PSYCHOSOCIAL FACTORS IN RURAL SMALLHOLDER FARMERS' DECISIONS TO ACCEPT ORANGE-FLESHED SWEETPOTATO IN UGANDA

BY

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DECLARATION

This study, titled "*Psychosocial factors in rural smallholder farmers' decisions to accept orange-fleshed sweetpotato in Uganda*", is an original output of my own efforts, and has not been previously submitted for any other degree award to any other University.

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Dedicated to: My wife, Kulsum Lwanga; *Our children,* Acksum, Shaheen, Muhammed, Sulaiman, Rahmah, Imran, Ibrahim, Asiya and Aishamariam; *And to,* Dr. Frank Matsiko for the years in mentoring PhD researchers in-training

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

ABBREVIATIONS

CEDO	Community Enterprises Development Organization
CGIAR	Consultative Group for International Agricultural Research
DDBC	Dissemination and Delivery of Bio-fortified Crops
FAO	Food and Agricultural Organization of the United Nations
GoU	Government of Uganda
HBM	Health Belief Model
HI	Historical Institutionalism
MAAIF	Ministry Agriculture Animal Industry and Fisheries
NARO	National Agricultural Research Organization
NGO	Non-Governmental Organizations
OFSP	Orange-fleshed Sweetpotato
SoC	Stages of Change Model
TPB	Theory of Planned Behaviour
UBOS	Uganda Bureau of Statistics
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VA	Vitamin A
VAD	Vitamin A Deficiency
VEDCO	Volunteer Efforts for Development Concern
WHO	World Health Organization
WFSP	White-Fleshed Sweetpotato

LIST OF PUBLICATIONS

The chapters; one, three through six of this dissertation were published in peer reviewed journals, list of which is offered below:

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DEFINITION OF TERMS AND VARIABLES

1.	**Rural smallholder farmer:**	A person who mostly subsists on family farming in a locations that experience poor social service infrastructure.
2	**Orange-fleshed sweetpotato:**	Vitamin A rich orange-fleshed sweetpotato (OFSP) varieties that are often promoted both as a food security and public health intervention strategy.
3	**Decision maker:**	An individual who makes a choice among the available options on his/her own behalf or that of an 'institution'.
4	**Acceptance:**	One's valuation of a practice or technology and the attendant decision to try out, cultivate and maintain the cultivation of OFSP for at least two consecutive growing seasons.
5	**Psychosocial factors:**	Comparative valuation of a practice or technology based on beliefs and derived attitudes towards a base and a comparison technology.
6	**Social-cognitive context:**	A framework of key influences originating from the minds and souls of significant individuals and their interpretation of such influences.
7	**Capability perceptions:**	Perceived control over production assets and the ease or difficulty of taking up a technology or practice compared to using a conventional technology or practice.

8	**Approval by peers:**	Positive attitudes towards a technology or practice by persons deemed significant by the decision maker.
9	**Perceptions of health risk:**	Perceptions of threats to self or household members' health and the capability of the promoted technology or practice to meet both the food and health goals of individuals and households.
10	**Perceptions of risk to one's/household members' health:**	The perceived likelihood of someone or a household member to contract health challenges and the likelihood that once contracted such a challenge would have significant impact on the individuals concerned.
11	**Perceptions of effectiveness of OFSP to meet food and health goals:**	Perceived relative agronomic, palatability, marketability and health benefits of OFSP.

ABSTRACT

With vitamin A deficiency enduring as a major public health concern in many developing countries, orange-fleshed sweetpotato (OFSP) continues to be promoted as a food-based alleviation strategy for the deficiency. It is also noteworthy that while a multiplicity of studies have determined that consumers tend to be inclined to pay for OFSP, limited attention has been paid to household level social-cognitive mechanisms that drive the OFSP acceptance process. This study sought to enhance understanding of the role of rural smallholder farmers' socio-cognitive contexts in OFSP acceptance in Uganda. It specifically aimed to: (i) determine whether farmers' beliefs about sweetpotato varieties influence OFSP cultivation; (ii) assess the extent to which perceptions of health risk correspond to OFSP cultivation and; (iii) determine whether farmers' perceived control over production assets and peer approval influence OFSP cultivation. The research was conducted in two Ugandan rural sub-counties that had participated in an NGO sponsored, nation-wide OFSP delivery program for three contiguous years. A multimethods approach involving a survey of farmers' perceptions of OFSP cultivation, and in-depth key informant interviews were used to collect data about sweetpotato producers. The ANOVA showed that farmers at the various stages of the OFSP cultivation process differed in the belief sets they held. Additionally, sustained OFSP cultivation was positively influenced by social pressure and farmers' valuation of their capability to cultivate OFSP relative to WFSP ($Adj.R^2 = .189,\ p \leq .001$) and health-related risk ($Adj.R^2 = .102,\ p \leq .001$). Through compliance and conformity, farmers created a cycle of low cultivation intensity that led to limited access to vines, and the attendant cultivation defections. This study points to a cardinal role for processes that create supportive social and cognitive environments for the acceptance of bio-fortified technologies such as the orange-fleshed sweetpotato.

CHAPTER ONE

CONTEXT AND SETTING

1.0 Introduction to the study

This study was conducted in Uganda; in two locations (Kyotera and Buyende districts) where the production and consumption of the Orange-fleshed sweetpotato (OFSP) had been promoted by HarvestPlus (an international NGO) over a 4-year period, stretching between 2012 and 2016. Under the auspices of the "Developing and Delivering Bio-fortified Crops" (DDBC) project, HarvestPlus distributed OFSP vines to 409,711 households in a process that also involved large-scale delivery of nutrition information and marketing advice, (Menon, 2017). The objectives of DDBC were to encourage widespread use of bio-fortified crops, to evaluate the feasibility of the associated adoption methodologies, and to identify the major constraints to sustained promotion of the bio-fortified crops.

