP) and other development partners. An assessment by CIP in 2005 of varietal preferences by farmers in Uganda identified sweet taste and nutritional value as the most important sought-after attributes of OFSP (Yanggen and Nagujja, 2006). However, nutritional value was identified only

[7] Social marketing is a form of marketing that seeks to influence social behaviour for the benefit of the audience and general society as opposed to the benefit of the marketer. It seeks to respond to the needs of the audience as opposed to persuading them to buy what is available. KOTLER, P. & ZALTAN, G. 1971. Social Marketing: An Approach to Planned Social Change. *Journal of Marketing,* 35**,** 3-12.

in areas where OFSP had been introduced. The importance of nutritional value did not imply that it is a highly sought-after characteristic in the choice of a sweetpotato variety (Yaggen and Nagujja, op.cit). Disadvantages of OFSP that were identified included susceptibility to rotting and pest and disease infestation. A similar study by CIP and NARO (Tumwegamire *et al.* 2007) indicated that one OFSP variety, *Ejumula,* was highly accepted for its good yield, starch content, root appearance and taste. However, it was also highly susceptible to viral infection and prolonged drought, which resulted into scarcity of vines at the onset of the planting season, thereby affecting adoption. The implication is that specific OFSP varieties may have variety-specific attributes that may affect uptake and adoption along the value chain.

Analysis of consumer acceptability of OFSP among 105 non-farming households in Soroti Municipality and 65 non-farming households in Kampala city in 2006 (Oburu, 2006) revealed low levels of consumer acceptance, estimated at 14%, and attributed this to a lack of awareness of OFSP among consumers. Knowledge of nutritional value, sweet taste and compatibility with existing sweetpotato consumption habits were identified as key determinants of acceptability. The provision of information on the nutritional value of OFSP greatly improved acceptance to 55%.

During the diagnostic phase of the REU project, it was reported that OFSP was not traded in significant quantities. Where it was sold, it was often in heaps mixed with the preferred white or yellow types (Tomlins *et al.* 2009). Traders in the Kampala markets reported that there was little interest in OFSP, where most consumers preferred the yellow-fleshed variety *Tanzania* with its high dry matter content. Acceptability of OFSP was observed in areas where it had been actively promoted and among educated consumers, aware of its nutritional benefits. In some of these areas, OFSP sold at a higher price compared to non-OFSP (Coote *et al.* 2007).This finding underscored the importance of nutrition information in influencing the decision to adopt OFSP.

A Willingness-to-Pay study for OFSP in Uganda reported that the price of OFSP was comparable to that of non-OFSP in the markets, when not accompanied by nutritional information (Chowdhury *et al.* 2009). It concluded that where sweetpotato are produced and consumed on-farm, and their agronomic properties are acceptable, the likelihood that OFSP will be accepted in the household is high. However, when information of nutritional benefits of OFSP

was provided, consumers were willing to pay a higher price, with higher premiums for the deeper orange OFSP varieties (Chowdhury *et al.* ibid). This underscores the potential role that nutritional information and social marketing can play in promoting OFSP in the markets.

In conclusion, the literature on uptake and acceptability of biofortified crops is largely in respect to maize and sweetpotato, two of the most widely promoted biofortified crops in the developing world. Biofortified maize and sweetpotato are visually different. Most of the studies have focussed on uptake of biofortified maize and sweetpotato by producers and acceptability by consumers. No work has been done on uptake of biofortified crops in general and OFSP in particular by traders. Another key thread in these studies is that while biofortified crops are initially not as acceptable as the non-biofortified ones, acceptability greatly increases with the provision of nutrition information. Finally, in addition to nutritional benefits, biofortified crops should possess desirable agronomic and sensory attributes. This is the first acceptability study that addresses the entire value chain of a biofortified crop.

2.8 Summary of key issues highlighted by the literature review

The literature review sought to understand the factors that are likely to play a role in the adoption of OFSP along the value chain and the role of marketing in a biofortification intervention. The literature reviewed was in five broad, but related themes: i) overview of marketing theory, ii) the role of markets in reducing poverty, ii) factors affecting smallholder farmer inclusion participation, iii) adoption of improved agricultural technology, and iv) adoption and acceptability of biofortified staple crops.

The literature on agricultural marketing theory postulates that it originated as a discipline dealing with the process of getting agricultural commodities from the farmer to the consumer, and was initially shaped by the commodity, functional and institutional schools of thought. From the 1950s, the management approach took a central role in influencing agricultural marketing with behavioural and quantitative sciences as key concepts both underpinning the need companies to hold a deep understanding of the wants and needs of their customers Research studied the optimal use of marketing instruments such as the four ‘Ps (Products, Prices, Place and Promotion), that intended to push products through distribution channels meanwhile creating a pull on consumer markets through promotion and price actions This approach departed from the

previous one in that it was informed by behavioural sciences, decision sciences, giving it a multi-disciplinary outlook.

Other theoretical foundations that shaped current marketing discourse include market structure analysis, market efficiency studies, regional and spatial analysis and price analysis and recently the value chain approach, which is particularly relevant to this work. The value chain (VC) describes a full range of activities which are required to bring a product or service from conception through the different phases of production, delivery to final consumers and final disposal after use. The VC has its theoretical underpinnings in the business management paradigm; world systems theory; and the political economy of food and agriculture. Within the VC discourse, three concepts are particularly relevant to this work: chain, upgrading and governance. Chain originates from the supply chain literature and connotes the processes and actors that take a product (OFSP in this case) from its conception to its disposal after end use or the life cycle of the product. Upgrading denotes the process of increasing the competitiveness of the value chain by moving it in a new direction-towards a new market, market segment or customer; towards increased efficiency within the value chain; or towards adding operations within the value chain. Finally, governance refers to the process of specifying, communicating and enforcing compliance with key product and process parameters along the value chain. A recent application of value chain concepts to food and nutrition has resulted in the emergence of the concept of food value chains, which comprise activities necessary to bring farm products to consumers, including agricultural production, processing, storage, marketing, distribution and consumption. Within this body of work, a typology of FVCs based on participants and their interactions, markets targeted, and types of products offered to end consumers has been developed. This clusters FVC into four: traditional, modern, modern-to-traditional and traditional-to-modern. A criticism of the VC literature, which could be extrapolated to most marketing literature, is that it has focussed more on high value crops, livestock and livestock products with an apparent neglect on staple crops particularly the perishable and bulky ones which support the livelihoods of most of the poor. There is also an apparent proliferation of different terminologies which discuss similar concepts or ideas, with more in common compared to what sets them apart. Finally, most work has focussed on particular aspects of the VC notably producers and to some extent consumers undermining the holistic nature of the approach.

The second strand of literature highlights the relationship between technology adoption and poverty reduction, underscoring the need to improve market access particularly for the poor as a pathway out of poverty. However, although improved market access is a critical driver of sustained and broad-based poverty-reducing development, on its own, it is neither a magic bullet nor a sufficient condition for development: other social, political and technical processes of change are also vital.

Most work on smallholder farmer market participation is on high value cash crops, livestock and livestock products. There is also an emerging and growing body of work on smallholder participation in modern value chains, epitomised by supermarkets. The literature on smallholder farmer market participation, with respect to staple crops, is still thin, with most of it focussing on hard grains such as maize, rice and wheat, and less on bulky and perishable staples such as cassava and sweetpotato. There appears to be little written about the role of marketing in a biofortification crop intervention, where marketing is a means of achieving nutritional benefits as opposed to increasing smallholder farmer incomes *per se*. Three themes have been identified by this strand of literature: first the level of market participation is low, and concentrated among a few smallholder farmers. Smallholder inclusion in input market and financial services markets is even much lower; second there is a positive relationship between wealth of the farmer, as epitomised by asset ownership, favourable geography and market participation; and third, transaction costs in particular constitute a key barrier to smallholder market participation.

The key barriers to market participation by smallholder farmers include a shortage of producer organizations; lack of understanding of markets or how they operate; limited business and negotiation skills; and difficulty in accessing markets in rich countries as major factors limiting market access.

Many studies have been undertaken on adoption of improved staple crop technologies by farmers in the developing world. A majority of these studies focussed on the general factors influencing or affecting technology adoption, but a limited and growing body of work explores the role of specific factors such as social networks and commercialisation in technology adoption. While the key factors affecting technology adoption vary from technology to another, they can be grouped into: i) nature, attributes and availability of the technology, ii) access to and quality of extension

support, and iii) characteristics of the farm and farmer. Specific factors in the adoption process that have been of interest to scholars include the role of social networks and commercialisation. This work departs from these earlier ones in that it will focus on uptake and adoption along the value chain, that is, by producers, consumers and traders. It is also novel in that it situates uptake within the context of a biofortified staple crop, and uptake specifically for the market. However, a likely weakness is that, the study was undertaken after one year since inception of the intervention. In contrast, all the adoption studies were conducted at least one-year after the end of the project. That is, depending on the technology, most adoption studies were conducted at least three years after the introduction of the intervention under study, since most projects are implemented for at least two years.

Turning specifically to adoption and acceptability of biofortified staple crops, the work reported to date concerns sweetpotato and maize. Three conclusions emerge from the review of literature on adoption and acceptability of biofortified maize. Firstly, all the studies reported were on consumer acceptability. Therefore, no work has been done on farmer and trader adoption and uptake. This emphasis on end-user (consumer) acceptability contrasts work done on adoption of staple crops in general, which as earlier noted, are mainly farm level studies. Secondly
, most of these studies conclude that white maize is more preferred to yellow and orange maize types and commands a price premium, provision of nutrition information has the potential of creating a positive impact on acceptability of yellow and orange maize types. Finally, one of the key barriers to acceptability of yellow and orange maize types is the negative attitude to it as an inferior food suitable for animals and distribution as food aid, signalling the importance of awareness creation in driving acceptability.

OFSP is still relatively new among producers, traders and consumers in Uganda. In the markets, it is rarely traded separately and not considered as acceptable as the preferred YFSP and WFSP. However, provision of nutrition information, especially to consumers is likely to improve consumer acceptability. Varietal attributes such as root appearance, agronomic traits and taste appear to play an important role in adoption and acceptability of OFSP. Extension approaches, particularly community-level education, and participation of women, are other important determinants of uptake. Most of the literature cited particularly on consumer acceptance, is based on hypothetical scenarios. There is no work reported on uptake of OFSP by traders.

The work reported in this thesis, therefore, is novel and contributes to existing knowledge by analysing the factors that will influence the decision of producers and traders to sell OFSP, and consumers to purchase it. It will also assess the role that a marketing component can play in a biofortification intervention.

Chapter Three: Theoretical and Conceptual Framework

3.1 Introduction

This chapter presents the main theories that inform and guide this study, which examines factors influencing adoption of OFSP as a tradable commodity, and the role of marketing in a biofortified intervention. It illustrates how the key concepts that underpin the study are derived from the value chain and adoption decision theory. It illustrates how and why both are used to complement each other rather than focussing on single theories. The first part of this chapter presents the theoretical perspectives, and the second part demonstrates how the key concepts, which underpin this study, are derived from the theory.

3.2 Theoretical framework

This thesis locates decision making within the realm of adoption of agricultural innovations, in the context of a nascent value chain. The theoretical foundation is provided by decision theory, adoption theory and the value chain. Explanations are provided below of how these three concepts can help explain, predict and understand the factors influencing decision making along the OFSP value chain, and the role of marketing in a biofortification intervention.

3.2.1 Value chain theory as a means of understanding the decision to adopt OFSP

The value chain is a concept that has widely been used in agricultural research and development, specifically in the field of agricultural marketing. In this study, it will be used as a unit of analysis of decision making with respect to OFSP. It will help provide an understanding of the dynamics of OFSP marketing decision-making, and in identifying and analysing the key players, as well as investigating the interactions and relationship between the chain actors.

An entry-point in applying the VC will be in mapping the chain to identify the key actors and their interconnectedness. Each of the actors or nodes will be viewed as both an independent and

interconnected unit of analysis. Key activities performed, factors underlying the choice of a particular activity and subsequent value added or product transformation along each of the nodes will be analysed. It is envisaged that some activities will be performed in specific nodes only while others may be vertically integrated. Within each of the nodes, the input-output relationship will be examined, as well as value addition. In case of vertical integration, linkage mechanisms within and between the nodes will be examined. This will also form the conceptual bridge between the value chain and adoption decision theory.

While the VC will analyse decision-making in terms of input-output relation, there are other non-economic influences to decision making, which are particularly important since OFSP was promoted not as a means of increasing income, but reducing vitamin A deficiency. The VC, therefore, falls short of providing these theoretical explanations, and decision and adoption theory provide this additional dimension.

3.2.2 Decision theory

Decision theory is a multi-disciplinary discourse, which has its roots in economics, psychology, sociology, philosophy, mathematics and statistics. Decision theorists contend that when there are options to choose from, choice is made in a non-random way. Hence, decision theory is concerned with goal-directed behaviour in the presence of options (Hansson, 2005). One of the key theories that has shaped neoclassical economics, and has been used to explain decision making is rational choice theory - human beings act as if balancing costs against benefits to arrive at action which maximizes personal advantage (Friedman, 1953; Becker, 1978). In other words, while choosing from a set of possible courses of action, human beings opt for the alternative that minimizes costs and maximizes benefits (Blume and Easley, 2008).

However, this study rejects the notion that decision-making is based on considerations of costs and benefits only, since a multiplicity of other factors often contribute to the decision making process. Besides, OFSP, which is at the core of this work, is promoted for its nutritional value, and marketing is used as a means of increasing consumption not income *per se*. Instead, this work builds on aspects of the bounded rationality paradigm of decision making. The key proponents of bounded rationality contend that decision making is limited by available information, the finite amount of time available to make a decision and information processing

ability of the mind (Herbert, 1955). The theory of bounded rationality brings to the fore the importance of the cognitive abilities of the decision-making unit in the decision-making process. The theory of bounded rationality is therefore a rejection of the theory of rationale choice. Later proponents of the theory of bounded rationality (Landa and Wang, 2001) have broadened the model, justifying the need to look beyond the cognitive limitations of the mind in decision making, and include the adaptive relationship between decision strategies and the ecological, social and institutional environment in which the decision task is presented. In other words, examining the impact of the wider environment in the individual decision making process.

Therefore, the theory of decision making provides three key insights for this study. First, in understanding the decision-making process there is need to look beyond the constraints of the rational economic model in which decision making is taken based solely on an analysis of marginal costs and marginal returns; second the importance of the cognitive ability (access to information, time and processing ability of the mind) in the decision making process; and third the need to re-cast the analysis of decision making within the wider social, political and economic environment that surrounds the decision making units.

3.2.3 Adoption theory

Like decision theory, the core of adoption theory examines the individual and the choices that they make to accept or reject a particular innovation or an innovation process. Adoption theory can, therefore, be viewed as a microcosm of decision theory applied to an innovation. In some models, the concept of adoption is extrapolated beyond just accepting an innovation but also to include the extent to which such an innovation is integrated into the appropriate context (Straub, 2009). Accordingly, adoption theory is a micro perspective on change, focusing not on the whole but rather pieces that make up the whole (Straub, 2009). This work is on the decision to accept or reject OFSP as a marketable commodity.

Two concepts in the adoption literature, relevant to this study are often used: innovation and adoption. It is, therefore, necessary to have an understanding of these concepts. Innovation involves the use of new ideas, new technologies or new ways of doing things in a place or by people where they have not been used before (Bernett, 2004). It does not necessarily matter if the idea, practice, or object is objectively new; rather it is the perception of novelty (Rogers,

1995). In agricultural development, the concept of an innovation system is increasingly used. An innovation system refers to a network of organisations, enterprises, and individuals focused on bringing new products, new processes and new forms of organisations into social and economic use, together with the institutions and policies that affect behaviour and performance (World Bank, 2007a). The innovation in this study is promoting marketing of OFSP along the value chain as means of increasing consumption.

Adoption, on the other hand, refers to the process through which an individual or other decision making unit passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision (Rogers, 2003). At the producer and trader level, adoption is considered to have taken place if OFSP is sold by producers and traders. Among the consumers, adoption is equated to acceptability and repeat purchase of OFSP. Diffusion or aggregate adoption is the process through which a technology is communicated through certain channels, over time, to members of a social system (Rogers, 1995).

Due to its wide applicability, adoption decision theory has been used in a multiplicity of fields and disciplines such as health and medical (DiClemente, 1994; Reyna, 2008); education (Pennington, 2004); computer science (Venkatesh *et al.* 2003); and sociology (Rogers, 1995; Deffuant *et al.* 2005). Of particular relevance to this thesis is the "Diffusion of Innovations Model" (Rogers, 1995), which has widely informed studies on adoption of agricultural innovations by farmers.

Rogers (2003) identifies five determinants of the adoption process: attributes of the innovation; nature of the innovation decision; communication channels used; social systems; and extent of change agents' promotion efforts. He further contends that there are five attributes upon which an innovation is judged by a potential adopter: First, it can be tried (triability); second, results can be observed (observability); third, it has advantages over other innovations present or under the circumstances that obtain (relative advantage); fourth it is not overly complex to learn or use (complexity); and finally it fits or is compatible with the circumstances into which it will be adopted (compatibility).

In the case of this study, there is therefore need to consider the key attributes of OFSP, and how these may influence production, trading and consumption decisions along the value chain. The five attributes of an innovation identified by Rogers (op cit) will be used in understanding the factors influencing decision-making by producers, traders and consumers. For example, does OFSP have advantages over other sweetpotato types, and can they be observed?

Innovation decision theory (Rogers, 2003) postulates that potential adopters of an innovation progress over five stages on the diffusion process (Table 3.1): first, they must learn about the innovation (knowledge); second, they must be persuaded of the value of the innovation (persuasion); then they must decide (decision); the innovation must then be implemented (implementation); and finally the decision has to be reaffirmed or rejected (confirmation).

Table 3.1: Description of the five stages that potential adopters of an innovation follow in the technology adoption process as described by Rogers, 2003

Stage	Description
Knowledge	The individual is first exposed to an innovation but lacks the information. During this stage, the individual has not yet been inspired to find more information
Persuasion	In this stage, the individual develops interest in the innovation and actively seeks for more information
Decision	This is when the individual takes the concept of the innovation and weighs the advantages and disadvantages of using it and decides whether to adopt it or not. It is considered the most difficult stage to acquire information on due to its individualistic nature
Implementation	The individual employs the innovation to a varying degree depending on the situation. It is at this stage that the individual determines the usefulness of the innovation
Confirmation	In this stage the individual finalises the use of the innovation to its fullest potential

Source: Rogers, 2003

In real life the adoption process may not be as linear as suggested by the technology adoption model. There are also other stages that precede the knowledge stage such as need recognition. In essence, the model treats the farmer as a passive recipient of technological innovations. Despite

these limitations, adoption of innovations model is one of the robust concepts used to examine and explain agricultural technology adoption, especially at producer level.

Another important dimension to decision-making that the adoption decision theory is silent about, yet critical to this study, is the influence of the characteristics of the decision making unit (producers, traders and consumers) on their perception towards an innovation, and ultimately decision to adopt or not to adopt it. In other words, there are differences both across the three key decision making units, and even within the actors in the same decision making unit that have implications on their adoption decision behaviour. Thus not all farmers, traders and consumers are homogeneous in terms of variables such as access to information, access to resources, and willingness to take risk associated with adoption of new commodities. These shortfalls are addressed in the theory of decision-making, and thus, together they form a comprehensive framework for this study.

3.3 Conceptualising the decision to adopt OFSP

The conceptual framework (Figure 3.1) provided a means of analysing and understanding the decision-making process along the OFSP value chain. In so doing, it framed the entire research process. This framework used the concept of the map or chain (Porter, 1995; Albu and Griffith, 2005) to map the key actors in the OFSP value chain (Box 1). Although the conceptualisation treated each of these nodes as independent, it recognised the interdependencies between and among them, since decision-making at one node is both relevant to and has implications on what happens in the other nodes.

The conceptualisation posits that awareness of and perceptions (Box 2) towards the innovation (OFSP) are critical to the decision of the value chain actors to adopt or reject it (Box 3). Perception of an innovation influences value assessment and propensity to adopt the new product/practice (Rogers, 1995). In other words, the decision to adopt OFSP will be influenced by awareness and perception of it by the decision making units, not necessarily on the reality of what OFSP is. To illustrate, the reality is that OFSP is nutritionally enhanced, but the perception of the actors may be negative (it has a bad smell) or positive (it is medicine or higher yielding). It is therefore this perception that influences adoption.

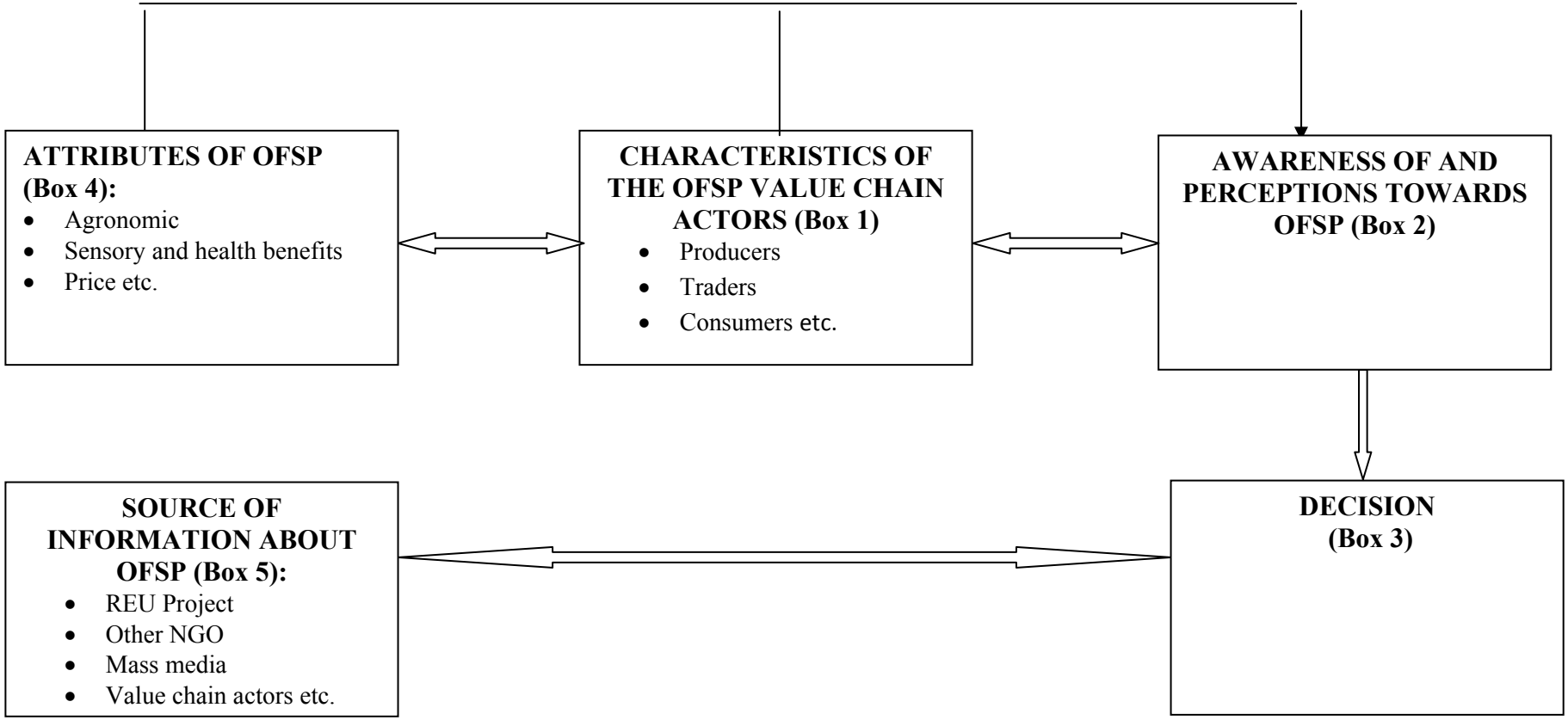

Figure 3.1: Visual representation of the conceptual framework used in this thesis. Its key tenet is that awareness of and perceptions towards an innovation (OFSP) by farmers, traders and consumers are central to their decision to adopt it as a marketable crop

Awareness and perception towards OFSP are influenced by i) the attributes of the crop (Box 4), source of information on the attributes (Box 5) and iii) characteristics of the decision-making unit (Box 1). The attributes of OFSP can include agronomic (yield, maturity period etc.), sensory and cognitive (colour, taste and health benefits) or market related (price and availability). The source of information on the attributes of OFSP may be the REU project, other NGOs, mass media or other actors in the value chain. After initial trial or experiences with OFSP, the decision-making unit (farmer, trader and consumer) also becomes a source of information of the attributes of OFSP, which lead to a further decision- making cycle either by the same actors or other actors in the chain. This may result into sustained uptake or even total rejection. The characteristics of the decision-making unit, access to resources including information, level of innovativeness and organizational form have an influence on their ability to process information about OFSP. The arrows denote flow of information, two way arrows denoting a two-way flow of information along the VC.

Chapter Four: Methodology and the Research Process

4.1 Introduction

This chapter presents the methodology used to collect and analyse the information and data presented in this thesis. It is divided into ten sections: section 4.2 describes the areas from where the data and information were collected. Section 4.3 provides an overview of the approach used to collect the data, building the case for a mixed methods approach. Section 4.4 to 4.7 outlines how information and data were collected at each of the three nodes of the OFSP value chain: the producers (4.4), traders (4.5) and consumers (4.6&4.7). This is followed by a description of how each of these data sets were analysed. The main ethical issues considered in this research are presented in section 4.8. The last two sections identify the main challenges encountered during the research (4.9) and the key limitations of the study (4.10).

4.2 The study areas

This sub-section presents a description of the socio-economic characteristics and the farming systems of the districts of Bukedea, Kamuli and Mukono (Figure 4.1), the main study areas. These are the same districts where the REU project was implemented. However, for the trader and consumer work, Mbale District, particularly the district capital, also called Mbale was included as it provided a major market outlet for OFSP produced in Bukedea district. The information presented in this sub-section is mainly derived from secondary data (published and unpublished), including REU project documents. This overview highlights the differences and similarities in the three areas that are likely to have implications for uptake of OFSP by producers, traders and consumers.

Please note that the description and boundaries of the districts reflects how they were at the time of the survey. New districts have since been formed and some of those described may have had their boundaries changed in the process.

Figure 4.1: Map of Uganda showing location of the three study districts (shaded) of Mukono, Kamuli and Bukedea relative to Kampala, the capital city and Lakes Victoria and Kyoga .

4.2.1 Bukedea district

Bukedea District, formerly a county of Kumi District until 2007, is located in the semi-arid areas of north eastern- Uganda. It borders the districts of Mbale and Pallisa in the South; Ngora to the west; Sironko to the East; and Kumi to the North. Bukedea forms part of the Teso Farming System (TFS).

According FAO a farming system is a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihood constraints, and for which a similar development strategy and interventions would be appropriate (FAO, 2001).The TFS is an agro-pastoral system based on mixed annual crop and livestock production. It is unique, principally due to the characteristic predominance of ox-cultivation facilitated by the existing gently undulating topography (Akwang *et al.* 1998; Awa *et al.* 1999). Animal traction was introduced into this system as far back as 1909 in order to facilitate opening up of bigger pieces of land for production of the key cash crop, cotton (Starkey and Kaumbutho, 2000).

The crop-livestock interaction gives an important synergism as animals provide draught power for land tillage and manure for crop production, while crop residues and stovers are important feed sources for the animals (Oluka *et al.* 2003). Although livestock ownership tends to be associated with wealth status, draught animal power is cheaper and faster to use for ploughing land compared to manual labour. If poor farmers lack cash, they can still access oxen by offering their labour as ox-drivers in exchange for a turn to use oxen to plough (Okwadi and Akwang, 2003).

The district is also close to the densely populated foothills of Mount Elgon, which provide a good market for food crops because they are close to the Kenya-Uganda border and are one of the leading areas of coffee production. Cotton used to be the major cash crop in this farming system but collapsed due to a poor marketing system including delay in paying farmers for their produce, low prices and the demise of the primary cooperatives (Akwang *et al*.op.cit). Recent efforts at revamping the sector have achieved little success as cotton farmers have shifted to the production of dual-purpose food crops such as rice, maize, sweetpotato, cassava and groundnuts in response to market opportunities both domestic and across the border with southern Sudan and western Kenya (MAAIF, 2008).

The TFS is the main supplier of sweetpotato to the urban markets of Kampala, Jinja and Mbale (Wanda *et al.* 2003; Coote *et al*. 2007). The emergence of sweetpotato from being a minor staple to becoming a leading cash earner is partly attributed to decimation of cassava by the African cassava mosaic virus disease (ACMVD) in the early 1990s (Fowler *et al.*1993). In contrast, sweetpotato were not among the main crops grown in Bukedea (see 5.3.1 for more discussion), although this was contrary to what was thought at the inception of the REU project. One of the criteria used to select REU project districts was that they were known to be producing sweetpotato.

In Bukedea District, the qualitative investigations were conducted in the sub-counties of Kidongole and Kachumbala (Figure 4.2), which were also the two areas in which the REU project was implemented in the district. These two sub-counties are located in the southern part of the district, sharing a common border with the districts of Mbale and Sironko at the foot hills of Mount Elgon and Pallisa. The trader survey was conducted in Bukedea cattle market, located within Bukedea district headquarters.

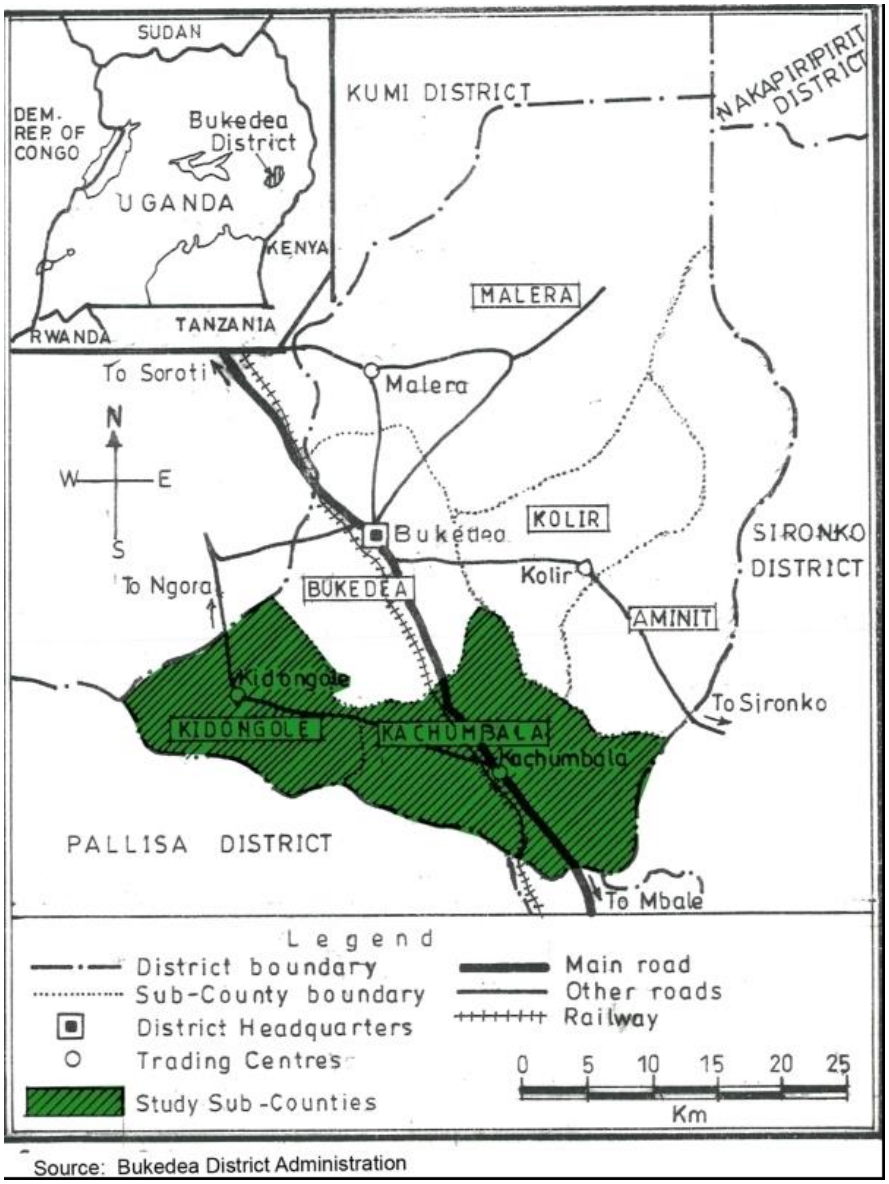

Figure 4.2: Map of Bukedea district showing the two study sub-counties of Kachumbala and Kidongole. The map also shows the location of Mbale district in Uganda.

4.2.2. Kamuli district

Kamuli District, in East-Central Uganda, forms part of the Busoga Farming System which is also known as the banana-coffee system (van-Asten, *et al.* 2011). The population is essentially rural and the district is ranked among one of the poorest districts in Uganda (UBOS, 2001). Kamuli lies at an average altitude of 1,083 m above sea level and extends from 00 - 56' North / 330 - 05' East up to 01 - 20' North / 330- 15' East. Kamuli district is bordered by the River Nile and Kayunga District to the West, Jinja district to the South, Iganga district to the South East, Kaliro District in the East, and Lake Kyoga in the North. It has a total land area of 3,444 square kilometres and 835 square kilometres (23%) is covered by water (KDDP, 2008). Its rainfall pattern is bimodal, with an annual total of 135 cm and a monthly mean of 7.5 – 10 cm (UBOS, 2009).

Subsistence agriculture is the main activity, which engages about 84% of the population. The key crops grown are sweetpotato, cassava, bananas, coffee, groundnuts, and sugarcane. Kamuli District has one of the highest per capita consumption of sweetpotato in the country. The earliest formal VAD survey in Uganda was carried out in Kamuli, which revealed the prevalence of clinical and sub-clinical VAD, according to the WHO classification (Kawuma and Serunjogi, 1991). Since then, the district has been one of the areas targeted by most VAD eradication campaigns.

In Kamuli District, the household investigations were conducted in the sub-counties of Nawanyago, Bugulumbya and Bulopa (Figure 4.3).These sub-counties are located in the Southern part of the district, bordering the districts of Jinja and Iganga. Travelling from these sub-counties to Jinja and Iganga, one notices the prominence of out-grower sugar cane schemes, which may have implications on land and labour availability for food crop production, including sweetpotato. The trader and consumer surveys were conducted in Kamuli main market (Figure 4.3) and in the main markets in the three study sub-counties were included.

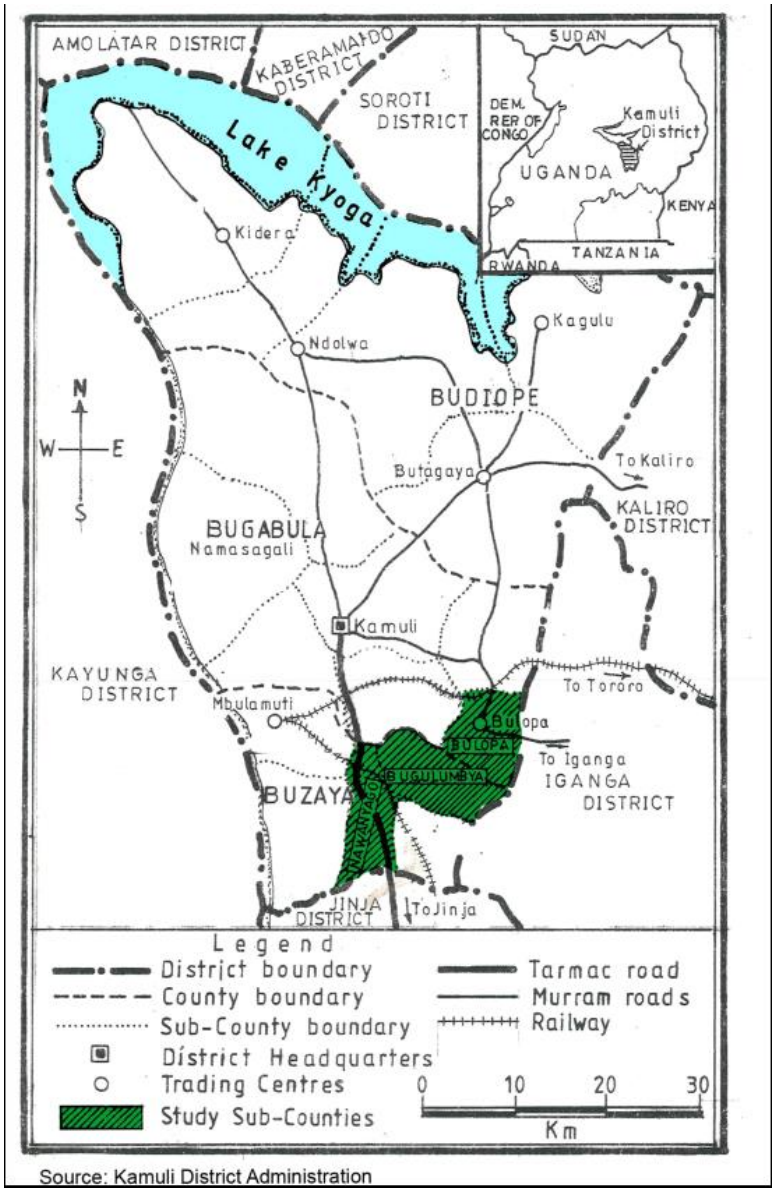

Figure 4.3: Map of Kamuli district showing the three study sub-counties of Bulopa, Bugulumbya and Nawanyago. The map also shows the location of Kamuli district in Uganda.

4.2.3 Mukono district

Mukono District lies between longitudes 32^0 35^0 E and 33^0 05^0E and 1^0 30^0 N. The district is bordered by the districts of Mpigi and Luwero to the West, the Republic of Tanzania to the south, Jinja and Kamuli Districts in the East, and Apac District in the North. It has a total land area of 14,242 square kilometres of which 9,648 square kilometres is under open water and swamps (MDDP, 2008).

Mukono District is located in the Lake Victoria crescent agro-ecological zone, in the traditional coffee-banana farming system. However, the impact of banana bacterial wilt

(BBW) on banana production, with a resulting increase in banana prices, has encouraged consumers and producers to switch to producing, purchasing and consuming sweetpotato[8] (PMCA, 2005).The district has also witnessed the introduction of several cash crops such as vanilla, cocoa, floriculture, and aloe vera, which have had their own price and production booms and busts. Commercial agriculture exists, typified by large sugarcane and tea estates. These estates are principally maintained by migrant labour from the north and eastern parts of Uganda (Mukono, 2008), who rely mainly on the market for their food requirements.

Since more than half of Mukono's surface is covered by water, fishing is a particularly important economic activity. Fishing has also attracted many migrants from within Uganda and the neighbouring countries as well. The migrants provide a good market for the food crops produced in the district. This is particularly relevant because some of them migrated from areas where sweetpotato, as opposed to bananas, is the staple food crop.

[8]The main food crop in Mikono is *Matooke,* a dish prepared by steaming bananas.

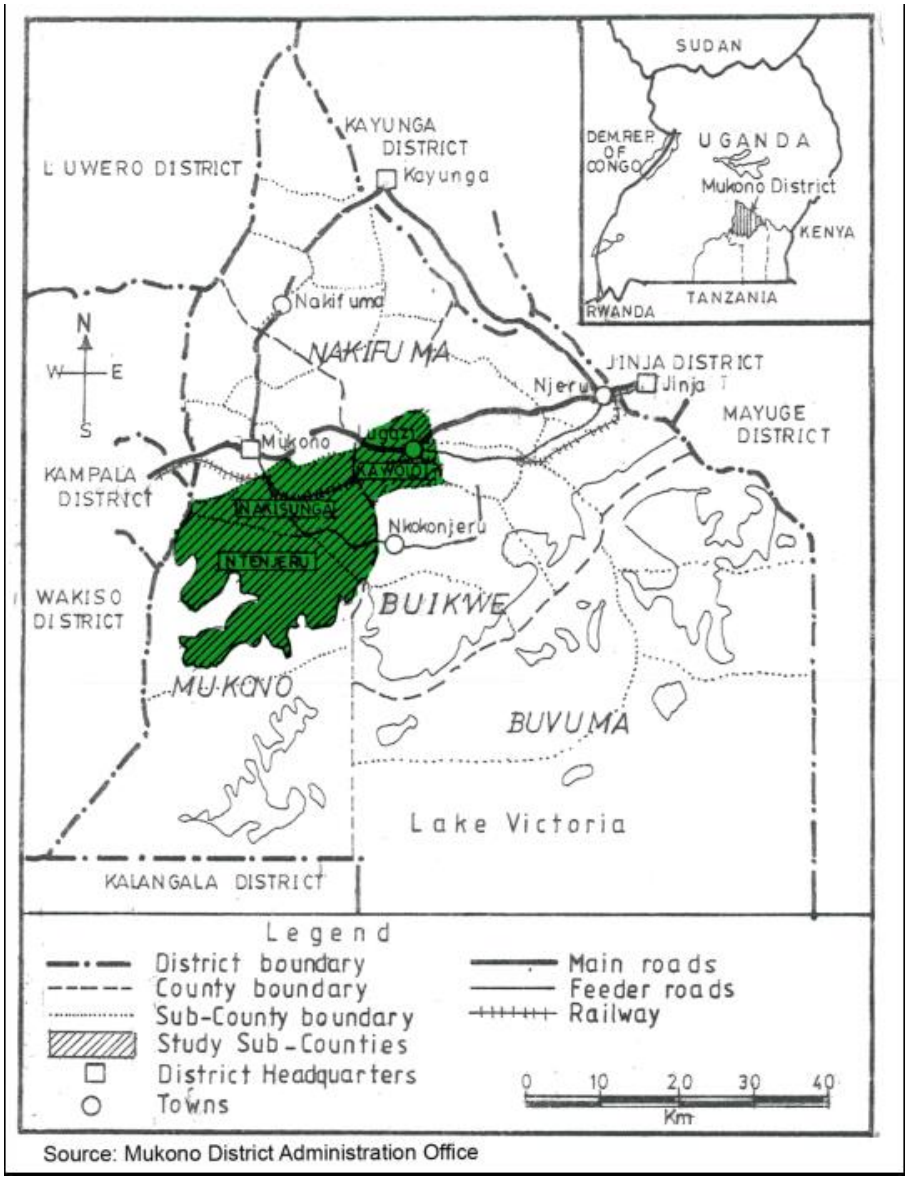

Figure 4.4: Map of Mukono district showing the three study sub-counties of Kawolo, Nakisunga and Ntenjeru. The map also shows the location of Mukono district in Uganda.