1.1 General background

Hidden hunger, a form of starvation due to micronutrient deficiency, is a major public health challenge for sub-Saharan Africa (FAO *et al.,* 2017). In Uganda, US$145 million per year is lost in fighting the big four deficiencies, which include vitamin A (VA), Iodine, Zinc and Iron (World Bank, 2011). Scenario models by the Government of Uganda (GoU) estimated the total losses associated with child food deficiencies as standing at US$ 899 million per year, an equivalent of 5.6 % of national GDP (GoU, 2013). These deficiencies particularly affect women and children in rural impoverished households (UBOS and ICF, 2018). Uganda is particularly at risk of these deficiencies since 76% of its 7.2 million households are located in rural areas, where 90% of the inhabitants subsist on nutrient-poor

staples, such as cassava (UBOS, 2016). de Brauw *et al.* (2015) noted that micronutrient deficiencies are primarily caused by routine dependence on diets that are mostly comprised of staple foods that are low in micronutrients. However, the causes of vitamin A deficiency (VAD), the deficiency that provides the context of this study, is traced in several origins.

Graeub *et al.,* (2016) argue that the most proximal cause that cuts across rural communities is chronic poverty. Poverty drives VAD by undermining food security, primarily through the constraints it exerts on access to diverse and nutritious foods, and impeding access to health services (Ahmed *et al.*, 2016). Prevalence is also often fuelled by landlessness through the latter's influence on household capacity to cultivate own food and diversify diets (Chaparro *et al.,* 2014). Asare-marfo *et al.* (2013), assert that while VAD is attributed to multiple causes that often vary by region, it is mostly occasioned by routine reliance on low-nutrient foods and the seasonality of micronutrient-rich foods, such as fruits. Moreover, child survivors of VAD commonly suffer irreversible mental retardation which limits their potential for adult productivity and ultimately feeds the cycle of poverty (UNICEF, 2007). It may thus be argued that individual behaviour, geography, and social context have converged consequently crystallizing household level VAD and the attendant risks, which is expanding the role of and/or the need for introducing new nutrient rich crops.

In 2016, the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), endorsed bio-fortification—a strategy that aims to improve micronutrient concentrations in staple crops via breeding techniques—as a major approach to combating hidden hunger in developing countries (Garcia-Casal *et al.,* 2017). Under the approach, OFSP, orange, cassava, maize, and golden rice were enriched with ß-carotene, a precursor for vitamin A production in the human body, once consumed (Talsma *et al.,* 2017). Unlike the other approaches, such as fortifying processed foods, which might be

hazardous to health if excessive vitamin A (VA) is consumed by ingesting multiple fortified foods (Kyamuhangire *et al.*, 2013; Chen *et al.*, 2019), the ß-carotene strategy poses no such danger. Low *et al.* (2017) suggest further that OFSP has enormous potential to combat VAD, if widely accepted by affected communities. It is also argued that OFSP when eaten regularly supplies 100% of the daily VA needs (HavestPlus, 2011) and that a 500m^2 plot of OFSP is adequate for meeting the annual vitamin A needs of a family of five.

Over the last two decades, Uganda has attempted to integrate OFSP into strategies to improve VA intake among rural households. These efforts fit into a context where proponents of OFSP maintain that it shares many attributes with the energy-dense conventional white-fleshed sweetpotato (WFSP). The WFSP is popular for its short maturity period, the staggered root maturation which allows harvesting over several months, and the easy access to planting materials which is facilitated by the crop's vegetative propagation habit (Low *et al.,* 2017). Accordingly, OFSP promotional strategies tend to work with WFSP producing and consuming communities with the aim of progressively replacing it with OFSP (Asare-marfo *et al.,* 2013). A major challenge for the bio-fortified strategy, however, is getting the farmer to accept and grow the new varieties (De Moura *et al.,* 2014).

Wani and Ali (2015) asserted that farmers' beliefs are vital to innovation acceptance. In decision theory, acceptance refers to the user's mental readiness to move beyond intention and embark on the process of using a new technology (Binbasioglu and Turk, 2020). Both theory and practice indicate that over time, beliefs get consolidated into relatively enduring belief sets (e.g., norms, attitude and perceptions), which often mediate the relationship between people's beliefs and their decisions (Rogers, 1995). Decision-making is a process by which an individual ascertains a choice to be made, gathers and evaluates information about alternatives, and selects the best choice among alternatives (Ahimbisibwe *et al.*, 2019). Thus,

arguably, food related decisions are likely to vary to the extent that individuals' beliefs vary. Likewise, foods with health benefits involve choices engendered by additional personal factors such as health consciousness, nutrition knowledge, and attitudes towards novel foods (Jezewska-Zychowicz and Królak, 2015; Steur *et al.*, 2015). In a nutshell, decisions within target rural households to replace WFSP varieties with OFSP are likely to be guided by context specific psychosocial variables of the main household decision-makers/ farmers, regarding the bio-fortified sweetpotato and the base sweetpotato variety.

In analysing the potential of psychosocial contexts to influence OFSP acceptance, Myers' definition of "psychosocial as the scientific study of how people think about, influence, and relate to one another" (Myer, 2007, p. 4) is quite helpful. It embraces three related domains: social cognition, expressed and unexpressed influence, and interpersonal and/ or personal-technological relations (Dessi *et al.,* 2022). These may work together to contribute to acceptance of technologies like OFSP.

1.2 Positioning OFSP in Uganda's VAD alleviation efforts

White-fleshed Sweetpotato varieties (*Ipomoea batatas, L.*), are of South American origin, and were introduced into Africa by Portuguese explorers in the 16th Century as a food security crop (Huaman and Zhang, 1997; Stather, *et al.,* 2018). Currently several sweetpotato cultivars exist because the crop is capable of producing viable seeds. The capacity to set seed has also led to continual evolution of climatically adapted cultivars along the crop's cultivation trajectories across different ecological zones (Stather, *et al.,* 2018).

In Uganda, sweetpotato has been cultivated by farmers for over a century (Akimanzi, 1982), hence, most farmers consider the crop to be indigenous. Preceded by banana, maize and cassava, the crop is the fourth most important staple food in Uganda (UBOS, 2017). It is

a staple whose production is very widely distributed across the country (*Fig. 1.1*) (UBOS, 2016). This partly explains why it is deemed to be the most suitable potential conveyer of VA in the country (Asare-marfo *et al.,* 2013). Given, sweetpotato also thrives through vegetative propagation, quality planting materials of desired varieties can easily be shared in farmers' networks, which could entrench the crop among target communities (Namanda *et al.*, 2011).

A major drawback for sweetpotato, however, is that the majority of the farmers continue to rely on conventional WFSP varieties, which are largely rich in energy and minerals but void of VA (Yanggen and Nagujja, 2006). OFSP varieties are comparatively new, having only been introduced into the country from south America and among the farming communities in 1991 and 2000s, respectively (Mwanga and Ssemakula, 2011).

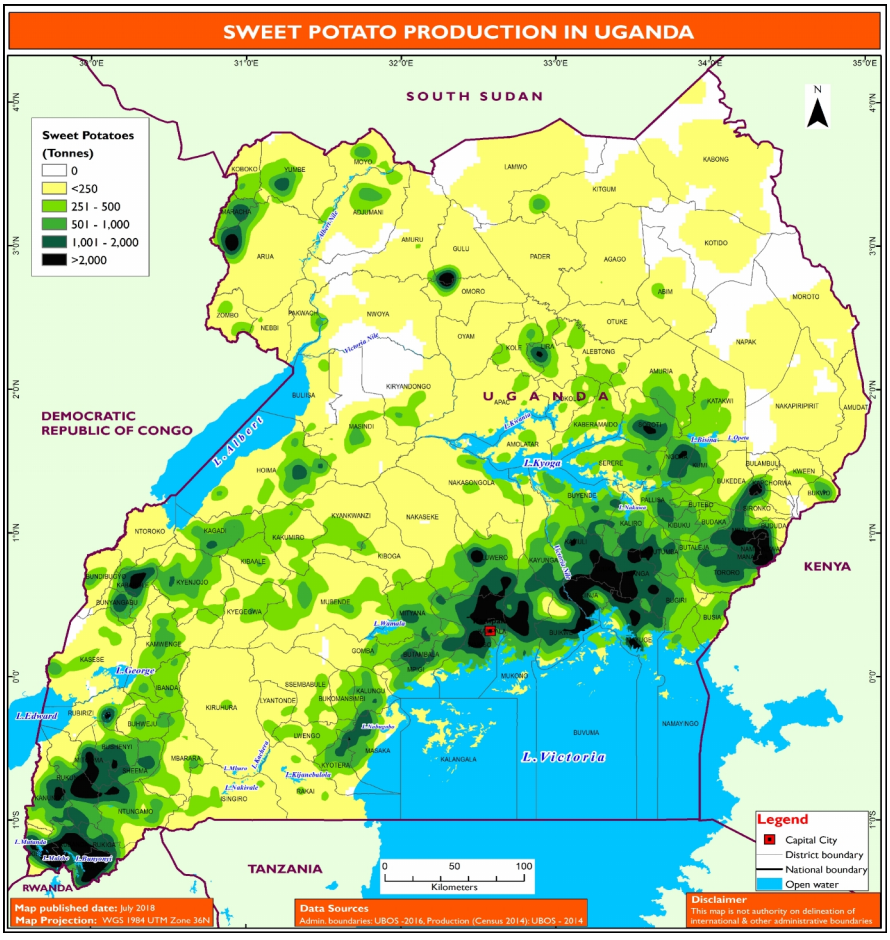

Fig. 1.1: Sweetpotato cultivation density in Uganda

First introduced, OFSP were technically and rudimentary deemed by scientists and farmers' to be less adapted to local conditions, such as weather and susceptibility to disease and pests (Mwanga and Ssemakula, 2011). This meant that, WFSP outmatched the technical qualities and performance of OFSP varieties in the fields and diets (Low *et al.,* 2017).

Through the Uganda National Sweet Potato Program at the National Crops Resources Research Institute–an arm of the National Agricultural Research Organization (NARO), Uganda has worked towards developing locally adapted OFSP (Mwanga and Ssemakula, 2011). The OFSP varieties currently being disseminated; (Kakamega (SPK004) and Ejumula; NASPOT 9 O and NASPOT 10 O; and NASPOT 12 O and NASPOT 13 O) were released by the GoU in 2004, 2007 and 2012 respectively. These releases were done within a broader framework of increasing access to nutritious foods by citizens (GoU, 2011). The varieties have been credited by breeders for root shape, dry matter content and yield potential (Low *et al.,* 2017). Mwanga *et al.* (2007, page 1729) had previously observed that "by 2004 Kakamega and Ejumula were spreading quickly via various channels and had already reached 28 districts in Uganda".

1.3 Efforts for disseminating OFSP in Uganda

At the beginning of this century, OFSP delivery efforts were woven around communally owned, isolated, small-scale pilot plots. The initial efforts, which were implemented from 2000 to 2002, were sponsored by Micronutrient Operational Strategies and Technology (MOST), a USAID project implemented in partnership with local and national agricultural and medical organizations (Mwanga *et al.,* 2007). The project demonstrated that multi-sectoral partnerships played a vital role in enhancing demand for OFSP vines. The other major attempt was the "*promotion of OFSP varieties through schools in urban and*

peri-urban communities of Kampala, Uganda". This was a joint initiative by Makerere University, the National Agricultural Research Organization (NARO), the International Potato Center (CIP), and the Joint-Energy and Environment Project (JEEP) (Miiro *et al.,* 2006). This project concluded with the recommendation to integrate nutrition and health components throughout OFSP project cycles (Loechl *et al.*, 2010). Around the same time, NARO's promotional efforts focused on OFSP production and post-harvest management through farmer field schools in Soroti (Stathers, 2005). These initiatives demonstrated that the OFSP value chain approach and a focus on contributing toward VAD alleviation could broaden innovative value addition.

Building on lessons from earlier delivery pilots, HarvestPlus—a research program of the Consultative Group on International Agricultural Research (CGIAR) on Agriculture for Nutrition and Health—implemented a relatively large scale multi-component pilot between 2007 and 2009 (HarvestPlus, 2012). This "reach the end users" initiative had agronomic, consumption, nutrition and health components targeting OFSP end users in three districts: Kamuli, Mokono and Bukedea. This was a consortium of international, regional and national research and development organizations. End-line assessments showed that the area under OFSP cultivation increased from one percent to 44% of total sweetpotato production area in project sites (HarvestPlus, 2012).

The outcomes of earlier projects coupled with pressure to strategically respond to widespread VAD deficiency triggered major OFSP delivery interventions. Notable among these interventions were those by the MAAIF and a HarvestPlus led national campaign executed between 2012 and 2016 (later extended until 2018). The HarvestPlus's "the Dissemination and Delivery of Bio-Fortified Crops (DDBC)" aimed to disseminate NASPOT 9 O, NASPOT 10 O, NASPOT 12 O and NASPOT 13 O) nationally and re-branded the

varieties with names that rhyme with local languages. OFSP was also a major crop in a US$ 27.7 million, multi-sectoral, World Bank funded five-year project (2016–2020) of the GoU that aims to increase the production and consumption of micronutrient-rich foods by women and children in 15 hidden hunger hit rural districts.