The urbanisation level in Mukono is higher at 18% than the national average of 12% and slightly below the urbanisation level of the central region of 25%. This, together with the fact that the western side of Mukono borders Kampala and Mukono District headquarters is only 20km away from Kampala, the capital city, presents potential opportunities for both on-farm and off-farm employment, which has implications for labour availability for household food production. These reasons partly explain why the prices of most food crops tend to be higher in Mukono compared to the other districts of Uganda (PMCA, 2005).

In Mukono, the study sub-counties sampled were Kawolo, Nakisunga and Ntenjeru (Figure 4.4), and for the trader and consumer survey, Gaba market (Figure 4.1) was included. Kawolo is located within Lugazi town council, which is one of the key sugar cane growing and processing hubs in Uganda. The other two sub-counties are close to the Lake that separates Mukono from Kampala.

In conclusion, there are differences and similarities between the three principle study areas, which may have implications for the adoption of OFSP for the market. Firstly, Bukedea, Kamuli and Mukono are in the three distinct agro-ecological zones: the Teso Farming System, the Busoga Sub-Farming System and the Lake Victoria Crescent Farming System, respectively. The TFSF is distinct in the use of oxen for ploughing, permitting timely preparation of large pieces of land for crop production. If used for OFSP production, animal traction could ensure timely opening up of large gardens permitting surplus production for the market. Bukedea is close to the densely populated districts in the foot-hills of Mount Elgon, which provide a market for agricultural produce from the Teso region, including OFSP. The Busoga Farming system is in the traditional banana-coffee production belt. It is the region with highest per capita consumption of sweetpotato and among the highest prevalence rates of VAD (Kawuma and Serunjogi, 1991). High consumption of sweetpotato could influence OFSP uptake as it could easily build on existing food preferences, but could also pose a challenge especially if the attributes of the OFSP varieties are not similar to those of the locally preferred sweetpotato types. Mukono is the most urbanised of the three districts, It is also close to (about 20 km) to Kampala city. Other key features are the presence of plantation agriculture and a booming fisheries sector. These factors, plus proximity to Kampala could present opportunities for other non-farm and off farm employment and markets, as well as opportunities for marketing food crops including OFSP.

4.3 Research approach

The research presented here used a mix of social research methods (Creswell *et al.* 2004; Johnson and Onwuegbuzie, 2004; Brannen, 2005). Mixed methods investigations involve integrating quantitative and qualitative data collection and analysis (Creswell *et al.* op.cit.). It involves not just collecting both qualitative and quantitative data but integrating the data collected. This approach recognises the benefits that each of these approaches brings (Johnson and Onwuegbuzie, op. cit) and offers a logical and practical alternative. The underlying logic is that neither qualitative nor quantitative methods are sufficient in

themselves to capture the trends and details of the situation and when mixed both complement each other to yield a more complete analysis.

A mixed methods approach was adopted for several reasons. Firstly, this research was conducted within the context of a research and development project. It was part of the operations research (OR) component of the REU project. Operations Research was mandated to provide the requisite knowledge base to implement, monitor, evaluate and advise on implementation of REU activities (HarvestPlus, 2010). This entailed conducting research and using the findings to inform project implementation. Results had also to be disseminated to a wide array of stakeholders including implementing teams at national and NGO level, policy makers, farmers, consumers and traders. This necessitated collecting both qualitative and quantitative data and presenting it in different ways depending on the needs of the targeted audience.

A qualitative approach was considered most suitable for the in-depth household investigation since this research was more exploratory in nature. Quantitative approaches were considered more suitable for trader and consumer surveys since they were not willing to spend a lot of time during the interviews, since qualitative interviews take relatively longer time.

The main studies (data sources) used in this thesis and time when they were collected are summarised in Table 4.2. This is followed by a description of how each of these data sets were collected and analysed in the subsequent sub-sections of this chapter.

Table 4.1: Main studies undertaken among producers, traders and consumers between November 2007 and March 2009, when they were undertaken and type of data collected

Study	Stage in Value chain	Date collected	Data type
Urban consumers survey	Consumers	November 2007-March 2008	Quantitative
In-depth household investigations	Producers	August 2008 – September 2009	Qualitative
Trader survey	Traders	January – March 2009	Quantitative
Rural consumers survey	Consumers	January – March 2009	Quantitative

4.4. Qualitative household investigation

4.4.1 Introduction

In order to generate an in-depth understanding of farmers' decision-making processes with regard to production of OFSP for the market and the reasons that underlie such behaviour, the producer (household-level) study used a qualitative approach (Creswell, 2003; Maxwell, 2005; Brett-Daines, 2007). This was chosen because the research topics were exploratory in nature, and aimed at generating an understanding of an area about which little was previously known. It was also appropriate because the research attempted to find the meaning of, or understand the experience of, a given situation (i.e. introduction of OFSP as a nutrient-rich crop at household level and the implications of market development) to a group of individuals (Kendra and Taplin, 2004).

Since OFSP was relatively new, and few households had sold it, the study was designed to collect in-depth information from representative households. It was necessary to conduct interviews with this small sample, which otherwise may have been "lost" in the process of randomly selecting many respondents typical of a quantitative survey. The focus of the field work was on the dynamic decision-making "process" as opposed to a decision "event". It was also necessary to address the *why* and *how* of decision-making and not just the *when* and *where.* For this reason, smaller and focussed samples were selected (Quin, 1990; Bryman, 2008).

4.4.2 Sample selection

Sixty-four households from 16 farmer groups supported by the REU project were sampled. The respondents were purposively sampled to include farmers who had already sold OFSP as well as those who had not sold any OFSP at the time of the interview. By doing so, "experts" in the phenomena under study were chosen who provided the best insights possible (Corbin & Straus, 1998). The respondents were sampled from two groups in each of the eight project sub-counties: Kidongole and Kachumbala in Bukedea district; Nawanyago, Bugulumbya and Bulopa in Kamuli district; and Kawolo, Ntenjeru and Nakisunga in Mukono district.

Based on production and marketing records, where they existed, and or expert opinion from the local extension workers and the market link farmers[9] (MLF), two farmer groups were purposively sampled in each sub-county. One group represented groups in which farmers had sold OFSP while the other represented groups in which farmers had not sold OFSP.

At the group level, four farmers (two men and two women) who best typified the group dichotomy were purposively selected (Bernard, 2002). As in the case in group selection, the researcher relied on production and marketing records, where they existed, and or on the expert opinion of the extension workers and the MLF. Generally, the four farmers interviewed in the producer groups that had sold OFSP were those who had sold the largest amount of OFSP by the time of the interview. In the groups that had not sold, the four farmers who had consistently grown OFSP since project inception but had not sold any OFSP were the ones selected and interviewed. The sampling frame is presented in Table 4.2.

[9] MLF were OFSP farmers selected by other OFSP farmers, and facilitated by the REU project, to help farmers sell their OFSP.

Table 4.2: Sampling frame used to identify the 64 producers interviewed during the qualitative producers' survey between August 2008 and July 2009

Sampling unit	Number	Explanation
District	3	The 3 districts (Bukedea, Kamuli and Mukono) of the REU project
Sub-county	8	The 8 sub-counties of the REU project: Bukedea district: Kachumbala and Kidongole. Kamuli district: Bugulumbya, Nawanyago and Bulopa. Mukono district: Kawolo, Ntenjeru and Nakisunga.
Farmer groups	16	2 farmer groups in each of the 8 sub-counties.
Respondents per group	4	2 male and 2 female
Total respondents	64	4 respondents in each of the 16 farmer groups

This dichotomy had its own challenges. In a few cases, some of the farmers who had been sampled on the basis of having not sold OFSP had sold prior to the interview; others had handed in sweetpotato in exchange for school fees and therefore did not consider it a sale. Under such circumstances, appropriate replacements were enrolled.

In Mukono, the men were not as actively involved in the FG as in Bukedea and Kamuli districts. In one sub-county, a female respondent had to be interviewed in place of the selected male respondent.

4.4.3 Data collection

Information was collected with the help of a checklist (Appendix 1). The checklist was divided into five key areas:

i) Farm and farmer characteristics which explored household demographics, resource access, ownership and utilisation;

ii) Priority crop enterprises;

iii) Participation in the OFSP farmer group as well as activities in other groups

iv) Decision-making with regard to production, consumption and marketing OFSP; and

v) Experiences in marketing other crops.

The checklist sought to aid exploration of the factors that made it possible for some farmers to produce and sell OFSP, while others opted to reserve it for home consumption. The open-ended structure of questions and probes yielded in-depth responses about farmer's experiences, perceptions, opinions, feelings and knowledge in regard to OFSP production and marketing (Quin, 1990). Information collected consisted of verbatim quotations with sufficient context to be interpretable as well as rich detailed descriptions, including the context within which the observations were made (Quin, ibid).

Data collection tools used included semi-structured interviewing, listing and ranking, timelines and historical profiles (Pretty *et al.* 1995; Conroy, 2002) in relation to introduction of OFSP. These were complemented with direct observation and in some cases, participation in some activities, by the research team. In Bukedea, the research team accompanied the farmers on three market visits and observed the trading process, particularly how trust was being built among the actors and how transactions were negotiated. Participation in some activities provided a practical understanding of the process and built rapport and confidence between the research team, the respondents and other actors in the marketing chain (Bernet *et al.* 2006).

Interviews were conducted and field notes were transcribed in the main local languages in each district (UNBS, 2002) - *Ateso* in Bukedea, *Lusoga* in Kamuli and *Luganda* in Mukono. Since the author was not able to communicate fluently in *Lusoga* and *Luganda* a research assistant (see plate 3) was hired to help in translation and recording results of the interviews in the field and later on translating field notes into English.

Although the key respondent was the sampled farmer, in most interviews the spouse often joined in the discussions, as shown in the picture on plate 3. This was beneficial in a sense that the men tended to be more familiar with the marketing issues while the women were more conversant in the production-related issues. However, in some cases it was a hindrance as it held back responses to some issues deemed sensitive or out of the domain of the respondent, especially where links to resource ownership, access and decision making were being explored. Where this obtained, the research team triangulated with other data sources such as farm records and took time to explain the purpose of the research again in order to build confidence among the respondents.

Plate 3: Author (second right) conducting one of the qualitative household surveys with farmer in Kamuli district in the presence of his wife. Language barrier in this district necessitated the use of a research assistant to help in translation of the interview from *Lusoga* to English.

Interview sessions lasted on average two hours (where no interpretation was required) and three hours where interpretation was needed. However, the research team spent about five hours with each of the farmers. This allowed the respondents, especially women, to carry out their normal household chores in between the discussions. Where culturally acceptable and practical, the respondents were provided with resources in advance to prepare a meal which was shared either at the end or in between the interview sessions. In other cases, an in-kind token of appreciation, consisting of sugar, soap and salt, was provided to the respondents *in lieu* of their time.

Other data sources that were consulted included sub-county and district profiles and development plans (BDDP, 2008; KDDP, 2008; MDDP, 2008) and production and marketing records at farmer group or NGO level.

Data were collected in October and November 2008 in Bukedea, January and February 2009 in Kamuli and May and June 2009 in Mukono. This sequencing of data collection mirrored the timings in which OFSP had been introduced to the districts (Wamaniala, 2007).

4.4.4 Data analysis

One of the important characteristics of qualitative research is that data analysis starts at the time of data collection. Thus, iterative analysis of the interviews through the data collection process generated patterns, categories and dimensions in the data (Straus and Corbin, 1998; Kwortnik, 2003). Specifically, patterns and trends were determined; cause-effect relationships were established; key issues were ranked in order to determine prioritisation; and issues generated from previous interviews were triangulated.

After fieldwork, each of the 64 interviews was written out verbatim, using the key issues contained in the checklist to structure the interview reports. Where interviews were conducted in the local language, they were translated into English. Key issues, patterns, categories and dimensions emerging from each interview were categorised into main themes (Table 4.3).

With each interview, new patterns, categories and dimensions emerged. These were added to the checklist and probed in the subsequent interviews. After the first set of interviews, the need to specifically probe for food crops and cash crops, as opposed to priority crops in general, was realised. This was incorporated in subsequent interviews. Some topics were dropped especially when it became apparent that a point of theoretical saturation (Strauss and Corbin, 1998) had been reached or that a particular area if investigation was not relevant to some respondents. For example, the section on use of oxen for traction was dropped in Kamuli and Mukono as it became evident that oxen are not used for traction in these farming systems.

Table 4.3: Main themes coded during analysis of qualitative data collected from the 64 producers in the three study districts of Bukedea, Kamuli and Mukono

Theme	Details included
Household	Composition by gender and age
Group	Name and type of FG, history of FG, activities, organisations working with FG. Other FG respondent is working with
Land	Availability (rented or own land), allocation of key enterprises, share of land allocated to sweetpotato/OFSP, nature of tenure system
Lowlands	Access to valley bottoms/lowlands, enterprises allocated to lowlands, terms of renting
Crop management	Sources and costs of farm power, crop management cycle, roles and responsibilities
Crop enterprises	Priority crops grown and reason (food, cash), position of OFSP and SP in prioritisation
OFSP introduction	How OFSP was introduced, main reasons respondent got involved, proportion of OFSP eaten, sold, given away
Subsequent OFSP crops grown	Production cycle of main crops grown, constraints and opportunities, proportion eaten, sold, given away etc.
Marketing OFSP	How OFSP was marketed, where, when, price. Ease and or difficulty associated with marketing, sustainability or lack of it? Factors that hindered or supported OFSP marketing
Marketing other crops	Experiences marketing key commercial crops. Similarities and differences between OFSP and non-OFSP marketing,

The four interviews from each of the groups were synthesized and written up into a group report. The synthesis of the individual reports into group reports was facilitated by the code sheet. It permitted similarities and differences among the groups to be teased out. In total, 16 group reports were written.

Using a similar process, group reports were synthesized into sub-county reports (8 reports in total) and the sub-county reports into district reports. The last level of synthesis and analysis involved cross-district comparisons. This was done in two ways: first, synthesis of information from districts and second, refocusing on the research questions and using available data and information to answer them.

Timelines were constructed from the interviews in order to understand and analyse the decision-making process from a historical perspective. Where data permitted, some variables such as priority crop enterprises were ranked and prioritised to generate priorities at group, sub-county, district and national levels (see Table 5.2). Other variables such as land size were computed and extrapolated to come up with means. In essence, such data were analysed quantitatively.

Verbatim responses were translated and used to support various arguments in the reports, and some were written up as case studies.

4.5 Trader survey

4.5.1 Introduction

A quantitative survey of sweetpotato traders was conducted between January and March 2009, towards the end of the main sweetpotato marketing season. This timing was deemed appropriate because it was understood that traders would have had experience of at least two main marketing seasons. However, the down side was that there were relatively fewer sweetpotato traders in the market as well as the sweetpotato sold. Therefore the sampling frame had to be altered from random sampling to a census of all the traders available and willing to be interviewed.

4.5.2 Sampling sites and respondents

The traders' survey was conducted in the districts of Mbale, Bukedea, Kamuli and Mukono. Bukedea, Kamuli and Mukono were selected because they were the implementation districts for the REU project. Mbale was chosen because it is an important market outlet for food, including sweetpotato, planted in Bukedea district. It was also understood to provide a key outlet for OFSP from Bukedea. The choice of the survey districts was further supported by experience during project implementation, which suggested that OFSP was traded mainly in the markets within the vicinity of the production sites. In each of these districts, markets were sampled according to their importance in sweetpotato trade (Table 4.4).

Table 4.4: Markets sampled and traders interviewed during the traders' survey in Bukedea, Mbale, Kamuli and Mukono between January and March 2010

District	Traders interviewed	Markets	Type of market
Bukedea	36	Bukedea cattle market Kachumbala and Kidongole markets	Rural weekly assembly markets
Mbale	39	Mbale main market, Nylon market and Nkoma market	Daily urban markets
Kamuli	39	Kamuli main market and Buwenge market,	Daily urban markets
Mukono	43	Mukono main market, Kawolo market, Kisoga market and Gaba market.	Daily urban markets (Mukono, Kawolo), rural weekly markets

Some of these markets, such as Gaba in Mukono and Buwenge in Kamuli, are outside the administrative remit of the project districts but were sampled because they were important outlets for sweetpotato from the project areas. There were also some markets that had been identified for the survey but had to be cancelled because when the research team visited these markers, there were no sweetpotato on sale and therefore no traders to be interviewed. These included Kiyola and Katosi in Mukono, and Nawanyago in Kamuli. These markets are located in the sub-counties in which the project was operating. In Mbale, the survey coincided with the heavy rains that resulted in mud slides. Hence, data were not collected from the markets at the foot hills of Mount Elgon, such as Kamu and Mutufu, which were initially considered for the survey.

One feature that distinguishes the markets sampled in Bukedea from other markets (Table 4.4) is that they do not take place every day. Bukedea cattle market operates every Monday; Kachumbala every Tuesday and Kidongole operate every Wednesday. These markets are usually busy from morning until the afternoon. Hence the survey team had to be in these markets on those specific days, within the marketing hours. Although trading takes place in the other markets every day, they tend to be busier in the mornings, evenings and over the weekends.

4.5.3 Data collection and management

As all the quantitative data sets were collected and managed using a similar procedure, rather than repeat this section for each data set, this section, describes how all the quantitative data sets were collected and managed.

Quantitative data were collected using structured questionnaires (Appendix 2 for the questionnaire used in the trader survey and 3&4 for questionnaires used in the consumer surveys), which were pre-tested and refined prior to the survey. The markets used for pre-testing the questionnaires were Nakawa and Kalerwe in Kampala.

Enumerators were recruited and trained specifically for each of the districts based on their competence in the local language and experience with formal surveys and interacting with traders. The first two days in each district were spent training the enumerators, pre-testing and adapting the questionnaire since the interviews were conducted in the local language. Enumerators were also trained on how to distinguish OFSP from other sweetpotato types and the characteristics of the four OFSP varieties that the REU project was promoting.

In addition to training in the survey tool, enumerators were also introduced to the NRI Code of Practice for conducting research[10]. They were required to seek the consent of the traders before the interview and to let respondents know that they were free to withdraw from the interview at any time without giving any reasons. They were also assured that in the event that they opted out of the interview before it was completed, they would not be criticised for their decision.

Traders interviewed were those who turned up to trade on the particular day when the survey team was in their market. In some instances, especially with farmer traders, bicycle traders and retailer/wholesalers, interviews were pre-arranged and took place at a time and place convenient for the respondent.

[10]See section 4.8 for details.

Plate 4: Half-sack of sweetpotato being weighed after interviewing the trader (centre) in Bukedea, 2009.

Interviewing traders also entailed weighing heaps with electronic scales, as demonstrated in the picture in plate 4 above, in order to establish prices per kilogramme of the sweetpotato sold. This was necessary because sweetpotato is sold in volumetric units including heaps, basins, sacks and tins. Weighing permitted comparison since prices per kilogramme were established. It was not always possible to weigh all the samples especially those sold in bigger units such as sacks. Under such circumstances, representative units were weighed and used to extrapolate the weight of the larger volumes.

Data were entered in Epidemiological Information (EpiInfo) and analysed using Statistical Package for Social Scientists version 16 for Windows (SPSS V 16) and Microsoft Excel. EpiInfo was chosen for data entry because it allows the development of the data entry screen similar to that of the questionnaire. With EpiInfo it is easy to place validation controls and checks, thereby minimising errors, which often occur during data entry.

After entry, data were exported to both SPSS V16 and Excel for analysis, and also for back-up. Data analysis entailed uni-variate and bi-variate analysis. Uni-variate analysis involved generation of frequencies and other descriptive statistics, while bi-variate analysis entailed generating contingency tables to explore relationships between key variables of interest to the researcher.

4.6 Survey of consumers in Kampala

4.6.1 Introduction

The survey of sweetpotato consumers in Kampala, the capital city of Uganda, was undertaken between October 2007 and March 2008, during the first sweetpotato marketing season after inception of field-level project implementation in June 2007.

4.6.2 Sampling sites, traders and respondents

The survey was conducted in the markets of Kalerwe, Bwaise and Kazo in Kampala city. These markets were selected on the basis of their importance as sources of fresh sweetpotato to low and middle income earners in Kampala. Kalerwe market is one of the largest open-air staple food markets in Kampala. Bwaise and Kazo are comparatively smaller open markets, located within the vicinity of Kalerwe market. They were selected because the wholesaler, who was the market contact point for this study, supplied sweetpotato to retailers in these two markets.

A total of five traders were involved in this survey: one wholesaler and four retail traders. Two retail traders were from Kalerwe market and one from each of the other two markets (Bwaise and Kazo). The retailers were identified by the wholesaler from the sweetpotato traders that he usually supplies. The most important criteria were that the trader should be available, selling sweetpotato on the day of the survey and willing to participate.

The consumers were identified by the traders. The criteria used were that the respondent had to be regular purchasers of sweetpotato and willing to be interviewed. The interviews took place over a two-week period from Friday to Sunday each week, from 8a.m to 11a.m; and from 4p.m to 7p.m. These week days and times were understood to be the peak market periods.

4.6.3 Sweetpotato varieties

The four OFSP varieties (*Kabode, Vita, Ejumula* and *Kakamega*) that the project was promoting were obtained from gardens in Luwero district. Since OFSP roots were not readily available in the market at the time of the study, the research team had to source the roots. After the roots were harvested, they were sorted and graded by the wholesaler in order to meet the requirements of the market. Thus, only those roots that were free of pest and

disease infestation; as well as physical damage were packed and transported to the market. The wholesaler then supplied the four OFSP varieties to the identified retail traders on terms similar to those under which he usually supplied sweetpotato. However, it was not feasible to ask the retail traders to pay for the OFSP roots since they were not familiar with the product and the quantities of each variety available to each trader were relatively small.

4.6.4 Sale of sweetpotato and interviewing consumers

The traders displayed OFSP roots alongside their non-OFSP types. They then set the price at which they sold the OFSP heaps with no interference from the enumerators. The enumerators recorded price, weight and variety (OFSP and traders' own) of each heap sold and interviewed consumers on acceptance as judged by the visual appearance of whole and cut roots, knowledge of sweetpotato, purchasing decisions and likelihood to purchase OFSP in future. A total of 200 consumers were interviewed: 53 from Bwaise, 90 from Kalerwe and 57 from Kazo. The interviews took no more than 10 minutes.

4.7. Survey of consumers in Mbale, Kamuli and Mukono

4.7.1. Introduction

The survey of sweetpotato consumers in Mbale, Kamuli and Mukono was undertaken between January and March 2009, concurrently with the traders' survey.

4.7.2 Sampling sites and respondents

The rural consumers' survey was conducted in the districts of Mbale, Kamuli and Mukono. Kamuli and Mukono were selected as they were the implementation sites for the REU project. Mbale was chosen because it is an important destination for food, including sweetpotato, planted in Bukedea District. It was also understood to provide a key outlet for OFSP from Bukedea. While the original intention was to conduct the survey in Bukedea, at the time of the market visits there were very few consumers purchasing sweetpotato for home consumption. Instead, most of the customers were traders bulking up quantities of sweetpotato for other markets. The majority of the people buying were traders rather than consumers. With the exception of markets in Bukedea, which were not included in the consumer survey, the markets (Table 4.4) in which the traders' survey are the same ones in which the consumers' survey was conducted.

4.8. Ethical considerations

Ethical considerations are an important component of any piece of research involving human beings (Shaw, 2003). In undertaking this research, the NRI ethical code of conduct for research was followed. This code requires that all researchers must obtain informed consent from the respondents prior to undertaking any research. In addition, it allows the respondents to withdraw from any research at any time without giving any explanation or reason.

All enumerators and field guides were made aware of this requirement, during their training. In the preamble to all the data gathering tools, the purpose of the research was highlighted as well as the requirement that the enumerators obtain informed consent before proceeding with the interview. Enumerators explained the purpose of each of the surveys to the respondents in the local language or the language in which the respondent is most comfortable with, and sought their consent to participate before proceeding with the interviews.

Another important ethical consideration is keeping the identity of the respondent anonymous. This was done at the data entry and analysis stage where information identifying the respondent, such as their name, was "hidden". Similarly, there were certain pieces of information that respondents provided but did not want to be used. In such cases, the views of the respondent were respected. In the case of qualitative research involving case studies and the voices of the respondents, the names of the respondents were either withheld or were not used.

The Government of Uganda also requires that necessary clearance from central government, the respective local governments and the Uganda National Council of Science and Technology (UNCST) must be obtained before any research is conducted. The researcher did not independently obtain this clearance, since this thesis was part of the REU project for which clearance to conduct research had already been sought from both the central and respective local governments. Furthermore, all activities undertaken by the REU project were fully covered under the Memorandum of Understanding between UNCST and the host implementing association of the REU project, the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA). In spite of this, the researcher introduced himself and his team to the local authorities and sought permission from them before proceeding to collect data from their respective areas of jurisdiction.

4.9. Challenges faced during the field research

Uganda does not have a national language. Each ethnic group speaks their own language. This research was conducted in four areas, where four different local languages are spoken: *Ateso* in Bukedea, *Lumasaba* in Mbale, *Lusoga* in Kamuli and *Luganda* in Mukono. The challenge faced by the researcher was the inability to speak all four indigenous languages in the study areas. Therefore, research assistants and field guides, who not only knew the local languages but were also sensitive to the cultural norms and practices, had to be recruited. However, it was not possible to get a research assistant or field guide who could fluently speak more than one of these indigenous languages. The researcher had to engage a field guide in each of the three areas where he could not speak the local language. There was also a high "turnover" rate of the field assistants since most of them were students and were mainly available during school vacations or while they looked for permanent job placements. Where questionnaires were administered, one set of enumerators could not be used in all study areas, due to language differences.

The second challenge was that there were often high expectations among the respondents. These ranged from expecting to be compensated for their time to receiving direct, immediate and tangible benefits from the researcher for their participation. Expectations were easier to manage at producer level since respondents had interfaced with the other components of the project such as Seed Systems and Demand Creation that provided tangible support, in the form of production inputs and training. The challenge, however, was that some of them expected the researcher to provide such support as well.

At the consumer level, the main challenge experienced was that most of them were not the key decision makers in the households, and they usually did not have time to be interviewed, as they were often in a hurry. The researcher deliberately designed a short questionnaire for the consumers and was flexible in terms of the interviewing time and place. Besides, only those consumers who consented were interviewed.

Another challenge, especially at the producer level, was that there was high and often competing demand for the time of the producers. This resulted from the fact that the project consisted of many components and partner organisations each interfacing with the same farmers. Besides the REU project, there were others, such as the government extension agency, the National Agricultural Advisory Services (NAADS), also targeting the same

farmers, on top of the farmers' own priorities and activities. In some cases, the project combined activities, which at times, had its own trade-offs.

4.10 Limitations of the research

The main limitation with this work is that it was carried as part of the implementation process of the project, which aimed at encouraging consumption of OFSP. In the ideal world, marketing comes after producers have tried out the technology, have invested in expansion and therefore generated adequate marketable surplus. Therefore, these findings can be treated as initial perceptions of value chain actors towards the introduction of a new crop.

The trader survey was conducted at the end of the marketing season and the results may have been influenced by the timing of the study. Similarly, one of the two consumer surveys was undertaken at the onset of the project, while the second was undertaken concurrently with the trader survey. In both cases, OFSP was not as available in the markets as may have been the case during other seasons. Therefore, results may have been influenced by timing of the study, particularly in regard to types of sweetpotato sold and number of traders and consumers present at the time of the study.

There was no counterfactual in this research, that is, the existence of a control group upon which it would have been easier to assess the decision making in the absence of a marketing intervention. It was considered that all producer groups in the project should have access to the same level of training and market facilitation. In Bukedea, some producers were able to respond to an exogenous demand for OFSP vines by NGOs working in Northern Uganda and orchestrated by FADEP, the REU project implementing NGO. This subsequently led to a surplus of OFSP roots which the producers then felt was the responsibility of the project to find markets for, although this was not part of the project marketing strategy.

Chapter Five: Presentation and Discussion of Findings on Decision-Making by Producers

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5.1 Introduction

This chapter focuses on decision making with regard to production and marketing of OFSP at the producer level, the first node of the OFSP value chain. Producers, in this thesis, are the OFSP farmers sampled from households participating in the REU project. As such, producer, farmers and households may be used interchangeably. This chapter addresses research objective one: To evaluate the factors that influence producers to grow OFSP for sale. It seeks to answer four research questions related to this research objective: i) what are the priority crops that producers grow, ii) what is the nature and characteristics of OFSP marketing among producers; and iii) what factors influenced the decision of producers to sell OFSP?

The rest of this chapter is divided into five sections. The first section (5.2) presents an analysis of the priority food and cash crops that the producers grow. This if followed by an examination of the evolution, nature and characteristics of OFSP trade in 5.3. Experiences of the producers in marketing OFSP are presented in section 5.4. In section 5.5, the factors influencing the decisions of the producers to plant OFSP for sale are examined. The last section (5.6) presents a synthesis of the key insights from this chapter.

Data and information presented in this chapter were collected from the in-depth qualitative household investigation (see section 4.4 for a description of the methodology). To reiterate, the in-depth qualitative investigation was conducted among 64 OFSP producers from 16 project supported farmer groups sampled to represent those who had sold OFSP (32) and those who had not sold OFSP (32) at the time of the survey.

5.2. Priority food and cash crops

In this sub-section, the important food and cash crops as prioritised by the producers are examined. The aim is to investigate the importance of sweetpotato within the food and farming systems of the study areas. However, due to the increasing prominence of "dual purpose" crops, that is, those that address household food and cash needs, the once familiar dichotomy between food and cash crops is becoming blurred. This has been attributed to problems experienced in marketing traditional cash crops and an increase in demand for food crops both domestically and across the borders to South Sudan and Western Kenya (MAAIF, 2008).

5.2.1 Food crops

Sweetpotato are one of the crops grown within the complex food and farming systems in the study districts. This section examines the relative importance of sweetpotato among the producers in the three areas. It draws mainly on findings from the qualitative investigation that was conducted in 2008-2009 among 64 producers.

Producers were asked to identify and rank the most important food and cash crops that they produce. The priorities were then aggregated at group, sub-county district level and for the entire sample of 64 farmers, as illustrated in Table 5.1. Results indicated that the most important food crops, in order of preference were sweetpotato, maize and cassava (Table 5.1). However, at the national level, sweetpotato is considered the third most important food crop, by area, after bananas and cassava (MAAIF, 2010). The difference could be because the qualitative investigation was conducted among sweetpotato farmers who already attach high importance to this crop.

Table 5.1: Priority crops grown by the producers in Bukedea, Kamuli and Mukono, aggregated from qualitative household survey, 2008

	Bukedea	**Kamuli**	**Mukono**	**Overall**
Food crops	Cassava	Sweetpotato	Sweetpotato	Sweetpotato
	Maize	Maize	Maize	Maize
	OFSP	Cassava	Bananas	Cassava
Cash crops	OFSP	Maize	Coffee	Maize/sweetpotato
	Cassava	Coffee	Maize	Coffee
	Maize	Sweetpotato	Bananas/Sweetpotato	

There were differences and similarities in the prioritisation of food crops in the three districts. In Bukedea, cassava was the most important food crop followed by maize and OFSP. While OFSP was specifically ranked as the third most important food crop, sweetpotato in general was not considered an important food crop by producers in Bukedea. Prior to the introduction of OFSP, sweetpotato were not of major importance in this district, as captured below:

> *"We never used to grow sweetpotato at a large scale in this area, until the introduction of OFSP. The few producers who used to plant would heap a few mounds mainly for home consumption. However, we were aware that producers in other parts of Teso region used to heap sweetpotato for commercial purposes". Female respondent, Bukedea, August 2008.*

Plate 5: A household preparing OFSP for dinner in Mukono District, 2009. This involves peeling and washing the roots

In Mukono and Kamuli, sweetpotato is the most important food crop. Sweetpotato is the main staple crop in Kamuli and is considered a vital part of ethnic identity among the *Basoga*, the native and largest ethnic group in Kamuli, as expressed by one of the female respondents, during the qualitative investigation:

"Much as we now eat other food including posho, a few years back, whenever you could be seen eating posho, you would be asked whether you are a Luo because we knew posho was a staple food for the Luo only. We also knew sweetpotato were the only food for us the Basoga. So when OFSP was introduced it was not exactly a new thing" Farmer, Kamuli, December 2008.

As in Bukedea, maize was the second most important food crop in Kamuli and Mukono. There were differences in the ranking of the third most important crop in Kamuli and Mukono: bananas in Mukono, and cassava in Kamuli. In Mukono, bananas used to be the main staple food crop but were decimated by the banana bacterial wilt (BBW). Sweetpotato emerged as a key staple as a result of this devastation. Similarly, cassava used to be a more important food crop in Kamuli but its production was affected by the African cassava mosaic virus disease (ACMVD), first reported in the mid-1980s.

With respect to food crops the key conclusion is that while sweetpotato was the most important crop in Kamuli and Mukono, cassava was the most important food crop in Bukedea. In fact, sweetpotato was not even among the top three food crops in Bukedea. Adoption studies reviewed here suggest that adoption of a new variety of a staple crop such as cassava and sweetpotato is more likely among farmers who accord high importance to that crop compared to those to which the crop is relatively new. This would imply that uptake of OFSP would be higher in Kamuli and Mukono compared to Bukedea. Therefore, it will be of interest to determine whether the importance of sweetpotato as a food crop, will have an influence on the decision by producers to plant it for sale. Finally, it is evident that production challenges, particularly pests and diseases, can have an impact on the prioritisation of a crop.

5.2.2 Cash crops

Overall, maize, sweetpotato and OFSP were identified as the key cash crops during the qualitative investigation (Table 5.1 on page 95). However, in Bukedea, OFSP was distinguished from other sweetpotato types and prioritised as the leading cash crop, since its introduction by the REU project.

Coffee and maize were more important cash crops compared to sweetpotato in Kamuli and Mukono respectively. Coffee was more prominent among older, usually male headed producers and young producers that had inherited land on which it was already growing. Coffee, like other perennials, was a priority crop among producers having security of tenure. It thus has the advantage of providing a steady, though not necessarily highly profitable,

source of income. However, even in these districts, there was a decline in the importance of coffee as a cash crop resulting from the coffee wilt disease, declining land sizes, declining soil fertility and fluctuating prices.

These findings also reinforce the fact that, with the possible exception of coffee, there is a decline in the importance of the traditional cash crops, particularly cotton, in Kamuli and Bukedea. Again, with the exception of coffee, the most important food crops also doubled as the most important cash crops. Food crops appear to have emerged as dual-purpose crops in response to the void resulting from the collapse in the production and marketing of traditional cash crops. The implication is that even for crops introduced mainly for their health/nutritional value (home consumption bias), availability of market for either surplus production or commercial and semi commercial production is likely to have a bearing on its sustained uptake. Also, the importance of sweetpotato as a staple crop in these areas is likely to propel uptake of OFSP.

Overall, there is considerable variation in the prioritisation of cash crops across the three districts. In Bukedea, the key cash crops were OFSP and cassava; in Kamuli they were maize and coffee; and in Mukono coffee and maize. Reflecting on the prioritisation of the food and cash crops in the districts, there appear to be more similarities in both cash and food crops produced by farmers in Kamuli and Mukono, compared to Bukedea. The next sub-section examines the experiences of producers in marketing non-OFSP.

5.3 Nature and characteristics of OFSP marketing

This sub-section addresses research question two: what is the nature and characteristics of OFSP marketing among producers? In order to answer this question, timelines were constructed and historical profiles explored with each of the respondents. The individual timelines were aggregated to generate group, sub-county and district timelines. The district timelines are presented in Tables 5.2 for Bukedea, 5.3 for Kamuli and 5.4 for Mukono. Each of these timelines examines differences between farmers in groups that had sold OFSP and those that had not sold.

The timelines are presented in a matrix. The first row on the matrix provides information on the time (year or month) when an event took place. The second row contains a summary of the event. The farmer type is presented in row three, where type one are the farmers who had sold OFSP and type two the famers who had not sold OFSP. The last two rows summarises

how and why the activity was carried out, respectively. In the next sub-sections, the timelines for each of the three districts are presented and analysed.

5.3.1 Bukedea

The REU project in Bukedea was implemented by the NGO, Farming for Food and Development-Eastern Uganda (FADEP-EU) on behalf of HarvestPlus. Rather than work with individual farmers, FADEP opted to use farmer groups. In some cases, the farmers were already in groups while in others, farmers formed groups in response to the opportunity of working with FADEP. This implied working with existing groups in some cases, and forming new groups or reconstituting old groups in other cases to meet the project criteria.

The first difference between the groups of farmers who sold and those who had not sold OFSP is that all the groups that sold existed and were functioning prior to this intervention. In contrast, only three out of the groups that had not sold OFSP existed before this intervention.

The timeline (Table 5.2) indicates that project implementation started in August 2007. Farmer groups were sensitized on the benefits of OFSP and the expectations of the FADEP from the groups that they would work with.

All of the 16 producers interviewed in Bukedea, irrespective of the producer type, attested to the fact that it was the message of the nutritional value of OFSP that inspired them to plant the first OFSP crop. This is typified by a remark from one of the respondents:

> *"We were inspired by the message that OFSP has vitamin A that gives health to the children. We therefore decided to grow and eat this medicine so that we treat ourselves at home instead of going to the hospital" Farmer, Bukedea, September 2008.*

Therefore, the decision to plant the first OFSP crop among farmers in Bukedea was influenced by the nutritional value of OFSP. In other words, two issues influenced the decision to plant the first OFSP crop: first is the REU project as the source of both information about OFSP, planting materials and management support, and second is the attributes of OFSP being a nutritionally enhanced sweetpotato type, unlike the common YFSP.

Table 5.2: Timeline of significant events among the 16 households interviewed in Bukedea aggregated into producer type 1 producers who had sold OFSP and producer type 2 producers who had not sold OFSP, September 2008

Time	**1997-2007**	**Sept- Oct 2007**	Nov - Dec 2007	March-August 2008	March – May	May 2008	**July**	**Aug – Oct 2008**
Event	Groups started	OFSP vines distributed, first crop planted	Second crop planted	Vines purchased	Second and third OFSP crop planted	First OFSP sales, fourth crop	MLF identified, root sales increase	Third and fourth crop planted Root sales peak
producer type	1-1997-2004 2-2007	Both	Group 1	Group 1	1- Third crop 2- Second crop	Group 1	Both, but worked more with 1	1-Fifth crop 2-Third crop
How it was done	Group 1, self-help or by other NGO. Group 2 in response to project opportunity Groups registered with sub-county. They had to meet project requirements e.g. number of members	Sensitization of producers on benefits of OFSP Vines planted in sub-groups, on own rented or borrowed land within vicinity of homesteads for ease of management	In valley bottoms either owned or hired	FADEP extension workers coordinated purchase at farm level	Massive adoption and increase in acreage. Renting land for expansion	Bicycle traders main outlet. Producers (those with experience) also took to trading centre on bicycles	Project organized test-marketing OFSP in Mbale markets MLF coordinated supply and demand Other traders taking to urban traders got involved	Producers opened up bigger pieces of land MLF organised routine delivery schedules in consultation with traders
Why	Help each other by pooling resources Response to government policy & project	Nutrition reasons, and urge to try something new	Vine sales opportunities. Propagate vines for next crop	FADEP wanted clean vines for onward distribution Some producers planted vines to sell, High demand for vines	Group 1:Vine sales, expectation of root sales Group 2: good taste, children like	Mature OFSP roots available	Encourage producers to sell; Introduce OFSP to markets; link supply and demand	Group 1: increase quantity sold Group 2: expect to sell.

The first point of departure in terms of decision-making and resource allocation was when the second OFSP crop was planted. Among producers who had sold OFSP (producer type 1), the second OFSP crop was planted in November and December 2007. Two issues underpinned this decision: first, these producers were aware, early enough, of opportunities of purchase of vines either by the project or by other NGOs.

The second important factor was that most of these producers had access to valley bottoms[11] and were willing to incur extra costs and take the risks associated with investing in an off-season crop.

> *"We were told that we could harvest between 100 and 150 sacks of vines from an acre and that each sack would be bought at between UGX 10,000[12] and UGX 15,000. I had never known that sweetpotato vines are a tradable commodity, but decided to take the risks and plant 1 acre of OFSP in the valley bottoms". Farmer, Bukedea, September 2008.*

Plate 6: One of the valley bottoms used for conserving and multiplying OFSP vines during the dry season in Bukedea, December 2008.

The risks included the possibility of losing the OFSP crop due to the long dry spell, usually between November and February. This was compounded by the fact that these producers had never sold sweetpotato vines or roots before and were not previously aware that vines were a tradable commodity. This underscores the importance of information (possibility of vine

[11]Valley bottoms of lowlands are areas with permanent or residual moisture that can be used for propagating sweetpotato vines during times of moisture stress, especially in semi-arid areas.
[12]1 US$ equivalent to 2,590 in April 2013

purchase), access to or ownership of extra resources and willingness by the producers to take risks.

In contrast, the second crop among the producers who had not sold OFSP was planted between March and May 2008. For these producers, the decision to plant this crop was influenced by the good taste of the previous OFSP crop and the strong preference that children particularly professed for it. This underscores the importance of consumer attributes, as opposed to market attributes in the decision-making process among the producers who had sold OFSP.

> *"I planted my second OFSP crop in May 2008, mainly for home consumption as a nutritious crop, and my children liked the taste. The ideal would have been to plant 2 acres, 1 acre for sale and the other for home consumption, but I was not sure of marketing possibilities, much as I had been told that OFSP vines would be bought. Therefore, I opted not to incur extra costs and risks associated with off-season sweetpotato crops", Farmer, Bukedea, September 2008.*

Amongst the non-market oriented, five of the eight farmers interviewed were aware early enough of the possibility of vine purchase, but opted not to take the risk and incur costs[13] involved in planting OFSP in the valley bottoms. Instead, they opted to plant from May, at the onset of the rainy season when risks and costs are significantly reduced. Risks were reduced because of the on-set of the main rains and crop planting season. Costs were reduced because producers did not have to rent land in the valley bottoms.