1.4 The known explanatory factors for OFSP acceptance

The most widely accepted explanatory factors for the acceptance of OFSP can be categorised into technology push (claims about nutritional knowledge and information and the product's characteristics) and technology pull factors (beliefs, attitude and perceptions, contextual factors such as socio-demographics and markets). Push factors are inclined toward objective attributes and represent the objective realities about food. On the other hand, the pull factors, are oriented towards beliefs of targeted individuals, and as such represent the construed/ perceived realities about food. These two domains are known to influence acceptance behaviour inter-dependently. However, in a state of contradiction, or misaligned status of a construed reality and objective reality about an innovation, students of innovation, for example, Rogers (1982), Chambers (1983, 2007), Kim and Mauborgne (2005) and Ndaula (2019), assert that the acceptance/ rejection of an innovation would be inclined more towards the dictates of construed realities. Relatively aligned construed and objective realities, are deemed to be the trigger of epidemic acceptance of new ideas (Kim and Mauborgne, 2005).

Evidence, for example, suggests that nutritional claims and product characteristics about the health benefits of foods are influential in their acceptance (Mogendi *et al.,* 2016). Typically, though, one's nutritional knowledge is moderated by the context in which one lives and is often associated with one's attitude towards the food itself and the risk and benefit one associates with the food (Sun *et al*., 2006). Related evidence gathered by

Chowdhury *et al.* (2011) on acceptance of OFSP versus WFSP, for example, indicated significant impact of perceptions regarding nutritional benefits and sensory quality indicators, such as colour (appearance), texture and flavour on purchase intentions. Some studies, though, indicate that acceptance is primarily an outcome of decision-makers' trade-off between health benefits and dietary attributes (Lagerkvist *et al.,* 2016); meaning that acceptance is based on one's willingness to concede certain benefits such as taste in exchange for health (Verbeke, 2006).

Several students of OFSP posit that its several varieties have several advantages (e.g., yield potential, maturity time, acceptable taste, dry matter content and health value) beyond those possessed by the conventional WFSP (Mwanga and Ssemakula, 2011; Low *et al.,* 2017). Others, Chowdhury *et al.* (2009) for example, aver that consumers feel more positive about the dietary characteristics of the OFSP varieties compared to the WFSP varieties. de Brauw *et al.* (2015), in a study of OFSP adoption and health information pathway for VA consumption, also concluded that OFSP attributes, such as the resistance of vines to pests and yield potential, are sufficient for acceptance of OFSPs but did not find nutrition information to influence the acceptance of these new sweetpotato varieties.

It can thus be argued that the decision to accept OFSP is largely an individual farmer's psychosocial calculus; one based on valuation of perceived fit of OFSP with individual farmer's food and health goals. Some of the extant literature also points to the association between psychosocial factors and people's willingness to pay for or consume OFSP (Chowdhury *et al.,* 2009; Talsma *et al.,* 2013; de Brauw *et al.,* 2015; Hummel *et al.*, 2018). Other studies have tended to focus on harnessing women's bargaining power in OFSP cultivation, as embedded in gender-based patterns of ownership and control of land and assets (e.g., Gilligan *et al.,* 2014); farmer propensity to accept OFSP planting materials (e.g.,

Shikuku *et al.,* 2019); and on enhancing farmers' food insecurity awareness to motivate them to cultivate OFSP (Okello *et al.*, 2017). Therefore, undertaking a study on the relationship between the core psychosocial variables and household decision-makers'/ farmers' decisions regarding OFSP cultivation was deemed essential due to its potential to provide vital inputs for OFSP delivery programs and for improving the suitability of bio-fortification strategies.

1.5 Problem statement

In 2007, HarvestPlus embarked on a countrywide effort to promote vitamin A rich orange-fleshed sweetpotato (OFSP) among rural households in Uganda. This effort was premised on the assumption that since energy-dense WFSP is a staple that is widely grown across the country, substituting it with OFSP should be a fit-for-purpose for vitamin A deficiency alleviation strategy. However, scoping studies within farming communities and major local food markets (e.g., Nakasero, Owino, Kalerwe and Kibuye), showed that OFSP varieties continue to have a low profile both in the farmers' fields and the markets.

Some studies, Mwanga and Ssemakula (2011), Mwanga *et al.* (2007) and Talsma e*t al.* (2017) for example, further suggest that farmers cultivate OFSP during variety promotion periods but the cultivation is never sustained overtime. Equally telling, even during variety promotion periods, cultivation of OFSP is mostly limited to small 'trial' plots or communal plots (Hagenimana *et al.,* 2001; Yanggen and Nagujja, 2006; Farm Radio International, 2014) and not rolled out on a relatively larger scale to mainstream fields. OFSP uptake, thus, largely remains limited to project life-cycles (HarvestPlus, 2017).

Studies focusing on rational assessment of OFSP attributes generally indicate that the status of these attributes enhances a farmer's decision to switch from WFSP to OFSP (Chowdhury *et al.,* 2009; de Brauw *et al.,* 2015; Low *et al.,* 2017). Less certain, though, is the

influence of the farmer's valuation of own capabilities such as selection of planting materials, site preparation and vine preservation, and the health risk posed by VAD on OFSP cultivation even where the initial assessment was positive. Interventions thus may fail because the farmer's socio-cognitive processes are not sufficiently supportive of such interventions. Such factors have been found to influence farmers' intentions to consume or willingness to pay for OFSP (e.g., Chowdhury *et al.,* 2009; de Brauw *et al.,* 2015). It is this gap in knowledge regarding how farmers' valuation of: i) the benefits of OFSP; ii) food and health goals and; iii) how the approval of peers influences their cultivation of OFSP, which this study aimed to address. The study also recognized that any variety substitution process requires an extension of the models conventionally used to study behavioural intention to accommodate the variation that subsequently occurs in implementation behaviour.

1.6 Objectives

The main objective of this research was to enhance the understanding of the influence of farmers' cognitive and socio-cultural contexts on orange-fleshed sweetpotato (OFSP) acceptance behaviour in Uganda.