The producers who had sold planted their third crop between March and May 2008, at the time those who had not sold were planting their second crop. The main factor that influenced these producers to plant the third OFSP crop was vine sales coordinated by FADEP. Farmers who had planted the off-season crop benefited from vine purchase. Most of them immediately doubled the acreage of their OFSP crop. To illustrate, from an acre of a dual-purpose OFSP crop, a farmer could harvest an average of 90 sacks of vines. Each sack of vines was purchased at UGX 8,000, earning a gross income of UGX 720,000. This is more than the UGX 575, 000 that a farmer could earn from an acre of roots, assuming that they harvested an average of 25 sacks per acre and sold at UGX 25,000 per sack in 2008.

[13]Cost of renting a garden in the valley bottom is usually higher and there is a risk of the crop being destroyed by animals grazing in the valley bottoms

In areas where access to land was not the main constraining factor, the producers who had sold planted at least one acre of OFSP each, with the hope of selling more vines and later the roots. They had the money (from vine sales) which they used for renting in land, oxen and labour, if they needed to. While vine sales had influenced OFSP production decisions among the producers who sold, it created a feeling among producers that the project would organise or directly get involved in marketing roots as it had with the vines. However, the project marketing strategy stressed market facilitation, using existing sweetpotato traders and marketing chains as opposed to direct intervention in the marketing process.

At the time of the investigation (September 2008), farmers in the groups that had sold OFSP had planted at least four OFSP crops and were preparing land for their fifth crop. Most farmers in the groups that had not sold OFSP had planted two crops and some were preparing land for the third crop. Within these groups, farmers who were preparing their gardens for the third crop were expecting to sell vines and roots. Most of them had sold non-OFSP varieties before. However, they were sceptical about the reaction of the traders to OFSP as a marketable sweetpotato type since it was new.

> *"While I had been selling non-OFSP in small quantities, I was worried about the reaction of the traders to OFSP since it was new. In order not to spoil my sweetpotato market, I opted to retain OFSP for home consumption, but I later learnt that FADEP was buying OFSP vines and roots, so I decided to plant more OFSP", Farmer, Bukedea.*

A couple conclusions are worth reflecting upon. First, farmers in "older" groups had sold OFSP compared to those in "new" or reconstituted groups. While sweetpotato were hitherto a minor crop in Bukedea, prospects of vine and root sales had an impact on uptake and availability of OFSP for home consumption and sale, as farmers who marketed planted more crops within the same period of time and on bigger pieces of land. They also invested in extra resources such as land and oxen in order to produce more for sale. Subsequent sub-sections compare this with the trends in the other two districts in which sweetpotato were relatively a more important staple crop. Attributes of OFSP, the REU project, vine sales, farmers' access to and use of productive resources and characteristics of the farmer were important factors that influenced the decision among producers to plant OFSP for the market. Finally, among farmers who had not sold OFSP, taste of OFSP and particular preference by children is an important driver of uptake.

5.3.2 Kamuli

In Kamuli and Mukono, the project was implemented by the NGO, Volunteer Efforts for Development Concerns (VEDCO). Unlike in Bukedea, the VEDCO approach was to work with pre-existing groups, rather than form new groups or reconstitute old groups in response to this opportunity. This partly supports the finding in 5.4.2 of the thesis that there were more producers in Kamuli and Mukono who had either worked with other service providers or were community leaders compared to Bukedea.

The timeline of significant events (Table 5.3) indicates that OFSP was introduced to Kamuli between October and November 2007, after its introduction to Bukedea. Producers planted the first OFSP crop for three main reasons. First, sweetpotato is a key staple food crop in Kamuli. OFSP therefore built on existing food preferences. The main reason of planting OFSP, like any other type of sweetpotato was home consumption.

> *"Sweetpotato are the main staple crop in Kamuli, so it was easy for us to try OFSP since we like sweetpotato and know how to plant them" Farmer, Kamuli, January 2009.*

Second, all the 24 farmers interviewed in Kamuli, posited that, in addition to sweetpotato being the key staple crop, the other reason for planting the first OFSP crop was its nutritional benefits. Finally, comparing the two farmer types, although nutrition information was the main factor among producers who had not sold, for those who had sold, the possibility of marketing was a very important consideration on top of nutritional information. But, this was often attributed to information or expectation of marketing support from the project.

> *"I planted OFSP because I was told that it is good for the children as it makes them grow when they are healthy. It is also good for the eyes" Female producer, Kamuli, January 2009.*

> *"For us in Kamuli, sweetpotato are for home consumption, but we were told by VEDCO that they will support us to market OFSP, so we opted to plant it as well, since we had been planting our sweetpotato mainly for household consumption and some for sale", Female producer, Kamuli, January 2009.*

In contrast, among the male producers who had sold OFSP, the most important reason that influenced their decision making was the positive experiences associated with new crops or crop varieties. These experiences included high yield and good market potential. These previous positive experiences created the belief that whatever is new and promoted by an NGO is good and beneficial. For example, in Bulopa sub-county some producers had

benefited from the National Agricultural Advisory Services Programme (NAADS) by early adoption of SERENUT[14] groundnuts varieties. As a result, they were later on contracted as seed suppliers for other farmers in the district. Such producers anticipated similar benefits from OFSP:

> *"I planted OFSP because I like trying out new things and I have always got positive results including financial benefits. For example, in 2007 when NAADS introduced SERENUT groundnuts, I tried it out and became the leading SERENUT farmer in the whole sub-county. I received groundnut seed which planted a garden of about 0.25 acres. From this garden, I harvested 5 sacks of clean groundnut seed which I sold back to the NAADS programme at UGX 100,000 per sack. This earned me a contract of supplying SERENUT to the NAADS programme farmers in our sub-county. From then onwards, I stopped growing rice, which used to be my cash crop and instead concentrated on groundnuts and now OFSP. I do not regret taking on OFSP because in November 2007 when I realised that the first crop was doing well, I decided to expand my acreage to almost 1 acre immediately and from that crop, I sold 6 sacks and had enough for home consumption as well" Farmer, Kamuli, January 2009.*

[14]SERENUT (Serere Groundnut) is a new type of improved groundnuts developed by NARO and promoted by NGOs and government programmes, including NAADS. These varieties are high yielding and some of them are early maturing, resistant to drought and the groundnut rosette disease.

Table 5.3: Timeline of significant events among the 24 households interviewed Kamuli aggregated into producer type 1 producers who had sold OFSP and producer type 2 producers who had not sold OFSP, December 2008

Date	**2004**	**Sept-November**	**Nov 2007**	**April/June 2009**	**May/June 2008**	**August 2008**	**Aug/Sept 2009**
Event	Groups started	Vines delivered, first OFSP crop grown	Second crop planted	Third crop in 1 Second crop in 2	Vine sales	Root sales start	Third and fourth crop planted
Farmer type	Both	Both	1	Both	1	1	Both
How it was done	Started as self-help, registered in sub-county	Producers sensitized about benefits of OFSP	Planted by producers only who had been growing SERENUT	All respondents increased size of their gardens	Sold to neighbours and other customers	Main outlets were local schools, neighbours, traders and markets	Third crop for most, fourth crop for one
Why	Only producers in group could access government support VEDCO used existing groups	Male producers had positive experiences with new crops e.g. SERENUT Females motivated by vitamin A and market potential	Realised yield of first crop was bound to be good. Increased to have enough to sell and for home consumption Benefits (good yield and market potential) of new varieties	Farmer type 1: Good market opportunities Good yield and taste of OFSP Need to have enough for home consumption and nutritional issues Farmer type 2: Messages received from extension (would help market vines and roots; prize given to best performers) as well as good taste and yield	Planted in anticipation of this opportunity	Planted OFSP to sell	Farmer type 1: Sell roots One member was a member of drama and had become popular so this inspired her to continue planting OFSP Farmer type 2: Nutritional value and good market prospects were key factors

The decision to plant the second OFSP crop was influenced by the crop's sensory and agronomic attributes which, in turn, had an influence on whether it was taken on as a food or cash crop. In all the sub-counties, it was reported that children in particular professed a strong linking and preference for OFSP compared to non-OFSP. This inspired many producers to grow it for home consumption as it blended well with the nutrition information that targeted children as a VAD vulnerable group.

> *"At first my children used to like non-OFSP varieties but after tasting OFSP, they have lost interest in the local varieties. As such, I see no reason why I should continue growing the local varieties" Farmer, Kamuli, January 2009.*

In some areas, the yield of OFSP was reported to be better than non-OFSP[15]. Good yield implied that producers had enough for home consumption and sale. Due to this advantage some respondents mainly from the groups that had sold, opted to grow OFSP in place of non-OFSP. In contrast, some farmers who had not sold OFSP, reported that OFSP roots did not store long enough in the ground, takes a longer time to mature and the yield is not as good as non-OFSP varieties.

> *"I will continue to plant OFSP and non-OFSP. I will plant more OFSP compared to non-OFSP for sale. Non-OFSP will mainly be for home consumption since it is more drought resistant and stores longer in the ground thus more suitable for piece meal harvesting" Farmer Kamuli, January 2009.*

Among the farmers who had sold OFSP, it was planted in place of non-OFSP and the over-arching factor that sustained uptake was the market prospects for the crop. Producers who had not sold continued to plant OFSP and non-OFSP. This is partly because they were not confident of the performance of OFSP to warrant a complete switch over.

> "*I increased OFSP because I liked the taste. However, since OFSP was new, I could not abandon the local varieties that I am sure of as I am only studying OFSP. Because new varieties of some crops, like maize, perform very well in the first planting when you buy the packed seed but the next planting they do not germinate well. That is why I had to plant OFSP three times while maintaining non-OFSP and am now sure of it since I have not seen any change in its yield yet" Farmer Kamuli, January 2009.*

[15] The OFSP varieties were virus free and likely to yield more in the first few years after release.

Most of the farmers who had sold OFSP in Kamuli had planted three OFSP crops by September 2009; a few producers had planted a fourth crop by then. Those who had not sold had planted two crops only.

To conclude, the most important factors that influenced the decision to plant OFSP for sale in Kamuli were the importance of sweetpotato as a key staple crop; anticipated support in marketing; positive experiences with new crops; and its sensory and agronomic attributes. As in Bukedea, producers who planted with the aim of selling planted at least one crop more than those who planted for home consumption only.

5.3.3 Mukono

OFSP was introduced to Mukono between November and December 2007, after its introduction to Bukedea and Kamuli. The timeline (Table 5.4) depicts that most of the farmer groups in Mukono started around 2001, with the inception of the NAADS programme. Prior to this, most of them were informal self-help associations. Compared to the other districts, the involvement of the local civic and political leaders was more prominent, particularly sensitising producers on the benefits of OFSP and encouraging them to participate in project activities. From the timelines it can be seen that, both farmer types had planted three OFSP crops by the end of 2008.

As in Bukedea and Kamuli, all the producers in Mukono were inspired to plant the first OFSP crop by the nutrition message that they received. However, unlike in Bukedea and Kamuli, market opportunities were clearly important in farmer-decision making from the time the project was introduced. This could partly be a result of the market opportunities created by the high level of urbanisation of Mukono compared to Bukedea and Kamuli.

Table 5.4: Timeline of significant events among the 24 households interviewed in Mukono aggregated into producer type 1 producers who had sold OFSP and producer type 2 producers who had not sold OFSP, March 2009

Date	**1999-2001**	**Nov- Dec 2007**	**March-May 2008**	**July 2008**	**July 2008**	**July 2008**	**August 2008**
Event	Group started	OFSP introduced, first crop planted	Second crop planted	Agricultural show/	Peak OFSP marketing season starts	Vine sales	Third crop planted
Farmer type	Both	Both	Both	Producer type 1	Producer type 1	Producer type 1	Both
How it was done	Leaders sensitized public on importance of groups producers formed groups and registered in sub-county	Sensitization of producers on benefits of OFSP Farmer type 2: planted on land meant for non-OFSP due to land shortage	Producer type 1: Some female producers planted as a sub-group; male producers as individuals Farmer type 2: substituted OFSP for non-OFSP	Organized by catholic church. Producers invited to show case "best-bets"	Sold at farm gate to traders Took to Gaba market Sold to schools	A few producers Sold to buyers directed by group chairperson	Producer type 1: expanded acreage Farmer type 2: reduced acreage
Why/implications	Government and NGO's preferred to work with producers organised in groups	OFSP is nutritious, matures early and has a market. Involvement of local civic and political leaders in mobilisation	Producer type 1: Vine sales, home consumption Female producers to sell roots. planting as a group was to have greater control Producer type 2: Nutritional benefits. Some to sell but traders refused to buy VEDCO promised to support in marketing roots and vines	Producers exhibited OFSP. Sold roots, vines and later invited to train church groups and provide OFSP vines	Used outlets they had been using before	Propagates vines for sale	Sub group planted for sale, preserve vines and home consumption

In Mukono, many of the high value agricultural commodities such as vanilla, cocoa and floriculture have been introduced by government and NGOs. Over the years, farmers have taken them up then dropped them depending on their assessment of the marketing prospects. Thus, producers look at whatever commodity is introduced from a marketing perspective first.

> *"I was motivated to grow OFSP in order to get money. I believed that I would be able to get money from OFSP that I would use for buying other assets and indeed I have been able to buy two goats. Unfortunately, I consumed my entire first crop because the yield had been affected by drought; otherwise the intention was to sell part of it". Farmer Mukono, April 2009.*

> *"I accepted to plant OFSP because of the nutritional message but even if it did not have the nutrients, I would still have planted OFSP in order to determine how it performs in terms of yield, taste and the market." Farmer Mukono, April 2009.*

As alluded to earlier, the other factor that influenced the decision of producers in Mukono to plant the first OFSP was the involvement of local civic and political leaders in mobilising and sensitising producers. Indeed, most of the producers themselves were either community leaders or had been involved in other agricultural projects before (see Table 5.1).

The second OFSP crop in Mukono was planted at the onset of the second rains, between March and May 2008. While the main reason was home consumption, market opportunities were frequently raised. Producers who grew with the aim of marketing were inspired by the fact that they had learnt, from the previous season, that there was a high demand for OFSP in the community.

> *"In February 2009, I planted an acre of OFSP and half-an acre of non-OFSP. I planted a bigger field of OFSP because people were asking for it with the intention of buying. I planted with the aim of having enough OFSP for home consumption and selling some. If the intention had been home consumption alone, I would have planted only half an acre of OFSP." Farmer Mukono, April 2009.*

Unlike Bukedea and Kamuli, the decision to plant OFSP was influenced by prospects of selling by both farmer types. However, the non-market oriented producers were not as successful in selling their OFSP compared to the producers who had sold. Consequently, they reduced the size of their OFSP gardens as the market oriented producers expanded the size of their gardens.

> *"I planted OFSP with the aim of selling most of it and retaining some for home consumption. However, traders refused to buy OFSP reasoning that their customers will not like/purchase it. As such, I have since reduced the OFSP that I plant, just to cater for my home food needs" Farmer, Mukono, April 2009.*

In some cases, the decision to plant OFSP for the market was a result of information that was received from VEDCO about marketing opportunities for OFSP roots and vines. This was mainly, but not limited to, the producers who had not sold. These farmers tended to rely more on VEDCO for both information and support on marketing.

> *"We decided to plant OFSP for sale because the extension worker told us that it has a good market. Four of us, all women in this group, decided to plant one acre jointly for sale. Individually, each of us had their own OFSP garden at home for home consumption. For the case of vines, we were trained on how to propagate vines and told that the vines were bought and transported from a far place, implying that we would also be able to sell our vines when they mature". Farmer Mukono, April 2009.*

Therefore, while nutrition benefits were important in influencing producer decisions, market considerations played a key role from the onset. The main difference between producers who had sold and those who had not is that, while both planted with the aim of selling, the producers who had not sold either tried and failed to sell or hesitated to sell OFSP, being relatively new.

In summary, in Mukono, unlike in Bukedea and in Kamuli, all the producers planted OFSP with the aim of selling. The key difference is that producers who had not sold either tried to sell and failed or opted not to sell fearing that being new, OFSP may not be as acceptable to traders as non-OFSP. However, nutrition information was a very important consideration in the decision to plant OFSP.

Overall, therefore, the key factors that influenced the decision to plant OFSP for sale were crop attributes, the REU project, previous experiences with new crops, and access to and use of productive resources. In all the three areas, and more so in Bukedea and Kamuli, marketing propelled uptake of OFSP as producers who sold had planted at least one crop more than the producers who had not sold. Compared to Bukedea and Mukono, anticipated support in marketing was one of the key factor that influenced producers to plant OFSP for sale in Kamuli, while retaining non-OFSP for home consumption. Since sweetpotato is the key staple food in

Kamuli, this could suggest that marketing has a more important role in areas where a crop is produced mainly for home consumption.

Having analysed the key factors that influenced the decision by producers to plant OFSP for the market, the next sub-section examines the experiences of the producers in marketing OFSP.

5.4. Producer experiences in marketing OFSP

This section focuses on experiences of producers in marketing OFSP. The aim is to understand factors influencing the decision to plant and sell it. It makes use of a variety of data from the qualitative investigation; and farm level OFSP sales records. It seeks to analyse and determine the key factors influencing producers' decision to plant OFSP, either for the market or home consumption, and what they eventually did with the OFSP that they produced, that is, did they sell it or was it retained for home consumption?

5.4.1. Marketing channels for OFSP

This section provides a description of the OFSP marketing channels observed in the three study districts of Bukedea, Kamuli and Mukono. The description is based on findings from the qualitative investigation.

Bukedea

Records from the Market Link Farmer (MLF) indicated that OFSP root sales started in May 2008 and reached the peak in September 2008 and continued up to January 2009 (Wamaniala, 2009). However, most producers who sold started selling their roots in July and all of them had roots ready for sale at the time of the interview, including some of the producers who had not sold OFSP.

The main marketing channels for the OFSP were: producers selling to bicycle traders; producers selling as a group or individually to urban markets through the MLF; and producers selling to wholesalers at the farm gate.

Producers who sold directly to urban traders had prior experience in selling non-OFSP varieties in the markets. The most important markets were in Mbale town, 30 kilometres away and other markets within Bukedea district. Most of the OFSP sales through this channel were coordinated

by the MLF, who took over some of the roles of the market intermediaries, such as coordinating supply and demand; bulking up sweetpotato; transporting; and negotiating and guaranteeing credit sales. Some producers, especially women and those with little experience in marketing staples, fully delegated the responsibility of selling their OFSP to the MLF, while others took responsibility for their sales.

Examination of the farmer sales records kept by the MLF in Bukedea reveal that 76% of the OFSP sold were from the three farmer groups (Kachul Agricultural Promoters, Arapai Central and Aipecitoi FG), all from the sub-county of Kidongle. Within the groups a few producers were responsible for most of the OFSP sales. For example, 80% of OFSP sold in Kachul Agricultural Promoters was supplied by one farmer. While there may be issues of accuracy of these records, this finding is consistent with findings of farmer marketing of staple grains in east and southern Africa (Jayne *et al.*2006). This study concluded that 1-2% of the farms accounted for 50% of the overall maize marketed by smallholder producers. When a broader set of staples (maize, cassava, sweetpotato, millet and sorghum) were taken into account, 55% of the sales are still accounted for by 10% of the producers with the largest sales.

The second channel was the one in which producers sold to bicycle traders. Producers sell to bicycle traders who in turn take the OFSP to the urban markets. Here most of the marketing costs and risks are met by the bicycle trader. While the bicycle traders are male, it is mostly female producers who sell to bicycle traders. The highest price that the bicycle traders offered was UGX 35,000 per sack, while the lowest was UGX 8,000 per sack. From the producers' point of view, the key limitation with bicycle traders is that they buy OFSP in small quantities (in basins[16] and a maximum of 1 sack per bicycle trader per day).

In conclusion, two points are worth reflecting upon: firstly, OFSP sales are concentrated among a few farmers in a geographically localised area; and secondly, "small markets and small traders" are particularly important in driving the marketing of OFSP. These two factors could apply to the initial marketing trends of any introduced biofortified crop.

[16]About the size of a washing-up bowl

Kamuli

The main market outlets for OFSP in Kamuli were the local schools, itinerant traders and rural markets. Producers who sold OFSP were those who had been selling non-OFSP varieties before and the outlets used for OFSP were the same as those they had used for non-OFSP varieties.

Schools were a particularly important market outlet for OFSP because most producers who were also parents found it easy to supply food to the schools in exchange for school fees. These schools were either boarding or day schools that prepared and served mid-day meals for their students. In some cases, the school administration requested particular producers to supply OFSP.

> *"I sold four sacks non-OFSP in July 2008 to Bulopa Primary School at UGX 18,000 per sack. I got in touch with this school through a colleague who is a teacher in that school. One day, he informed me that the school was interested in buying sweetpotato but had failed to find a supplier. I then informed him that I had OFSP, which was already mature. He then asked be to supply it to the school. Unfortunately, my stock could only supply one consignment of OFSP yet they had still wanted more. I then asked another farmer who had a lot of OFSP to get in touch with the school. When he contacted the school, he was also asked to supply OFSP". Farmer Kamuli, December 2008.*

While schools were potentially a good outlet for OFSP, most producers were not able or willing to meet the quantity and quality requirements of the school. Farmers need to be more organised to take advantage of this market opportunity.

The other outlet for producers, especially those in areas within the proximity of the main Kamuli to Jinja highway was bicycle traders. These traders mainly supplied OFSP to the roadside markets of Buwenge, Kasambira and Nawanyago. In some of these areas, producers reported that they sold OFSP at a higher price than non-OFSP.

> *"In November 2008, I sold six basins of OFSP at UGX 2,500 per basin. I also sold 1 sack of OFSP (equivalent to 6 basins at UGX 2,000 each. Basin I sold to different traders but two of them came back for the second time and bought a sack of OFSP each. I sold OFSP at a higher price than non-OFSP because I sensitized the traders on the nutritional benefits of OFSP. I told the trader that OFSP was a new variety of sweetpotato which has more nutritional values compared to the local varieties. The trader bought it at a higher price than I had initially told him and directed fellow traders to come to my place to buy more OFSP" Farmer Kamuli, December 2008.*

Based on their experiences, producers in Kamuli who had sold OFSP expected OFSP to still sell at a premium price compared to non-OFSP, for a number of reasons. First, OFSP matures earlier than the local varieties, so it can be sold before there is a glut in supply of non-OFSP in the market. Second, whenever available, traders would buy more OFSP compared to non-OFSP suggesting that there was a high demand for OFSP. Related to this, in most cases, traders had offered a higher price for OFSP than non-OFSP. Local consumers and traders alike had developed a preference for OFSP-after tasting-they always return specifically looking for OFSP. Local schools preferred OFSP and were encouraging producers to grow it. In addition, there was assurance from the extension worker that in case producers have more OFSP than they can sell on their own, they would be supported to market.

Unlike Bukedea, farm level sales records were not readily available in Kamuli mainly due to the relatively small amount of OFSP that was available for sale. But, as in Bukedea, the marketing channels in Kamuli have also attested to the importance of small markets as epitomised by schools as outlets of OFSP. The other important point is that, OFSP has a novelty value, which may attract a premium price.

Mukono

The main outlets for OFSP were the local schools and the rural markets. It was reported by the producers who had not sold OFSP that the markets in the tea and sugarcane estates were potential outlets but there had been no attempt to introduce and promote OFSP in these places.

> *"We are surrounded by tea and sugarcane estates and they provide a good market for sweetpotato. However, OFSP is yet to be introduced to these markets". Farmer, Mukono, March 2009.*

Other market outlets that were identified as potential for OFSP were the main market in Mukono town and Nakawa market in Kampala, which attract urban workers. This optimism, among the producers who had not sold OFSP, was based on the fact that traders come looking for sweetpotato and it was unlikely that they would reject OFSP, if they found it. A different view from some farmer traders selling sweetpotato, not OFSP, was that it was not profitable to trade in OFSP as producers always expected a higher price compared to what they were willing to take for non-OFSP.

I trade in non-OFSP because producers expect me to pay UGX 15,000 per sack for OFSP yet I buy non-OFSP at UGX 7,000 per sack. Besides, they are not always willing to sell as they prefer to retain it for home consumption. Unfortunately, customers in Mukono market, where I take non-OFSP, are not aware of the nutritional benefits of OFSP. I would buy OFSP if the price was the same as non-OFSP because my customers are not aware of the difference". Farmer Mukono, March 2009.

In the in-land markets of Kisoga and Kiyola the prices of OFSP were noted to be higher than the price of non-OFSP. This was attributed to the fact that traders and consumers in these markets were aware of the nutritional benefits of OFSP and paid a premium price[17].

"I sell my sweetpotato at the farm gate to traders from Kiyola and Kisoga markets. For some time now, OFSP has been selling at UGX 8,000/basin compared to UGX 6,000/basin for non-OFSP. I do not know exactly why but I think it is because traders are aware of the nutritional benefits... Other producers plant OFSP for home consumption as they do not have enough land to support both home consumption and the needs of the market," Farmer Mukono, March 2009.

Another market that was an important destination for OFSP from Mukono is Gaba, on the shores of Lake Victoria. This market serves as a weekly bulking market for produce destined for markets in the mainland suburbs and centres in Kampala. Unlike Kisoga and Kiyola where it was reported that OFSP sold at a premium, the price in Gaba was the same as the price of non-OFSP. However, it was clear is that the profile of OFSP has moved from a little known sweetpotato to one of the preferred types, as the following quote indicates:

"Being a sweetpotato trader, I took two basins of OFSP to Gaba market alongside non-OFSP to test whether it would be bought. I managed to sell each basin at UGX 6,000 without difficulty. I then decided to retain the rest for home consumption. However, I continued buying OFSP from other producers and taking to the market. At first my customers liked the non-OFSP more than OFSP because OFSP was a new product in the market but I would tell them that OFSP is food as well as medicine...now there are customers who like strictly OFSP even if you have mixed it with non-OFSP, they would ask you to sort out OFSP." Farmer Mukono, March 2009.

In conclusion, although OFSP was produced and marketed in all the three districts, the largest volumes sold were recorded in Bukedea, the district in which sweetpotato were a minor staple crop. In all the districts, the informal small markets and small traders were the most important marketing channels for OFSP. Sales were concentrated among a few producers, and in some

[17]The marketing strategy included training traders and it highlighted the nutritional advantages of OFSP.

cases, OFSP became a niche product. Female farmer traders in Mukono and the MLF in Bukedea were particularly important in marketing OFSP.

5.5. Factors influencing producers decision to market OFSP

This section addresses Research Objective One: to evaluate the factors that influence producers to grow OFSP for sale. It builds on insights and analysis in the previous sub-sections of this chapter.

In analysing the drivers of OFSP marketing, a distinction is made between those factors that are more generic in nature, in a sense that, they may apply to any agricultural product, and those that are more specific to OFSP. The next sub-section examines two of the key generic drivers of OFSP marketing: farmer access to productive resources and previous experiences in marketing other crops.

5.5.1 Access to productive resources

Land, labour, OFSP vines and oxen for animal traction are the resources (inputs) used in OFSP production. The key innovation in this intervention was provision of clean planting materials of the four OFSP varieties. In other words, with the exception of vines, what is needed for OFSP production is similar to what is need for production of non-OFSP. Availability and use of these resources had implications for OFSP production for sale. Each of these factors and how they influenced the decision by producers to sell OFSP is discussed below.

Access to Land

Land is an important resource in agricultural production. Access to land and willingness to allocate part of it to OFSP was one of the criteria that were used for selecting producers to participate in the REU/OFSP project. Data extrapolated from the 64 producers interviewed indicate that the approximate average size of land among producers, in acres, was six in Bukedea, four in Kamuli and four in Mukono.

In Bukedea, where average land sizes are comparatively larger, all producers who had sold OFSP had access to at least four acres of land. Similarly, all the producers who sold OFSP had planted at least 0.25 acres of this crop. In areas where land shortage was a serious constraint, landlords were willing to hire out land for one cropping season only. In the allocation of family land,

important food crops such as cassava and maize were given priority. These food crops are controlled by the women and are rarely sold. In order to plant enough OFSP (at least 0.25 acres) for home consumption and sale, producers constrained by a small land holding had to either borrow or rent land.

> *"Much as I had wanted to plant half-acre of OFSP in order to have enough for home consumption and sale, I did not have adequate funds for hiring the extra land so I ended up planting a few heaps around my homestead primarily for home consumption. The size of the next garden will depend on availability of resources for hiring land since priority in the allocation of family land is usually on food crops." Farmer, Bukedea, September 2008.*

In Mukono and Kamuli, the average land size was four acres. However, the actual land available for OFSP was often less than half an acre as most land was committed to perennial crops such as coffee, sugar cane and bananas. Coffee and sugar cane are traditional cash crops and like land, they are owned and controlled by the men. Limited availability of land was reported, especially among the female respondents as one of the key obstacles to producing OFSP for sale. This was reinforced by the fact that in some areas it was difficult to find landlords who were willing to rent out their gardens for sweetpotato since, compared to other annual crops such as maize, groundnuts and beans, they stayed longer in the ground, due to the practice of piece meal-harvesting.

> *"I always plant sweetpotato for home consumption because I do not have enough land. Otherwise, I would be planting enough to sell to neighbours who ask me for OFSP. I would rent land but it is not readily available especially for sweetpotato. The few producers who have extra land rent it out expensively, at UGX 50,000 per acre per season." Farmer, Mukono, March 2009.*

> *"For people with land, OFSP would be a good cash crop because its yields are good. For us with small pieces of land, OFSP is just a food crop", Farmer Kamuli, December 2008.*

> *"I would have loved to plant more OFSP but I am limited by land. The people, who rent land to us, usually in kind, cannot allow one to plant sweetpotato because they prefer to give land for a crop that they can sell off with ease, like maize, not sweetpotato that cannot be sold off easily. Besides, sweetpotato stays longer in the ground due to piece meal harvesting". Farmer Mukono, March 2009.*

While land shortage was identified as one of the key constraints to production of OFSP for sale in Kamuli and Mukono, farmers with access to bigger parcels of land cultivated other "high" value cash crops such as maize, sugarcane, coffee and bananas.

Across the three districts, producers who planted OFSP for sale were more willing, if necessary, to rent in more land for OFSP production compared to those who planted it for home consumption. In other words, producers who planted OFSP for home consumption often cited land shortage as the key limiting factor, while those who planted OFSP for sale looked at renting land as an opportunity rather than a limitation.

Previous studies have reported the importance of land size in technology adoption. For example, a unit increase in area of land owned was observed to result in a corresponding increase in the adoption of improved cassava varieties in Tanzania (Kavia *et al.* 2007). In Mozambique, farmers who allocated a bigger area of their land to sweetpotato were more likely to adopt OFSP (Mazuze, 2004), signalling the importance of the value attached to sweetpotato rather than land size *per se* in the adoption-decision process. Similarly, farmers with bigger land sizes in Ethiopia were reported to be more likely to sell cereals (Gabre-Madhin and Hoekstra, 2007). Therefore, in keeping with results of these previous adoption studies, land holding or access to bigger parcels of land has been demonstrated to have a bearing on household ability to sell sweetpotato in general, and OFSP in particular.

Access to land in valley bottoms

Access to land in the valley bottoms, particularly in Bukedea and to some extent in Kamuli, had implications for OFSP production for sale. Due to the relatively long and severe dry season, in these districts, land in valley bottoms is important for both vine conservation and ensuring that an early crop, usually sold at a premium price, can be planted. Land in the valley bottoms are often natural water reservoirs in the dry season due to the high water retention capacity, suggesting a potential source of water for irrigation. Sweetpotato can be planted in the valley bottoms between November and March, during the long dry season. This crop matures between April and July, a time when sweetpotato is scarce in the market and therefore commands a high price. Besides direct benefits from the roots, producers who plant OFSP in the valley bottoms are sure of having sufficient, clean planting material at the on-set of the first rains in March. If they

opt to plant an OFSP crop in March/April, they will be sure of marketable roots between June and August, before the start of the main marketing season, when sweetpotato prices start to go down.

Prior to the introduction of OFSP, most producers in Bukedea were using the valley bottoms for rice production. Rice was grown as a cash crop. In Kamuli, valley bottoms were rarely used for OFSP but instead reserved for grazing animals and production of sugarcane, vegetables and maize. Compared to sweetpotato, which were largely planted for home consumption, these enterprises were considered to be high-value cash earners. However, some producers in Kamuli, who considered OFSP to be a key cash crop, allocated some of their valley bottoms to it. For example, some of the female producers who had been growing maize as a key cash crop opted for OFSP, while others substituted sugarcane with OFSP as their priority cash crop. Maize was substituted with OFSP because both crops serve as food and cash crops. Sugarcane was substituted with OFSP because both crops were considered cash crops and utilise the valley bottoms yet unlike sugarcane, OFSP is early maturing (two crops can be grown in a year, compared to a sugarcane crop that takes at least 18 months to mature). It was therefore considered to be more profitable.

> *"We were told that OFSP has a good market and it yields very well. Indeed, we have realized that it yields very well and have been able to sell it. As such, we have opted to remove sugarcane and replace it with OFSP because sugarcane takes a minimum of 12 months to mature compared to 3 months that OFSP takes and in a year, I can harvest 2 OFSP crops, which is not the case with sugarcane." Farmer, Kamuli, December 2008.*

However, other issues underpinning these crop substitution decisions could be issues of access to and control over crops and resources accruing from their sale. Sugar cane and maize are both considered to be men's crops in Kamuli while sweetpotato is considered to be a woman's crop. Compared to the male-controlled maize and sugarcane, women were more inclined to plant OFSP for sale, since they could have more control over the crop and proceeds from its sale.

However, producers with access to valley bottoms often utilised them for OFSP production, if OFSP was produced for sale. In parts of Kamuli where other enterprises such as vegetables, livestock and maize were considered to be of higher commercial value than OFSP, they were planted in the valley bottoms over and above OFSP.

In both Kamuli and Bukedea, land in the valley bottoms was rarely available for renting, and when it is available it is for a short time, usually for one season and at a higher price, often twice the cost of other land.

Oxen for Animal Traction

One unique feature of the farming system in the Bukedea area is the use of oxen for animal traction(Akwang *et al.* 1998). Animal traction permits producers to open up larger pieces of land in a relatively short time, and in a cost-effective manner. While all producers in Bukedea had access to oxen for opening up land, most of those who sold OFSP owned the oxen and used them for ploughing OFSP gardens.

> *"Ownership of oxen is critical for the production of OFSP. If I did not have oxen, I would have planted less than 0.25 acres of OFSP, in which case I would hardly have had any OFSP for sale. With oxen I managed to plant one acre", Farmer Bukedea, September 2008.*

Plate 7: Different methods used for land preparation; animal traction (left) and hand hoe (right). Oxen are owned and mainly used by men while the women still use the rudimentary hand hoe.

Producers who did not own oxen could still access oxen either by cash payment or in-kind through provision of labour as an ox driver in exchange for a turn to plough. However, given the vast portfolio of crops planted, priority in the use of oxen was given to crops such as cereals and oil crops that need a clean seed bed before planting.

Ownership of oxen is particularly important if producers are to grow an early crop since oxen owners are hesitant to hire oxen out until they have ploughed their gardens first. This is exacerbated by the increasingly variable and unpredictable weather. Therefore, even among producers who own oxen, the decision to prioritise their use in preparing OFSP instead of other

crops depends on the relative importance of OFSP. This partly explains why some farmers who sold OFSP opted to invest part of the proceeds in acquiring ox-ploughing units[18].

> *"I will still grow OFSP because it helps me in feeding my children but the acreage will depend on how and when I get oxen." Farmer, Bukedea, September 2009*

The pictures in plate 7 also demonstrate the gender issues in access to and ownership of oxen for ploughing. Oxen are owned by men and ox-ploughing is predominantly a male activity. This contrasts farm operations performed using the hand hoe such as weeding or even land opening which are female activities. The implication could be that where OFSP is produced for the market, the activity is dominated by the men who may use oxen. Conversely, if OFSP is mainly for home consumption, it may be a woman's enterprise principally relying on the hand hoe as the primary garden tool.

Thus, access to oxen or availability of cash for hiring oxen was a key determinant of the actual acreage allocated to OFSP. By extension, the larger the size of the OFSP garden, the more likely will it be that the farmer will be able to harvest a marketable surplus. This finding resonates well with findings from Ethiopia, which highlighted the importance of animal traction in staple crop production for marketing (Gabre-Madhin and Hoekstra, 2007).

5.5.2 Previous experience in marketing other crops

Producers who engaged in commercial production of other crops were more likely to take up OFSP as a marketable crop since their production and resource allocation decisions were always taken in light of the market opportunities. In Bukedea, producers who had been growing cotton and rice for sale found it easy to take up OFSP as a commercial enterprise, even though they had not been growing sweetpotato before. They were able to transfer some core skills into OFSP production and marketing. For example, the model of cotton production required the use of oxen for preparing large fields. Cotton marketing involved sorting, bulking and collective marketing through the local co-operative society. Rice was planted in the valley bottoms; producers transported it to Mbale and sold it directly to the millers. It was therefore easy for these producers to substitute rice with OFSP in the valley bottoms, use oxen for opening up big OFSP fields, bulk and collectively market OFSP in Mbale, either directly or through the MLF.

[18]Includes a pair or two (depending on the size) of oxen and ox-plough

Table 5. 5: Skills gained from other crops that were used in marketing OFSP as reported by farmers in Bukedea, Kamuli and Mukono, 2009

Crop	*Area*	*Skill/acumen*	**Use in OFSP**
Cotton	Bukedea	Opening bigger land Bulking in cooperative store Credit transactions	Bigger OFSP gardens Group marketing through MLF Credit sales to traders
Rice	Bukedea	Use of valley bottoms, selling directly to millers in Mbale	Valley bottoms used for OFSP OFSP sold by producers in Mbale
Non-OFSP	Kamuli/Mukono	Selling to schools, fixed quantities and quality, payment not always on delivery	Entry point for selling OFSP to schools

Similarly, farmer traders in Mukono and Kamuli who had been supplying non-OFSP to either the local markets or schools used the same outlets to sell OFSP. However, selling OFSP, a new product, in these markets necessitated innovation and personal initiative, as related by one of the farmer traders in Mukono:

> *"I took two basins of OFSP to the market to test whether they would be bought and I sold each of the basins at UGX 6,000. This inspired me to continue selling OFSP from my own garden and other farmer's gardens as well. Initially, customers preferred non-OFSP to OFSP because OFSP was a new product in the market. However, I started sensitizing them on the nutritional benefits of OFSP. Whenever I took OFSP to the market, I would dress in my OFSP attire[19] to reinforce the message. This was my own initiative as a trader since experience in selling sweetpotato taught me that in business one has to be creative in order to compete for customers in the market. As a result, many customers prefer OFSP and now always ask only for it", Farmer Mukono, April 2009.*

In Kamuli, some male producers were inspired to take up OFSP on the basis of the positive experiences they had had with the introduction of SERENUT groundnut varieties. The new

[19]As part of the marketing strategy, the REU project provided aprons, T-shirts and caps with printed OFSP promotional material to community based promoters.

groundnut varieties were high yielding, and since there was a high demand for them, the early adopters were contracted to produce and supply seed for other producers. These producers were anticipating similar benefits to follow from adopting OFSP.

However, there were cases where some producers who had been selling non-OFSP were reluctant to sell OFSP using the marketing channels used for non-OFSP. Their main concern was that being a new crop, it was likely that it would affect the market for non-OFSP, should customers not like it.

The decision to continue growing OFSP, especially for sale, depends in part on the price and marketing opportunities of other crops. Therefore, there is a possibility that, should more remunerative enterprises emerge or should OFSP become unprofitable, it will be substituted with the more profitable crop enterprises.

Having analysed the generic factors that influenced the decision of producers to grow OFSP for sale, the next sub-section assesses the more specific factors. These are project market facilitation, role of "small" markets and "small" traders, attributes of OFSP and opportunity for vine sales.

5.5.3 Project market facilitation

OFSP was introduced to Bukedea, Kamuli and Mukono by the REU project. This project had a marketing strategy that emphasised a facilitatory, as opposed to an interventionist, approach (Coote *et al*. 2007; Wamaniala, 2007). It emphasised the importance of linking producers to existing market chains through identifying and compiling a trader data base, creating awareness among traders and consumers about the benefits of OFSP, training market chain actors including farmers and provision of promotional materials. Later, MLFs were introduced, in response to the need to coordinate OFSP marketing between farmers and traders (Wamaniala, 2009). The MLF provided marketing support to some producers who would probably have not sold OFSP on their own, as exemplified by this female farmer in Bukedea.

> *"I handed over four sacks of OFSP to the market link farmer to take to Nylon market in Mbale. I am not sure of how much the OFSP will be sold for as I delegated the market link farmer to market them on my behalf. What I know is that the OFSP was taken on credit and the traders promise to pay by the end of this week". Farmer, Bukedea, September, 2008.*

Plate 8: Market Link Farmer (in white T-Shirt) guaranteeing a credit transaction between OFSP farmer (centre) from Bukedea and sweetpotato trader (in orange T-shirt) in Mbale central market

Between April 2008 and March 2009, 254 tons of OFSP roots, worth some UGX 38,000,000[20] were sold in the three project districts mainly through the MLFs (Wamaniala, 2009). OFSP sales were concentrated, with sales from Bukedea contributing to about 94% of documented OFSP sales. Even within Bukedea, over 70% of the documented OFSP sales were in Kidongole sub-county. Again this finding is consistent with findings of other studies on staple crop marketing that reveal concentration of staple crop sales among a few households within a geographically defined area.

In addition to these monetary benefits, trust and confidence between producers and traders was built as most of the transactions were on a credit basis, of up to one week. Furthermore, these relationships meant that producers were able to appreciate the quality and quantity of root specifications of the Mbale markets, which minimised wastage through rejection. In Kamuli and Mukono, introduction of the MLF gave some producers, who had hitherto not sold OFSP, the confidence that they would be able to sell their crop, should they opt to.

[20]It was not possible to capture all the quantities of OFSP sold by the individual farmers directly.

As a way of broadening utilisation and adding value to OFSP, producers were taught how to make various products from OFSP. This created the belief among some producers, especially women, of an alternative and perhaps better outlet for OFSP.

> *"In March 2009, I intend to plant 300 heaps of each of the OFSP varieties because I now know how to make bread from OFSP. Besides income, baking will keep me occupied." Farmer, Kamuli, December 2008.*

While this outlet may be good in a sense that it provides women with a market that they have control over, the main limitation is that baking requires few OFSP roots. Thus, it is very difficult to justify or encourage expansion of OFSP production on the basis of this opportunity. Besides, it may not be economically viable given the cost of the other inputs such as wheat flour, cooking oil and the extra need for firewood.