The specific objectives were to:

1) Determine the influence of farmers' beliefs about sweetpotato varieties on their decisions to cultivate OFSP.
2) Determine the influence of farmers' perceived control over production assets, and peer approval on their decisions to cultivate OFSP
3) Assess the extent to which farmers' perceptions of health risk influence their decisions to cultivate OFSP.
4) Determine the mechanisms through which farmers' perceived control over production assets and peer approval influenced their OFSP cultivation behaviour.

1.7 Significance of the study

The study used a two-pronged approach to generate two categories of outputs. First, the study identified key constructs that can be used to predict OFSP related behavioural change outcomes. Such constructs can be used by practitioners to improve intervention targeting, social marketing as well as in designing training programs associated with OFSP delivery efforts.

Second, the study identified the process through which farmers align their cognitive-cultural environment with acceptance decisional outcomes. This output can be helpful to policy-makers who are keen on creating an environment, which simulates bio-fortification interventions that follow self-driven behaviour change trajectories in the effort to combat hidden hunger. Insights into the processes of acceptance can also be helpful for practitioners in improving the economic feasibility of theory of change pathways utilized to deliver bio-fortified crops. They are also key inputs into delivery strategy articulation and implementation design. Thus, behavioural antecedents of OFSP cultivation, which the present study unveils, are important practical ingredients for interventions that advance agricultural development for improved public health outcomes.

1.8 Theoretical Analysis

This thesis sought to understand the influence of farmers' cognitive and socio-cultural contexts in uptake behaviour of bio-fortified crop varieties. Key theories that have been widely used in understanding cognitive and socio-cultural processes include: the Theory of Planned Behaviour (TPB) (Ajzen, 1991), an annexe of Fishbein and Ajzen's (Fishbein and Ajzen, 1975), Theory of Reasoned Action, the Health Belief Model (HBM) (Janz and Becker, 1984), the Protection Motivation Theory (Rogers, 1975), the Social Learning Theory

(Bandura, 1977), Thomas Schelling's game theory of 1960, Talcott Parsons' social theory, popularly called action theory of 1937, Bicchieri's theory of Social Norm Activation and the Stages of Change (SoC) Model (Prochaska and DiClemente, 1982).

For purposes of conceptualizing the research gap in this study, however, utility of the theory of planned behaviour (TPB), the health belief model (HBM) and stages of change (SoC) model seemed to offer the most relevant antecedents. The choice of the theories was particularly done because acceptance of bio-fortified crops is likely to follow a staged trajectory and is inclined to health-related behavioural changes (Conner and Norman, 1998; Mceachan *et al.,* 2016). However, Frederiks *et al.* (2015) suggest that household decision maker behaviours are not entirely or even primarily driven by rational considerations. Often individuals strategically respond to such aspects as norms in order to optimize self-motivated-interests (Mackie *et al.*, 2015). Thus, individuals may fail to conform to rational calculus because of the constraints imposed on decision-making by other reasons/factors that shape or constrain their worldview. In such contexts, beliefs and network effect concepts may be used to explore the mechanisms involved in acceptance behaviour, within the confines of historical institutionalism (HI) (Steinmo, 2008). HI asserts that how individuals behave depends on three variables: the individual (psychology), context (situations), and the rules (culture). Network effect, also known as, Metcalfe's Law, posits that adopter likelihood to switch to a new product is associated with how fast the critical level of the consumers' technology performance expectations and the final size of the network of users is reached.

Theory of Planned Behaviour (TPB)

TPB concepts cater for farmers' rational evaluations regarding OFSP growing compatibility against their subjective norms and capability beliefs. According to TPB,

behaviour (such as cultivation of OFSP) is a conscious effort mediated by one's *intention* to engage in an act of interest. Intention is, in turn, determined by a person's attitudes toward the behaviour, their subjective norms and *perceived behavioural control (PBC),* which are in turn, intermediary outcomes of salient beliefs (accessible beliefs). One's attitude is a function of one's beliefs about the likelihood of outcomes and their importance. Subjective norms draw attention to one's considerations of 'what others think the individual should do' and 'that person's motivation to comply'.

PBC is the third predictor of intentions, which also has a direct influence on behaviour. PBC refers to one's control beliefs regarding behaving in certain way. Tavousi *et al.* (2009) suggest PBC is predicted by two variables, self-efficacy (SE) beliefs (Bandura, 1977, 1991) which measure internal control beliefs and speaks to the extent to which performance of an act is believed to be easy or difficult. The other variable is external control beliefs, which reflects the individual's beliefs about the level of control held on the necessary conditions required to perform a behaviour (Terry *et al.,* 1999).

Health Belief Model (HBM)

HBM concepts are aimed at farmers' assessment of the potential of OFSP to help them cope with perceived health threats posed by VAD. The HBM posits that behaviour is a result of a number of personal beliefs or perceptions about exposure to health threats and the available strategies to mitigate the health threat incidence (Prochaska *et al.,* 2013). The original HBM uses a set of four core beliefs, including *perceived susceptibility*, *perceived severity*, *perceived benefits* and *perceived barriers* to predict health behaviour. Latter expansions of the model include *Self-efficacy*, *cues to action* and modifying factors as predictors of behaviour. *Perceived susceptibility* speaks to beliefs about personal risk to a

health problem whereas *perceived severity* draws attention to a person's beliefs about the seriousness of a health threat. Likewise, *perceived benefits* relates to one's beliefs about health or non-health gains from taking action while *perceived barriers* are linked to one's beliefs about the costs or negative results associated with a behaviour (Janz and Becker, 1984). *SE* is similar to the concept described above under TPB and has its origins in Bundura's SLT (Bandura, 1977); *cues to action* are people, events or things, such as advice, media stories and sickness of family member that trigger or maintain actual adoption of behaviour. The concept of cues to action may take on one or both of two dimensions; the internal, which covers symptoms related to a health problem and the external, which are constructed via media stories or social relations (Morris *et al.,* 2012; Li and Williams, 2016). Modifying factors are largely contextual, such as education, age and past experiences (Armitage and Conner, 2000).

Stage of Change Model (SoC)

The Stages of Change model was used to model a farmer's decision to grow OFSP, which is the dependent variable. In keeping with the SoC, household members' decisions to engage in consumption-oriented production behaviour of OFSP is envisaged as a journey that farmers walk iteratively, starting from pre-contemplation, contemplation, preparation, and action that ideally leads to 'maintenance'. Pre-contemplation and contemplation can be deemed to feed "behavioural intention" as described in the TPB, whereas preparation and action relate to 'trial' activities, in which one experiments with the new behaviour, before deciding to maintain it (Vet *et al.,* 2007). Up and downstream movement along SoC stages are viewed as being motivated by two constructs, self-efficacy and rational calculations made by individuals (Armitage *et al.,* 2004; Morris *et al.,* 2012).