In conclusion, the REU project provided the technology (OFSP) and marketing extension support. Provision of extension has been reported as the single most important factor in influencing adoption of staple crops by farmers in eastern Africa (Doss *et al.* 2003). Similarly, access to extension services was identified as an important factor in the adoption of quality protein maize. Farmers who participated in extension activities were more likely to have heard of protein, to be aware of quality protein maize, demonstrate understanding of its benefits to human nutrition and adopt it (De-Groote *et al.* 2010). In the case of this study, provision of extension services or the REU project on its own may not provide sufficient explanations as to why some farmers sold OFSP while others did not. Since all respondents, irrespective of whether they sold OFSP or not, in theory, received the same extension support from the REU project. However, it does underscore the importance of provision of information (through extension) in positive behaviour change and therefore the need to include marketing extension in biofortification projects with a marketing focus.

5.5.4"Small" markets and "small" traders

Earlier work on sweetpotato marketing in Uganda (Fowler and Stabrawa, 1993; Wanda *et al.* 2003; Tomlins *et al.* 2009) identified the key urban markets as the main drivers of sweetpotato marketing. These markets included Nakawa, Owino and Kalerwe in Kampala, as well as markets in the regional hubs of Jinja, Tororo and Mbale. This body of work further revealed the existence

of cross-border trade into Kenya, Rwanda and Southern Sudan. The main actors in these national and cross-border markets were producers, brokers, wholesalers, transporters, retailers and consumers.

While these outlets and actors have remained important in marketing non-OFSP, "small" markets (Table 5.6) and "small" traders have emerged as the most important outlets for OFSP. The OFSP chains were dominated by emerging small-scale farmer and bicycle traders who supply OFSP to rural and urban markets. In contrast, non-OFSP market chains are longer and dominated by more actors (Coote *et al.* 2007).

Plate 9: Bicycle traders delivering OFSP from Bukedea to Mbale central market, September 2008. These traders are exclusively male and relatively young

The prominence of small markets and traders implies shorter and more localised value chains, resulting, in part, from more concentrated production areas and low output relative to non-OFSP production. However, it could also reveal the hidden and often neglected potential role of informal markets in driving production, marketing and acceptability of a new agricultural product. Various studies have equally confirmed the importance of small traders and local markets in staple crop marketing. In a recent typology of food value chains, Gomez *et al.* (2011), characterised these markets as "traditional" in which local traders buy primarily from smallholder farmers, and sell to consumers and traders in wet, mostly local markets. They note

that such markets help reduce micronutrient deficiencies by offering low-priced fruits, vegetables, livestock products, and staples, particularly in rural areas and in the poor neighbourhood of urban areas. These benefits notwithstanding, they cautioned that production seasonality combined with lack of post-harvest and distribution infrastructure increase intermediation costs and limit the ability of these chains to reduce micronutrient deficiencies and under nourishment. In spite of this, in Africa in general, the existence of very few formal market links for non-grain staples has been documented (Fafchamps and Gabre-Madhin, 2001; Fafchamps and Hill, 2005).

Table 5.6: Main outlets and market actors in the OFSP marketing chain as determined by farmers in Mukono, Kamuli and Bukedea, 2009.

District	Market outlets	Main actors
Mukono	Gaba, Kiyola, Kisoga Kawolo, local schools	Farmer traders
Kamuli	Buwenge, Kasambira, Namulesa, local schools	Farmer traders and bicycle traders
Bukedea	Mbale, Ali, Kamu, Katekwan	Farmer traders, bicycle traders, MLF, wholesalers

5.5.5 Attributes of OFSP

The key attributes of OFSP that differentiate it from other sweetpotato types are nutritional, agronomic, sensory and visual. The nutritional attribute was among the most important, and in all the districts, uptake of OFSP, initially for home consumption, was influenced by the nutrition message that accompanied its introduction.

> *"OFSP has vitamin A that helps improve sight, health and is particularly good for women and children" Farmer, Mukono, April 2009.*

> *"OFSP is good for the children as it makes them grow when they are healthy. It is also good for the eyes" Farmer, Kamuli, December 2008.*

> *"We decided to grow and eat this medicine so that we treat ourselves at home instead of going to the hospital" Farmer, Bukedea, September 2008.*

However, nutrition information was also important in positioning OFSP in the sweetpotato market that hitherto had been dominated by yellow and white fleshed types.

"Initially customers (read traders) preferred non-OFSP to OFSP because OFSP was a new product. I started to sensitize them on nutritional benefits of OFSP and whenever I would take OFSP, I would dress in my attire to reinforce this message…many customers now prefer OFSP and ask for it" Farmer trader Mukono, April 2009.

"The school administration learnt about the benefits of OFSP from producers through drama and took interest in buying it for the pupils. I was then contacted and asked to supply OFSP to the school" Farmer Kamuli, December 2008.

"To introduce OFSP to the school, I sensitized the head teacher about the nutritional benefits of OFSP and that I had wanted to supply it on besides cassava and non-OFSP that I was already supplying. I was then asked to take a sample for students to taste and fortunately they liked it" Farmer Mukono, April 2009.

In conclusion, while nutrition information was the most important reason for the uptake of OFSP by the producers for home consumption, in some cases it was construed to mean that OFSP was solely for home consumption. It did appear that nutritional information was more important in driving acceptability and marketing of OFSP at the trader and consumer nodes of the value chain, compared to the producer level. This is discussed further in the subsequent chapters.

The second sets of attributes are agronomic. Under favourable agronomic conditions (fertile soils, adequate rainfall and good management), it was observed that OFSP performs well and in most cases better than non-OFSP. Where these conditions pertained, as was the case in parts of Kamuli, producers harvested adequate quantities of good (marketable) quality roots. Under such circumstances, producers substituted non-OFSP with OFSP as a means of addressing the twin objectives of meeting household food self-sufficiency and generating an income.

"I had never sold sweetpotato to this particular restaurant but when I saw that my OFSP had yielded more than I could consume and the yields were even better than those of my non-OFSP crop, I was forced to look for the market and that is how I ended up in this restaurant" Farmer, Kamuli December 2008.

However, as a result of declining land sizes, deteriorating soil fertility and increasing weather variability and unpredictability, the yield of OFSP was in most cases worse than that of non-OFSP. Consequently, most producers, particularly in 2009, reported poor harvests of OFSP compared to non-OFSP and a lack of marketable OFSP roots. It was also noted that once OFSP roots mature, they do not store as long as most non-OFSP varieties in the ground and therefore not suitable for piece meal harvesting. Based on this criterion, producers opted to sell OFSP once

mature and retain non-OFSP for home consumption. In this respect, a negative agronomic trait (poor in-ground storage) became a positive influence on farmers' decision to sell OFSP (the urgent need to harvest and sell roots once mature).

> *"Since customers prefer OFSP, I will plant more OFSP compared to non-OFSP for sale. Non-OFSP will mainly be for home consumption since it is more drought resistant and stores longer in the ground thus more suitable for piece meal harvesting" Farmer, Mukono, April 2009.*

Sensory attributes were equally important. Consistent with findings from previous studies, children were reported to profess a strong preference for OFSP to non-OFSP due to its sweet taste. Although most adults reported a liking for OFSP, some still preferred the local varieties. The strong preference that children demonstrated for OFSP was a key reason why producers retained OFSP for home consumption. This bonded very well with the vitamin A campaign that targeted children as a particular at-risk category of being vitamin A deficient.

> *"What I have seen is that children like OFSP very much and prefer it to atap, the local staple meal. As such, I will not sell even what is still in the garden. OFSP should be at home always so that it is easily accessible to the children who like eating it" Farmer Bukedea, September 2008.*

The importance of crop attributes in uptake of a sweetpotato variety is consistent with findings of earlier studies. For example, an analysis of farmer preferences in sweetpotato varieties in Uganda by the International Potato Centre (CIP), identified high yield, sweet taste and early maturity as the most sought after characteristics in a variety (Yanggen and Nagujja, 2006). These attributes have implications for marketing. High yield can enable farmers produce OFSP which is surplus to consumption requirements; early maturing varieties can help cope with the vagaries of weather and produce an early crop with better marketing opportunities; and sweet taste is a consumer (marketing attribute). Drawing parallels with cassava, in the Lake Zone of Tanzania, farmers who grew cassava for sale preferred local verities to improved ones on account of their superior taste and therefore preference by urban consumers (Kavia *et al.* 2007). However, the challenge has been that these constraints and therefore possible solutions are often diagnosed and approached from a production perspective with little linkage to the marketing perspectives. Yet, earlier studies in Uganda (Gonzalelez de Urqueta de Lorza, 2006; Yaggen and Nagujja, 2006) identified lack of consistent markets for roots as a major constraint to farmer uptake of new

OFSP varieties. In addition, few studies, as well as interventions promoting OFSP, have included market development, which may be essential to ensuring sustained adoption of a food-based approach (Low *et al.* 2007).

5.5.6 Opportunity for OFSP vine sales

The unanticipated opportunity to sell vines to the project and to NGOs operating in the north of the country through the extensionists and Soroti Sweetpotato Producers and Processors Association (SOSPPA) was also responsible for wide spread uptake of OFSP in Bukedea. Like most rural innovations, it was those producers who had access to resources –land, valley bottoms, labour and oxen as well as timely information that were able to respond to and benefit from this opportunity. Some producers were aware of this opportunity but lacked the resources to invest; others had the resources but did not hear about this opportunity so could not invest; others had the information and the resources but feared to invest and a few had the resources and invested without knowing about the opportunity available.

Vine sales had an impact on root sales in Bukedea as most producers wanted to sell vines first before selling roots. Producers expanded their OFSP fields with the belief that even if they failed to sell roots, they would have made adequate returns from vines sales. A comparison of vine and root sales across the three districts is instructive. It reveals that vines sales in Bukedea accounted for 72% of the total vine sales, and 93% of the total OFSP root sales (HarvestPlus, 2010).

Since FADEP extension officers were involved in coordinating vine sales, it partly created an erroneous belief among producers that the project would be directly involved in purchasing roots as well. However, by directly contributing to an increase in the number and size of the OFSP fields, vine sales had the unintended effect of increasing the quantity of OFSP roots available for home consumption and sale.

> *"We were told that the project will buy vines so we decided to deposit UGX 80,000 as part payment for an acre of land on which we expanded our OFSP" One farmer, who did not heap OFSP earlier in March/April, also decided to heap 1.5 acres in June when he learnt of the possibility of selling vines. "This (vine purchase) encouraged me to heap more as I thought that I would be able to sell vines first then roots later" Farmer, Bukedea, September 2008.*

"I will plant 2 acres of OFSP in November, one acre will be a rapid multiplication plot for vines and the other will be for roots for the market. I expect to sell vines in April 2009 and roots from May 2009." Farmer Bukedea, September 2008.

While the impact of vine sales on area expansion and availability of roots for the market was very evident in Bukedea, there were similar cases in Kamuli and Mukono as well, though relatively few. The difference was mainly because producers in Bukedea had access to other NGOs promoting OFSP production in northern Uganda. They also had better access to valley bottoms and oxen. Although this work found out that vine sales were a critical driver of OFSP uptake for the market, the end of project impact assessment reported that while vine sales were large, they did not drive adoption of OFSP (de-Brauw *et al.* 2010). They concluded that Bukedea, the district with the largest vine sales had the lowest adoption rate at the end of the project. This could be because farmers who sold vines may not have been sampled in their study, since marketing may have been concentrated among a few farmers, suggesting the need for a mixed-methods approach to such studies.

5.6 Chapter summary

The focus of this chapter is on decision making at the producer level, the first node of the OFSP value chain. It addressed research objective one: to evaluate the factors that influence producers to grow OFSP for sale? It answered three research questions: i) what are the main crops that producers grow, ii) what are the nature and characteristics of OFSP marketing, and iii) what factors influenced the decision of producers to sell OFSP?

The most important food crops that producers grow were sweetpotato maize and cassava. There were differences in the prioritisation of the crops in the districts: in Bukedea, cassava was the most important food crop, maize and OFSP were the second and third most important food crops respectively. While sweetpotato and maize were the first and second most important food crops in both Kamuli and Mukono, the third most important food crops in Kamuli and Mukono were cassava and bananas, respectively. Maize, sweetpotato and OFSP were the most important food crops. In Bukedea, OFSP was considered the most important cash crop, while in Kamuli and Mukono, coffee and maize were more important cash crops compared to sweetpotato.

OFSP market chains are relatively short, compared to non-OFSP, and localized within the vicinity of the production areas. They are dominated by small traders operating in small niche markets.

In this chapter of this research, five factors that influence the decision of producers to market OFSP have been identified. These factors, illustrated in Figure 5.1**,** include project support, access to productive resources, previous experience marketing other crops, crop attributes and access to appropriate markets. They are likely to be important considerations in the marketing of a newly introduced biofortified food crop.

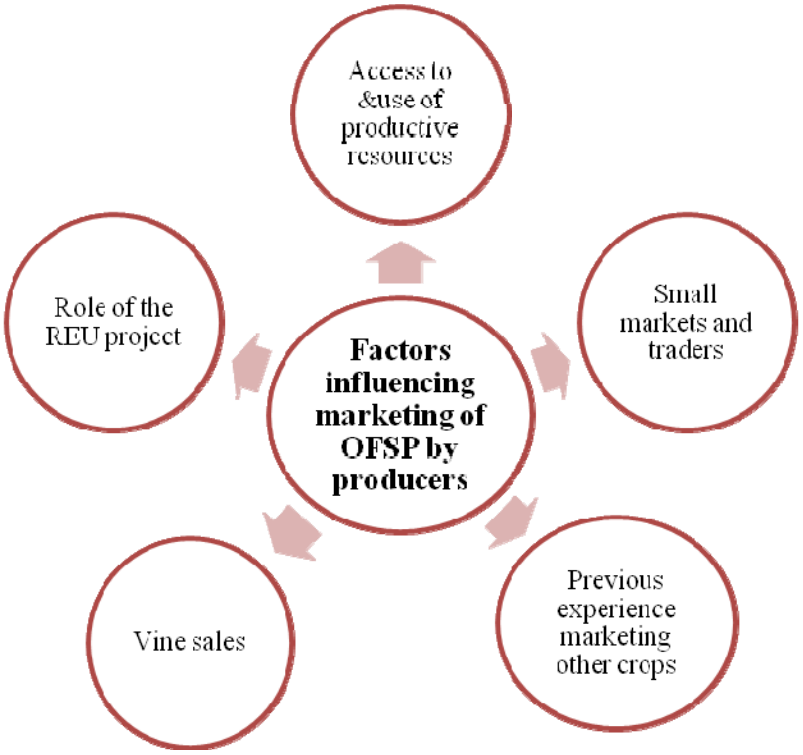

Figure 5.2: Factors influencing the decision of producers to plant OFSP for sale

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Chapter Six: Presentation and Discussion of Findings on Decision-Making by Traders

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6.1 Background

The previous chapter examined decision making at the producer level. This chapter moves the analysis of decision making to the next node of the value chain: traders. It addresses research objective two: To explore the factors influencing trader decisions to sell OFSP either alongside or in place of other food staples. To address this research objective, the research within this chapter answers three research questions. i) what are the characteristics of the market intermediaries involved in OFSP trade, ii) how does trade in OFSP compare to trade in non-OFSP, and iii) what influenced the decision of traders to sell OFSP? Each of the subsequent sub-sections of this chapter addresses one of these three research questions. The data used in this chapter are from the quantitative trader survey of 2009, described in detail in chapter four.

6.2. Nature of OFSP trade and traders

This sub-section answers research question one: what are the characteristics of the market intermediaries involved in OFSP trade? This question is answered by developing a typology of the OFSP market intermediaries and then analysing the salient socio-demographic characteristics of these traders.

6.2.1 Typology of OFSP traders

A total of 157 traders (Table 6.1) were sampled for this survey, from the markets in the districts of Bukedea (39), Mbale (36), Kamuli (39) and Mukono (43). The districts of Mukono, Kamuli and Bukedea were sampled because they were the districts in which OFSP was promoted by the REU project. Mbale was included because it was the only regional market with substantial quantities of OFSP at the time of the survey. It was the major outlet for OFSP produced in Bukedea.

This work identified four main types of OFSP traders, who played an important role in moving OFSP from producers to consumers (Table 6.1). These were farmer traders, bicycle traders, retailers and retailer/wholesalers. Whereas earlier reports (Wanda *et al.*, 2003; Coote *et al.*, 2007) on sweetpotato marketing suggested that wholesalers and brokers were important actors in sweetpotato marketing, this work did not identify the presence of either of these. A possible explanation for this is that the amount of marketable surplus of OFSP available was still small relative to non-OFSP and therefore, roots were not being supplied to distant markets. As such, the brokerage and wholesaling functions were easily absorbed by other actors. The market chains were still relatively new, short and localised. As the OFSP market chain develops, wholesalers and brokers are likely to emerge as key actors in these chains. The OFSP value chain could be considered to represent a nascent case of chain upgrading.

Based on the location, farmer traders and bicycle traders can be categorised as rural-based traders, while retailers and retailer/wholesalers can be categorised as the urban-based traders. Needless to say, like all typologies, there is variation as well as a considerable degree of overlap between these trader types.

Table 6.1: Typology of sweetpotato traders found in the districts of Bukedea, Mbale, Kamuli and Mukono, March 2010

	Bicycle traders			**Farmer traders**			**Retailers**			**Retailer/ Wholesalers**			**Total**		**Grand total**
	M	**F**	**%**	**M**	**F**	**%**	**M**	**F**	**%**	**M**	**F**	**%**	**M**	**F**	
Bukedea	17	0	85	1	3	25	6	9	15	0	0	**0**	**24**	**12**	**36**
Mbale	2	0	10	0	1	6	14	18	32	2	2	**20**	**18**	**21**	**39**
Kamuli	1	0	5	1	6	44	2	28	30	1	0	**5**	**5**	**34**	**39**
Mukono	0	0	0	0	4	25	0	24	24	1	14	**75**	**1**	**42**	**43**
Total	**20**	**0**	**100**	**2**	**14**	**100**	**22**	**79**	**100**	**4**	**16**	**100**	**48**	**110**	**157**

M – Male; F - female

Description of the trader types

a) Bicycle traders

Bicycle traders reside within the villages and most of them started as OFSP farmers. With the help of a bicycle (owned or hired), they are able to move around the villages in search of sweetpotato. They sell sweetpotato either to retailers in the markets or directly to consumers. All the bicycle traders were male and relatively young (average age of 31 years). Bicycle traders formed 13% of the sampled traders and most of them were in Bukedea (85%), with much smaller numbers in Mbale (10%) and Kamuli (5%). There were no bicycle traders in Mukono, partly because of the hilly terrain that does not favour use of bicycles for ferrying heavy loads. Most bicycle traders started the sweetpotato business by planting and selling their own OFSP.

With an average trading experience of two years, bicycle traders were relatively new in both OFSP trade and produce trade in general. This implies that they responded to the commercial opportunities presented by OFSP to establish themselves as traders, possibly as a result of the awareness-raising training provided by the REU project.

b) Farmer traders

Farmer traders are farmers who prefer to sell their sweetpotato mainly to the urban markets themselves, rather than rely on other traders. They rarely buy from other farmers but instead sell what they have planted only. The role and function of the farmer traders is encapsulated in the words of two farmer traders:

> *"I am a farmer and do not want to waste my time trading. My work is to heap OFSP and sell it, not to buy from other farmers". Farmer trader, Kamuli, March 2010.*

> *"I will not get involved in buying OFSP from other farmers because riding is extremely tedious. Besides, I cannot rely on trading to support my family as farming is a key source of food for home consumption. Becoming a trader will also affect my family. That is for young boys without family obligations" Farmer trader, Bukedea, January 2010.*

Farmer traders consisted of 10% (Table 6.1) of the sampled traders. Most of them were in Kamuli (44%), while Mukono and Bukedea each constituted 25%. This suggests that the market chain for OFSP may not have been as developed in Kamuli as was the case in Bukedea and Mukono. As a result, farmers had to devise ways of directly marketing their OFSP. A rival

explanation could be that farmers in Kamuli were more entrepreneurial and risk-takers than their counterparts in Mukono and Bukedea.

c) Retailers

Retailers were based in the urban and village markets. They purchased sweetpotato from farmers or fellow traders and sold mainly to consumers. In markets which serve as bulking centres for other traders such as Bukedea cattle market, retailers sell sweetpotato to other traders as well. Retailers were mainly and in most markets exclusively women. The majority (64%) of actors in the OFSP chain were retailers. While these could potentially skew the results, it reflects the reality of sweetpotato trading – a majority of the traders are retailers. In the absence of reliable census data on traders, the project data base of sweetpotato traders can be used as a reference point. In this data base, 86% of the traders catalogued are retailers (Wamaniala 2008).

d) Retailer/wholesalers

Retailers/wholesalers were mainly retailers who have been in sweetpotato trade for a relatively longer period of time, compared to the other three trader types. In the process they have acquired the skill and more capital that enabled them to buy relatively bigger quantities of sweetpotato. During times of scarcity, these traders move to the rural markets to search for sweetpotato. Otherwise, they prefer to wait for either farmers or wholesalers to deliver sweetpotato to their stalls but this is not usually the case during times of scarcity. They sell mainly to consumers but also to fellow traders, mainly retailers. This category consisted of 13% of the sampled traders, mainly found in the more urbanised Mukono (75%) and Mbale (20%).

Main reasons for performing a particular trading function

The main reasons why traders opted to trade (Table 6.2) as bicycle traders, farmer traders, retailers or retailer/wholesalers were low capital requirements (37%), profitability (25%) and relative ease of operating (22%).Of these three reasons, it is only profitability that was significantly different ($p<0.05$) across the trader types. Profitability appears to have been a less important factor in influencing the decision of farmer traders to start selling OFSP. This is not surprising since farmer traders do not buy OFSP but instead sell what they have produced.

Table 6.2: Reasons for trading as a bicycle trader, farmer traders, retailers or retailer wholesaler as reported by the traders interviewed in the study areas (%)

	Trader Type					
Reason	**Bicycle traders (n=20)**	**Farmer traders (n=25)**	**Retailers (n=144)**	**Retailer/ Wholesalers (n=47)**	**Total (n=236)**	**Probability**
Requires less capital (n=57)	40	48	35	36	37	NS
Profitable (n=60)	30	12	24	34	25	P<0.05
Easy to operate (n=50)	20	24	23	19	22	NS
Customers buy in small quantities (n=14)	5	12	6	6	6	NS
Fellow traders may not have (n=9)	0	0	5	4	4	
Others* (n=14)	5	4	7	1	6	

e* Includes no potential customers, it is flexible and plenty is available; ** where n is the number of cases; and ***P values from single-sample chi-square test with 3 df

6.2.2 Socio-economic characteristics of the traders

Gender and education level

The majority of the interviewed traders (69%) were women. If bicycle traders, who were exclusively men are discounted, then female respondents would account for 83% of the traders. This result underscores the fact that women are the key actors at the trader node of the value chain. This finding resonates with other findings on crop marketing in Uganda which suggest that female traders are more likely to be engaged in low-value staple crop trading than high value export trade (Nkonye, 2002). Although there were no wholesalers in OFSP trade, most sweetpotato wholesalers are men as it involved relatively bigger amounts of capital, travelling longer distances and dealing in bulky units (Coote *et al.* 2007; Wanda *et al.* 2003). Most OFSP traders (68%) were literate in a sense that they had studied up to primary level (46%) or secondary (22%).

Ownership and source of initial capital

Sweetpotato trade is managed by the owners and requires relatively low start-up capital. Low start-up capital requirements, low core skills and limited barriers to entry and exit suggest that sweetpotato traders are relatively fluid.

The main source of capital used by traders to start a sweetpotato trading business was savings from other trade (47%), while other traders planted sweetpotato (28%) which provided the start-up input. Credit (12%) from both formal and informal sources and sweetpotato credit[21] (8%) were other sources of start-up capital. Planting of sweetpotato was a more important source of capital in Bukedea compared to savings from other trade (19%). This could be because traders in Bukedea were/are not engaged in other trade compared to other districts or that most traders started as or combine trading with farming sweetpotato. Credit as a source of capital was more important in Mbale compared to the other districts. The Fishers test showed that sources of start-up capital were significantly different ($p < 0.002$) across trader types. The most important source of start-up capital for bicycle traders and farmer traders were from sales of sweetpotato from own gardens. Savings from other businesses was a more important source for the retailers (54%), and retailer/wholesalers (50%). Credit was a more important source of capital for retailers compared to other trader types. Urban based traders were, and may still be engaged in, other trade in addition to sweetpotato.

Rural-based traders or trading system is largely informal. Their transactions are not reflected within the trading records since most of them had no trading licence or a registered business premise, which are normally pre-requisites for setting up a business. This could imply that these requirements are either not relevant to these traders or are simply difficult to enforce. In addition, they did not belong to any traders' association. Trading requirements in general, and membership of a traders' association in particular can be barriers to entry into and exit from trade (Aneubunwa, 2002).

[21]Sweetpotato credit is a scenario where traders are given sweetpotato on credit and payment is effected at a later, often agreed time.

Years of experience as a trader

The average amount of time spent working as a trader selling any type of produce other than OFSP varied between six and 14 years, with a similar range of the length of time spent trading sweetpotato. The average length of time selling OFSP was much shorter (about 2 years), but the range was much more uniform, reflecting the availability of this new produce and the project's efforts to get it known in the market.

Staple crops sold

Traders were asked to list up to four staple crops that they traded in and to rank them in order of importance, where rank 1 was for the most important and rank 4 for the least important. During data entry, each of these ranks was given a weight, where a commodity ranked 1 was given a weight of 4 and that ranked 4 given a weight of 1. Mean weights were then computed in order to determine the prioritisation of the food crops sold. Since responses were multiple, the number of cases represents the number of times a particular staple crop was identified by the respondents.

Sweetpotato was the most commonly traded agricultural staple crop among the respondents (Table 6.3), with a mean weight of 3.73 out of a possible 4 and a standard error of 0.54. Its importance is further illustrated by the fact that 146 of the 157 traders (or 93%) interviewed were selling sweetpotato at the time of the interview. This should not be surprising because the survey primarily targeted sweetpotato traders. Other important agricultural produce that these traders sold included OFSP (mean score of 3.63), cassava (mean score of 2.91) and *matooke* (mean weight of 2.49). OFSP was the second most important crop in Bukedea after sweetpotato. While only 15% of the traders (n=24) were selling OFSP at the time of the interview, among these traders, it was the second most important staple crop (mean score of 3.63 and a standard error of 0.71) after sweetpotato.

Table 6.3: Main staple crops sold by traders in the districts of Bukedea, Mbale, Kamuli and Mukono, March 2010

	Bukedea		Mbale		Kamuli		Mukono		Overall	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Sweetpotato (n=146)	3.76	0.61	3.85	0.36	3.63	0.55	3.70	0.59	3.73	0.54
Cassava (n=88)	3.22	0.67	2.75	0.55	3.22	0.74	2.72	0.70	2.91	0.71
Matooke (n=39)	2.50	0.55	2.50	1.00	2.21	0.97	2.73	0.70	2.49	0.82
OFSP (n=24)	3.62	0.52	3.83	0.41	4.00	0.00	3.29	1.11	3.63	0.71

Therefore, in the absence of sweetpotato or if trading in sweetpotato becomes less profitable or more risky, these traders may fall back to trading fresh cassava roots and *matooke*.

6.3 Differences and similarities between OFSP and non-OFSP trade

Having developed a typology of the OFSP market intermediaries, understood their socio-economic characteristics and identified the priority staple crops that they trade and consume, this sub-section focuses on understanding similarities and differences between OFSP and non-OFSP trade. It answers research question two: how does trade in OFSP compare to trade in non-OFSP. This sub-section starts by examining the main sweetpotato types sold and the reasons underpinning trader choice of a particular sweetpotato type. It then analyses the difference between OFSP and non-OFSP, from a trader perspective. The last part compares prices and trading margins of OFSP to non-OFSP.

6.3.1 Sweetpotato types sold by traders

Among the sweetpotato traders interviewed, 48% were selling YFSP, 30% WFSP and 22% OFSP. This was in January 2009 and December 2010, about two and a half years after the introduction of OFSP by the REU project. There were differences between districts (Figure 6.1) and trader types (Figure 6.2). In Bukedea, YFSP was the most common sweetpotato type sold by 64% of the traders, followed by OFSP (34%). WFSP was sold in negligible quantities. A similar trend can be discerned in Mbale where YFSP (48%) was the most common sweetpotato type sold by traders followed by OFSP (34%) and then WFSP (17%). In contrast, WFSP (62%) was the most common sweetpotato type sold by traders in Kamuli followed by YFSP (23%) and

OFSP (15%). In Mukono, YFSP (53%) was the most common sweetpotato type sold by traders, followed by WFSP (36%) and finally OFSP (9%). The one-way ANOVA tests further confirms that differences in sweetpotato types sold in the districts were statistically significant (P=0.001).

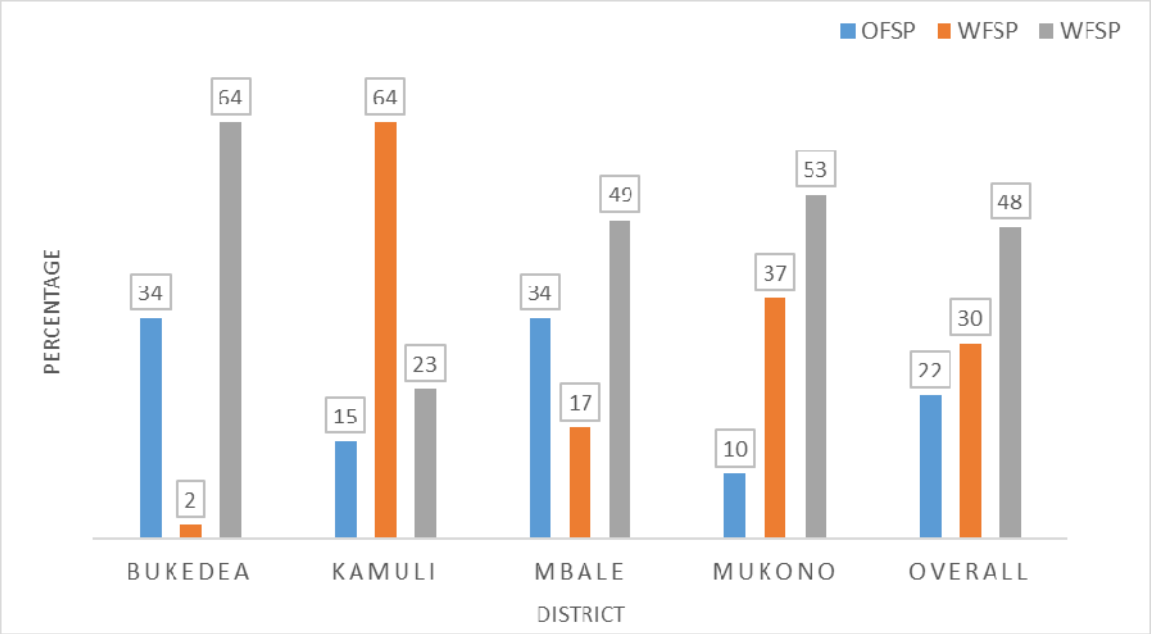

Figure 6.1: Types of sweetpotato sold by traders in the districts of Bukedea, Kamuli, Mbale and Mukono, March 2010.

Differences in sweetpotato types sold in the study areas reflect local preferences for the specific sweetpotato types. Consumers in Kamuli prefer WFSP types, while consumers in Mbale and Bukedea prefer YFSP types. Although YFSP was the sweetpotato type sold by a majority of traders in Mukono, more than one-third of the traders sold WFSP as well. This reflects the more cosmopolitan nature of the community that the markets in Mukono serve and the variety of channels through which the sweetpotato are sourced.

Among the traders, differences in the sweetpotato types sold were not statistically different (P>0.05). However, if the typology of traders earlier developed, that is, rural-based and urban-based is considered, differences in sweetpotato types sold by these two trader types is statistically significant (P<0.05), as most of the OFSP is sold by the rural-based traders. This is probably a reflection of the level of value chain development since the introduction of OFSP.

6.3.2 Reasons for selling a particular sweetpotato type

Having understood the variation in sweetpotato types sold across the districts, the next is to understand why traders opted to trade in each of the three sweetpotato types. The main reasons (Table 6.4) for selling a particular sweetpotato type were that it was always available (45%), customers like it (31%) and that the flesh is hard or has a high dry matter content (11%). The Chi-square test revealed that the reasons why traders sold the different sweetpotato types varied significantly ($p < 0.001$). Thus, looking at the three attributes above, traders like selling OFSP since it is preferred by customers (46%) compared to both YFSP (25%) and WFSP (23%). The benefits of OFSP to human health were recognised by 21% of the traders who also considered this attribute one of the reasons for selling it. However, OFSP is not as available (21%) as either WFSP (55%) or YFSP (56%). In the same token, OFSP is not as hard (5%) as either YFSP (14%) or WFSP (11%).

Table 6.4: Reasons why traders in the four study areas opted to trade in a particular sweetpotato type, March 2010.

Reason	Sweetpotato Type (Responses expressed as a %)				
	OFSP (n=99)	WFSP (n=78)	YFSP (n=142)	Total (n=319)*	Probability**
Always available (n=145)	21	55	56	45	P<0.001
Customers like it (n=99)	46	23	25	31	P<0.001
It is hard (n=34)	5	12	14	11	NS
Has vitamin A (n=25)	21	3	1	8	P<0.001
Takes long to get bad (n=10)	2	6	2	3	NS
Cheap (n=4)	2	1	1	1	
Profitable (n=4)	3	0	1	1	

*where n is the number of cases

**P values from single-sample chi-squared test with 2 df; n=sample size per response variable

Price or cheapness was not an important consideration in traders' decision to sell a particular sweetpotato type. This could be because there were no significant price differences across the sweetpotato types (see 6.4.3). It could also stem from the fact that compared to other starchy staples such as *matooke*, rice and *posho*, sweetpotato were relatively cheaper.

Since availability and customer preference were the most important reasons for the choice of a particular sweetpotato type to trade in, options aimed at improving availability by increasing production levels and customer preference of OFSP e.g. promoting the nutritional benefits of the crop are likely to influence traders to continue selling it.

6.3.3 Attributes used for distinguishing between OFSP and non-OFSP

The main attributes (Table 6.5) that traders knew about OFSP, and used for distinguishing it from other sweetpotato types included the visual orange colour of its flesh (34%), its nutritional attributes, and specifically, that it is rich in vitamin A (23%) and that it has a sweet taste (16%). Other attributes included the big size of the roots and the strong preference that the children have for it. The Chi-square test ($p < 0.05$) reveals that there were significant differences in the attributes that traders used for distinguishing OFSP from other sweetpotato types across the districts.

Table 6.5: Attributes that traders in Bukedea, Kamuli, Mbale and Mukono used to distinguish OFSP from other sweetpotato types (%), March 2010

Attribute	District				
	Bukedea (n=100)	**Kamuli (n=99)**	**Mbale (n=81)**	**Mukono (n=77)**	**Overall (n=357)****
Orange Colour (n=119)	29	34	37	35	34
Rich in vitamin A (n=83)	26	17	33	17	23
Sweet taste (n=56)	20	12	11	20	16
Big size of roots (n=33)	9	13	6	8	9
Preferred by children (n=26)	6	7	9	8	7
Strange smell (n=20)	2	10	3	8	6
Others*	8	7	1	4	5

*others include soft texture, takes long to mature, low fibre and takes long to mature.

**where n is the number of cases

Among the top three attributes that traders' used for distinguishing OFSP from other sweetpotato types, orange colour and sweet taste are sensory attributes while vitamin A is more of a cognitive attribute. If vitamin A is controlled for, results of a chi-square test indicate that there were no significant ($p > 0.05$) differences between colour and sweet taste as known attributes of OFSP in

the districts. However, knowledge of vitamin A as an attribute of OFSP was statistically ($p < 0.05$) significant across the districts. In Bukedea and Mbale, more traders were aware of vitamin A as an important attribute of OFSP compared to Kamuli and Mukono.

Traders' Source of Information on Attributes of OFSP

Traders obtained information about the attributes of OFSP (Table 6.6) from REU/OFSP project staff (45%), personal experience of the traders (27%), fellow traders (14%) and farmers (12%). While project staff was the most important source of information across the districts, it was a significantly ($p>0.001$) more important source of this information in Kamuli and Bukedea compared to Mbale and Mukono. This suggests that there might have been more project market facilitation in Kamuli and Bukedea compared to Mbale and Mukono. It could also be that being bigger towns, there are also more sweetpotato traders in Mukono and Mbale, which makes it more difficult to reach out to all the traders. Again, Kamuli and Bukedea are more remote compared to Mbale and Mukono. Similarly, personal experience as a source of information about the attributes of OFSP was significantly more important ($p<0.001$) in Bukedea and Mbale compared to Mukono and Kamuli. This suggests that there could have been more trade in, and perhaps consumption of OFSP, in Mbale and Bukedea compared to Mukono and Kamuli.

Table 6.6: Sources of information (%) about attributes of OFSP reported by traders in Bukedea, Mbale, Kamuli and Mukono, March 2010

Source of information	District					
	Bukedea (n=36)	Kamuli (n=39)	Mbale (n=39)	Mukono (n=43)	Total (n=157)	Probability**
Project staff (n=69)	42	67	33	35	45	P<0.001
Personal experience (n=45)	39	15	36	26	27	P<0.01
Fellow traders (n=21)	11	10	15	16	14	NS
Farmers (n=19)	8	8	11	21	12	NS
Radio (n=3)	0	0	5	2	2	NS

*Where n is the sample size; ** P values from single-sample chi-squared test with 3 df

6.3.4. Availability of OFSP relative to non-OFSP

The next attribute used for comparison was availability of OFSP relative to non-OFSP. Results indicated significant variations in availability of OFSP across the districts ($p < 0.05$). Overall,

OFSP was less available (80%) in all the four districts compared to the other two sweetpotato types. However, 39% of the traders in Bukedea felt that OFSP was more available than other sweetpotato types (Figure 6.2).

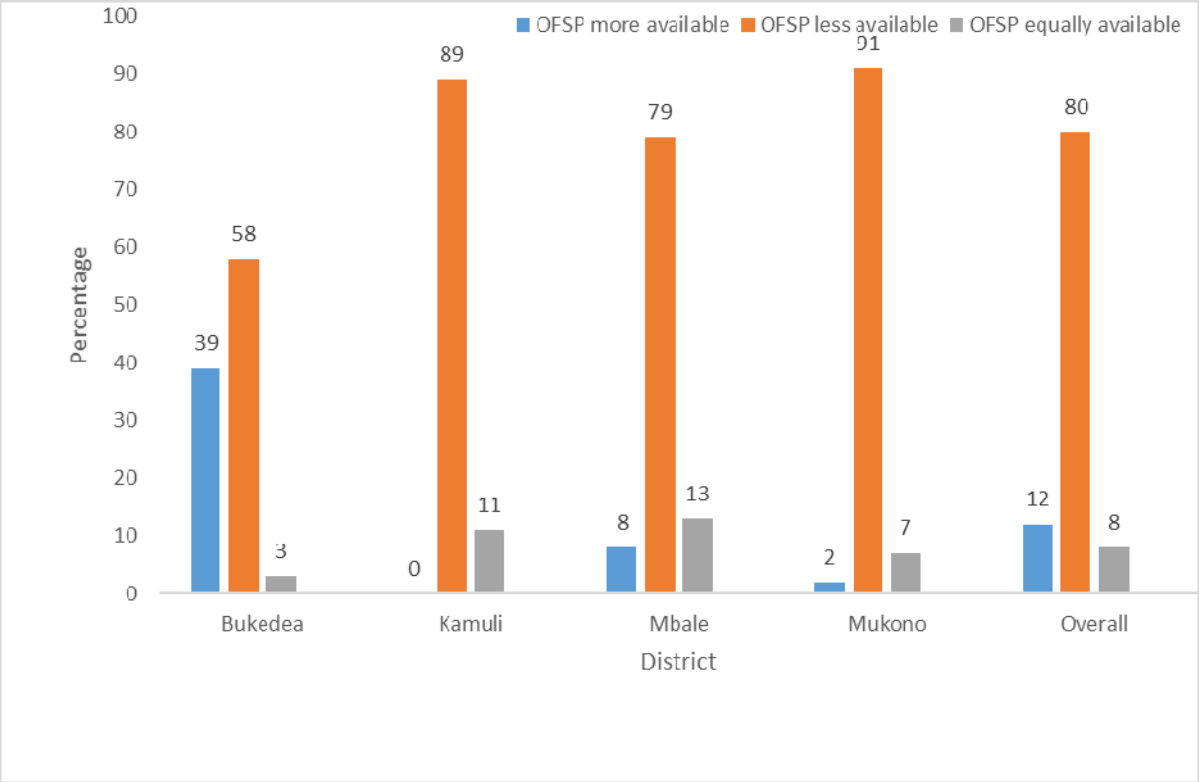

Figure 6.2: Relative availability of OFSP compared to other sweetpotato as reported by traders in Bukedea, Kamuli, Mbale and Mukono, March 2010.

There were significant differences ($p < 0.05$) in availability of OFSP among the four trader types. While 60% of the bicycle traders reported that OFSP was more available compared to the other two sweetpotato types, the other traders (retailers, farmer traders and retailer/wholesalers) noted that OFSP was not as available as the other sweetpotato types. This could be an indication that the development of bicycle traders was related to the introduction of OFSP or the trading opportunities that OFSP presented.

6.4 Trader understanding of and experiences with OFSP

6.4.1 Trader awareness of OFSP

Roger's (2003), seminal work on *Diffusion of Innovations* identified five stages that individuals go through during their evaluation of an innovation. The first stage is when the individual becomes aware of that innovation. Based on this premise, in order for a trader to decide to start trading in OFSP (adopt the innovation), they have first to become aware of it. In order to determine the levels of awareness of OFSP among the traders, two questions were asked: whether respondents had heard about OFSP; and when they had learnt about it.

Results revealed high levels of awareness about OFSP among traders. At the time of the survey, all traders reported that they had already heard about OFSP. Most traders had known about OFSP by the first half of 2008 (Figure 6.3), just before the onset of the first main sweetpotato marketing season following the introduction of OFSP to the districts by the project.

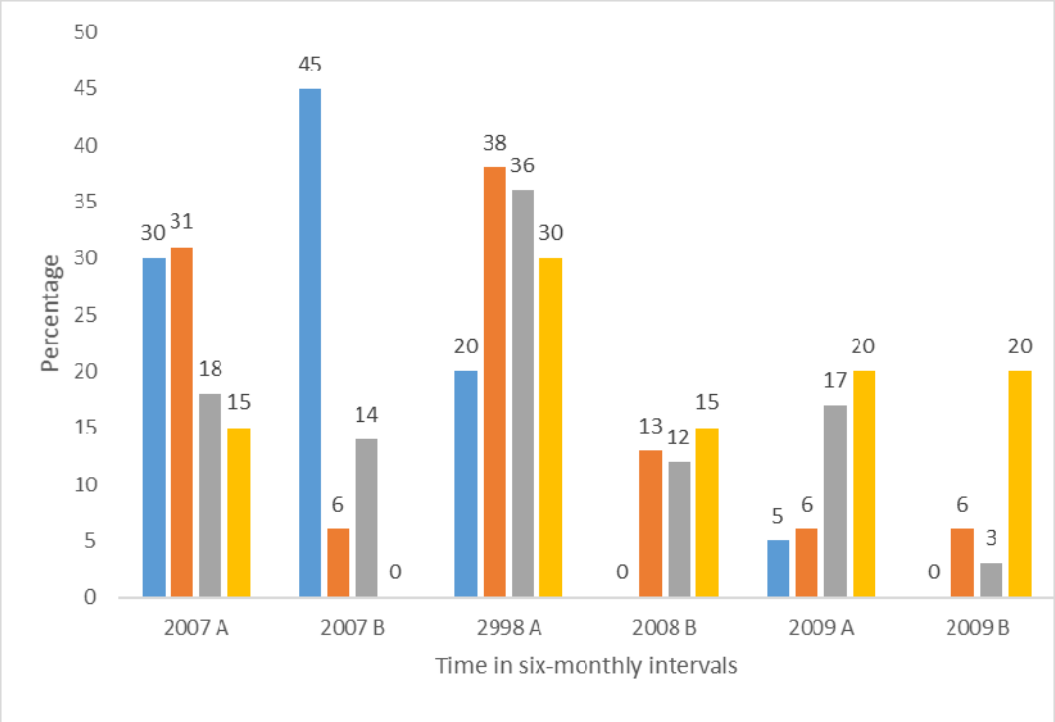

Figure 6.3: Time when the traders in Bukedea, Mbale, Kamuli and Mukono first learnt about OFSP. March 2010, where A=January-June; and B=July-December.

6.4.2 Trading in OFSP

This sub-section reports on trader experiences in trading in OFSP. The aim was to establish whether and when traders started selling OFSP, what motivated them to start selling OFSP, and how they normally sell it.

As reported earlier in this thesis, 95% of the traders had sold OFSP before and 22% were selling OFSP at the time of the interview. The majority of those who had never sold OFSP were from Kamuli district (Table 6.7). As earlier reported, the per capita consumption of sweetpotato is highest in Kamuli compared to the other study districts.

When traders first sold OFSP

To determine when traders first sold OFSP, the period between 2007 and 2010 was divided into eight seasons (Table 6.7). The first and last seasons were the time prior to the introduction of OFSP and the period of the survey, respectively. The rest of the period, from July 2007 and December 2008, was divided into six, six-monthly seasons.

Table 6.7: Time when traders in Bukedea, Mbale, Kamuli and Mukono first sold OFSP. March 2010 (%).

	Season							
District	**Never sold (n=8)**	**2007A (n=26)**	**2007B (n=4)**	**2008A (n=42)**	**2008B (n=28)**	**2009A (n=28)**	**2009B (n=19)**	**2010A (n=2)**
Bukedea (n=36)	3	11	0	39	24	6	11	6
Kamuli (n=39)	13	8	0	28	18	28	5	0
Mbale (n=39)	0	41	5	23	16	10	5	0
Mukono (n=43)	5	7	5	19	14	26	26	0
Total (n=157)*	5	16	3	27	18	18	12	1

A= first half of year; B= second half of year

* where n is the sample size

The majority of the traders (63%) started selling OFSP between January 2008 and July 2009. However, the chi-square test reveals that there was a statistically-significant difference in the season when traders started selling OFSP across the districts ($p < 0.05$) and across trader type ($p < 0.05$). In Mbale, 41% of the traders reported that they started selling OFSP at or prior to project

inception (season 1). This suggests that traders could have had access to OFSP from areas further north of Bukedea where other projects may have been promoting OFSP. This explanation is given more weight from findings during the diagnostic phase which identified *Colour* as one of the predominant OFSP varieties in eastern Uganda. However, the project did not promote it because of its relatively low levels of beta carotene. Another possible explanation could be that some of the deep yellow sweetpotato varieties especially *Tanzania,* which were popular prior to project inception, could have been mistaken for OFSP. As with OFSP, the Teso region was also the main source of these varieties.

In contrast, most traders (52%) in Mukono started trading OFSP in 2009, which was over a year later, especially when compared to Mbale. The majority of traders in Bukedea (63%) started trading in OFSP in 2008. In Kamuli, there were two seasons when most traders started selling OFSP: 2008 A (28%) and 2009 A (28%). Overall, the trends reported above especially in Mukono and Bukedea reflects the sequence in which OFSP was introduced to these areas.

Reasons that Motivated Traders to Start Selling OFSP

The main reasons that motivated traders to start trading in OFSP (Table 6.8) were that customers liked it (24%), OFSP has vitamin A (16%) and OFSP is sweeter than other sweetpotato types (14%). Others include OFSP was available, the orange colour, OFSP is good for children, and it was profitable to trade in OFSP. These reasons were statistically significant across the districts ($p< 0.05$) but not significant across the trader types ($p > 0.05$). Vitamin A, as a factor for trading in OFSP was more important in Mbale and Bukedea compared to Mukono and Kamuli. Sweet taste was more important in Kamuli and Bukedea compared to Mbale and Mukono. Availability of OFSP was a more important consideration in Mukono and Kamuli compared to Bukedea and Mbale. Profitability was a relatively minor consideration in the traders' decisions to start selling OFSP.

Table 6.8: Main reasons (%) that motivated traders in Bukedea, Mbale, Kamuli and Mukono to start selling OFSP, March 2010

Reason	District				
	Bukedea (n=103)	Kamuli (n=76)	Mbale (n=110)	Mukono (n=83)	Total (n=372)*
Customers like (n=91)	23	17	21	34	24
It has vitamin A (n=58)	18	8	20	15	16
It is sweeter (n=53)	15	19	13	10	14
It was available (n=41)	9	15	7	16	11
Orange colour (n=39)	9	13	14	6	11
Good for children (n=30)	9	4	7	12	8
It is profitable (n=27)	11	4	9	4	8
Introduced by project (n=28)	5	18	9	0	7
To have variety (n=4)	1	0	0	4	1

*where n is the number of cases

6.4.3. Spot sweetpotato prices

Spot prices of sweetpotato (Table 6.10) were collected during the trader interview by weighing and recording samples of heaps of sweetpotato that traders were selling. Weighing enabled volume prices to be converted to prices per kilogramme, which made it easier to compare prices across districts and sweetpotato types. The prices reported in Table 6.9 reflect the prices of sweetpotato sold in heaps converted into kilograms.

Table 6.9: Spot prices of the three sweetpotato (UGX/Kg), as sold by traders in Mukono, Kamuli, Bukedea and Mbale March 2010

Sweetpotato Type	District				
	Mukono (n=56)	Kamuli (n=33)	Bukedea (n=13)	Mbale (n=15)	Overall (n=117)
OFSP (n=10)	700	364	203	227	332
YFSP (n=61)	733	296	242	250	464
WFSP (n=46)	738	326	324	274	478
Overall (n=117)	732	309	284	256	449

Results of a t-test reveal that the prices of sweetpotato varied significantly between the districts (t= -6.464; df=11; and P =0.001). However, the prices of the three sweetpotato types did not vary significantly within the same district (t= -6.505; df = 11; and P = 0.729). Furthermore, a regression analysis of sweetpotato prices across the four districts using Kamuli as the district of comparison shows that prices in Bukedea ($p > 0.05$) and Mbale ($p > 0.05$) were not statistically different from those in Kamuli. This indicates that sweetpotato prices in these three districts were comparable. Prices in Mukono were statistically different ($p < 0.001$) from those in Kamuli. Thus, traders in Mukono sold their sweetpotato at higher prices compared to the other three districts. This trend is consistent with price data collected by the REU project which recorded higher prices of *matooke*, sweetpotato and cassava in Mukono compared to the other project areas (Wamaniala, 2009). The higher prices in Mukono may reflect the larger market due to high levels of commercialisation and proximity to markets in Kampala. The presence of a large number of fishermen in Mukono as well as the sugar cane and tea estates which provide a good market for food crops as well.

Within the districts, prices of YFSP compared to both OFSP ($P > 0.05$) and WFSP ($P > 0.05$) were statistically similar. In other words, all the three sweetpotato types sold at about the same price in each of the districts. However, anecdotal evidence, and observations during data collection, suggests that OFSP was often the first sweetpotato type that customers purchased and the first to sell out. This may be because it was the preferred sweetpotato type or the quantities brought to the market are smaller compared to the other sweetpotato types.

6.4.4 Trading costs and margins

Data on trading costs and margins were collected in interviews with selected traders in each of the markets. Due to difficulties in soliciting this type of information, only respondents whose cost data which were comparable with that obtained during the reconnaissance survey, undertaken as a precursor activity to this survey, were entered and used for calculating trading costs and margins.

To derive such information requires making a considerable number of assumptions about a variety of situations and encapsulating these into a scenario with a single price. The figures given in the following tables present indicative figures, based on the experiences of some of the traders

from whom credible data could be obtained. However, it should be noted that the prices received per sack or unit of sweetpotato sold can vary widely – depending on where it is sold, the time it was sold, who is buying it and how it is packed. OFSP has a novelty value that can enable it to achieve a price in certain situations that, on a weight, basis is much higher than for non OFSP types. In other situations it will sell for the same as other SP types. Costs and margins for three trading scenarios in the three districts of Bukedea, Mukono, and Kamuli are presented.

Bukedea to Mbale

The costs and margins for the scenario for Bukedea were based on a value chain where bicycle traders sourced OFSP from farmers in Bukedea, transported it to Mbale and sold it to the retailers (Table 6.10). A typical bicycle trader purchased OFSP from farmers at an average of UGX16, 000 a sack (of 110 kg). It was then transported by bike to Mbale and sold to retailers in one of the Mbale markets at an average price of UGX27,000 per sack. Although a monetary value should be attached to harvesting, packing and transporting the roots to the markets, in reality these activities were performed by the bicycle traders themselves as part of the trading function and have only an opportunity cost. The only cash outlay, apart from the potatoes, is for sustenance during the working day. Bicycle rent, depreciation or repair is not included. The retailer, in turn, sold the sack of OFSP to consumers in heaps. Each bag or sack, on average, turns out 36 saleable heaps, inclusive of 'add-ons' (extra roots given as a free gift to a customer). In terms of the final selling price, the bicycle trader receives 75% of this and makes a net margin of 28% for his efforts. The net marketing margin earned by retailer was 19% of the final selling price.

Table 6.10: OFSP prices and margins as reported by traders in the Bukedea - Mbale value chain, January 2010

Marketing chain participant	Selling price (UGX/sack of 120 kg)	% of final selling price
Farmer in Bukedea sells to bicycle trader	16,000	44%
Bicycle trader sells to Mbale retailer:	27,000*	75%
Purchase price	16,000	
Gross margin	11,000	
Costs		
Own labour		
Bicycle rent/depreciation		
Food	1,000	
Total costs	1,000	
Net margin	10,000	28%
Retailer in Mbale sells to final consumers		
Selling price (36 heaps@1,000)	36,000	
Purchase price	27,000	
Gross margin	9,000	
Total costs	2,000	
Net margin	7,000	19%

*equivalent value

The margins for marketing OFSP are in line with margins calculated in 2007 (Coote *et al.*2007), for a retail trader taking sweetpotato (not OFSP, as they were not available in the market at the time of this survey) from Bukedea to Koloin market in neighbouring Kumi district. In this case, the retailer had to pay for transport and for the sack to be packed and loaded onto the vehicular transport, which increased actual costs and reduced the margin per sack traded.

Mukono

In Mukono, computation of the marketing margin was based on the scenario where a retailer/wholesaler sources OFSP from the farmers' gardens and transports it to the markets (Table 6.12). While prices in Mukono are higher than the other study areas, the retailer/wholesaler appears to gain the same net margin (17%) as the final retailer (17%). Although the prices are higher, the gains from trading appear to be lower than in Bukedea.

Table 6.11: OFSP prices and margins as reported by traders in the Mukono value chain, March 2010

Marketing chain participant	Selling price UGX/sack of 120 kg	% of final selling price
Farmer in Mukono to retailer/wholesaler (standing crop)	45,000	60%
Retailer wholesaler to Retailer in Mukono		
Selling price	60,000*	75%
Purchase price	45,000	
Gross margin	15,000	
Costs		
Own labour		
Transport charge; loading/unloading		
Total costs		
Net margin	2,000	
	13,000	17%
Retailer in Mukono to final consumers		
Selling price	75,000	100%
Purchase price	60,000	
Gross margin	15,000	
Costs and charges		
Market dues, labour, interest		
Total costs	2,000	
Net margin	13,000	17%

*equivalent value

Kamuli

At the time of the interview, most OFSP traders were retailers in Kamuli and purchased OFSP directly from the farmers' fields and then transported it to the market (Table 6.12). Retailers in turn sold the OFSP directly to the final consumers. Their net margin is 36% of the final cost of the OFSP. The trader retains a higher percentage of final price compared to traders in Mukono and Bukedea because there is only one trader in the chain.

Table 6.12: OFSP prices and margins as reported by traders in the Kamuli marketing chain, March 2010

Marketing chain participant	Selling price UGX/sack of 120 kg	% of final selling price
Farmer in to retailer (standing crop)	30,000	60%
Retailer in Kamuli to final consumers		
Selling price	50,000*	100%
Purchase price	30,000	
Gross margin	20,000	
Costs and charges		
Transport, labour, market dues, interest		
Total costs	2,000	
Net margin	18,000	36%

*equivalent value

6.5. Factors influencing trader decision to sell OFSP

This sub-section addresses research objective two: to assess the factors influencing trader decisions to sell OFSP either alongside or in place of other food staples. It draws on insights from the previous sub-sections of this chapter. The main drivers of OFSP marketing, from the trader perspective were importance of sweetpotato; crop attributes; role of rural-based traders; role of the project; and price of OFSP. Each of these factors is discussed in turn.

6.5.1 Importance of sweetpotato

Sweetpotato is the most important staple crop sold by traders in all the districts (see sub-section 6.2). Other important staples sold were fresh cassava and *matooke*. Since traders were already involved in sweetpotato trade, it was easier for them to take up OFSP. The challenges associated with marketing sweetpotato, such as the short shelf life and bulkiness, apply equally to OFSP. Similarly, the opportunities with sweetpotato trade, such as being a relatively affordable staple crop for the urban and peril-urban consumers and demise of both *matooke* following the BBW and cassava, as a result of ACMDV, applied to OFSP as well. Therefore, there were few adjustments that the traders had to put in place to be able to start trading in OFSP.

However, importance of sweetpotato and experiences that traders had in trading in it explains part of the story. This was more the case with the urban-based traders who had been in the trade for a relatively long time. It does not account for what motivated the rural-based traders to get involved in OFSP, since almost all of them started as OFSP traders.

6.5.2 Attributes of OFSP

OFSP has attributes that it has in common with other sweetpotato types and those that are unique to it as a specific sweetpotato type, which propelled its marketing. Firstly, the attributes that OFSP shares, with other sweetpotato types. OFSP is planted, takes a relatively short time to mature and with the exception of vines, other inputs required for sweetpotato production apply to OFSP as well. These had two key implications: OFSP was easily and relatively quickly adapted to the local farming system, making it available to traders in a reasonably short time. Where favourable conditions obtained such as rainfall and soil fertility, the yields of OFSP were either comparable or better than the yields of some of the non-OFSP varieties. Since yield is the most important attribute in the adoption of a sweetpotato variety by farmers (Tumwegamire *et al.* 2007), good yields of OFSP did not only ensure that it was adopted, but that farmers were able to realise a good marketable surplus. The other implication is that, because it was locally available, the start-up costs for an OFSP trading enterprise were relatively low. As a result, rural-based traders, who could have been constrained by capital and other start-up requirements, found it easy to start trading in OFSP. Indeed, as reported in section 6.2.1 of this chapter, among the most important reasons for choosing to trade in OFSP were low capital requirements and relative ease of operating. These two reasons were more important among the rural based traders and retailers, compared to the retail wholesalers.

Attributes that are unique to OFSP include orange colour; pro-vitamin A, and to some extent, sweet taste. As reported in section 6.4.2, pro-vitamin A, sweet taste and colour were, respectively, the second, third and fifth most important reasons that motivated traders to get involved in trading in OFSP. They were, respectively, three of the most important attributes used for distinguishing OFSP from other sweetpotato types. The visible orange colour was important in establishing OFSP as a unique sweetpotato type, making it easy to distinguish it from other sweetpotato. In Bukedea, Mbale and Mukono, OFSP easily built on the existing trader preference for deep yellow sweetpotato types such as *Tanzania*. In Kamuli, where traders traditionally

preferred white varieties, orange colour was initially an impediment to the marketing of OFSP. However, insights from the producer survey (Chapter 5) indicated that even in Kamuli the orange colour may have been a marketing driver as some households preferred to retain their preferred white varieties for home consumption and sell more OFSP.

Where levels of awareness of pro-vitamin A, as an attribute of OFSP, were high, as was the case in Bukedea and Mbale, more trade in OFSP was reported. This is consistent with earlier work that identified nutritional value as the second most important sought-after attribute in OFSP (Yaggen and Nagujja, 2006). However, these authors observed that the importance of nutrition as sought after value in OFSP was higher in intervention communities compared to non-intervention communities. But, as raised earlier in this thesis, while nutritional value is a distinct advantage of OFSP, it is not a sought-after characteristic in traders' prioritisation of the sweetpotato types they trade in. Sweet taste was particularly important in that, although OFSP was new, it conformed to the taste of sweetpotato. A combination of the attributes above (taste, vitamin A and colour), attracted a high demand for OFSP among consumers. Indeed, "customers like it" was often cited as the most important reason why traders started selling OFSP (6.4.2).

6.5.3 The REU project

The REU project promoted OFSP in Bukedea, Kamuli, Mukono and Mbale. Therefore, in this regard alone, the project was an important driver of OFSP marketing. The marketing component of the REU project aimed at developing sustainable supply links between farmers, traders and consumers in rural and urban markets, within and outside the project areas. A key element was raising awareness among sweetpotato traders of the nutritional benefits of OFSP and encouraging traders to promote the nutritional benefit of OFSP among their consumers. It entailed training existing sweetpotato traders on the nutritional benefits of OFSP and to link them with OFSP farmers and farmer groups, particularly farmers producing or likely to produce OFSP surplus to household requirements. It included promotional events such as radio talk shows and the use of trader boards, T-shirts and kiosks; and training in more generic aspects of marketing, such as the 5 P[22]s. Another key feature was establishing and facilitating the MLF to act as a link between producers and market intermediaries.

[22]Price, Product, People, Promotion and Place

As earlier reported, one of the most important factors that motivated traders to start selling OFSP was nutritional information and particularly that it is high in pro-vitamin A. The main source of this information was the project (45%), see section 6.3.2. Other important sources included other traders (14%) and farmers (12%). The most likely primary source of this information, to these other sources as well, was the project. As a result of the training, most traders (81%) reported that they had been able to influence customers to purchase OFSP.

The MLF, particularly in Bukedea, played a pivotal role in linking farmers to traders in Mbale town. Sales records indicate that OFSP sales, by value, through the MLF in Bukedea between April 2008 and March 2009 were the equivalent of US$ 18,800.

6.5.4 Price and profitability of OFSP

OFSP was promoted by the project and subsequently by traders as a superior sweetpotato type due to its high level of beta-carotene. By extension, it was anticipated that this could translate into a premium price. However, as reported in section 6.3.4, the price of OFSP was not significantly different from the price of the other sweetpotato types within the same location. Since OFSP was relatively new, it is likely that if it sold for a higher price than non-OFSP, this could have been a possible deterrent to its successful marketing. This relates to the fact that low price or cheapness (section 7.2.1) was one of the most important considerations in consumers' decision to purchase a particular staple.

Similarly, where comparison data of trading margins and costs were obtained, it revealed that the costs and returns to OFSP trade were similar to the costs and returns to non-OFSP trade (see section 6.4.3). Traders are motivated by the prospect of making a profit. Since costs and margins of OFSP trade were comparable to those of non-OFSP, they provided an incentive for them to invest in this new enterprise as well.

6.6 Chapter summary

The survey of traders was conducted in the markets in the districts of Mukono, Kamuli, Mbale and Bukedea using a quantitative research approach. Contrary to the producer-level where sweetpotato marketing is dominated by the men, at the trader-level, it is a female-dominated activity. The main source of the initial capital used to start sweetpotato trade was savings from

other petty trade and sweetpotato planted for sale. OFSP marketing chains were relatively short and localised within the vicinity of the main project areas, indicating that OFSP chains were not as developed as non-OFSP chains. The main actors in these chains include the rural-based farmer traders and bicycle traders and the urban-based retailers and retailers/wholesalers. Informal markets typified by rural-based traders played a pivotal role in moving OFSP from the production to consumption areas. The nature and functioning of the OFSP value chain appears to typify a nascent case of chain upgrading in a product sense.

The main sweetpotato types sold in the markets were YFSP, WFSP and OFSP. Differences in sweetpotato types sold were statistically significant across the three districts but there were no significant differences across trader type. However, if the typology of traders into rural and urban-based is taken into account, then differences becoming statistically significant as most OFSP was sold by rural-based traders. In Mukono, Bukedea and Mbale, YFSP was the most frequently sold sweetpotato type: in Kamuli it was WFSP. OFSP accounted for about one-third of the sales in Mbale, Bukedea and Mukono but only 15% of the sales in Kamuli. The main reasons for selling a particular sweetpotato type were availability and consumer preference. Traders liked selling OFSP due to high consumer preference compared to YFSP and WFSP, but it was not as available as the other sweetpotato types.

Vitamin A was cited by 25% of the traders as one of the main reasons for selling OFSP. Due to this recognition, OFSP as was sold in separate units (not mixed with other sweetpotato types) as was often the case previously.

Price was not an important consideration in traders' decision to sell a particular sweetpotato type and there were no significant differences in prices across the sweetpotato types sold. However, while sweetpotato prices in Mukono were significantly higher than prices in the other districts, there were no significant differences in prices between Kamuli, Mbale and Bukedea. Again, the high OFSP prices in the Mukono value chain did not necessarily translate into a higher margin for the traders. Higher trading margins were recorded in the Bukedea value chain. OFSP was often the first sweetpotato type to be purchased by consumers in all the markets. Therefore, while OFSP has a novelty value that may enable it to achieve a higher price than non-OFSP in certain circumstances as it is recognised as a nutrient-rich sweetpotato, this recognition has,

overall, not yet translated into a premium price for OFSP over and above other sweetpotato types. This is consistent with findings of an earlier study in Mbale (Tomlins *et al.* 2009), which also concluded that high acceptance of OFSP has not yet led into higher prices than for non-OFSP.

The visual orange trait was among the key attributes used by traders to distinguish OFSP from other sweetpotato types. Others include "OFSP has vitamins" and "sweet taste". Presence of vitamins was associated with OFSP's deep orange colour. The main sources of information to traders on OFSP were the REU/OFSP project staff, personal experience, fellow traders and farmers. The orange colour has been a key identifier and promoter of OFSP in the markets.

One of the key challenges in trading in OFSP was availability. Compared to other sweetpotato types, OFSP was less available in all the four districts. However, there were significant variations in availability across the districts, OFSP being more available in Bukedea and Mbale compared to Kamuli and Mukono. Limited availability of OFSP was linked to limited experiences in trading in OFSP and low levels of awareness of OFSP. Like availability, awareness and trading experiences were lower in Kamuli and higher in Bukedea and Mbale. However, when all sweetpotato types were available, OFSP was the most preferred among traders. Other challenges include relatively short shelf life, poor odour and softness upon cooking.

In this chapter of this research, four factors that influence the decision of producers to market OFSP have been identified. These factors, summarised in Table 6.13 are: importance of sweetpotato among the traders; attributes of OFSP; REU project; price and profitability. These are likely to be important considerations in the uptake of most biofortified food crop by traders.

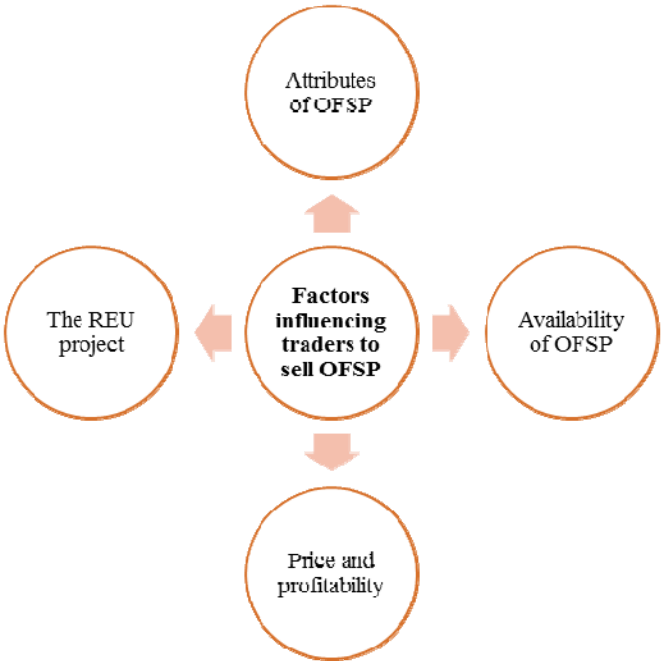

Figure 6.4: Factors influencing the decision of traders to sell OFSP

Chapter Seven: Presentation and Discussion of Findings on Decision-Making by Consumers.

7.1 Introduction

This chapter addresses research objective three: to analyse factors determining acceptability and likelihood of repeat purchase of OFSP by consumers. In the context of this research, consumers are those households, mainly urban-based, that purchase OFSP for home consumption. This distinguishes them from traders and producers, who are also consumers in their own right. As OFSP is visibly different from white and yellow sweetpotato, the orange colour may influence adoption and may be an opportunity to create a "brand image". However, it may also act as a deterrent to adoption.

Four research questions are addressed in this chapter, i) how acceptable are OFSP roots in terms of appearance, heap weight, size and price ii) what are the main characteristics of urban consumers of OFSP, iii) how do consumer purchase decisions of OFSP differ from non-OFSP, and iv) what factors determine acceptability and repeat purchase of OFSP?

Results presented in this chapter are from two main data sources: a quantitative survey of consumers in Kampala markets conducted between November and December 2007; and a quantitative survey of consumers in urban markets of Mbale, Mukono and Kamuli conducted from January to March 2010.

This chapter is, therefore, divided into two main sections, each presenting results from one of the surveys referred to above.

7.2 Acceptability of OFSP in Kampala markets.

7.2.1. Introduction

This sub-section presents the results of a survey aimed at evaluating acceptability, and the likelihood of repeat purchase of OFSP among urban consumers in Kampala, the capital city of Uganda in 2007. The study was premised on the fact that OFSP was still a relatively new crop that was not traded in significant quantities in Uganda. Little was known about consumer perceptions of this crop, although it was being promoted mainly by the REU project as well as other agriculture-nutrition interventions. It was anticipated that, as with WFSP and YFSP, OFSP produced in the project areas would end up in the main produce markets in Kampala. The results of this study were expected to assist in the marketing and promotion strategies for OFSP in Uganda and elsewhere.

The objective of the study was to evaluate the acceptability and likelihood of repeat purchase of OFSP by consumers in the urban markets of Kampala. The research questions that the study addressed were i) how do the OFSP varieties compare with traders variety in terms of heap weight and price, ii) how acceptable are the OFSP varieties by root appearance, iii) what knowledge do consumers have about OFSP, and iv) what factors are likely to influence consumer decisions on repeat purchase.

Four OFSP varieties of *Ejumula, Kakamega, Kabode* and *Vita* were provided to four market traders in the markets of Kalerwe (2 traders), Kazo (1 trader) and Bwaise (1 trader). The traders sold the OFSP alongside their own sweetpotato varieties. An enumerator was assigned to each trader to interview consumers who purchased sweetpotato, OFSP inclusive. Besides interviewing the consumers, the enumerators also weighed and recorded the prices of the sweetpotato heaps purchased. Please refer to chapter four for details of the methodology.

7.2.2 Characteristics of the heaps sold by traders

The mean heap weight was 3.3 kg and did not differ significantly either by sweetpotato variety or across the four traders involved in the study. The mean price (on a weight basis) at which the varieties were sold are shown in Table 7.1, and they significantly differed (Anova; P=0.004). The Duncan's multiple range test indicated that the traders' own varieties and two OFSP

varieties (*Vita* and *Ejumula*) sold for the highest prices. Of these OFSP varieties, the skin colour of *Ejumula* is cream, similar to the traditional *Tanzania*, the preferred sweetpotato variety, especially by consumers from eastern and northern Uganda. Likewise, *Vita* has a purple skin like *Kawogo*, which is preferred by consumers from central Uganda. Two OFSP varieties (*Kabode* and *Kakamega)*, however, sold at significantly lower prices. The shape and size of *Kabode* is significantly different from most of the local varieties that are sold in the market. Its roots are distinctively big, oval and at times amorphous. The market prefers roots that are medium sized, slim and long, since they are attractive and easy to peel.

Table 7.1: Price (UGX/kg) of the four OFSP varieties compared to the traders' own variety as sold by traders in the Kampala markets of Uganda in December 2007.

Sweetpotato variety	Price (UGX/kg)	
Traders' own	284.4a	± 111.0
Vita	269.5ab	± 87.1
Ejumula	252.2ab	± 73.7
Kakamega	235.3b	± 60.4
Kabode	234.5b	± 52.0
Overall	263.2	± 91.7

Where: 'a and b' donate differences in mean values using Duncan's multiple range test. Prices are ± the standard error.

The findings of this research suggested that without nutritional information, consumers were not willing to pay a premium for OFSP. There is circumstantial evidence that the traders who participated in this study might have sold OFSP for a higher price than they indicated. This is because the traders were not familiar with OFSP and also they had been given the OFSP roots gratis and therefore did not have to increase the price to make a profit. The results of this research are consistent with an earlier willingness-to-pay study (Choudhury *et al*. 2009).

The study examined whether there were any differences in the overall prices of sweetpotato sold by the four traders used in this survey. Traders 1 and 2 were selling from the same market, Kalerwe, while traders 3 and 4 were selling in two other markets, Kazo and Bwaise. However, all the four traders (retailers) received sweetpotato from the same wholesaler. Results revealed significant difference in the price (UGX/kg) of sweetpotato with respect to the market traders

(P=0.024) as illustrated in Table 7.2. The Duncan's multiple range test indicated that the prices at which traders 1 and 2 sold their sweetpotato differed from traders 3 and 4. The difference in price between these two groups of traders was 26%. This suggests a possibility of price difference across the markets. However, data collection from more traders from each market would be required in order to validate this finding.

Table 7.2: Difference in the mean price (UGX) at which the traders in the Kampala markets of Kalerwe, Kazo and Bwaise sold their sweetpotato cultivars in December 2007

Trader	Market	Price (UGX/kg).	
1	**Kalerwe**	314.7a	± 126.2
2	**Kalerwe**	298.7a	± 96.8
3	**Kazo**	232.6b	± 41.0
4	**Bwaise**	223.4b	± 71.8

Where: 'a and b' donate differences in mean values using Duncan's multiple range test; and prices are ± the standard error.

7.2.3 Consumer acceptability, by root appearance, of sweetpotato varieties

Consumers were asked to assess the quality of the root appearance of the four OFSP varieties and the traders' own sweetpotato variety. The assessment was based on a seven point score: i) like very much; ii) like moderately; iii) like slightly; iv) neither like nor dislike; v) dislike slightly; vi) dislike moderately; and vii) dislike very much. The Friedman test was used on the ranks because the distribution of acceptance scores did not follow the normal distribution. Acceptability (Table 7.3) based on the root appearance significantly differed ($P<0.001$; Friedman test). Consumers ranked the traders' own as the most acceptable sweetpotato variety, followed by the OFSP varieties, in decreasing order, of *Ejumula, Kakamega, Vita and Kabode* (Table 7.3).

Table 7.3: Ranking of the four OFSP varieties and the traders' own by consumers in the based on mean consumer acceptability scores for the appearance of whole sweetpotato root.

Sweetpotato variety	Mean score	Rank sum
Traders' own	6.5 ± 0.848	892a
Ejumula	5.5 ± 1.348	581b
Kakamega	4.9 ± 1.522	450c
Vita	4.7 ± 1.897	447c
Kabode	4.5 ± 1.732	354d

Where: Scores are ± the standard error, a to d donate differences in rank sums using the Friedman test.

Table 7.4 lists the defects that consumers identified with each sweetpotato variety and the percent of consumers who mentioned a particular defect. The total percentage of defects followed a similar order to acceptability in table 7.3. The 'traders' own variety had the least number of defects, while *Kabode* had the greatest number of defects. The defects that were most commonly mentioned were that the OFSP roots appeared to be too soft when cooked, had poor taste/texture, the wrong shape, watery, the wrong skin colour and too large. In particular, *Kabode* had the wrong shape and too large while *Kakamega* had the wrong skin colour.

Table 7.4: Defects identified by consumers in the four OFSP varieties and traders' own sold by the traders in the Kampala markets of Kalerwe, Kazo and Bwaise, December 2007

	Consumers (%)				
Defect	**Traders own**	**Ejumula**	**Vita**	**Kakamega**	**Kabode**
Think texture is too soft	5.5	11.5	11.0	9.5	10.0
Poor taste/texture	0.0	5.0	2.5	8.5	3.5
Wrong shape	0.0	0.5	5.5	3.0	7.0
Think it is watery	0.0	3.5	5.5	2.5	3.5
Bad odour	0.5	3.0	2.5	1.0	4.5
Wrong skin colour	0.0	0.5	3.0	6.0	2.0
too large	0.0	0.0	0.0	0.0	7.5
Total	**6.0**	**24.0**	**30.0**	**30.5**	**38.0**

In order to identify groups of consumers that are similar to each other yet different from others with respect to acceptability of OFSP, cluster analysis was used (agglomerative hierarchical cluster analysis, Ward's method). This method groups objects or consumers of OFSP in this case in such a way that those with more similar attributes in terms of acceptability of OFSP fall in the same group. Therefore, consumers in one group are different from those in the other groups with respect to acceptability of OFSP. Results indicated that the variation of consumer acceptability within the population interviewed was multi-modal. Three segments were identified (Figure 7.1) and acceptance significantly differed for all varieties apart from Traders own ($P<0.001$; Kruskal-Wallis).

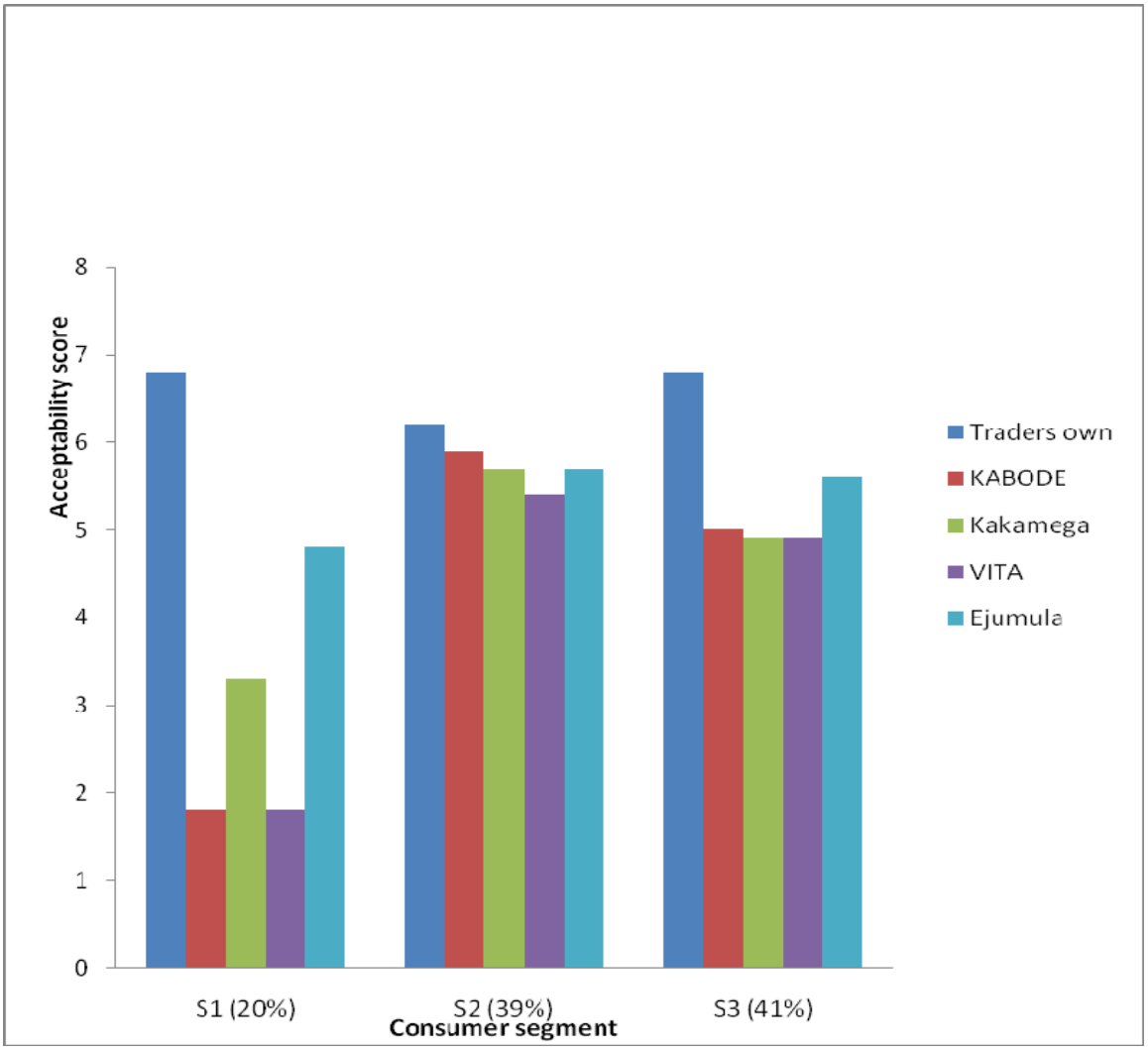

Figure 7.1 Mean consumer acceptability scores for the appearance of whole sweetpotato root for the four varieties of *Ejumula, Kakamega, Kabode* and *Vita* as well as the traders' own by consumer segment

Consumers in all the three segments gave the traders own variety the highest acceptance score, followed by the two OFSP varieties, *Ejumula* and *Kakamega*. Consumers in the largest segment S3 (41%) gave the highest score to the traders own followed by *Ejumula*. They then awarded an almost equal score for the other three OFSP varieties. Consumers in the second largest segment S2 (39%) gave an almost equal score to all the four sweetpotato varieties. Finally, consumers in the third segment S3 (20%) demonstrated a high acceptance for traders own, followed by Ejumula and Kakamega. Overall, results indicate that Ejumula is the most acceptable OFSP

Table 7.6 shows that the price paid significantly differed with respect to socio- economic parameters (P<0.05, Kruskal-Wallis). Consumers in segments 2 and 3 gave higher acceptance scores for OFSP and also paid the highest prices. Those in segment 2 were also the most likely to have heard about OFSP previously, most likely to have bought OFSP during the survey and were the most likely to say that they would purchase OFSP again.

Table 7.5: Socio-economic determinants of the price that consumers paid for OFSP disaggregated into the three consumer segments.

Socio-economic parameter	Segment						Probability
	S1 (20%)		S2 (39%)		S3 (41%)		
Price paid (UGX/kg)	233	± 83	260	± 98	282	± 87	<0.001
Purchased OFSP at the time of interview (% within each segment)	39	± 49	65	± 48	52	± 50	0.014
Heard about OFSP before	57	± 50	86	± 35	9	± 28	<0.001
Consumers who said yes	1.8	± 0.8	1.3	± 0.5	1.6	± 0.6	<0.001

Where: Scores are ± the standard error.

7.2.4 Consumer knowledge of OFSP

Of the 200 consumers interviewed, 42.5% reported that they had previously heard of OFSP. The three most common avenues by which consumers reported learning about OFSP were at the "market", from friends and the radio (Table 7.7).

The main attributes of OFSP that consumers were (Table 7.7) aware of are taste (49%), it has vitamins in general (31%), and it is good for health (17%). Results of a chi-square test (P=0.006) reveal that differences in the information on the known attributes of OFSP varied by source of information. For example, the "market" and "trader" were more important sources of information on the taste of OFSP and that it has vitamins. The radio was a more important source of information on the general health benefits of OFSP.

Table 7.6: Attributes of OFSP (%) that consumers were aware of and sources of the information on the known attributes

Source of information	OFSP attributes (%) that consumers were aware of						
	Taste (n=42)	**Health (n=14)**	**Children like it** (n=3)	**Vitamin A (n=8)**	**Carrots** (n=8)	**Vitamins (n=26)**	**Overall (n=85)**
Market (n=30)	22	2	0	1	1	13	35
Trader (n=15)	9	2	1	4	0	8	18
Radio (n=10)	1	6	0	1	2	2	12
Friend (n=9)	4	1	1	2	1	2	11
Relative (n=7)	4	4	1	0	2	2	8
Chance (n=5)	5	0	0	0	0	1	6
Hotel (n=5)	6	0	0	0	0	0	6
Trade fair (n=3)	0	1	0	0	1	1	4
Farmers (n=2)	0	0	0	1	1	0	2
Overall (n=85)	49	17	4	9	9	31	100

7.2.5 Factors influencing likelihood of purchasing OFSP

Of the 200 consumers interviewed, 59% reported that they would purchase OFSP in the future, 31% possibly and 10% would not. The factors related to likelihood of purchasing OFSP were related to acceptability (Table 7.8) and socio-economic factors (Table 7. 9) (Kruskal-Wallis; $P<0.05$). Consumers who said that they were likely to purchase OFSP again tended to give the OFSP varieties (*Kabode, Kakamega* and *Ejumula*) the highest acceptability scores and those sold by the trader the lowest.

Table 7.7: Mean acceptability scores of the four OFSP varieties and the traders' own variety by root appearance and the likelihood of repeat purchase of these varieties by consumers based on acceptability.