Integration of concepts of TPB, HBM and SoC

The study adopted a situated bounded rational choice (Donahue and Klaver, 2009) model, where TPB, HBM and SoC were applied to untie the key antecedents in behavioural change processes of interest while working within the tradition of Historical Institutionalism. Theoretical integration was premised on the hypothesis that decisions regarding farmers' cultivation of OFSP are largely determined by weighing two dimensions of the behavioural change universe, namely: the perceived net benefit of the outcomes and the perceived appropriateness of the activities undertaken to achieve the outcomes.

The three models were deemed compatible since considerations for social approval and perceived capabilities as envisaged under the TPB and the risk perceptions under the HBM can arguably feed an individual's valuations that influence the decision to transition between SoC stages. Besides, because an individual mentally applies a new idea to his or her present or likely future state before deciding whether or not to try it (Rogers, 1995), intention under TPB could be considered as the first point under SoC. The study, thus, adopted a SoC-based dependent variable whereas elements of TPB and HBM were used to generate indicators of decision-makers' perceptions about their capability to pursue the health-related opportunities nested in OFSP. TPB and HBM were similarly used to generate indicators of decision-makers' predisposition to adopt the VAD alleviating varieties in the face of social pressures to stick with the conventional WFSP varieties. The conceptualization illustration is given in *Fig. 1.2*. The conceptual framework was further reduced into a thesis puzzle, *ANNEX I* and the research analysis plan, *ANNEX II*. This was done in order to make the research engagingly interesting and continually focused to the conceptual purpose.

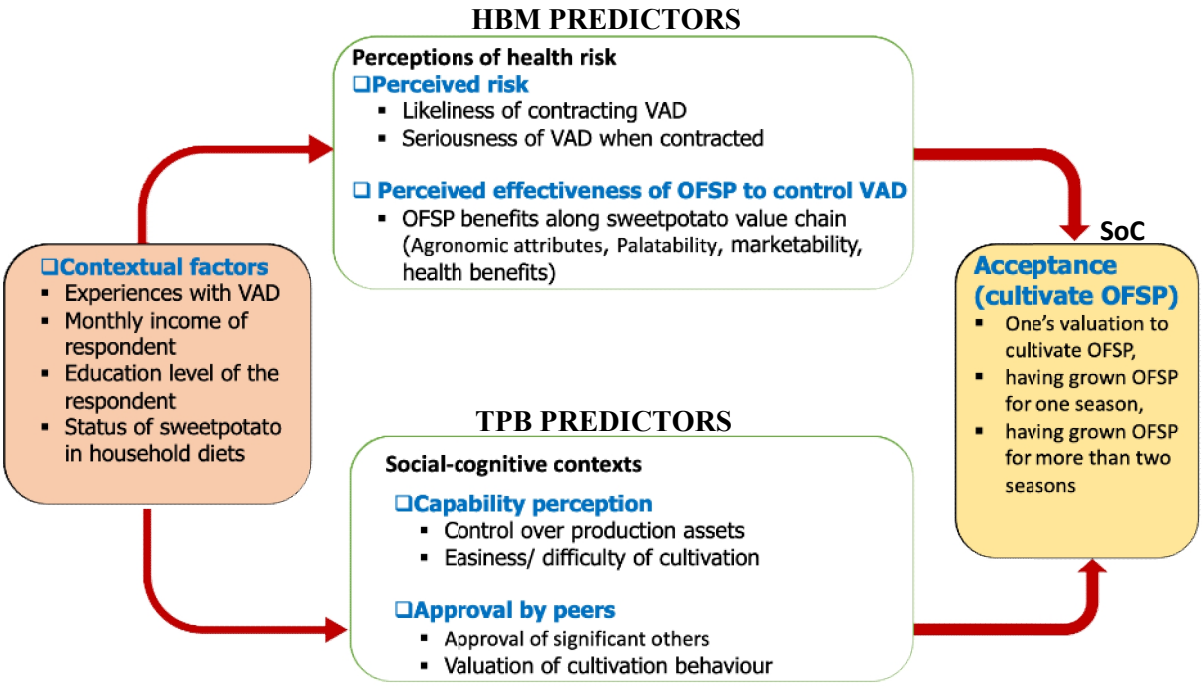

Fig. 1.2: Study conceptual framework (generated by Ndaula Sulaiman, 2022).

1.9 Structure of the thesis

The thesis is organized into seven chapters, including the present, which introduces and discusses the relevant conceptual threads and historical trends so as to frame the context and setting in which the objectives of this study were pursued. Chapter two is dedicated to the description of the methodological framework used to pursue the study objectives. Chapters three through six, present the empirical findings of the study. Each of these empirical chapters deals with a specific thread of argument that consolidates into the general purpose. Additionally, each of the chapters is structured to provide the specific introductory section to situate the chapter into the relevant scientific context, a conceptual framework, a supplementary research design concerned with chapter specific data analysis, results, discussions, conclusions and recommendations, and the reference list. Regarding content

coverage, Chapter three examines the role of beliefs in the cultivation of OFSP. The chapter appraises the theoretical threads deemed relevant to OFSP cultivation behaviour. Chapter four assesses the extent to which perceptions of risk predict farmers' decisions to cultivate OFSP. Chapter five discusses the status of perceived capability and perceived social approval as predictors of farmers' decisions to cultivate the orange-fleshed sweetpotato. Chapter six scans the mechanisms through which social-cognitive environment influence OFSP cultivation outcomes. Finally, Chapter seven wraps the thesis by bridging the arguments in the empirical chapters, via highlighting the main findings, conclusions and recommendations for practitioners, policy-makers and future research opportunities.

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CHAPTER TWO

GENERAL METHODOLOGY

2.0 Philosophical stance

This study took a broadly positivist philosophical stance, which was complimented with a constructivist-case study strategy. This perspective was taken because of two major considerations; the belief that the social world within which farmers operate has a structure that can objectively be studied and the assumption that farmers have the powers of agency by which they can shape the world they live in. In this study, analysing the structure was deemed important for understanding the objective constraints within which farmers make technology substitution decisions. On the other hand, the case study was considered useful for understanding the mental calculus that helps the farmer link the various concepts outlined in the study's logical structure. The study used survey data and statistical tools to cluster observed events of OFSP acceptance behaviour into different observable levels. Thereafter, qualitatively capture the operative reasons behind individual's OFSP acceptance behaviour via establishing meaningful variations in the comparative narratives across the case studies using pre-determined theory-based concepts, as is the case for positivist procedures.