	Yes	Possibly	No	
Sweetpotato variety	**Acceptability (score)**			**Probability**
Traders	6.4	6.7	6.6	0.001
Kabode	4.9	4.7	4.0	0.052
Kakamega	5.2	4.8	3.7	<0.001
Ejumula	5.8	5.4	3.6	<0.001

Note: there was no significant difference with respect to the VITA variety of sweetpotato

The likelihood of purchasing OFSP was significantly influenced ($P<0.05$) by the price paid by consumers for sweetpotato on the day of interview. Those who were mostly likely to purchase OFSP in the future had paid the lowest mean price UGX 248/Kg followed by possible (UGX283/kg) and not likely to purchase was the highest (UGX 292/kg). There was no significant relationship with heap weight or heap price.

Consumers who had purchased OFSP on the day of the interview or previously were more likely to purchase it in future (Table 7.9). Consumers who had previously heard about OFSP (in particular from a friend or at the market) and those who had knowledge that OFSP had a good taste and that it is good for human nutrition were more likely to purchase it in future. Also, many consumers would purchase again just because they wanted to try OFSP.

Table 7.8: Socio-economic factors determining the likelihood of future purchase of OFSP by consumers in the Kampala markets of Kalerwe, Kazo and Bwaise, December 2007

		Consumers (%)			
		Yes	Possibly	No	Probability
Purchasing of OFSP	Purchased OFSP on the day of interview	39	13	3	0.001
	Purchased OFSP previously	33	6	5	<0.001
	Previously purchased OFSP in a market	29	3	5	0.004
How previously heard about OFSP	Previously heard of OFSP	38	7	6	<0.001
	Heard from a Friend	8	3	0	0.005
	Heard at a market	12	1	4	0.031
Knowledge of benefits of OFSP	OFSP has good taste	15	5	4	0.020
Reasons for wanting to purchase OFSP again	OFSP has better nutrition	24	8	0	<0.001
	OFSP has good appearance	19	9	0	0.007
	Would like to try OFSP	18	17	1	<0.001
	Would like the taste	27	5	0	<0.001

7.3 Acceptance of OFSP by consumers in Mukono, Mbale and Kamuli

7.3.1 Introduction

This sub-section analyses decision making by consumers in the markets of Mukono, Mbale and Kamuli. It is based on the findings of the quantitative consumer survey conducted between January and March 2009, a time when it was anticipated there would be substantial supplies of OFSP in these markets, making it possible for the urban consumers to access it. Initially, the consumer survey was meant to cover markets in Kampala as well. However, the OFSP produced from the project sites did not reach as far as the Kampala markets. Therefore, a direct comparison of consumer acceptance at project inception and at the end of the project was not possible.

The main questions addressed here are: i) what are the socio-economic characteristics of the consumers, ii) what are the consumer levels of awareness of and experiences with OFSP, iii)

how do consumer purchase decisions of OFSP compare to non-OFSP and iv) what are the key determinants of acceptability and repeat purchase.

7.3.2 Socio-economic characteristics of the consumers

The consumers were sampled from the markets in the districts of Kamuli (27%), Mukono (33%) and Mbale (40%). The majority of the consumers were female (71%), with a mean age of 32 years (std 10 years). The ethnic group of the respondents corresponded to the main ethnic group in each of the districts, hence in Mbale respondents were mainly from the *Bagisu* community, the *Baganda* in Mukono and the *Basoga* in Kamuli. Most (79%) of the respondents had completed formal education and were either the head of household (35%) or spouse of the household head (50%).

Main starchy staples consumed

Consumers were asked to identify and rank four of the most important starchy staple food crops that they purchase for home consumption, where 1 was the most important and 4 the least important staple. This helped to identify the relative importance of sweetpotato among the respondents. During data entry, the most important staple was given a weight of 4 and the least important a weight of 1. Results (Table 7.9) indicate that sweetpotato (mean weight of 3.60 and standard error of 0.66), *posho* (mean score of 2.52 and a standard error of 1.03), *matooke* (mean score of 2.52 and a standard error of 1.11) and rice (mean score of 2.02 and a standard error of 0.84) were the most important staples consumed by the respondents.

Table 7.9: Priority food staples purchased by consumers in Mbale, Kamuli and Mukono, March 2010

Staple	Districts						Overall	
	Mbale		Kamuli		Mukono			
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Sweetpotato	3.56	0.58	3.59	0.85	3.63	0.59	3.60	0.66
Posho	2.46	1.13	2.53	0.94	2.55	1.06	2.52	1.03
Matooke	3.05	0.89	2.07	1.10	2.18	1.17	2.52	1.11
Rice	2.07	0.73	2.47	0.72	1.53	0.80	2.02	0.84
Cassava	1.89	0.60	1.50	0.84	2.32	0.75	2.10	0.78
Atap	4.00		0	0	2.53	0.80	2.02	0.84
Irish potato	1.60	0.55	2.00	0	2.33	1.21	2.57	1.27

Where SE=Standard Error

Although sweetpotato was the most important food staple purchased by consumers, there were significant differences in the prioritisation of the subsequent staples ($p < 0.05$). Thus, while the second most important food staple among the respondents in Mbale was *posho*, it was *matooke* in Mukono.

Since the survey was conducted among consumers who had already expressed interest in sweetpotato by purchasing it, caution needs to be exercised in interpreting these results. These results don not necessarily imply that sweetpotato are the most important food staple consumed in the three districts or that posho and *matooke* are the second most important staple food consumed in Mbale and Mukono, respectively. They, however, indicate that among those purchasing it; sweetpotato is an important component of their diet.

Reasons for consuming a particular staple

Overall, the main reasons (Table 7.10) for consuming a particular staple were that it was preferred by children, it is a traditional staple food, it is easy to prepare and it is cheap. The chi-square test ($p < 0.05$) revealed that reasons for consuming a particular food crop differed significantly from one staple to the other. For example, consumers preferred to consume sweetpotato because they are sweet and always available in the market; *posho* because it was cheap and liked by children; *matooke* because it is a staple and eaten occasionally (a change from the usually eaten staple); cassava because it is easily cooked with other food and easy to prepare; and rice because it is liked by children and easy to prepare.

While sweet taste was the most important consideration by consumers in purchase and consumption of sweetpotato, studies on farmer evaluation and acceptability of new sweetpotato varieties identified sweet taste as the second most important factor in the evaluation criteria (Mwanga *et al.* 2007; Tumwegamire *et al.* 2007). Therefore, OFSP is more likely to be accepted if it is as sweet as or sweeter than the existing white and yellow sweetpotato varieties. OFSP is also likely to be consumed if it is available in the market. It is also likely to be more acceptable in households where sweetpotato is among the key traditional staple foods. Again, if children develop a high preference for OFSP compared to other staples commonly eaten, it is more likely to be adopted by the urban consumers, since preference by children was reported to be the leading consideration in consuming a particular staple.

Table 7.10: Reasons (%) consumers in Mukono, Mbale and Kamuli gave for consuming a particular staple, March 2010.

Reason	Staple					
	Matooke **(n=44)**	**Cassava (n=32)**	***Posho*** **(n=52)**	**Rice (n=29)**	**Sweetpotato (n=89)**	**Overall(n=246)***
Preferred by children	0	13	29	55	10	18
It is our staple food	41	0	15	0	17	17
Easy to prepare	18	22	0	45	8	14
Cheap	2	13	37	0	10	13
Always available in the market	16	0	8	0	22	13
It is sweet	0	0	0	0	33	12
Easily cooked with other foods	0	34	12	0	0	7
Change diet	23	19	0	0	0	7

* Where n is the number of cases

Reasons for purchasing a particular staple crop

The main reasons for purchasing a particular food type for home consumption (Table 7.11) were price (16%), preference by children (16%), traditional staples (15%) and ease of preparation (15%). Reasons also differed significantly between the key staple foods ($p< 0.05$). As a case in point, the most important factors that influenced consumers' decision to purchase sweetpotato were sweet taste, availability in the market and being a staple food. Sweet taste was a favourable characteristic unique to sweetpotato. Similarly low price was the most important factor influencing the decision to purchase *posho*, though this factor was not cited in the purchase of *matooke*.

In conclusion, consumers are more likely to purchase OFSP either in place of, or together with, other food staples if it is not expensive, is preferred by children, is easy to prepare and if sweetpotato are already a key staple food. However, consumers are likely to purchase OFSP in place of, or together with, other sweetpotato types if it is as sweet as or sweeter than other sweetpotato types and is available in the markets. Sweet taste was also identified as the second

most important factor in the choice of a sweetpotato variety by farmers in Uganda (Yaggen, 2006).

Table 7.11: Factors that influenced the decision of consumers in Mukono, Kamuli and Mbale to purchase a particular staple (%).

Reason	Staple						
	Cassava (n=31)	***Matooke* (n=38)**	***Posho* (n=46)**	**Rice (n=39)**	**Sweetpotato (n=87)**	**Overall** (n=241)	**Probability ****
Cheap (n=38)	23	0	37	10	12	16	P<0.001
Preferred by children (n=39)	13	0	26	44	7	16	P<0.001
Staple food (n=36)	0	42	17	0	14	15	P<0.001
Easy to prepare (n=35)	23	26	11	26	3	15	P<0.001
To change diet (n=28)	16	32	0	21	3	12	P<0.001
Sweet taste (n=26)	0	0	0	0	30	11	P<0.001
Always in the market (n=20)	0	0	0	0	23	8	P<0.001
Easily mixed with other food (n=15)	25	0	9	0	3	5	P<0.001
Always much in quantity (n=4)	0	0	0	0	5	2	P<0.001

*where n is the number of cases

** P values from single-sample chi-square with 4 df.

In conclusion, interventions aimed at improving availability of OFSP in the urban markets, among others, are likely to have an impact on household consumption of OFSP by urban consumers. It is important that the OFSP varieties should have a sweet taste as this is the key attributes sought after by urban consumers' in a sweetpotato variety.

7.3.3. Consumers' awareness of and experiences with OFSP

This section deals with consumers' awareness of, and experiences with OFSP. In order to analyse awareness, consumers were asked whether they had heard of, seen or eaten OFSP (Table 7.12). Results indicated that the levels of awareness of OFSP among the consumers were relatively high. A majority (85%) of consumers' reported that they had heard of OFSP. Although more consumers in Kamuli had never heard of OFSP compared to the other districts, these differences were not statistically significant.

Table 7.12: Consumers (%) in Mbale, Kamuli and Mukono who reported that they had heard of OFSP, those who had seen OFSP and those who had eaten OFSP, March 2010.

Consumers who had	District				
	Mbale	**Kamuli**	**Mukono**	**Overall**	**Probability****
Heard of OFSP	91	68	93	85	NS
Seen OFSP	91	41	89	77	P<0.001
Eaten OFSP	93	32	79	72	P<0.001

** P values from single-sample chi-square with 2 df

Similarly, a majority (77%) of the respondents had ever seen OFSP. However, there was a statistically-significant difference in the consumers who had not seen OFSP across three districts, with more consumers in Kamuli reporting that they had never seen OFSP. Regarding consumption of OFSP, 72% of the consumers reported that they had consumed OFSP before. Again, more consumers in Kamuli reported that they had never eaten OFSP compared to Mukono and Mbale.

The main factors that motivated consumers' to eat OFSP were (Table 7.13) colour (32%), sweet taste (26%), vitamin A (21%) and preference by children (18%). With the exception of colour, the other factors varied significantly across the three districts.

Table 7.13: Factors that motivated consumer in Kamuli, Mbale and Mukono to eat OFSP (%), March 2010

Motivating Factor	District				
	Kamuli (n=14)	**Mbale (n=78)**	**Mukono (n=36)**	**Overall (n=128)**	**Probability ****
Colour (n=41)	29	27	44	32	NS
It is sweeter (n=33)	21	31	14	26	P<0.05
Rich in vitamin A (n=27)	21	26	11	21	P<0.05
preferred by children (n=23)	29	14	22	18	P<0.05
Others (n=4)*	0	2	9	3	P<0.001

where n is the number of cases; *others include was only variety available, early maturity and good smell

** P values from single-sample chi-square with 2 df

Future Consumption of OFSP

Most consumers' (94%) reported that they would purchase OFSP in future. The main reasons for purchasing OFSP (Table 7.15) were it is rich in pro-vitamin A (37%), sweet taste (32%) and availability (23%). This is surprising since vitamin A was not a major reason in consumers' decision to purchase sweetpotato in general and OFSP in particular (Table 7.14). However this response could indicate that knowledge of OFSP could have been acquired during the course of the interview and influenced this decision.

Table 7.14: Reasons why consumers in Kamuli, Mbale and Mukono would purchase OFSP in future, March 2010

	District				
Reason	**Kamuli (n=27)**	**Mbale (n=80)**	**Mukono (n=32)**	**Overall (n=139)***	**Probability****
It has vitamin A (n=51)	33	40	31	37	NS
Sweet taste (n=45)	22	31	44	32	P<0.01
if available in future (n=) 32	45	16	22	23	P<0.001
It is soft (n=9)	0	10	3	7	P<0.001
like it (n=2)	0	3	0	1	

* where n is the number of cases; and ** P values are from single-sample chi-square test with 2 df

Encouraging future consumption of OFSP

The main ways of stimulating future consumption of OFSP (Table 7.15) are to sensitise consumers on its benefits (37%) and to increase availability (35%). Linked to availability, provision of more planting materials to farmers (23%) was specifically mentioned as another way of encouraging OFSP consumption. In Mukono, the need to sensitise consumers on the benefits of vitamin A was particularly singled out as a way of promoting consumption of OFSP.

Table 7.15: The main ways through which consumption of OFSP can be encouraged as reported by consumers in Kamuli, Mbale and Mukono, March 2010 (%)

	District				
Ways of encouraging consumption	**Kamuli (n=34)**	**Mbale (n=64)**	**Mukono (n=44)**	**Overall (n=142)***	**Probability****
Increase on awareness (n=52)	35	34	41	37	NS
Increase availability (n=49)	50	45	7	35	P<0.001
Provide more vines (n=32)	15	19	34	22	P<0.01
Sensitize about vitamin A (n=8)	0	0	18	5	P<0.001
Improve on the smell (n=1)	0	2	0	1	

* where n is the number of cases; and ** P values from single-sample chi-square with 2 df

Similarly, a Willingness-to-Pay Study for OFSP in Uganda (Chowdhury, *et al.* 2009) concluded that with provision of nutrition information, consumers were willing to pay a premium, and the size of the premium was higher for deep orange than for orange varieties. Deep orange OFSP varieties have more beta-carotene.

7.3.4 Consumer purchase decisions of OFSP compared to non-OFSP

This sub-section answers research question three, how do consumer purchase decisions of OFSP compare to non-OFSP? To answer this question, the main sweetpotato types sold in the markets and known by the consumers are identified. The attributes that are used to distinguish these sweetpotato types are explored as well as the factors influencing consumer purchase decisions.

The main sweetpotato types available in the markets (Figure 7.2), as reported by the consumers were YFSP (69%), WFSP (17%) and OFSP (14%). The differences in sweetpotato types available were significantly different across the districts ($p < 0.05$). YFSP was the only sweetpotato type available in all the districts, and it was the predominant sweetpotato type in Mukono (89%). OFSP was only available in Mbale (33%). WFSP (46%) was more available in Kamuli (46%) compared to Mukono and Mbale.

However, availability of OFSP, as interpreted from the consumer's response, could well represent their level of awareness of the sweetpotato types. However, low levels of awareness of

OFSP in Kamuli could be a result of limited availability of OFSP in the markets as described above.

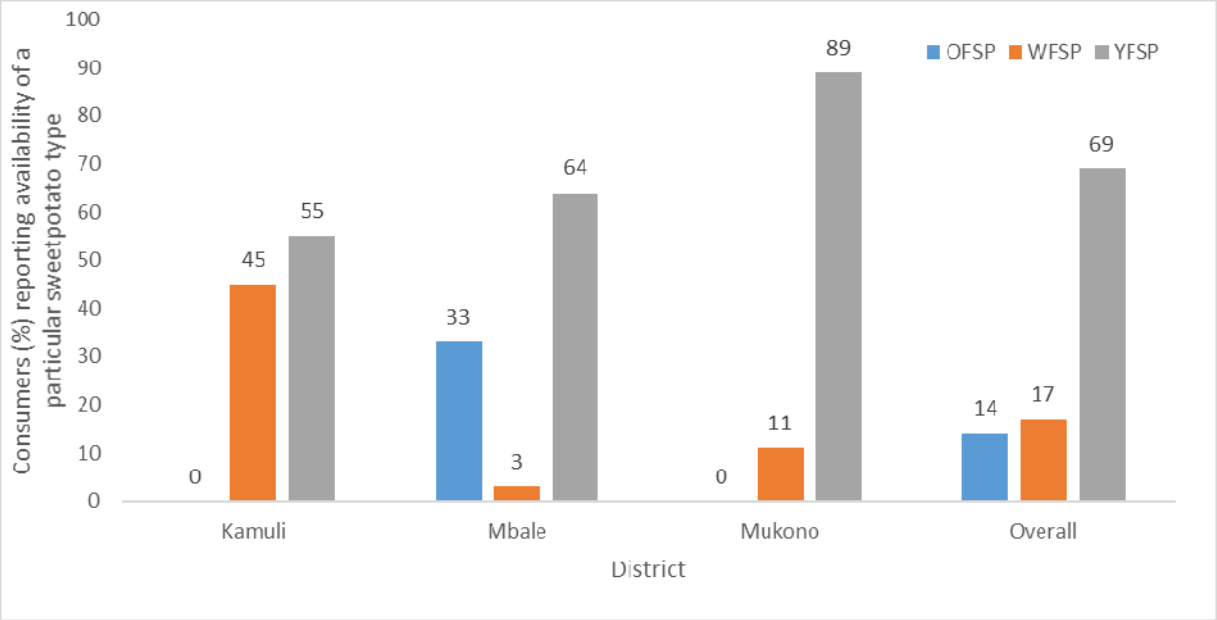

Figure 7.2: Sweetpotato types sold by traders as reported by consumers in Kamuli, Mbale and Mukono, March 2010

Attributes used for distinguishing OFSP from other sweetpotato

The key attributes that consumers used for distinguishing OFSP from other sweetpotato types were orange colour (44%), vitamin A (25%) and sweet taste (18%). The distinguishing attributes were similar across the districts. These attributes can be used for marketing OFSP as a means of promoting it and distinguishing it from existing yellow and white varieties.

Sources of Information about Attributes that distinguish OFSP from non-OFSP

Consumers learnt of the attributes that they used for distinguishing OFSP from other sweetpotato types (Table 7.16) through personal experience (45%), traders (16%), fellow consumers (16%) and farmers (11%). While earlier work (Tomlins *et al*, 2009) had suggested that the radio was one of the major sources of information for urban consumers in Mbale on OFSP, this work concludes that the radio, like project staff and posters/T-Shirts and wall murals, were not important sources of information to consumers. This could partly be explained by the fact that radio programmes were no longer broadcast at the time of this survey. Thus, while radio may be

an important source of information about OFSP, it is probably more effective at the time the broadcasts are running. Similarly, project staff was not an important source of information about OFSP because, unlike traders, the project marketing strategy did not explicitly target consumers. The marketing strategy was designed in such a way that the project trained traders who were in turn expected to sensitise their customers on OFSP. However both studies concurred that the market, stratified here as consumers and traders, was an important source of information to consumers on OFSP.

Table 7.16: Sources of information on the attributes of OFSP among consumers interviewed (%) in Kamuli, Mbale, and Mukono, March 2010.

	District				
Source of information	**Kamuli (n=6)**	**Mbale (n=27)**	**Mukono (n=23)**	**Overall (n=56)***	**Probability****
Personal experience (n=25)	50	56	30	45	P<0.01
Trader (n=9)	33	26	0	16	P<0.001
Fellow consumers (n=9)	0	0	39	16	P<0.001
Farmers (n=6)	0	0	26	11	P<0.001
Radio (n=3)	17	7	0	5	P<0.001
Poster/T-Shirt/Wall mural (n=2)	0	7	0	4	
Project staff (n=2)	0	4	5	3	

* Where n is the sample size; ** P values from single-sample chi-square with 2 df

Purchase of sweetpotato

Purchase patterns of sweetpotato were closely linked to availability. Accordingly, YFSP was the main sweetpotato type purchased by the consumers (Figure7.3). It was also the main sweetpotato type purchased in all the three districts. OFSP was purchased in Mbale only, while WFSP was mainly purchased in Kamuli and Mukono, with minor purchases recorded in Mbale (3%).

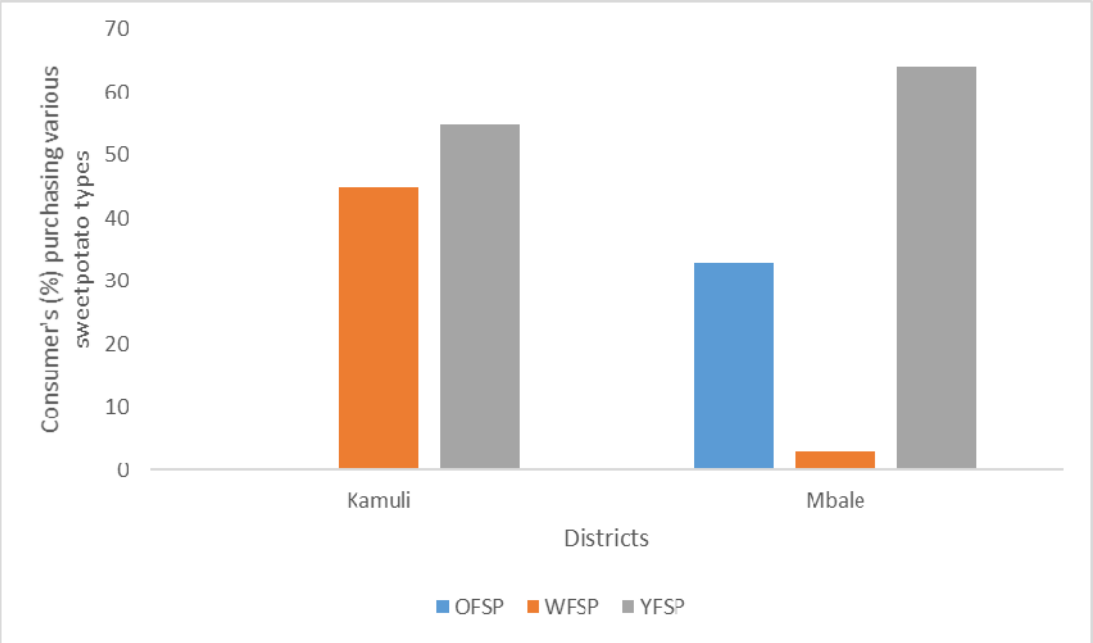

Figure 7.3: Type of sweetpotato purchased by consumers (%) in Kamuli, Mukono and Mbale, March 2010

Decision on type of sweetpotato bought

The decision about the specific type of sweetpotato to purchase (Table 7.17) was mainly taken by women (72%). However, in Kamuli children (22%) and men (22%) were also important in taking such decisions. This was not the case in Mbale. It is therefore important that the women, who are both the key decision-makers in regards to the type of sweetpotato to be purchased and one of the population segments most vulnerable to VAD, are targeted with nutrition information about OFSP so as to tilt their decision making in favour of purchasing it.

Table 7.17: Family member who decides on the type of sweetpotato to be purchased (%) as determined by consumers in Kamuli, Mbale and Mukono, March 2010

	District				
Family member	**Kamuli (n=22)**	**Mbale (n=33)**	**Mukono (n=27)**	**Overall (n=82)***	**Probability ****
Mother (n=58)	91	74	56	72	P<0.01
Children (n=9)	0	7	22	10	P<0.001
Father (n=7)	0	3	22	9	P<0.001
One who purchases (n=6)	9	10	0	7	P<0.001
Employer (n=2)	0	7	0	2	P<0.001

* Where n is the sample size; and ** P values from one-sample chi-square with 2 df

Overall, the main reason why consumers did not purchase OFSP (Table 7.18) was that it was not available (88%). Lack of knowledge about OFSP was cited as another reason for not purchasing it in Kamuli and Mbale. Other reasons identified in Mbale only were that the consumers/purchases were instructed not to buy OFSP and some family members did not like OFSP.

Table 7.18: Reasons why some of the consumers interviewed in Mbale, Mukono and Kamuli did not purchase OFSP (%), March 2010.

	District				
Reason	**Mbale (n=17)**	**Mukono (n=27)**	**Kamuli (n=22)**	**Overall (n=66)***	**Probability ** **
Not available on market (n=59)	77	100	86	88	NS
I do not know OFSP (n=5)	12	0	14	8	P<0.001
Told not to buy OFSP (n=1)	6	0	0	2	P<0.001
Family/consumer don't like it (n=1)	6	0	0	2	P<0.001

* where n is the sample size; and ** P value from one-sample chi-square with 2 df

Comparison of taste of OFSP with other sweetpotato types

Consumers were asked to compare the taste of OFSP to the taste of the sweetpotato types that they commonly consume (Table 7.19). The results of this comparison revealed that OFSP was either better than (70%) or similar to (20%) the commonly-consumed sweetpotato type. In contrast, about one-third of the respondents in Kamuli, compared to 13% in Mukono and 3% in Mbale, regarded the taste of OFSP to be worse than the taste of the sweetpotato type that they commonly consumed.

Table 7.19: Comparison of the taste of OFSP to other sweetpotato types (%) by consumers in Kamuli, Mbale and Mukono, March 2010

	District			
Comparison factor	**Kamuli (n=7)**	**Mbale (n=29)**	**Mukono (n=23)**	**Overall (n=59)**
Better than (n=41)	57	76	65	70
Similar (n=12)	14	21	22	20
Worse than (n=6)	29	3	13	10

Where n is the sample size

While, in general, the taste of OFSP was considered to be either better than, or as acceptable as the taste of the common non-OFSP, 23% of the consumers reported that not all the members of their household prefer OFSP to other sweetpotato types. The percentage who reported that not all members of their household prefer OFSP to non-OFSP was highest in Kamuli (43%) compared to Mukono (33%) and Mbale (11%), the only place where OFSP was available. Lower level of acceptance of OFSP in Kamuli can be attributed to the high prevalence of, and preference for, WFSP.

7.4. Factors determining acceptability and repeat purchase of OFSP

This sub-section addresses research objective three: to assess the factors determining acceptability and repeat purchase of OFSP among urban consumers. It draws on insights from the previous sub-sections of this chapter. The main factors determining acceptability and repeat purchase of OFSP among consumers were attributes of OFSP; price; and availability.

7.4.1 Attributes of OFSP

Like was the case among producers and traders, certain attributes of OFSP played an important role in influencing the decision of consumers to purchase it. Unlike producers and to some extent traders, the important attributes to the consumer are sensory. These include taste, colour, and root appearance. Earlier work suggested that texture upon eating is another important sensory attribute to the consumer. Each of these attributes and how they influenced acceptability and repeat purchase is assessed below.

Overall, this work has identified sweet taste as the most important reason for consumer purchase of sweetpotato compared to the other staples. It was also the second most important consideration in the decision by consumers on which of the three (white, yellow and orange) sweetpotato types to purchase. The acceptance of new healthier foods is important because while consumers may seek convenient and healthy products, taste is consistently rated as the most important factor that drives sustainable consumption and repeat purchase by consumers (Cardello *et al*. 2007). Earlier work on consumer acceptance of OFSP in the urban areas of Kampala and Soroti also identified sweet taste as one of the key determinants of consumer purchase (Oburu, 2006). Taste is important not only to the consumers, but it is also the second

most important criterion, after yield, in the on-farm evaluation criteria of sweetpotato varieties by farmers (Tumwegamire *et al.* 2007). This is not surprising because farmers are themselves consumers but they have to produce before they can consume, thus the high priority attached to yield compared to taste in their variety evaluation.

The orange colour is another important sensory attribute of OFSP resulting from the change in colour that pro-vitamin A bestows on sweetpotato. The orange colour was more important in distinguishing OFSP from YFSP and WFSP and helped raise awareness of the OFSP "brand". The impact of orange colour on consumer acceptance of OFSP is somewhat mixed and related to local preferences for particular sweetpotato types. In Kamuli where farmers and consumers traditionally prefer white sweetpotato, acceptance of the "orange" was relatively low. Kamuli is also the study area with the highest per capita consumption of sweetpotato and relatively high prevalence of vitamin A deficiency. Consumers in Mbale prefer deep yellow sweetpotato varieties and therefore found it easier to accept the "orange". This echoes findings from Kenya in respect to acceptance of biofortified cassava. The study noted that while the orange colour was found to be more attractive, especially among children and explained its acceptability, populations who frequently consumed cassava (white) were likely to be more reluctant in accepting the orange pro-vitamin A fortified one (Talsma, *et al.* 2013). Studies on acceptability of orange maize in East and Southern Africa (FAO and CIMMYT, 1997; Stevens & Winter-Nelson, 2008; Meenakshi *et al.* 2010) demonstrate that it is not as acceptable as white maize due to its colour and association with food aid. Fortunately, OFSP in particular and sweetpotato in general has no association with food aid. In examining the trade-offs between different characteristics of biofortified cassava and willingness-to-pay, Gonzalez *et al* (undated) report that while consumers were willing to pay a large premium of 160% for vitamin A, a -29% discount was required for them to shift from white to yellow cassava varieties and an additional -61% for the fact that the varieties under investigation were genetically modified. In conclusion, among consumers who traditionally prefer white sweetpotato types, the orange colour of OFSP acted as a disincentive towards its acceptability. In contrast, consumers with a strong preference for deep yellow sweetpotato types easily associated with the "orange" in OFSP. Children were particularly attracted to consume OFSP by its orange colour.

Acceptability and likelihood of repeat purchase of OFSP in particular, and sweetpotato in general, were found to be dependent on root appearance. Root appearance was judged by skin colour, root shape and size. OFSP varieties with skin colour and shape similar to the preferred non-OFSP types were more acceptable. Interestingly, low fibre content and hard texture, were among the reasons that influenced the decision of some consumers to purchase OFSP. This contrasts earlier work that identified these attributes as negative drivers of OFSP consumption, but may be explained by the fact that different OFSP varieties score differently in respect to these attributes. Overall, OFSP varieties that scored favourably in these attributes were more acceptable to consumers. This signals the need to identify consumer preferred, but variety specific characteristics of OFSP, for promotion in particular market segments along the value chain.

7.4.2 Price of OFSP

Price was identified as the most important consideration by consumers in their purchase decisions of a starchy staple crop. That is, consumers tend to purchase a staple crop whose price is lower. The consumer survey in Kampala markets also revealed that the likelihood of repeat purchase of OFSP was dependent, among others, on the price paid by the consumer. Thus, consumers who had purchased OFSP at a lower price were more likely to purchase it again, while those who had paid the highest price for it were unlikely to purchase it again. One of the key findings in the previous chapter is that, in spite of being new in the market and its nutritional benefits, the price of OFSP was similar to the price of YFSP and WFSP in all the markets investigated. Using a choice experiment, Chowdhury *et al*. (2009), also conclude that OFSP varieties are likely to compete with the local varieties in the market as there is unlikely to be a significant price discount. However, provision of information on benefits of OFSP consumption to human nutrition affects this as consumers become more willing to pay a premium, with higher premiums for the deeper orange varieties; the deep orange ones having more beta-carotene. In North East Brazil where both VAD and knowledge of vitamin A is high, consumers were willing to pay an average price premium of 64% for GM biofortified cassava (Gonzalez, *et al.* undated). However, considering that sweetpotato in Uganda is purchased and consumed by low to medium income earners, and nutritional value is not an important consideration in the purchase decisions of consumers, it is unlikely that most consumers will be willing to purchase OFSP at a premium

price in the real trading environment. Moreover, as per capita food expenditure and income increase among urban consumers, the share allocated to sweetpotato decreases (Oburu, 2006).

7.4.3 Availability

The most important determinant of consumer purchase of sweetpotato, irrespective of the type, was availability. Although availability was not as important a factor in the purchase of OFSP compared to YFSP and WFSP, lack of OFSP in the markets was identified as the most important factor limiting its purchase and consumption. Increasing availability of OFSP was recognised as the most important intervention in promoting future purchase and consumption of OFSP. Availability had an impact on awareness of the nutritional value of OFSP and subsequently consumption. In Mbale and Mukono, where OFSP was relatively more available, more consumers were aware of it and had consumed it. In contrast, in Kamuli, where OFSP was least available, level of awareness of its nutritional value were low, fewer consumers had eaten it before, and many consumers found the taste of OFSP to be worse than the taste of WFSP.

7.5 Chapter summary

Prior to this work, little was known about factors that influence acceptability and repeat purchase of OFSP by urban consumers. To fill this gap, two surveys were undertaken in urban markets of Uganda. Results revealed that women were the main purchasers' of sweetpotato for home consumption. They were the ones who also decided on the particular type of sweetpotato to be purchased. The main reasons for purchasing a particular staple were price, preference by children, being a traditional staple and ease of preparation. These reasons differed significantly across the three districts.

The main factors that influenced acceptability and repeat purchase were availability, characteristics of OFSP and price. With regard to sweetpotato types, YFSP was both the most available and only type available in all the markets. It was therefore the most commonly consumed. Although most of the consumers were aware of OFSP, it was available only in Mbale, while WFSP was available in Kamuli and Mukono only.

Lack of OFSP in the markets was identified as the key factor limiting its purchase and consumption. Where OFSP was more available, awareness of its nutritional value was also high, which had knock-on effects on consumption.

Orange colour, root appearance, size and sweet taste were the key attributes of OFSP which had implications for purchase and consumption. The orange colour was a key distinguishing feature and helped brand OFSP as a unique sweetpotato type. In places where YFSP varieties were preferred, OFSP easily built on this. Sweet taste was an important consideration for both purchase of sweetpotato compared to other staples and in the purchase of any sweetpotato type.

Another important attribute was root appearance, as judged by skin colour, root shape and perceptions towards taste and texture after cooking. Acceptability tended to be higher for OFSP varieties with root appearance similar to that of the preferred local varieties. In areas and among consumers with high levels of awareness of nutritional benefits of OFSP, repeat purchase and acceptability of OFSP were likely to be higher.

Comparing the three districts, there was a high preference for white sweetpotato types in Kamuli compared to Mbale and Mukono. Similarly, more consumers in Kamuli expressed a dislike in OFSP; the knowledge of OFSP, and particularly its nutritional benefits was equally low in Kamuli; and overall, OFSP was less available and therefore less purchased in Kamuli compared to Mbale and Mukono. Yet Kamuli is the district with both the highest per capita consumption os sweetpotato and the highest VAD prevalence rates among the study areas.

In spite of nutritional value and being new, the price of OFSP was similar to the price of YFSP and WFSP in the same market, though across markets prices were significantly higher in Mukono. Price was an important factor in current and future purchase decisions among consumers. Figure 7.4 presents a summary of the key factors that determine acceptability and repeat purchase of OFSP by consumers.

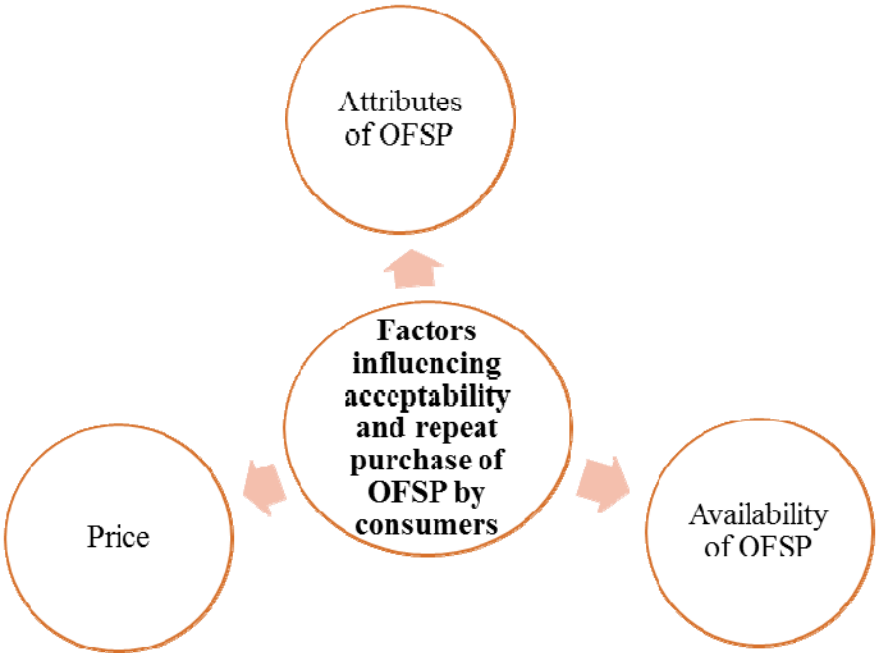

Figure 7.4: Factors determining acceptability and likelihood of repeat purchase of OFSP by consumers

Chapter Eight: Presentation and Discussion of Findings on the Role of Marketing in Crop Biofortification

8.1 Introduction

This chapter addresses the last research objective: to assess the role of marketing in a biofortification intervention. The research question that it seeks to answer is: does marketing have a role in a biofortification project intervention? It builds on results presented in Chapters 5 to 7 of this thesis to present a case for a marketing component in a biofortification intervention. This appears to be the first time that a study has been conducted and the results reported on the role of marketing in a biofortification intervention.

8.2 Role of marketing in biofortification

To reiterate, biofortification is the development and management of nutrient rich staple crops through either conventional breeding, modern biotechnology or agronomic practices for the purposes of correcting an identified deficiency in micronutrients.

Six roles of a marketing component in a biofortification project have been identified by this research. These are, i) increasing awareness of, and demand along the value chain; ii) increasing availability along the value chain; iii) encouraging farm-level uptake and adoption; iv) changing the perception and role of the crop; v) exploring alternative uses for the crop and vi) stimulating rural entrepreneurship and trading. Each of these roles is analysed below.

8.2.1 Increasing awareness and demand along the value chain

OFSP is a relatively new crop in Uganda, which is rarely traded in significant quantities and, at times, mixed with the preferred WFSP or YFSP as a way of selling it. Initial experiences among traders and consumers were rather mixed, with a majority (particularly at the on-set of the project) professing strong dislike for OFSP. In Mukono district, as a case in point, traders initially reported that they would not trade in OFSP because their customers did not like it.

However, children in particular, and the educated demonstrated strong preference for OFSP and often specifically sought out for it in the market (Coote *et al.* 2007). Strong preference by children and the educated is reported by other studies as well (Low *et al.* 2007; Tumwegamire *et al*. 2007). Furthermore, OFSP, as already described has a visible orange colour, which clearly distinguishes it from other sweetpotato types. This visible colour trait can potentially be of benefit to marketing as it enhances discernibility. It can also be a deterrent, especially among customers who do not like it since it makes it easily identifiable. Insights from the trader survey (Chapter 6) and the consumer survey (Chapter 7) attest to the fact that increasing awareness of the benefits of OFSP along the value chain is one of the key ways of increasing its consumption.

Awareness can be increased through exposure, and research on acceptance shows that increasing exposure increases acceptance. Repeated exposure to foods, particularly for children has been reported to increase liking (Wardle *et al.* 2003). In adults, acceptance of a bitter beverage increased after repeated exposure (Stein *et al.* 2003). In a review of the importance of healthy eating in childhood, it was concluded that children like what they know and they eat what they like. From the very earliest age, children's experiences with food influences both preferences and intake, and research suggests that the earlier and broader that experience, the healthier the child's diet (Cooke, 2007). Therefore, it is likely that repeated exposure of the OFSP to both children and adults may increase preference, particularly for the 'orange-dislikers'.

Under such circumstances, one of the pivotal roles of marketing in a biofortification intervention, therefore, is to promote awareness of, and demand for the crop especially among traders and consumers. So, while other components have a role to play in raising awareness at the immediate target group level (household), the marketing component extends beyond the household to the entire value chain.

Awareness may be raised through training traders and consumers on the benefits of a biofortified crop coupled with dispelling some of the myths that are often labelled on new products. Another area is developing linkages between traders and farmers so as to synchronize production and supply. Other promotional events such as test marketing and use of media could be explored. The importance of promoting awareness is further given weight by results of the trader and consumer surveys (chapter 6 and 7 of this thesis), which both argued that raising awareness of

the health, nutrition and income benefits of OFSP was one of the key ways of promoting its marketing and consumption. Similarly, awareness creation had an impact of positioning OFSP as a tradable commodity. Thus, at the time of the trader survey, OFSP was traded separately because it was now a distinct sweetpotato type with known nutritional benefits.

Raising awareness of nutrition benefits has been proved to influence consumer acceptance and purchasing behaviour in adults (Cranage *et al.* 2004) and school children (Conklin *et al.* 2005). Other research has indicated that when nutrition information was displayed, customers rated the food quality significantly higher, were more likely to choose the healthier food and had significantly higher intentions to repeat purchase than when no nutrition information was supplied. The effect of displaying nutrition information also seemed to influence food choices for other dishes, which also tended to be healthier choices. Nutrition messages influenced consumer preference of biofortified sweetpotato (orange fleshed sweetpotato) in Uganda (Chowdhury *et al.* 2009). Methods of delivering nutrition information can vary significantly in cost and how many people they reach. The use of community leaders (interpersonal contact) to deliver a message is the most effective (Zimicki, 1997) and the advantage is that delivery can be controlled. However, this method is also expensive because the leaders have to be trained and paid to deliver the message. The delivery of a nutrition message by radio, however, would be less costly, but there is less control over who will hear the message. In Zambia, it is estimated that there are 1.9 million radios (Taylor, 2006) of which around 30% are in rural areas (Zimicki, 1997). Work commissioned by the REU project on radio listenership in Uganda reported overall radio listenership in Uganda at 82%, with 98% listenership in Nakasongola; 61% in Kumi; and 88% in Kamuli[23]. In the USA, the use of radio (mass media) has increased the sales of low fat milk and sustained this over a six month period (Reger *et al.* 1999) suggesting that a mass media approach might also be effective at reaching rural communities in sub-Saharan Africa.

However, the key challenge in raising awareness of the nutritional value as an approach to marketing is that nutrients are often "credence characteristics". That is, they are unobservable to the purchasers and consumers of food even after consumption (Anim-Somuah *et al.* 2013), and with the exception of foods used for treatment of acute malnutrition, the positive effects of the

[23]Nakasongola and Kumi were among the first districts identified for the REU project to work in, but were later replaced by Bukedea and Mukono

food are not evident in the short-term or even easily attributable to the food. Therefore, in the absence of proper regulation or enforcement mechanisms in the food markets, there is a clear scope for miselling; and in many such contexts, a tendency for falsely differentiated products to drive out genuine products (Akerlof, 1970).

8.2.2 Increasing availability along the value chain

Results from the trader survey (chapter 6) revealed that availability was the most important determinant of the type of sweetpotato sold by traders. Traders sold more YFSP and WFSP relative to OFSP because they were more available. Similarly, availability was the most important consideration by consumers while purchasing sweetpotato (chapter 7). As was the case with traders, availability was a more important factor in consumer decision to purchase WFSP and YFSP compared to OFSP. Finally, availability, or lack of, was one of the key reasons why consumers never purchased OFSP. This underscores the importance of improving availability as a way of promoting consumption of OFSP.

To be relevant, therefore, marketing should work towards increasing availability and visibility of OFSP along the value chain. Marketing is particularly important in increasing availability of nutrient-rich foods to households that derive some or all of their food requirements from the market. These include producing households that are not self-sufficient in food for some or a considerable part of the year, rural non-farm and landless households and urban households, specifically the urban poor who in some cases may be poorer than the rural poor (Henson *et al.* 2013). Hawkes and Ruel (2011) observe that for a nutritious food to be successfully marketed especially to the poor it must be available in a location physically accessible and socially acceptable especially to the purchasers and or consumers. They contend that targeting informal markets as opposed to supermarkets and other commercial outlets could be a successful strategy for marketing nutritious food to the poor. Availability of a biofortified crop can be constrained by farm-level challenges such as access to clean planting materials, lack of capital, poor weather, and pest and disease outbreak. Other related constraints may be a mismatch between production (when the crop is ready for sale) and demand in the market or producing varieties that are not appreciated by a particular market segment. While the first set of obstacles may best be addressed by seed systems interventions, the second set can be addressed by providing relevant information on variety preferences, as well as supply and demand trends for competing staples.

This information if accurate and timely could support farm-level decision making and ultimately increase availability.

However, the real challenge in including a marketing component in a biofortification project is that increased production resulting from better market opportunities may not necessarily translate into increased consumption (and therefore nutritional benefits) especially by the producing household. This is particularly the case when or if most of what is produced is sold. Experiences from the USAID IYCN's project are worth reflecting:

> *"Agricultural projects are often justified on the grounds that the food produced will accomplish some combination of improving household food security and improving nutrition. Rarely, however, do agricultural projects actually measure these effects. In fact, even in retrospect, it is not always clear whether a given project had a positive or negative effect on food security and nutrition levels of food-insecure households and undernourished individuals": (IYCN 2011a: 12).*

In addition, there may be variable gender impacts on nutrition within the household, for example on men as opposed to women and infants. In fact, it is not unknown for agricultural interventions to promote market orientation to the extent that consumption by producer households declines *(IYCN 2011b: 2).*This is further compounded by the fact that most crop marketing decisions, processes are controlled by men, whose priority expenditure areas may not necessarily be nutrition focussed.

8.2.3 Increasing uptake and adoption

There appears to be a two-way link between market integration and technology adoption. Increased market integration may facilitate adoption of new technology and increase yield for small producers, but it may also be that higher yields, that often result from adoption of new innovations, results in increased market integration (Asfaw *et al.* 2010). Markets influence technology adoption patterns by affecting the returns to increased output. However, since biofortified crops are promoted for their nutritional value, not yield superiority *per se*, it is more likely that it is increased market integration that will facilitate technology adoption. As reported in chapter 5, farmers who produced for the market planted at least one crop more than those planting solely for home consumption. In Bukedea, the district where the largest volume of OFSP sales was recorded, farmers who planted OFSP with the intention to sell, had planted up to

five crops between project inception in August 2007 and December 2008. Farmers, who planted for home consumption only, in the same district, planted a maximum of three crops within the same period (two crops per year)**.** Therefore, OFSP was available for home consumption among households that had sold for most of 2008. However, there were months where OFSP from farmers' own gardens was not available among households that had not sold OFSP. In these months they had to either rely on farmers who had sold for OFSP or substitute it with non-OFSP or other food staples. Besides year-round availability, the actual acreage of the OFSP gardens increased among producers who had sold. The opportunity to market provided an incentive to the farmers to invest in extra resources such as oxen for ploughing, valley bottoms for an off-season crop and vine propagation. In contrast, farmers who were planting OFSP for home consumption often cited lack of these resources as the main factors inhibiting area expansion and subsequently their ability to have a marketable quantity of OFSP.

Consistent with results of studies on the role of commercialisation in the adoption and uptake of staple crops (CIP, 2006), marketing can promote increased uptake and adoption of a biofortified staple crop. Other studies also confirmed that lack of consistent markets for roots is one of the major constraints to farmer uptake of OFSP (Yaggen and Nagujja, 2006). Much as market development is essential for sustained uptake and adoption, most studies and interventions on OFSP rarely include it or if they do, it is not given the attention that other components such as seed systems and behaviour change receive (Low *et al*. 2007). This work has further demonstrated that rather than increase the amount of OFSP for sale, as most marketing interventions result in, the marketing component also increased availability of OFSP for home consumption. In all the three districts, there was an increase in the availability of OFSP for home consumption among farmers who produced it for the market. This is partly because sweetpotato can be harvested piece-meal and, with the exception of rotten roots, those rejected by the market due to poor root shape and size can still be consumed by the producing household.

However, the demand for most agricultural products tends to be inelastic. Technology adoption tends to shift the supply curve outwards which often results in a fall in prices. When this scenario occurs, markets can lead to disadoption of a new technology or biofortified crop, since the low returns may serve as a disincentive for further uptake. As explained by adoption theory, early adopters may benefit, at least temporarily, while late adopters and non-adopters may never

benefit or even suffer welfare losses due to adoption and diffusion of the new technology (Rogers, 2003; Barrett, 2008).

8.2.4 Changing the perception and role of the crop

Biofortification is targeted at staple crops, which may include cereals, pulses as well as roots and roots. Staple crops are eaten regularly and constitute the main part of diets, especially in the developing world. Most of them are readily available, inexpensive and some are considered low-value crops. Therefore, the first role that marketing can play in a biofortification intervention is to change the perception of the actors in the value chain towards the staple crop and the role of the crop in the food and farming system.

Traditionally, staple crops in general and sweetpotato in particular, are regarded as a source of carbohydrates rather than essential micronutrients. Therefore, a possible role of marketing is to change the perception of a biofortified crop along the value chain so that its nutritional value is appreciated and becomes a sought-after attribute. This is particularly important in biofortified crops where the trait is visible. In the case of the REU project, raising awareness of the nutritional benefits of OFSP was an integral part of the marketing strategy. Marketing training, for example, started with a module that addressed the nutritional value of OFSP. This explains why vitamin A was one of the key attributes that producers, consumers and traders used for distinguishing OFSP from the other sweetpotato types. Marketing influenced a change in the perception and role of sweetpotato in general and OFSP in particular in a number of ways.

In Bukedea, sweetpotato was a minor staple crop at the onset of the project. The Three Year District Development Plan (2009-2011), identified cassava, beans, cotton and groundnuts as the main crops grown in the district (BDDP, 2008). Similarly, the main food crops identified during the qualitative investigation (see chapter 5) were cassava, maize and OFSP. However, favourable marketing prospects for vines initially and then roots transformed OFSP into one of the leading cash crops, replacing cotton, maize and rice as a cash crop and competing with cassava to become one of the leading staple food crops. As reported in chapter 5, OFSP was identified as the most important cash crop followed by cassava and maize. Cotton, the traditional cash crop, was not among the top three cash crops. In terms of resource allocation, maize and

cassava would have been planted on the land allocated to OFSP, had it not been introduced. Few farmers reported that they would have planted sweetpotato on the land allocated to OFSP.

The implication of this change in the role and perception towards OFSP in Bukedea is that increased adoption of OFSP will depend on profitability of OFSP compared to other crops. Therefore, there is a possibility that if OFSP becomes less profitable, farmers will opt for more profitable crops in its place. Under such areas, marketing could, among other things, explore options of improving the returns to, and profitability of, OFSP in order to promote sustainable uptake. This could be done through exploring alternative market outlets or marketing options, including off-season production and enterprise combination options.

In Kamuli, interviews with the producers (chapter 5) identified sweetpotato and WFSP in particular as the most important food crop. Furthermore, the introduction of OFSP changed the mind-set of the farmers, especially the women, that sweetpotato, particularly OFSP, can be sold. In Kamuli, women who had sold OFSP were more likely to take on OFSP as a cash crop compared to the traditionally male-dominated cash crops such as coffee, sugarcane and maize, since they were likely to have more control over the production resources and proceeds from its sale. Due to strong preference of WFSP, farmers were more willing to plant more OFSP for sale and reserve WFSP for home consumption. Therefore, the marketing component occasioned a change in the mind-set of farmers that sweetpotato in general, and OFSP in particular, can be sold. In such a context, the marketing intervention could emphasize the health benefits of OFSP in a bid to influence household consumption patterns in favour of OFSP.

In Mukono, sweetpotato used to be a minor crop. In the baseline survey report of Mukono district commissioned by the NAADS programme in 2002, sweetpotato were not among the key priority crops in the district (DCI and NAADS, 2002). However, devastation of bananas, the staple food crop, by the banana bacterial wilt and declining soil fertility, led to the emergence of sweetpotato as a key food crop. Some farmers seized that opportunity to make money from OFSP sales. Given the previous experience on how new enterprises have been taken up due to promising market opportunities and dropped soon after due to poor marketing experiences, uptake of OFSP as a cash crop will depend on how profitable it proves to be. Uptake as a food crop will depend on how well and soon bananas recover from the effects of the BBW as well as

the impact of the current rising food prices on the price of bananas relative to sweetpotato. Furthermore, insights from acceptance studies suggest that repeated exposure to foods increases acceptance (Stein *et al*. 2003). Among children, exposure leads to liking (Wardle *et al.* 2003). As reported in chapter 6, the main reason for purchasing, and by extension consuming, a given staple was that children like it. Therefore, as consumers get more used to OFSP, bananas continue to succumb to BBW and OFSP performs better under marginal conditions, OFSP is more likely to be adopted as a food crop. Marketing, therefore, could focus more on promoting the crop as an alternative to the preferred staple, building on its nutritional benefits and strong preference that children have demonstrated for it.

8.2.5 Exploring alternative uses for the crop

Another role for marketing is to explore alternative uses and benefits that can be derived from the biofortified crop, which can provide additional incentives for uptake. For example, an ex-ante assessment of the adoption of dual purpose (feed and food) sweetpotato varieties in Western Kenya reported high adoption rates compared to sweetpotato grown either for feed or food alone (Claessens *et al.* 2009). Another potential benefit, as occurred during the REU project was opportunity to produce OFSP vines for sale as clean planting material. At the start of the project, vines were not known by farmers as a tradable commodity. However, during the course of the project, semi-commercial production of vines emerged into a viable enterprise. Vine multiplication records from SOSPA indicate that from an acre of a dual purpose (grown for roots and vines) OFSP crop, a farmer could harvest about 120 sacks of vines within four months. Each sack of vines was purchased at UGX 8,000, yielding a gross return of UGX 960,000, which is higher than UGX 750,000 gross returns from the sale of an acre worth of OFSP roots. Returns from vine sales influenced the decision of producers to plant more OFSP, resulting in more roots available for home consumption and sale.

Other potential benefits from a biofortified crop, which could be explored, include avenues for commercial utilization and value addition through product development. Besides financial benefits, value addition increases shelf-life and may promote year-round availability. Studies in Mozambique have demonstrated the potential role that OFSP pulp can play as a partial substitute for wheat flour in the manufacture of bread. A cost-benefit analysis of sweetpotato based on-farm enterprises promoted by the Coalition Project in Uganda (2003-2005) reported that

commercial production of roots, vines, storage technologies, snacks and flour were viable enterprises, and provided additional incentives for uptake (Lemaga, 2005). In contrast, results from the market diagnostic component of this project revealed that semi-commercial processing of OFSP flour, at household level, for commercial use was not a viable enterprise. Marketing therefore, should conduct comprehensive financial and economic analysis of alternative enterprises or enterprise combinations in order to generate robust data that can support decision-making on enterprise selection along the value chain. This may necessitate innovative and alternative forms of production, processing and marketing models. As, Henson & Humphrey (2013) caution, the incentive for value chain actors to create this value will depend on their ability to capture a sufficient part of its worth, yet the real success factor will be in the ability of the consumers to purchase the product created.

8.2.6 Stimulating rural entrepreneurship

Another important role for marketing in a biofortification project could be in stimulating the development of rural agro-entrepreneurs or facilitating the integration of entrepreneurial skills and practices into small-scale farming. This can be done through training farmers, as was the case in this intervention, on aspects of marketing such as farming as a business, market chains and the need to support and encourage linkages along the VC. Training in farming as a business was particularly useful as it not only helped in record keeping but also in subsequent decision-making regarding production and marketing. Other important aspects include the need to synchronize production calendars with the marketing seasons; encouraging farmers to incur costs and risks associated with production of off-season crops, targeting supply of OFSP to the markets during periods of scarcity. Evidence of the entrepreneurial acumen that resulted from the introduction of OFSP can be seen in the emergence of bicycle traders as one of the key drivers of OFSP marketing, linking small-scale and often dispersed producers to the small but important markets in the urban and peri-urban areas. Similarly, the MLF emerged as an important marketing institution providing a brokerage function, which at times included guaranteeing credit transactions, between farmers and traders.

Training may include testing alternative marketing models for linking small-scale farmers to remunerative markets. Options that seem to have worked, and could be adapted include the agro-territorial approach promoted by CIAT (Lundy *et al.* 2000; Kaganzi *et al.* 2009); the

Participatory Market Chain Approach (Bernet *et al.* 2006); and contract farming schemes such as the one between Nile Breweries Ltd in Uganda and sorghum farmers for the supply of *Epuripur* variety of sorghum for brewing (Elepu and Nalukenge, 2009).

8.3. Chapter summary

This chapter addressed the last research objective of this thesis: to assess the role of marketing in a biofortification intervention. It answered the question: does marketing have a role in a crop biofortification intervention. At least six roles have been identified, which are summarised in Figure 8.1.

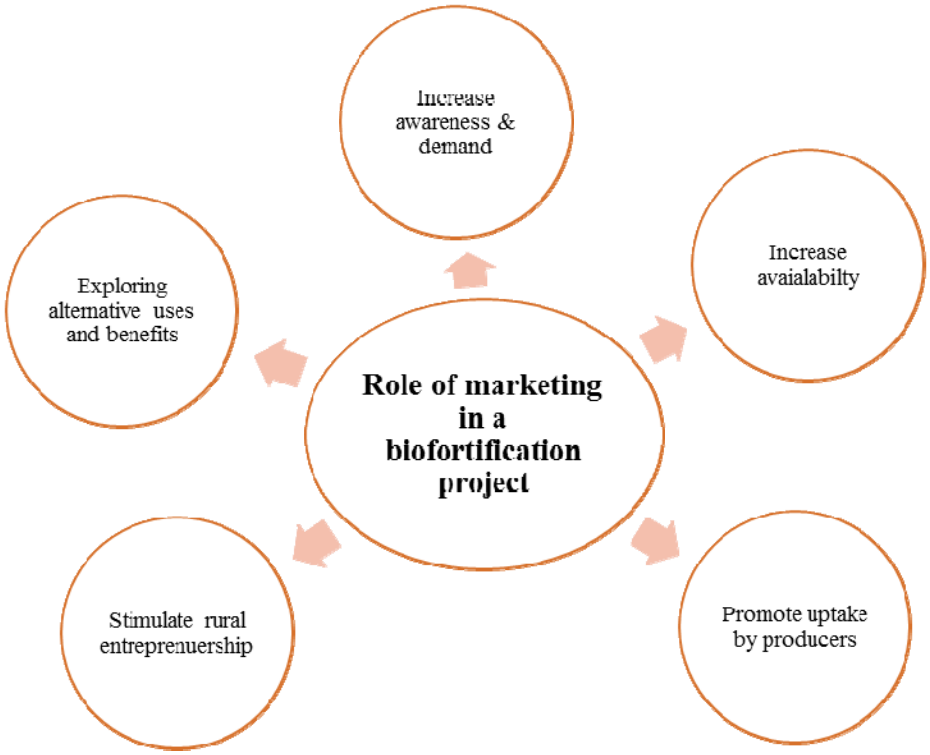

Figure 8.1: The six possible roles of marketing in a crop biofortifiction intervention

However, these roles should not be taken as a one-size fits-it –all, but instead tailored to respond to the local context particularly the nature of the crop (perishable, hard grain, high value etc.), type of food value chain (level of development, key actors, etc.), capacity and approach of implementing partners and the policy and institutional context.

Chapter Nine: Conclusions, Recommendations and Areas for Further Work

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This last chapter synthesizes the main conclusions from the study; recommendations for subsequent biofortification interventions that integrate marketing; and suggests areas for further work. It is divided into four main parts. Part one (9.1) presents the key conclusions; the key recommendations for future researchers, practitioners and policy makers are outlined in part two (9.2). In part 9.3, a framework for integrating a marketing strategy in a biofortifed crop is presented. The last part of this chapter (9.4) suggests areas that merit further investigation.

9.1 Conclusions

9.1.1 Introduction

This thesis investigated the factors influencing the decision of producers and traders to sell OFSP; consumers to purchase it; and the role of a marketing component in a biofortification project. It sought to systematically understand the nature and drivers of decision making with respect to production, marketing and consumption of OFSP. The objectives of this study were to, i) examine the factors that influence the decision by producers to plant OFSP for sale, ii) explore the factors that influence traders' decisions to sell OFSP either alongside or in place of other food staples, iii) evaluate factors that influence the decision of consumers to purchase and consume OFSP, and iv) assess the role of marketing in a biofortification intervention. This study was part of the HarvestPlus Reaching End-Users with biofortified crops research and development project that was piloting integrated mechanisms for promoting OFSP as a means of combating VAD in Uganda and Mozambique.

Data and information were collected from August 2008 to March 2009, using both qualitative and quantitative approaches. The study employed a value chain approach, in which data and

information were collected from producers, traders and consumers. The concepts that informed this research were drawn from the value chain and adoption decision theory.

This conclusion sub-section is divided into three parts. The first two present conclusions from the two themes that are at the core of this thesis: factors influencing producers and traders to sell OFSP, and consumers to purchase it; and the role of marketing in a biofortification intervention. The last section discusses conclusions that contribute to the theoretical framework.

9.1.2 Conclusions relating to factors influencing the decision to market OFSP

Prior to this work, there was a dearth of information and knowledge on the factors that influence the decision of producers and traders to sell OFSP, and consumers to purchase it. This thesis has demonstrated that the factors that influence uptake of OFSP along the VC can be divided into two: the generic factors that can apply to any crop or agricultural enterprise, and factors that are more specific to a biofortified crop such as OFSP. The generic factors include access to and use of productive resources, previous experience in marketing other crops, and the importance of sweetpotato.

Considering the generic factors, access to, and use of productive resources played a key role in influencing the decision of producers to plant OFSP for sale. The productive resources, whose access to have a bearing on farmers' ability to produce OFSP for the market, include land, valley bottoms, OFSP vines and oxen for ploughing. However, there was a two-way relationship between access to resources and production of OFSP for sale. Farmers with favourable access to these resources produced OFSP for sale, but it was only farmers who sold or had the intention of producing for sale who invested in renting in extra resources for OFSP production. The valley bottoms were often allocated to crops that were more profitable. Therefore, in places where OFSP was considered to be more profitable, as was the case in Bukedea and parts of Kamuli, it was planted on the valley bottoms. In other parts of Kamuli, valley bottoms were reserved for grazing animals and growing other crops such as maize, sugarcane and vegetables that were regarded to be more profitable than OFSP. Other resources were also important, particularly oxen in Bukedea, that enabled timely opening up of larger pieces of land for OFSP, making it possible for farmers to produce a marketable surplus.

The traders differed in terms of their involvement in OFSP trade. Whereas farmers with favourable access to productive resources (land, oxen etc.) tended to grow OFSP for sale, traders with greater access to resources tended to be less actively involved in OFSP trade. Instead, it was the poorer bicycle traders and farmer traders who were more involved in OFSP trade. The relatively low marketable output of OFSP (small and inconsistent supplies) compared to non-OFSP, coupled with the localised production patterns could have served as a disincentive towards the involvement of the bigger and better resourced traders, particularly the wholesalers, in OFSP trade. Proximity to production areas and ownership of a bicycle were other critical factors. Ownership or access to a bicycle helped reduce the high transport costs associated with staple crop marketing, besides guaranteeing timely delivery of OFSP.

This study did not establish whether it is the wealthier consumers who tended to purchase OFSP compared to the poorer consumers. However, previous studies on consumption patterns of OFSP in the urban areas of Kampala and Soroti revealed that an increase in income among OFSP consumers resulted in a decrease in the purchase of OFSP. This suggests that OFSP is more likely to be purchased and consumed by the poor but knowledgeable consumers.

Previous experience in marketing other crops was another important factor that influenced the decision of producers to plant OFSP for sale. All the producers who sold OFSP had been involved in selling other crops as well. Producers who engaged in commercial production of other crops were more likely to take up OFSP as a marketable crop since their production and resource allocation decisions were always taken in light of the market opportunities. In Bukedea, producers who had been growing crops such as cotton and rice for sale, found it easy to take up OFSP as a commercial enterprise even though they had not been growing sweetpotato before. They were able to transfer some core skills into OFSP production and marketing. In Kamuli and Mukono, producers who had been previously selling sweetpotato used the same market outlets for selling OFSP as well. In all cases continued uptake of OFSP for sale, would, in part depend on the price and marketing opportunities of these other competing crops relative to OFSP. Thus, there is a possibility that, should more remunerative enterprises emerge or should OFSP become unprofitable, it will be substituted with the more profitable crop enterprise (s).

Among the traders, and particularly the retailers, another important factor in their decision making process was the importance attached to sweetpotato as a tradable commodity. All retailers interviewed considered sweetpotato as the most important staple crop that they trade in. Traders who were already involved in sweetpotato trade found it easier to add OFSP to their portfolio of commodities since most of the challenges and opportunities associated with marketing sweetpotato are likely to apply to OFSP as well. This is in contrast with rural-based traders (farmer traders and bicycle traders) who opted to start selling OFSP even though most of them had no previous experience in selling sweetpotato. Similarly wholesalers, in spite of their experience with sweetpotato, were not involved in OFSP trade. However, the high importance attached to sweetpotato among the retailers could be a sampling bias since being a sweetpotato trader was a key criterion in selecting retailers who were interviewed.

Comparing the importance of potato among the producers across the districts provides further insights and raises questions. In Bukedea, sweetpotato were not among the top three priority food crops at the onset of the project, but it was the district where the greatest quantity of OFSP was sold, about 93% of the recorded OFSP sold. Conversely, Kamuli where sweetpotato was already a key staple crop is the district that recorded the lowest sales volume and uptake of OFSP. It is not entirely clear whether it is the importance (or low importance) that explains this trend or it is the district that is a key factor. It is thought that in Bukedea, other factors such as bigger land sizes, access to and use of valley bottoms, vine sales and proximity to Mbale could have also contributed to increased OFSP sales among the producers.

Turning to the factors that are specific to OFSP, the REU project played a pivotal role in influencing uptake of OFSP as a tradable commodity along the entire VC. OFSP was introduced to Bukedea, Kamuli, Mukono and Mbale by the REU project. About 45% of the traders first learnt about OFSP from the REU project, with more traders in the more rural Kamuli (67%) first learning about OFSP from the project. The marketing component of the REU project aimed at developing sustainable supply links between farmers, traders and consumers in rural and urban markets and within and outside the project areas. It raised awareness of the nutritional benefits of OFSP among market intermediaries and consumers and promoted better trading practices aimed at developing the OFSP "brand". There were differences between the districts. In Kamuli where sweetpotato (WFSP) was produced mainly for home consumption, there was a change in the

mind-set of farmers to the effect that sweetpotato in general and OFSP in particular can be a tradable crop. In Bukedea, the profile of sweetpotato evolved from a minor crop to the most important cash crop among the producers, as exemplified by the high sales of OFSP.

The agronomic, sensory and visual attributes of OFSP influenced the decision to market it. Under favourable agronomic conditions OFSP performed well and in most cases better than the local varieties. Where these conditions pertained, farmers harvested adequate quantities of good (marketable) quality OFSP roots. Where such conditions were favourable, farmers substituted non-OFSP with OFSP as a means of addressing the twin objectives of meeting household food self-sufficiency and generating an income. However, in Kamuli and Mukono where the soils were poor and episodes of increasing weather variability and unpredictability were recorded, the yield of OFSP was reported to be worse than that of non-OFSP, resulting in lack of adequate quantity and quality of marketable OFSP roots. Farmers also reported that once OFSP roots mature, they do not store as long as most non-OFSP varieties in the ground and therefore not suitable for piece-meal harvesting. Farmers who experienced this scenario opted to sell OFSP once mature and retain non-OFSP for home consumption. Therefore, a poor agronomic trait turned out to be a positive influence from a marketing perspective. This finding opens up a possible new area of research for agronomists and plant breeders.

Regarding sensory attributes, sweet taste has been identified as a key factor in the uptake of a sweetpotato variety along the value chain. It was one of the most important considerations by consumers in purchasing sweetpotato compared to the other starchy staples (such as cassava, posho, rice and potato). Sweet taste is also the second most important consideration, after yield, in farmer evaluation and uptake of a sweetpotato variety. Among traders, it is the third most important factor in influencing trader decision to start selling a particular sweetpotato type. Sweet taste was both a key factor determining acceptability of OFSP among urban consumers and one of the attributes used for distinguishing OFSP from the other sweetpotato types.

Children in particular professed a strong preference for OFSP due to its sweet taste and colour and it was one of the key reasons why some farmers retained OFSP for home consumption. Similarly, strong preference of OFSP by children was one of the key reasons that some consumers purchased it. However, among some adults, the taste of OFSP was not as acceptable

as non-OFSP. This was particularly the case in Kamuli, where traditionally preferred sweetpotato types are the WFSP, accounting for about 62% of the sweetpotato types sold in the markets. Here, there was a tendency to reserve WFSP for home consumption and to sell most of the OFSP. Therefore "poor" taste was a key factor influencing marketing of OFSP among certain population segments.

Visual attributes such as root appearance, as judged by skin colour, root shape and perceptions towards taste and texture upon cooking were key determinants of acceptability of OFSP by consumers. Acceptability tended to be higher for OFSP varieties with root appearance similar to that of the preferred non-OFSP varieties. Perhaps the most important visual trait was the orange colour, which helped brand OFSP as a unique sweetpotato type. Traders (34%) identified orange colour as the most important attribute that they used for distinguishing OFSP from other sweetpotato types, while one-third of the consumers considered orange colour to be the main factor that motivated them to eat OFSP. In places where YFSP varieties were preferred, OFSP easily built on this preference and was easily accepted. In conclusion, perception towards the visual, sensory and agronomic attributes tended to differ from one OFSP variety to another. It also tended to differ across locations, even among farmer categories within the same location and duration of exposure to OFSP.

Another important factor driving the marketing of OFSP was awareness of its nutritional benefits to human health, particularly that it contained pro-vitamin A. Consumers who were aware of pro-vitamin A in OFSP purchased it and, 55% of the consumers considered this as the most important attribute in driving future consumption of OFSP. Consumers who were aware that OFSP contains pro-vitamin A were more likely to purchase it in future. They were also more willing to pay a higher price for it. Among traders, where levels of awareness of pro-vitamin A as an attribute of OFSP were high, as was the case in Bukedea and Mbale, more trade in OFSP was also reported. Farmers in all the three districts reported that the pro-vitamin A benefits of OFSP was the most important factor that explained its uptake.

NGOs promoting OFSP in Uganda provided the unanticipated opportunity for farmers to produce and sell OFSP vines, particularly in Bukedea. This led to uptake of OFSP, which in turn influenced the decision to sell OFSP. Producers expanded their OFSP fields with the belief that

even if they failed to sell roots, they could earn adequate returns from sale of vines. It was those producers who had access to resources: land, valley bottoms, labour and oxen as well as timely information that were able to rapidly respond to and benefit from this opportunity. Some producers were aware of this opportunity but lacked the resources to invest; others had the resources but did not hear about this opportunity so could not invest; others had the information and the resources but feared to invest and a few had the resources and invested without knowing about the opportunity available. In contrast, while this work found out that vine sales were a critical driver of OFSP uptake, the end of project impact assessment reported that while vine sales were large, they were not driving adoption of OFSP (De-Brauw *et al.* 2010). They concluded that Bukedea, the district with the largest vine sales had the lowest adoption rate at the end of the project. This apparent contradiction suggests the need for further research in this area: examining the impact of vine sales on adoption of OFSP for sale.

Price was another important factor in driving the marketing of OFSP. In all the markets investigated, there were no differences between the prices of OFSP compared to non-OFSP. The consumer survey in Kampala markets also revealed that the likelihood of repeat purchase of OFSP was dependent, among others, on the price paid by the consumer. Thus, consumers who had purchased OFSP at a lower price were more likely to purchase it again, while those who had paid the highest price for it were unlikely to purchase it again. Since OFSP was relatively new, a higher price compared to non-OFSP could have been a possible deterrent to traders and consumers. This is more the case because low price was one of the most important considerations in a consumers' decision to purchase a particular staple. Traders on the other hand are motivated by the prospect of making a profit. Since costs and margins of OFSP trade were comparable to those of non-OFSP, it provided an incentive for them to invest in this new enterprise.

Availability of OFSP was a key factor that influenced its uptake along the value chain. Among traders, availability was the most important (45%) determinant of the type of sweetpotato sold. For the consumers, 35% reported that availability was the most important reason in the purchase of a sweetpotato type, and 88% attested to the fact that they did not purchase OFSP because it was not available in the market. With regard to sweetpotato types, YFSP was both the most available and the only type consistently available in all the markets and therefore the most

commonly traded and consumed sweetpotato type. Although most of the consumers' were aware of OFSP, it was available only in Mbale. WFSP was more available and therefore more traded and consumed in Kamuli. In areas where OFSP was more available, awareness of its nutritional value was also high, which had knock-on effects on consumption.

9.1.3 Conclusions on the role of marketing in a biofortification intervention

Agricultural marketing has often been viewed as a means of addressing income goals as opposed to nutritional concerns (Hawkes and Ruel, 2011). Therefore, the question on the role of marketing in a biofortification intervention remained unanswered. In response to this gap, this study has identified six possible roles for marketing in a biofortification programme. These are, i) increasing awareness of, and demand along the value chain; ii) increasing availability along the value chain; iii) encouraging farm-level uptake and adoption; iv) changing the perception and role of the crop; v) exploring alternative uses for the crop and vi) stimulating rural entrepreneurship and trading.

The first role that marketing can play in a biofortification intervention is to increase awareness and demand for the biofortified crop along the value chain, particularly if the crop is relatively new and has a visible trait. Awareness may be raised through training traders and consumers on the benefits of a biofortified crop coupled with dispelling some of the myths that are often labelled on new products. Other promotional events such as test marketing and innovative use of media to suit the unique communication and information needs of the various audiences could be explored.

Traders sold sweetpotato types that were more available in the market. Accordingly YFSP and WFSP were the most common sweetpotato types sold because they were more available. Similarly, availability was an important consideration in consumer decisions to purchase, and by extension, consume a particular sweetpotato type. This work has demonstrated that limited availability was a key constraint in uptake of OFSP among traders and consumers. Therefore, one of the pivotal roles of marketing is to increase availability of the crop along the value chain. Marketing can provide information that can address some of the farm-level production constraints (for example information on preferred OFSP varieties can help farmers target

production of those varieties), and can also help link traders to production areas; and producers to existing, potential and alternative market outlets.

Marketing can contribute to increased uptake and adoption of a biofortified crop. As demonstrated in this thesis, increased uptake and adoption may result in increased availability of the crop for consumption among the producing households. This is more the case with roots that are harvested piece-meal and have the double advantage in that some roots that are not suitable for sale, due to shape and size, can be consumed at home. Marketing may lead to year-round availability of the crop at the household and in the markets. This is because marketing provides an incentive for households to invest in extra resources such as land, oxen, water harvesting and improved management systems that increase availability. Households that produce for the home consumption only are often reluctant to invest in increasing production and productivity and cite lack of or inadequate resources as the main impediment. However, it is likely that remunerative market opportunities for a biofortified crop may compromise its availability for consumption in the producing households, as there may be a tendency to sell as much as possible.

A key challenge in the promotion of biofortifed crops is the negative perception of some of the actors towards some of the staple crops. Marketing can help build a positive image towards the staple crop and its role in the food and farming system. Marketing can contribute to changing the role and perception of staple crops from being a source of carbohydrates, to a source of essential micro-nutrients. This change will imply that micronutrients become a much appreciated and sought after attribute of the biofortified crop. Depending on the place, the position may change from a minor crop to a key staple; from a subsistence crop to a cash crop; and or from a minor crop to a key cash crop. This change will inevitably have implications for availability, uptake and commercialization of the crop.

Marketing can explore and promote alternative uses and benefits that can be derived from a crop, which can provide incentives for uptake. These may include opportunities for semi-commercial production of clean planting materials and options for commercial utilisation through value addition, processing and product development. Marketing therefore, should conduct comprehensive analysis of alternative enterprises or enterprise combinations in order to generate robust data that can support decision-making on enterprise selection along the value chain. This

may necessitate innovative and alternative forms of production, and marketing models. However, if such products have to be marketed as pro-vitamin A rich, a cost-benefit analysis could include studies on pro-vitamin A retention, since this is the primary reason for promoting a pro-vitamin A biofortified crop.

The final role for marketing is to proactively stimulate the development of rural entrepreneurs. This can be done by training them on both the opportunities and challenges in trading in the biofortified crop and equipping them with basic entrepreneurial skills such as book keeping to inform decision making. Training in market intelligence could be another role of marketing. Other approaches that have included some of these components with demonstrable success include the CIAT Territorial Approach to Agro-enterprise development (Lundy *et al.* 2005) and the PMCA pioneered by CIP (Bernet *et al.* 2006). However, caution should be exercised to ensure that support to rural entrepreneurs does not distort the free functioning of the market forces. In other words, marketing should facilitate not intervene.

9.1.4 Conclusions from the study on the theoretical framework

This section reflects on how the findings from this study add to, support or challenge the theoretical perspectives discussed in chapter three of this thesis. It reflects on how applicable the theory is to understanding the adoption decisions for a biofortified crop, using OFSP.

i) Generic and specific attributes in adoption-decision making

One of the key contributions of this study is to demonstrate how adoption decision theory can be used to analyse determinants of adoption of a biofortified crop along the value chain. Decision theorists contend that when there are options to choose from, choice is made in a non-random way (Hansson, 2005). This study has revealed that the decision to sell OFSP by farmers and traders and to purchase it by consumers is not random but instead informed by many factors. In examining the factors that influence the uptake of a biofortified crop such as OFSP, it is important to categorise these factors into two: those that are specific to the biofortified crop and those that are generic and can be important in uptake of the non-biofortified crops as well. The generic attributes include access to productive resources, importance of the crop and previous experience in crop marketing. Specific factors include the attributes of the biofortified crop, the

role of the extension service provider (REU project in this case), availability, price and profitability.

ii) Importance of crop attributes/reflections of diffusion of innovations theory

The diffusion of innovations theory (Rogers, 2003) identifies five determinants of the adoption process: attributes of the innovation; nature of the innovation decision; communication channels used; social systems; and extent of change agents' promotion efforts. In keeping with this theory, the agronomic, sensory, visual and nutritional attributes of OFSP were particularly important in influencing its uptake. This study contends that for OFSP to be adopted its attributes must be considered either the same as or superior to the preferred non-biofortified sweetpotato types. However, of importance is the fact that some attributes may be negative from the production perspective, yet prove to be important determinants of marketing. OFSP was considered to store for a shorter time in the ground and to be highly susceptible to pest and diseases. These negative attributes became positive drivers of OFSP marketing, since farmers opted to keep non-OFSP for home consumption since they stored longer in the ground and were less susceptible to pests and diseases.

iii) Rational choice theory can explain adoption decisions for the market

Access to productive resources such as land, valley bottoms and oxen influenced the decision of producers to plant OFSP for sale. Farmers producing for sale allocate these resources to particular crop enterprises depending on their assessment of their relative competitiveness and risk. Furthermore, the possibility of selling influences the decision of farmers to invest in acquiring and using these resources for a particular crop enterprise. This finding supports one of the key tenets of decision-making under the rational choice decision paradigm espoused by the neoclassical economists: that when confronted with options, in choosing, human beings act as *if* balancing costs against benefits to arrive at action which maximizes personal advantage (Friedman, 1953; Becker, 1978). In other words, while choosing from a set of possible courses of action, human beings opt for the alternative that minimizes costs and maximizes benefits (Blume and Easley, 2008). Where costs associated with uptake of OFSP for sale were higher than anticipated benefits, farmers opted for other crops considered to be more profitable.

9.2 Recommendations

This sub-section presents recommendations from this work, particularly for biofortification crop interventions. Five recommendations are suggested. 1) It is important to include a marketing component on a biofortification intervention; 2) options for targeting are suggested; 3) the need to re-cast the research and development agenda; 4) options for increasing availability; and 5) promoting awareness along the VC. These are discussed below.

1. The need for a marketing component: the first recommendation from this study is that, it is necessary to include a marketing component in a biofortification intervention, particularly one in which the crop has a visible trait such as sweetpotato, cassava, rice and maize. Marketing contributes to increasing availability of the crop along the value chain as well as raising awareness of its nutritional values. However, the marketing component should not be interventionist by nature, that is to say, should not get directly involved in marketing on behalf of the actors in the value chain since this will distort, and will not be sustainable. Neither should the marketing component seek to replace existing private sector functions unless the functions to be replaced are clearly ineffective, inefficient or unfair, since the reality is that they cannot and such actions are often not sustainable. Instead, the marketing component should focus on market research that promotes linkages between the VC actors.

   Therefore, at the onset of the project, marketing could focus more on providing contextual data and information that will inform the marketing strategy, and gradually work with value chain actors to test and develop alternative marketing innovations and models or new ways of organising actors in the VC (farmers, traders, consumers and providers of support services) to support themselves and demand services from the duty bearers especially government.

   Within the design of a pilot biofortification project, it may be necessary to have an officer responsible for market development whose remit could, among others, be to facilitate increased awareness of the role of marketing within the project and among key stakeholders and partners. It may be necessary to lobby local (district and sub-county) and central (ministry responsible for agriculture and nutrition) government to recruit and deploy professionals with agricultural marketing and or agri-business development skills within their

staff as a means of scaling up and ensuring sustainability. As the private sector appreciates benefits of market development, then they could be encouraged to gradually take up or finance some of these activities, but this necessitates involving them from the on-set and demonstrating the win-win benefits that can accrue from their involvement.

2. Targeting interventions: for impact and visibility, it is recommended that a biofortification intervention could target women; semi commercial and subsistence farmers; small traders and small markets; and children.

    a. Women as a target group: women need to be targeted due to their pivotal role as producers, traders (particularly retailers), and consumers of OFSP. As producers, women can be targeted by providing extension services that respond to their unique needs and addressing some of the underlying factors that limit their potential benefits from a biofortification intervention such as unequal access to and ownership of land and other productive resources; making the extension system more responsive to the needs of women; and developing options that reduce workload and drudgery. Women decide on the type of staple to be purchased, how it is prepared, consumed and are the key care-givers of young children. Therefore, they need to be provided with more information on the nutritional benefits of OFSP and better ways of preparing and serving OFSP that enhance pro-vitamin A retention. A majority of OFSP retailers are women, justifying the need to link them to year-round sources of OFSP and use them to disseminate information on the benefits of OFSP to human nutrition to the final consumers and other traders. Another way of targeting women is by using the institutions that directly serve their needs such as health centres and women groups particularly the village savings and loan schemes. These could be used as pathways for demonstrating the benefits to human health of an integrated nutrition intervention. Most health centres in Uganda have facilities such as land, a training hall and information communication technology such as video and cinema. Women especially pregnant and nursing mothers visit these centres routinely for medical attention and are now encouraged (or even rewarded) to visit with their husbands. Biofortification projects could, therefore, leverage on this to disseminate information and demonstrate proven approaches (e.g. seed and crop production, cooking, and consumption) that enhance availability and retention of the desired micronutrients.

Similarly, village savings and loan schemes can enhance access to capital (financial and human) that can enable women address some of the production (e.g. access to inputs) and consumption (e.g. access to complementary foods) challenges associated with access to and utilisation of biofortified crops. At the national level, this may necessitate a policy framework that outlines the rationale and modalities for closer collaboration between the ministries responsible for agriculture, health and community development. This should be reflected at the lower local governments where the health centres and subject matter specialists in charge of health, agriculture and community development are administratively and technically supervised. This needs to be anchored on a strong political will and commitment and where necessary a recognition to change the policy and institutional frameworks and regulations.

b. Semi-commercial and smallholder farmers: in a biofortification intervention with a marketing component, it may be necessary to pursue a two-pronged approach: work with both semi-commercial farmers and subsistence farmers. Semi-commercial farmers have access to adequate productive resources, may have had experience in marketing staple crops and may be more willing to take risks involved in investing in new crops. Therefore, they are in a better position to produce and sustain a marketable output in terms of quality, quantity and timeliness, especially in the short run. Semi-commercial farmers can be linked with the private sector entities such as the commercial seed companies in order to build their capacity in year-round production of quality declared planting material through use of appropriate irrigation technologies . They can also be linked to private agricultural financing institutions such as the Uganda Development Bank which operates an agricultural financing scheme in which it lends to farmers at 12% per annum but requires an intermediating organisation that ensures that the risks are substantially reduced. Such financing could be used to access technologies such as irrigation, animal traction and land especially for women. This is a good opportunity considering that most financial institutions consider agriculture to be too risky to invest in, and the few with agricultural financing schemes charge interest rates of between 26-30% per annum. For these successes to be replicated, linkages, partnerships and networks need to be instituted through which semi-commercial farmers share breakthroughs in market, knowledge and technology access with smallholder farmers.