2.1 Research design overview

The study adopted a multi-methods approach which involved both quantitative and qualitative methods. The initial data gathering phase employed a cross-sectional survey of farmers' perceptions and beliefs about OFSP cultivation. Beyond this qualitative in-depth and key informant interviews were used to sketch the decision-making process and the context for

OFSP uptake. The study aimed to understand technology acceptance behaviour by farmers operating as elements of rural households engaged in the production and consumption of OFSP. Households enrolled on DDBC project and that had participated on the project for three consecutive years were targeted by the study. These farmers were assumed to possess consistent experience and perceptions about OFSP cultivation (Rogers, 1983). Data were collected from 400 male and female smallholder farmers drawn, using stratified cluster sampling techniques, from among the 409,711 households HarvestPlus had distributed OFSP vines to between 2012 and 2016. Data analysis involved a comparison of individual farmers' acceptance behaviour, status of beliefs and predispositions with the help of ANOVA, Ordinary Least Square (OLS) regression and thematic content analysis.

2.2 Sampling and the sample

Two sampling procedures were employed to generate two samples customised for the survey and qualitative case study respectively.

2.2.1 Survey sample:

Table 2.1, summarises the procedures used to obtain the survey sample. Column four of the first row, shows that this study was conducted in two regions, which formed two strata. These regions were purposively selected, based on Uganda Bureau of Statistics (2011) data, to represent the low end of the VAD incidence continuum (22% prevalence rate), and the high end of that continuum (42% prevalence rate) respectively. It was intended that participants from low and high VAD incidence areas be combined to provide the range and variability in beliefs and predispositions necessary for detecting any acceptance trends within the sample.

Buyende and Kyotera, formed the two study district clusters level (Row 2, Column 4). The two were randomly selected by ballot. Kyotera district OFSP activities were implemented by CEDO whereas those in Buyende were executed by VEDCO. Random sampling was used to select study sub-counties from eligible sub-counties within the two districts by ballot (Row 3, Column 4). Kirumba and Bugaya sub-counties were selected from Kyotera (Kalisizo and Kirumba) and Buyende (Bugaya and Buyende) districts, respectively.

Table 2.1: Participant selection techniques

Item	Sampling level	Sampling frame	Selected	Sampling method
1	Region	4 regions (southern, northern, eastern and central)	Eastern and central	Purposive selection to form two strata
2	District	Four districts (Masaka, Kyotera, Kamuli and Buyende)	Buyende and Kyotera	Random using a ballot (with each district serving as a cluster)
3	Sub county	Four sub-counties (Kalisizo, Kirumba, Buyende and Bugaya	Kirumba and Bugaya	Random using a ballot (with each sub-county serving as a cluster).
4	OFSP contact group	26 groups (16 groups in Kirumba and 10 groups in Bugaya).	26	Purposively for having been enrolled on DDBC project in 2013
5	Household	918 households (593 households Kirumba and 325 in Bugaya)	200	Randomly using MS Excel (within each group cluster;each group cluster signed a quota of 100 households)
6	Individual farmer	400 smallholder farmers/ the two main decision-makers in a household.	400	Purposively based on their role in decision making process in the household.

When it came to selecting the groups, all the 26 farmer groups that had been enrolled on DDBC project in Season 1 (March to July) and Season 2 (August to December) of 2013 were purposively selected (Row 4, Column 4). Kirumba sub-county had 16 registered farmer

groups whereas Bugaya had 10 such groups. It was through these groups that households accessed OFSP packages, such as the vines, promotion materials and trainings. Each OFSP farmer group was constituted by members hailing from the same village and was coordinated by a trained community resource person (CRP).