Smallholder farmers in areas where the biofortified crop is a main staple can also be targeted, initially to address their household food and nutritional requirements. Gradually and in the long run, the emphasis could be on working with them, to address some of the supply side constraints to producing marketable surplus. This may necessitate addressing some of the underlying constraints to asset ownership since it is unlikely that smallholder farmers will benefit from market linkages unless they have enough land, labour, capital and skills to make use of the linkages, and take some additional risks of market inclusion. It is likely that the smallholder farmers will be motivated to produce for the market once success has been demonstrated by the semi-commercial farmers, their asset base has been improved and risks of market inclusion substantially reduced.

c. Small markets and small traders: for market development, it is recommended that the initial focus should be on the often neglected but important informal marketing channels characterised by "small markets and small traders", as these have been demonstrated to drive marketing of OFSP. This is likely to be an easier and cost effective approach since the small traders and markets are often within the vicinity of the targeted production sites. Again, it is easier for farmers to respond to the needs of the local markets, as opposed to the formal markets such as modern retail stores that are often far from their localities. One key lesson from this work is the importance of and the need to specifically target farmer traders and bicycle traders as key conduits of OFSP trade. But retailers should not be ignored as they are the conventional last link to the consumers, and can particularly be important in disseminating information on nutritional benefits of the biofortified crop to consumers. Besides, they are ever present in the markets, and perhaps the only trader category that have a known physical "address". It may be necessary to address some of the challenges associated with these markets such as inadequate market infrastructure including rural road network, power grid, post-harvest and storage facilities, which is a key role for government; and the poor quality and seasonal nature of the produce delivered. Addressing quality, quantity and seasonality of supplies could be the initial role of the "project", intermediating organisation or government extension services but gradually could be shifted to the traders as potential leavers of governance in the value chain.

Another potential area of improvement which should be spearheaded by government is in developing appropriate grades and standards that will regulate and stimulate ethical trade in these markets. However, as more quantities are produced, experience in marketing and partnerships developed, then gradually main markets and big traders can be targeted. In fact, they will be attracted by the opportunity of making a profit.

d. Children: the last category that deserves specific targeting is the children, for three main reasons. Firstly, they are one of the leading at-risk groups; therefore the extent to which they have been targeted is a likely critical factor in the success of any biofortification intervention. Secondly, children profess a strong liking and preference for OFSP, targeting them could enhance uptake, and finally, children are the future and may present one of the opportunities for sustainability. One option for targeting children may be the use of schools as information and knowledge dissemination pathways. Agricultural clubs, young farmers associations and drama groups can be used as appropriate entry points for mobilisation and sensitisation; school gardens for technology demonstration and multiplication; "talking" compound, music, dance and drama for sensitisation and dissemination of information. It may entail working closely with the Ministry of Education to ensure that lessons learned from initial piloting by a project (such as HarvestPlus) are scaled out to other schools but also used to influence policy as well as the agricultural curriculum at all levels. School going youth could also be used as a conduit for reaching out to the non-school going youth who are the bulk of the population, largely unemployed yet often overlooked or ignored.

3. Recasting the research and development agenda: while the main objective of biofortification is developing and disseminating crops for better nutrition, on their own, superior nutritional attributes may not guarantee uptake of a biofortified crop. Therefore, scientists need to ensure that traditional crop improvement objectives such as high yield, pest and disease resistance and drought tolerance are in cooperated in their biofortification work. In addition, consumer desired attributes such as sweet taste, colour, texture upon cooking; root size and shape need to be taken into account as well. Overall, there is need for a broader research agenda focussing on neglected but nutritionally

important crops such as staple crops, fruits, legumes and vegetables, integrating traditional crop breeding objectives with biofortification objectives; addressing the challenge of climate change by harnessing the potential of low lands and rain water; and sustainable soil and crop health management systems through climate smart agriculture that enhances agricultural resilience. This necessitates innovations in the current research, development, institutional and policy landscape and closer collaboration between biofortification projects, government line ministries (health and agriculture), regional, national and international research institutes for technology development and dissemination; and a more integrated research agenda that takes into consideration the entire crop value chain and a multidisciplinary approach, including harnessing recent break-through in the use of information communication technology for increasing access, dissemination and use of production and market information, learning from the experiences of pioneer organisations such as the Grameen Foundation in this area.

Scaling-up may also require governments and development partners to consider establishing challenge funds that can support proven initiatives. These may be in the form competitive agricultural funds administered through semi-autonomous units that scout for opportunities and allocate funds transparently based on merit.

4. Increasing availability of OFSP: availability of inadequate and inconsistent quantities of OFSP has been identified as one of the key obstacles to its uptake along the value chain. Consumers and traders require continuity. This underscores the need to address obstacles to availability as a way of promoting uptake. Constraints to availability may be production related or distributional. Production related constraints include access to clean planting materials, management practices and production resources. Timely access to clean planting materials which is a key constrain to OFSP production in general, and production of marketable OFSP roots in particular could be improved by encouraging more efficient water management practices through demonstration of appropriate irrigation techniques and scaling up proven innovations through public private partnerships. These could include harnessing the potential of low lands for vine propagation, rain water harvesting and use and simple moisture conserving and irrigation techniques. Distribution related constraints include a mismatch between production and

marketing calendars, which could be addressed through a better understanding of the market dynamics and closer collaboration between VC actors.

5. Increasing awareness of benefits to human health of biofortified crops: limited awareness of the nutritional benefits is one of the key obstacles to increased uptake of OFSP along the value chain. Increasing awareness of the nutritional benefits of OFSP is one of the ways through which its uptake can be improved. This can be done through innovative test marketing, promoting cooking and utilization methods that promote pro-vitamin A retention and the use of promotional materials tailor made to suit the communication needs of the various audiences. This is one area from which agriculture could benefit, through closer collaboration, from the experiences and expertise of the health ministry in Uganda in behaviour change communication as demonstrated by their success in containing epidemics such as HIV/AIDS and more recently the Ebola and Marburg.

In conclusion, integrating marketing in a biofortification project especially if the crop has a visible trait, together with appropriate targeting of interventions to specific target groups, market segments and farmer types, a broader research and technology dissemination agenda, increasing availability and awareness of the benefits to human health of consuming biofortified crops can go a long way in increasing availability of biofortified crops along the value chain and ultimately addressing micronutrient deficiencies. Nonetheless, interventions should avoid the one-solution-fits-it-all approach, and instead be targeted to respond to the variations in the food and farming systems including farmer, trader and consumer typology, policy and institutional context, the nature of the malnutrition problem being tackled and the biofortified crop to be used.

9.3 Framework for developing a marketing strategy for a biofortified crop

The framework for integrating a marketing component into a biofortification intervention is presented in Figure 9.1. It is developed by reflecting on the conceptual framework that guided this study (Figure 3.3), the results in this thesis (Chapters 5-8) and other work by the author as an implementer of the Operations Research component of the HarvestPlus Reaching End-Users' project. This framework is recommended for governments and other organisations intending to

integrate a marketing component into a food biofortification intervention. It can be adapted to countries and regions where similar circumstances obtain.

This study proposes that a framework for in cooperating marketing in a biofortified project needs to be informed by a thorough understanding of the marketing context through diagnostic studies (Box A, Figure 9.1). The diagnostic studies will aim at: i) analysis of existing and potential markets of the crop and its products in order to identify key constraints and opportunities to the introduction of the biofortified crop type, ii) perceptions of different consumer segments towards the biofortified crop, and ii) evaluating existing implementation models with a view to adapt and or develop the most appropriate for the biofortified crop. This will entail an analysis of the capacity of proposed collaborators in delivering market extension. Market diagnostic studies should be conducted in tandem with diagnostic studies on the other project components such as seed systems, impact, nutrition and behaviour change. The diagnostic phase will lead to a market strategy aimed at introducing and promoting the biofortified crop along the value chain. Specifically, it will help inform the decision as to whether the biofortified crop will be in cooperated into existing value chains or new chains will be developed for the biofortified crop. Overall, biofortified crops with invisible traits will easily be integrated into existing value chains compared to those with visible traits which may require a dual strategy on integrating them into existing value chains as well as developing new value chains.

Between six months to one year of implementation, in-depth value chain analysis could follow (Box C). The aim is to understand the factors that are likely to influence uptake of the biofortified crop by the key actors in the value chain such as producers, traders, consumers and processors. Unlike diagnostic studies done at inception, these studies could be done at least one year following the introduction and promotion of the biofortified crop among the producers. Another difference is that these studies will be more focussed on value chains for the biofortified crop. This will allow at least one season of implementation and production of a marketable surplus. It is also important to start with producers and follow the product flows along the value chain as this will unfold some unanticipated channels (e.g. bicycle traders).

The analysis in Box C will then form the basis for refining the implementation strategy for integrating marketing and product development in the intervention. Marketing should be seen as

a strategy to be promoted from the household level up to the final consumers. If the biofortified crop has a distinct colour identifier, marketing will have to be integrated with a strong behaviour change component, targeting all actors along the value chain. Finally, the marketing framework and will have to be periodically reviewed based on experiences in implementation, the changing context, emerging challenges and opportunities (Box B).

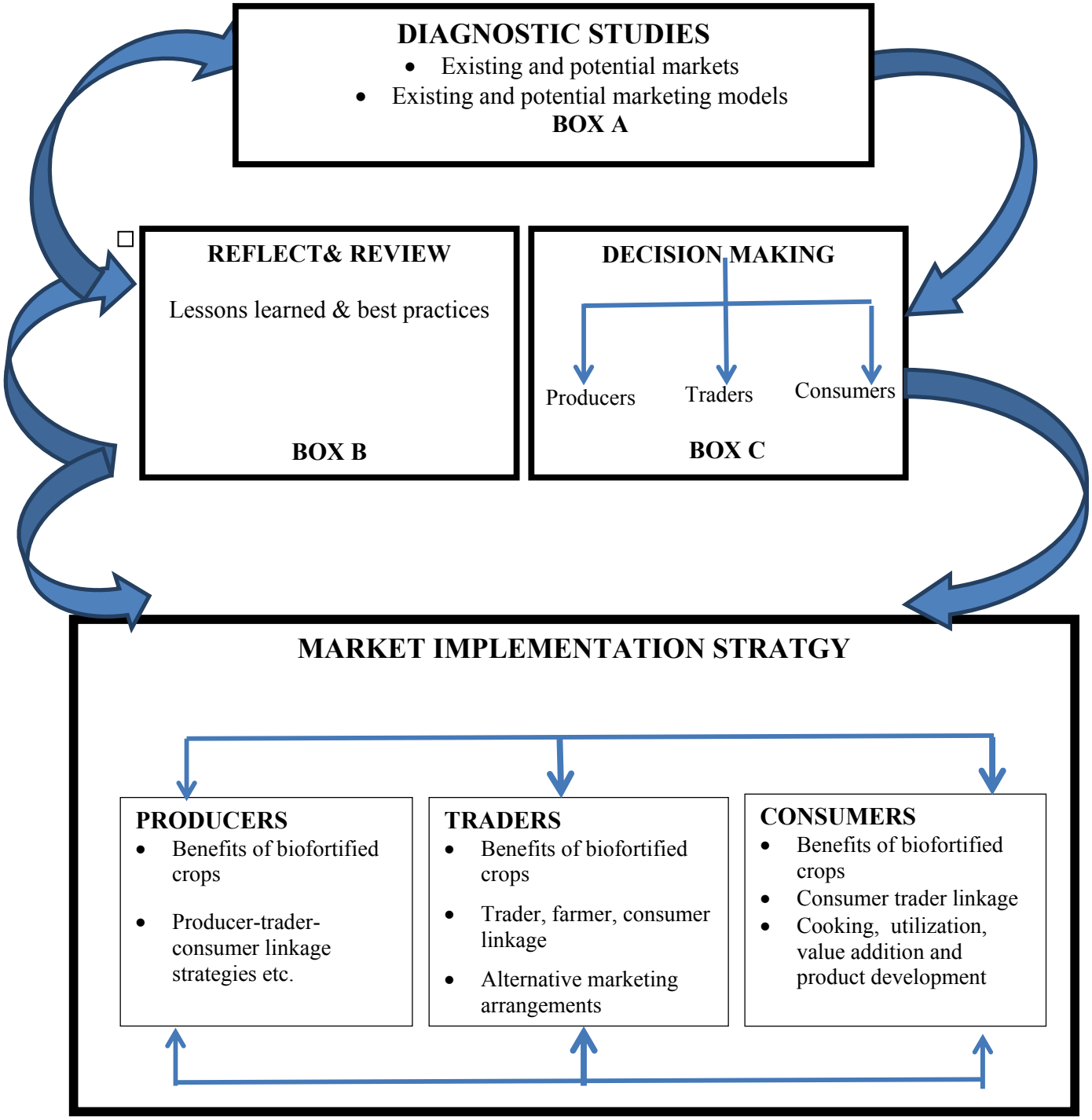

Figure 9. 1: Framework for developing a marketing strategy for a biofortified crop

9.4 Areas for further work

Firstly, the research and development intervention, which sets the context for this research was introduced between June and November 2007. The data and information reported in this thesis were collected from August 2008 to March 2010. This is a relatively short time for any meaningful adoption to have taken place, let alone substantial quantities of a crop to have been produced and marketed. These results therefore represent initial perceptions towards the uptake of a new crop along the value chain. It may be prudent to repeat this study at a later stage, for example after at least three years, when farmers, traders and consumers have had adequate experience with OFSP.

Related to the above, the trader and consumer surveys were undertaken between December 2009 and March 2010, at the end of the sweetpotato marketing season. As a result, OFSP in particular and sweetpotato in general were in short supply. It is therefore suggested that this study could be conducted at another time in the marketing season particularly during the peak marketing season in order to test whether similar findings will obtain at that time. It could well be that the findings were influenced by scarcity of OFSP at the time of the study.

Four OFSP varieties were promoted: *Ejumula, Kakamega, Vita* and *Kabode*. There are attributes that these varieties have in common, while there are those that distinguish one variety from the other. With the exception of the consumer survey in Kampala (see section 7.1), all the other work reported analysed OFSP as if it were one variety. It is therefore suggested that subsequent work could be conducted at variety level: looking at the benefits, issues and decision making associated with the different varieties, including their uptake and promotion for specific markets and uses.

One of the findings from this study, that merits further investigation, is the role that informal trade, characterized by rural-based traders and rural markets, in driving marketing of OFSP. Linked to this is the role of marketing in stimulating rural agro-enterprise development within the context of a biofortified intervention.

For agronomist and crop breeders, this study has established that one reason that influenced the decision of some farmers to sell OFSP was that the roots did not store in-ground for a long time

compared to non-OFSP. While this supported marketing, it may have implications for availability of OFSP for home consumption. Therefore, more research is suggested aimed at developing and testing varieties that, in addition to other preferred attributes, also store longer in the ground.

This work analysed marketing within the context of a low value, perishable biofortified staple crop with a visual trait. Some biofortified crops are hard grains with non-visual traits such as pearl millet and beans. Others are high value, with a visual trait such as rice. Little is known about the role of a marketing component in biofortified crops with non-visual traits, as well as high value crops with visual traits. This opens up another area for subsequent research: what are the key determinants of uptake and the role of a marketing component with respect to these categories of biofortified crops.

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Appendices

Appendix 1: Checklist for qualitative household survey

Consent/introduction

I am Julius Okwadi, a research fellow with the Natural Resources Institute of the University of Greenwich, a Ugandan by Nationality. We are collaborating in the HarvestPlus project that is promoting production, consumption and marketing of the pro-vitamin A-rich orange sweetpotato. I would like to interview you regarding your experiences & perceptions with regard to production, consumption and marketing of this sweetpotato. The results will be used to inform project design and implementation as ell s academic purposes. This interview and its results will be confidential. Your participation is entirely voluntary and you may opt out any time and do not have to give a reason for doing so.

Research question	To examine the factors that influence the decision by producers to grow OFSP for sale
Key questions	1) What are the characteristics of the OFSP producers? 2) What factors influence producer decisions to sell sweetpotato? 3) What is the nature and characteristics of OFSP marketing among producers? ***4)*** What factors influence the decision of producers to sell OFSP?

Areas of investigation

Key area/theme	Details
Household composition	Age, composition, gender, income sources (farm and non-farm)
Asset resource base	Land (size & utilisation); access to valley bottoms; labour availability, livestock (animal power for traction) Resource allocation decision (for OFSP and other enterprises)-alternative uses in absence of OFSP
Social capital	Membership & role in farmer group; type of group and level of market-orientation; benefits and cost of membership to group How did their membership of OFSP group influence their decision-making process with regard to production & marketing OFSP Did their membership to previous groups influence decision making? For OFSP group – number, fluidity, when they joined, how and when it was formed
Crop enterprises	Priority crops for food and cash & reasons for planting. Crops specifically introduced for nutritional benefits or grown for nutritional purposes
Experiences in crop marketing	For marketed crops- how marketing was/is organized, form in which crop is marketed, advantages and disadvantages (including risks, time taken to sell, sales on credit; distance they are prepared to travel to sell their crop, activities they are prepared to undertake to sell their produce)
Experiences with production & sale of OFSP	Timeline, key activities, their involvement, impact in relation to introduction of OFSP (should help probe

	how decision making has evolved over time and what factors influenced the dynamics) How they started (group or individual), project/individual contribution; original intention re home consumption/sale Vine access, sales and impact on Acreage Production, marketing, acreages, marketing (vines & roots, OFSP availability)
Marketing OFSP	Knowledge of the alternative outlets, what influenced choice of marketing system/outlet, Costs of marketing Important assets in marketing risks and opportunities experienced/associated with the outlet. How risks were managed (e.g. does farmer have a phone, contacts with traders, availability of information on prices and markets, group marketing; expectations of project staff; have farmers been discouraged because the project has not provided markets); views on sustainability of the market Price expected Vs. what they received Role of link farmer and how different it would have been in his absence
Consumption of OFSP	Which food staples have they purchased and why? Probe for sweetpotato or OFSP If they do not plant or a crop fails, will they purchase?
Looking ahead	What is necessary in order to influence sustained production and marketing of

	OFSP? E.g. if it was hard to sell OFSP or prices were the same as WFSP Do they expect OFSP market to increase, decrease or remain constant in the coming year and why How might increased marketing of OFSP influence production and consumption? How might their current experiences influence future decisions about production of OFSP for sale? Who are the farmers most likely to grow OFSP for the market: critical resources; necessary support; and location

Appendix 2: Questionnaire for traders' survey

CONSENT/CONFIDENTIALITY/INTRODUCTION

Consent/introduction/notes for enumerator

Please inform the trader that this survey is being undertaken by NARO and NRI as partners in the REU project that is interested in understanding the factors that will influence/have influenced the decision of traders to buy and sell OFSP, and would like to interview them in that regard. The project is funded by HarvestPlus, an organisation that aims at promoting production, consumption and marketing of crops that offer improved nutrition and health benefits to consumers. The results will be used to inform project design and implementation as well as for academic purposes. This interview will be confidential and its results will be used solely for the purposes stated above. Their participation is entirely voluntary and they may opt out at any time without giving a reason for doing so.

1.0: GENERAL INFORMATION

1.1	**Date and of Interview:**	
1.2	**Name of trader**	
1.3	**Gender** [1] Male, [2] Female	
1.4	**Ethnic group of trader**	
1.5	**Relationship with owner of business** [1] Owner, [2] Co-owner, [3] Spouse, [4] Employee, [5] Child	
1.6	**District** [1] Bukedea, [2] Kamuli, [3] Kampala, [4] Kampala, [5] Mbale	
1.7	**Market where interview took place**	
1.8	**Other markets in which trader operates**	

2.0 SALE OF SWEETPOTATO

2.1	**At the time of the interview, which type of sweetpotato was trader selling?** [1] WFSP, [2] YFSP, [3] OFSP	
2.2	**Are there any sweetpotato types that you sold in the past that you are no longer selling?**[1] No, [2] Yes	

2.3 If answer to 2.1 is yes, fill table below

Sweetpotato type [1] WFSP, [2] YFSP, [3] OFSP	**Rank consumer preference (Where, 1 is most preferred)**	**Reason for stopping to sell** [1] -no longer available, [2] very expensive, [3]would easily go bad, [4] customers did not like it, [5] other specify)

2.4 How would you categorise yourself as a sweetpotato trader [1] Retailer, [2]Wholesaler, [3] Retailer/wholesaler, [4] Farmer trader, [5] Bicycle trader	
2.5 What influenced your decision to trade as categorised in 2.4? [1] Requires less capital, [2] It is profitable, [3] Easy to operate, [4] Few traders engaged in this type of trade, [5] Many customers buy in small quantities, [6] Flexible, [7] other, specify	
2.6 Rank four main staples that you consume at home [1] Sweetpotato, [2] OFSP, [3] Fresh cassava, [4] Matooke, [5] Irish potatoes, [6] Rice, [7] Posho, [8] Atap, [9] Others, specify)	
2.7 Rank four main staples that you sell at home [1] Sweetpotato, [2] OFSP, [3] Fresh cassava, [4] Matooke, [5] Irish potatoes, [6] Rice, [7] Posho, [8] Atap, [9] Others, specify)	
2.7 How many years have you been selling agricultural produce?	

2.8. Fill in table below about details of sweetpotato types sold at time of interview

Type of sweetpotato[1] WFSP, [2] YFSP, [3] OFSP	**Unit of sale**	**Total quantity available**	**Price/unit**	**Kg/Unit** (use electronic scale to weigh)

2.9 Why are you selling those particular sweetpotato types? Fill table below

Sweetpotato type [1] WFSP, [2] YFSP, [3] OFSP	**Reason for selling [**1] Always available, [2] Customers like it, [3] It is hard, [4] Has vitamin A, [5]Takes long to get bad, [6] Other, specify

2.10 **If OFSP is not among those sold, why? [**1] Hard to get, [2] Customers do not like it, [3] it is soft, [4] Has a bad smell, [5] Others, specify)	
2.11 **Do you purchase sweetpotato for home consumption? [**1] No, [2] Yes	

2.12 If answer to 2.11 is yes, fill in the table below

Sweetpotato type purchased [1] WFSP, [2] YFSP, [3] OFSP	**Reason for purchasing [**1] Readily available, [2] Sweet taste, [3] It is hard, [4] Rich in vitamin A, [5]Children like it, [6] Good colour, [7] Do not have enough land, [8] Purchase when I do not have it in my stock [9]Other, specify

2.13If OFSP is not among those purchased for home consumption in 2.12, why?	**[**1] Gets .1from own garden, [2] Not available, [3] Bad smell, [4] Poor quality, [5] It is soft, [6] Pick from my stock, [7] Other, specify
2.14If OFSP is among those purchased for home consumption, how often	

3.0 KNOWLEDGE OF OFSP

3.1 **Have you ever heard of OFSP**? **[**1] No, [2] Yes	
3.2 **If response to 3.1 is no, show sample of OFSP and ask whether they have seen it[**1] No, **[**2] Yes	
3.3 **Those who know, when did they first** hear about OFSP mm/yyyy?	
3.4 **Those who know, when did they first see OFSP** mm/yyyy?	
3.5 **Those who know, when did they first sell OFSP** mm/yyyy?	
3.6 **Those who sold, what motivated them to sell OFSP[**1] Customers like it, **[**2] It was available, **[**3] It has vitamin A, **[**4] Good for children, **[**6] It is sweet, **[**7] Orange colour, **[**8] Have variety, **[**9] It is profitable, **[**9] Introduced by project **[**10] Given freely, **[**11] Other, specify	
3.7 **Those who know, list 3 attributes that distinguish OFSP from the other sweetpotato types[**1] Orange colour, **[**2] It is sweeter than other sweetpotato types, **[**3] Rich in vitamin **[4]** Has a strange smell, **[**5] Preferred by children; **[**6] Soft, **[**7] Big size of the roots, **[**8] Other, specify	
3.8 **How did you learn about the attributes you described in 3.7 above?[**1] Fellow traders, **[**2] Farmers, **[**3] Radio, **[4]** Project staff, **[**5] Poster/T-Shirt/Wall mural, **[**6] Personal experience	
3.9 **Those who did not sell, why?[**1] Customers do not like it, **[**2] Not available	
3.10 **Have you ever eaten OFSP?[**1] No, [2] Yes	
3.11 If yes, what was the source? **[**1] Own stock, **[**2] Bought from other traders, **[**3] Own garden, **[4]** Farmer	
3.12 How did the taste compare to the taste of the other sweetpotato? **[**1] Similar , [2] Better than, **[**3]Worse than)	

3.13. In what ways was the taste of OFSP (question 3.12) either better or worse than that of other sweetpotato?

Taste better than other sweetpotato	Taste worse than other sweetpotato

3.14. When all are available, which sweetpotato type do you prefer to eat at home[1] WFSP, [2] YFSP, [3] OFSP	

4.0. SWEETPOTATO TRADING PRACTICES

4.1 How do you compare profitability of sweetpotato to commodities in table below?

Commodity	More profitable than sweetpotato	As profitable as sweetpotato	Less profitable than sweetpotato
Fresh cassava			
Matooke			
Irish potatoes			

4.2. List the months in which you sell sweetpotato	
4.3. List the months in which you sell OFSP	
4.4. **How do you sell OFSP**[1] Mixed with other sweetpotato types, [2] In separate units	
4.5.Why do you sell OFSP in this way?[1] That is how it was parked, [2] Customers want specific variety, [3] For easy identification, [4] Customers do not mind, [5] Separating is a waste of time, [6] Determine profitability of each type, [7] Others, specify	
4.6.When all are available, which sweetpotato type is preferred by your customers?[1] WFSP, [2] YFSP, [3] OFSP	
4.7.Which sweetpotato type do you prefer to trade in?[1] WFSP, [2] YFSP, [3] OFSP	
4.8.If trader prefers either WFSP or YFSP to OFSP, why?[1] It is hard It is sweeter, [2] Many customers like it, [3] Readily available, [4] others, specify)	
4.9.If trader prefers OFSP to either WFSP or YFSP, why?[1] Has vitamin A, [2] Many customers like it, [3] Orange colour, [4] It is sweet, [5] More available, [6] Children prefer it, [7] Low fibre, [8] Introduced by project, [7]	

[9] Others, specify	
4.10. **Which type of customers is most likely or commonly purchases OFSP?**[1] Those who know benefits of OFSP, [2] Children, [3] Foreigners, [4] Expectant mothers, [5] Women with young children, [6] Civil servants, [7] Others, specify	
4.11. How does availability of OFSP compare to other sweetpotato types?[1] Equally available [2] OFSP less available [3] OFSP more available	

5.0 TRADING ASSETS AND CAPITAL

5.1.What was the source of the first capital you used in sweetpotato business? [1] Savings from other trade, [2] Planted sweetpotato, [3] Credit, [4] Sweetpotato credit, [5] Other, specify)	
5.2 How much was it?	
5.3 What quantity of sweetpotato did it purchase?	
5.4 Have you ever received credit for sweetpotato trade?[1] No, [2] Yes	
5.5 If yes, what was the source? **[**1] Friend/relative, [2] SACCO, [3] Merry go round, [4] Bank/microfinance organization	
5.6 **Do/did you need more capital to trade in/buy OFSP**? **[**1] No, [2] Yes	

5.7 If yes, to 5.6 above, what would you use it for?

……

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6.0. REU/OFSP PROJECT MARKET FACILITATION

6.1 **Have you ever been trained by the project about trading in or benefits of OFSP?[**1] No, [2] Yes	
6.2 **If yes, list three things that you remember from that training[**1] Helps children grow well [2] Good for expectant mothers [3] Has vitamin A [4] Sweetpotato types, [5] source of OFSP, [6] Good for sight, [7] Good for skin, [8] other, specify	

6.3 How did the training influence the way you trade in or understand OFSP?

…….

……..

……

6.4 Have you ever received any of the following items from the project?

Item	**[**1] No, [2] Yes	**Rank 3 most Useful** (1-most useful; 3 least useful)
T-Shirt		
Apron		
Trader board		
Cap		
Veil		
Kiosk (iron sheets or painting		

6.5 If yes, how did they help you sell OFSP?

……

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……

6.6 Have you been linked to farmers or production areas by the project?[1] No, [2] Yes	
6.7Are you aware of supply areas of OFSP?[1] No, [2] Yes	
6.8 Have you ever talked to your customers about the benefits of OFSP?[1] No, [2] Yes	
6.7 If no, why?[1] OFSP rarely available [2] Customers already aware, [3] Different customers come each day, [4] I do not know much about OFSP, [5] Others, specify	
6.8. If yes, did it influence their decision to buy OFSP?[1] No, [2] Yes	

6.10. If yes, how?

……

……

……

7.0 QUANTITIES, COSTS AND MARGINS

7.1 **When was the last time you sold OFSP?** Mm/yyyy	
7.2 **How did you sell that OFSP?**[1] Mixed with other sweetpotato, [2] Separately	
7.3 **Why do you sell OFSP in this way?**[1] Easy identification, [2] Usually parked like that, [3] Customers want specific variety, [4] When separate it takes long to sell in the market [5] Customers do not mind, [6], Determine profitability of each type, [7] Other, specify	
7.4 **Which year and months did sell the largest quantity of OFSP?**	
7.5 **What was the source of that OFSP?**	

7.6. Fill in table in the next page with information on the last time trader sold OFSP

Weekly purchase and sales of sweetpotato, when OFSP was last purchased

Type of SP	**Qty purchased**	**Unit**	**Kgs/ Unit**	**Price/ Unit**	**Purchased from (place)**1-own garden; market; 3-another market; 4-farmers field	**Who sold to you**	**Unit of sale to other consumers**	**Units sold**	**Price/unit**	**Total revenue**
OFSP										
WFSP										
YFSP										

Costs per week

Cost item	**Transport**	**Loading/offloading**	**Parking**	**Tax**	**Lunch**
Amount					

8.0 WRAP-UP QUESTIONS

8.1 **What has made it possible for you to trade in OFSP?** [1] Customers like it, [2] Readily available; [3] it is sweet, [4] Profitable, [5] Does not easily rot, [6] Has vitamin A, [7] Customers do not like other types of sweetpotato, [8] mixed with other sweetpotato types; [9] Children like it, [10] Other, specify	
8.2 **What are the main problems associated with trading in OFSP?**[1] Production is still very low, [2] Bad smell, [3] Rots quickly, [4] It is too soft, [5] too much fibre, [6] Some customers are not aware of OFSP, [7] High price, [8] Customers did not like it when they first bought it, [9] Others, specify	
8.3 **What can encourage you to start or continue trading in OFSP?**[1] Increase awareness of benefits, [2] Teach farmers how to grow OFSP, [3] Provide capital to traders, [4] If there is a high demand from customers, [5] Its health benefits, [6] Others, specify	

9. Other key issues you (trader) may wish to bring to the attention of the project

……

……

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Thank you very much for participating in this survey.

Appendix 3: Questionnaire for urban consumers' and marketing survey

CONSENT/CONFIDENTIALITY/INTRODUCTION

CONSUMER NUMBER _____

Consent/introduction/notes for enumerator

Please inform the consumer that this survey is being undertaken by NARO and NRI as partners in the REU project interested in understanding the factors that will influence/have influenced the decision of consumers to purchase and consume OFSP and would like to interview them in that regard. The project is funded by HarvestPlus that seeks to introduce crops that offer improved nutrition and health benefits. The results will be used to inform project design, implementation as well as academic purposes. This interview will be confidential and its results will be used solely for the purposes stated above. Their participation is entirely voluntary and they may opt out at any time without giving a reason for doing so.

1	**Name of trader and location:**	
2	**Date and time of Interview:**	
3	**Name of the enumerator:**	

4**. Sweetpotato purchased by the consumer:** [1] traders own (name.....), [2] SPK004/6, [3] Kakamega, [3] SPK004/6/6, [4] Ejumula (please tick one or more of these).

5.**Price and weight of heap(s) purchased by the consumer**

Heap	Sweetpotato variety	Heap price (UGX)	Heap weight (kg)
A			
B			
C			

6. **Have you purchased or eaten orange fleshed sweetpotato before today?**

[1] YES [2] NO

7.**Looking at the sweetpotato heaps in front of you, please tick one box in each column according to how acceptable you rate each sample for purchase.**

	Traders own	SPK004/6	Kakamega	SPK004/6/6	Ejumula
Like very much	☐	☐	☐	☐	☐
Like moderately	☐	☐	☐	☐	☐
Like slightly	☐	☐	☐	☐	☐
Neither like nor dislike	☐	☐	☐	☐	☐
Dislike slightly	☐	☐	☐	☐	☐
Dislike moderately	☐	☐	☐	☐	☐
Dislike very much	☐	☐	☐	☐	☐

8	**What did you like about the sweetpotato**	**Rank**	
	Traders own	[1]	[2]
	SPK004/6	[1]	[2]
	Kakamega	[1]	[2]
	SPK004/6/6	[1]	[2]
	Ejumula	[1]	[2]

9	**What did you dislike about the sweetpotato**	**Rank**	
	Traders own	[1]	[2]
	SPK004/6	[1]	[2]
	Kakamega	[1]	[2]
	SPK004/6/6	[1]	[2]
	Ejumula	[1]	[2]

Consumption of sweetpotato

10	Why did you purchase the sweetpotato that you have bought today?	Rank (first two) [1] [2]
11	Who are you buying this sweetpotato for?	

12	Have you heard about orange fleshed sweetpotato before (if not go to demographic section)	[0] no, [1] yes
13	Have you purchased orange fleshed sweetpotato previously and if so where?	
14	How did you hear about orange fleshed sweetpotato?	
15	If you have heard of orange fleshed sweetpotato before, what do you know about it?	

Demographic Information

16	Age (in years):	
17	Gender:	[1] Male [2] Female
18	Up to which class have you studied?	
19	What is your main employment?	

Purchasing behaviour

20	Would you consider purchasing orange fleshed sweetpotato in the future?	[1] Yes [2] Possibly [3] No

21	**Please give reasons for:**	
	a) Purchasing Orange fleshed sweetpotato	**b) <u>Not</u> purchasing Orange fleshed sweetpotato**
	[1]	[1]
	[2]	[2]
	[3]	[3]

Information awareness and communication

22	Which radio station do you listen most, what time and what day?	
23	If you were to receive more information about orange fleshed Sweetpotato, what would be the best for you?	

Appendix 4: Questionnaire for rural Consumers' survey

CONFIDENTIALITY

Consent/introduction/notes for enumerator

Please inform the consumer that this survey is being undertaken by NARO and NRI as partners in the REU project interested in understanding the factors that will influence/have influenced the decision of consumers to purchase and consume OFSP and would like to interview them in that regard. The project is funded by HarvestPlus that seeks to introduce crops that offer improved nutrition and health benefits. The results will be used to inform project design, implementation as well as academic purposes. This interview will be confidential and its results will be used solely for the purposes stated above. Their participation is entirely voluntary and they may opt out at any time without giving a reason for doing so.

1.0: GENERAL INFORMATION

1.1	**Date and of Interview:**	
1.2	**Name of consumer**	
1.3	**Gender** [1] Male, [2] Female	
1.3	**Education level** [1] No education, [2] Primary, [3] Secondary, [4] Tertiary	
1.4	**Age**	
1.5	**Ethnic group of trader**	
1.6	**Position in family** [1] Head, [2] Spouse, [3] Employee, [4] Child,[5] Other, specify	
1.6	**District** [1] Bukedea, [2] Kamuli, [3] Kampala, [4] Kampala, [5] Mbale	
1.7	**Market where interview took place**	
1.8	**Other markets in which respondent purchases sweetpotato**	
1.9	**Was OFSP on sale at the time of the interview?**[1] No, [2] Yes	

2.0 Main staple crops

2.1 Rank 4 main staple foods that you purchase

Staple food	**Rank**	**Reason for purchasing [1]** Always in market**[2]** Do not plant, **[3]** Easily cooked with other foods, **[4]** Easy to cook, **[5]** Cheap, **[6]** Children like, **[7]** Sweet, **[8]** Staple food, **[9]** Change diet

2.2 Rank 4 main staple foods that you consume

Staple food	**Rank**	**Reason for purchasing [1]** Always in market**[2]** Do not plant, **[3]** Easily cooked with other foods, **[4]** Easy to cook, **[5]** Cheap, **[6]** Children like, **[7]** Sweet, **[8]** Staple food, **[9]** Change diet

3.0 PURCHASE OF SWEETPOTATO AT THE TIME OF THE INTERVIEW

(Enumerator to weigh heaps)

3.1 Sweetpotato purchase

Type of SP available[1] WFSP, [2] YFSP, [3] OFSP	Type of SP purchased[1] WFSP, [2] YFSP, [3] OFSP	Kg/Heap	Heap value	price per kg

3.2 Why did you purchase those particular sweetpotato types?

Sweetpotato purchased [1] WFSP, [2] YFSP, [3] OFSP	Reasons [1] Sweeter, [2] It is hard, [3] Only type available, [4] Always available in market, [5] Low fibre, [6] Was told to buy this type, [7] Liked by family, [8] Low price/bigger heap size, [8] Others, specify)

3.3 If OFSP is not among those purchased, why? [1] Not available, [2] Family/consumers do not like it, [3] Bad smell, [4] Told not to buy OFSP, [5] High price/small heap size, [6] Do not know OFSP, [7] soft, [8] Others, specify	
3.4Which meals are you purchasing OFSP for?[1] Breakfast, [2] Midmorning snack, [3] Lunch, [4] Mid afternoon snack, [5] Supper, [6]Snack for children to take to school	
3.5Who are you buying this OFSP for? [1] Whole family, [2] Children under 5, [3] School going children, [4] Family excluding adults	
3.6 Who decided which SP variety to purchase? [1] Mother, [2] Father, [3] Children, [4] Other, specify	
3.7 How often do you purchase OFSP when available?	
3.8 How often do you buy non-OFSP when available?	
3.9 Do you buy OFSP from a particular vendor?[1] No, [2] Yes	
3.10 If from same vendor, why?[1] Can give credit, **[2] H**as good quality, **[3]**Gives big quantities, **[4]** 4 Sells at lower price	
3.11 If different vendor, why?[1] Vendor may not have specific type, **[2]**Vendor may have poor quality, **[3]**I look for a vendor with OFSP, **[4]A**void being cheated, **[5]**-Look for big quantity	
3.12 Have you ever purchased OFSP in heaps mixed with non-OFSP? **[1] No, [2] Yes**	

3.13. If answer to 3.12 is yes, what problems/issues do this present to you as a consumer?

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3.14 **Which other staples were purchased at the time of the interview?[1]** Fresh cassava **[2]** Matooke, **[3]** Rice, **[4]** Irish potatoes **[5]** Posho **[6]** None, **[7]** Other, specify)	
3.15 **Have you reduced quantities of or stopped buying some staples because you have or are to buy OFSP?[1] No, [2] Yes**	
3.16 **If yes to 2.24 above, which staples?[1]** Non-OFSP, **[2]** Cassava, **[3]** Posho, **[4]**Rice, **[5]** Matooke, **[6]** Irish potatoes, **[7]** Other, specify	

3.0 KNOWLEDGE OF ATTRIBUTES OF OFSP

3.1 **Have you ever heard of OFSP**? **[**1] No, [2] Yes	
3.2 **If response to 3.1 is no, show sample of OFSP and ask whether they have seen it[**1] No, **[**2] Yes	
3.3 **Those who know, when did they first** hear about OFSP mm/yyyy?	
3.4 **Those who know, when did they first see OFSP** mm/yyyy?	
3.5 **Those who know, when did they first eat OFSP** mm/yyyy?	
3.6 **Those who ate, what motivated them to eat OFSP[**1] Orange colour, **[**2] Liked by children, **[**3] It has vitamin A, **[**4] Good for children, **[**6] It is sweet, **[**7] Only available variety, **[**8] Other, specify	
3.7 **Those who know, list 3 attributes that distinguish OFSP from the other sweetpotato types[**1] Orange colour, **[**2] It is sweeter than other sweetpotato types, **[**3] Rich in vitamin **[4]** Has a strange smell, **[**5] Preferred by children; **[**6] Soft, **[**7] Big size of the roots, **[**8] Other, specify	
3.8 **How did you learn about the attributes you described in 3.7 above?[**1] Fellow traders, **[**2] Farmers, **[**3] Radio, **[4]** Project staff, **[**5] Poster/T-Shirt/Wall mural, **[**6] Personal experience	
3.9. **For those who have eaten OFSP, how did the taste of OFSP compare to the taste of other sweetpotato?** (fill in Table below): **[**1] Similar, **[**2] Better, **[**3] Worse 3	

3.10 If response to 3.8 is either better than or worse than, fill table below

	Reasons: [1] Sweet taste, **[**2] Has vitamin A, **[**3] Hard, **[**4] Liked by children, **[**5] It is soft, **[**6] Colour, **[**7] Bad smell), **[**8] Other, specify
OFSP worse than	
OFSP better than	

3.11. **When all are available, which sweetpotato type do you prefer to eat at home?[**1] OFSP, **[**2] WFSP, **[**3] YFSP	
3.12What are the reasons for your preference in 3.11?[1] Available in the market, **[**2] Good Taste, **[**3] Liked by children, **[**4] Low fibre, **[**5] Has vitamin A, **[**6] Hard when cooked, **[7**] Other, specify	

3.13 If OFSP is not the preferred sweetpotato type, please give reasons why?

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3.14. Do all members of your family like?[1] No, **[**1] Yes	
3.15. If no? Which ones like?[1] Children, **[**2] Adult male, **[**3] Adult Female	
3.16. If no? Which ones do not like? [1] Children, **[**2] Adult male, **[**3] Adult Female	
3.17 How does availability of OFSP compare to other SP types?[1] Equally available, **[**2] OFSP less available, **[**3] OFSP more available)	
3.18 How does price of OFSP compare to price of non-OFSP?[1] OFSP Equal to non-OFSP, **[**2] OFSP higher than non-OFSP, **[**3] OFSP Less than non-OFSP	
3.19 Since you started purchasing OFSP, have your purchases?[1 Increased, **[**2] Decreased, **[**3] Remained constant	

3.20 Probe reasons for responses in 3.19

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4 .0 WRAP-UP QUESTIONS

4.1 Do you grow your own sweetpotato?[1] No, **[**2] Yes	
4.2 Do you grow OFSP?[1] No, **[**2] Yes	
4.3 Will you purchase OFSP in future?[1] No, **[**2] Yes	
4.4Reasons for purchasing in future[1] It is sweet, **[**2] Rich in vitamin A, **[**3] If available in future, **[**4] Keep my children healthy, **[**5] It is soft, **[**6] Other, specify	
4.5 Reasons for not purchasing in future[1] Bad colour, **[2]** Bad smell, **[**3] GMO's are not good, **[**4] Other, specify	
4.6 How can consumers be encouraged to consume OFSP?[1] Increase its availability, **[**2] Increase awareness of benefits, **[**3] Provide more vines, **[**4] Other, specify	

Thank you very much for participating in this survey.