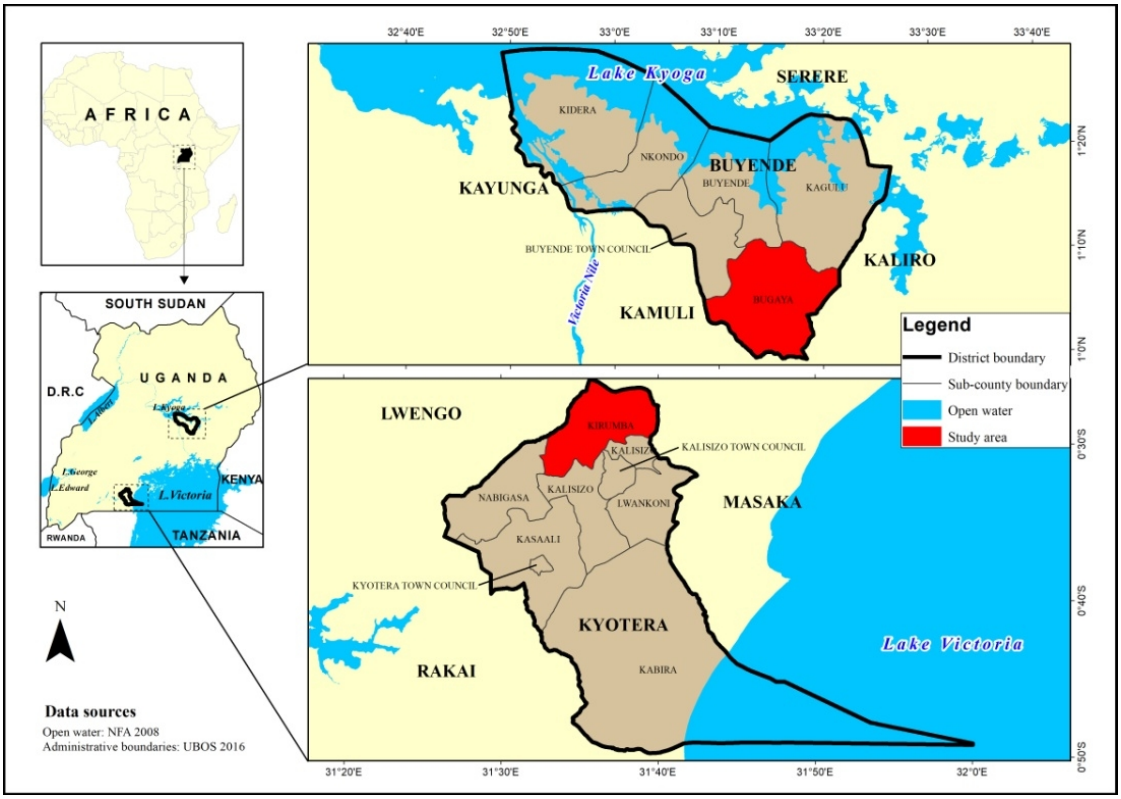

Fig. 2.1. Study sites

According to the group registry, Kirumba had an aggregate membership of 593 households whereas for Bugaya there were 325 enrolled households. To ensure comparability of data, each sub-county was assigned a quota of 100 households (Row 5, Column 5). The final sample was thus constituted of 400 smallholder farmers who were the dual decision-makers (wife and husband) in the 200 sampled households (Row 6, Column 4). The wives and husbands were purposively selected because they were deemed the main decision makers

within the household. Households with a single decision-maker (male or female only or orphaned) were wilfully excluded from the sample since their decision-making trajectories were regarded as unlikely to be similar to those of a conventional household. Decision outcomes for a conventional household were envisaged to be a negotiated position based on the perceptions held by the lead female (ordinarily a wife) and the lead male (ordinarily the husband) within the household.

2.2.2 In-depth sample

The survey results guided the selection of the qualitative interview subjects. From among the survey respondents, 341 farmers were classified into three stages adapted from Ndaula *et al.* (2020): 'underconsideration', 'trial action', and 'maintenance'. All the farmers belonging to the three acceptance stages were considered eligible to participate in the qualitative interviews. This was important for reconstructing the acceptance narrative based on the reasons and circumstances advanced by farmers to explain the trajectories they followed in their various acceptance journeys.

Snowball- sampling method was used to obtain the study participants for the in-depth interviews. Snowballing was deemed suitable because exploring reasons behind specified behaviour needed to first ascertain that an enrolled respondent had experienced the behaviour and falls in the category of behavioural cluster whose mechanisms were being examined (Steinmo, 2008). Respondents identified other farmers with whom they shared an acceptance stage using the village level categories generated using survey data. Data collection continued until additional interviews were deemed to give minimal or no incremental insights. All data collection events were recorded verbatim in field notebooks following a detailed transcription protocol (McLellan, MacQueen, and Neidig, 2003). Two members of the study team

(including the data collector) cross-checked the accuracy of the transcripts, every end of the day.

There were 42 final respondents for the interviews: 12 at 'underconsideration', 14 at 'trial', and 16 at 'maintenance' stage. Six key informants (3 females and 3 males) from three OFSP-promoting organizations (HarvestPlus, Volunteer Efforts for Development Concerns [VEDCO] and Community Enterprises Development Organisation [CEDO]) were also interviewed to supplement the farmers' narratives.

2.3 Instrumentation and variables

2.3.1 Survey interview guide design

A structured three-part interview schedule was used to collect survey data (*see ANNEX III*). Part 1 solicited information on the psychosocial explanatory variables. Part 2 of the schedule covered the dependent variable, which was a three-value discrete OFSP acceptance variable. Part 3 solicited for information about the respondents' socio-demographic status.

2.3.1a Part 1: Explanatory variables

The explanatory variables of interest were approval by peers regarding cultivating OFSP, capability perceptions and the perceptions of health risk. These variables were assessed using several item seven-point rating scales. The instrument was designed to assess accessible beliefs using relative phrases that required the farmers to evaluate OFSP against the conventional WFSP. Farmers were asked to rate how closely each scale item described their beliefs regarding OFSP as compared to WFSP. This was done because, as noted in the introduction, the delivery strategy of OFSP in the DDBC project targeted households that were already growing the conventional sweetpotato. Thus, farmers' assessment of utility of

beliefs in OFSP cultivation decisions were done by weighing the performance of OFSP against that of the conventional type on each belief's scale.

The items used to assess peer approval and capability perceptions were adapted from Ajzen (2013), Mackie *et al.* (2015) and Shikuku *et al.* (2019). Those used to help the farmers to assess their perceptions of health risk of VAD were adapted from Health Belief Model based previous studies (Weissfeld *et al.*, 1990; Soleymanian *et al.*, 2014) and previous studies on OFSP diffusion (e.g., Yanggen and Nagujja, 2006). Noteworthy, although there are more than 900 sweetpotato landraces in Uganda (Yada *et al.,* 2010), this study considered all OFSP as a batch of varieties the same way that at farm level, farmers tend to cluster varieties based on their visible traits. Similar consideration was taken in the discourses by de Brauw *et al.* (2015), Talsma *et al.* (2017) and several other scholars.

Approval by peers

Approval by peers was hypothesized as having two dimensions; 1) approval by significant others (subjective norm), measured using four (4) scale items and 2) farmers' valuation of cultivation behaviour (attitude), measured using five (5) items. The items for 'approval of significant others' focused on accessing farmers' *thoughts about the actions and approval of important others (spouse, nearby relatives, friends, nearby peer farmers, and members to groups one affiliated to)* regarding the intensity of OFSP and WFSP cultivation in their sweetpotato gardens. The importance one attached to relevant important other(s) involved their sweetpotato cultivation decisions as well as the reasons for their compliance or noncompliance. Items for 'farmers' valuation of cultivation behaviour' covered their *evaluative (mental feeling), general (external feeling) and affective (heartfelt feeling)* beliefs about cultivating OFSP as compared to the WFSP.

Capability to cultivate OFSP was assessed in terms of perceived control over production assets needed for cultivating OFSP (external control beliefs) and farmers' valuation of the level of ease or difficulty of cultivating OFSP (internal control beliefs/self-efficacy) compared to cultivating the WSFP. Perceived control over production assets was assessed using 10 items. The items were used to assess farmers' perceived relative control over productions assets needed to cultivate OFSP compared to cultivating WFSP. Belief areas assessed were *control over access to 'timely labour', 'vines', 'financing', 'fertile agriculture land', 'land with adequate water', 'professional advice' and 'other farmers cultivating similar sweetpotato variety(ies)'*. Farmers' valuation of the level of ease or difficulty of cultivating OFSP compared to cultivating the WSFP (internal control beliefs/self-efficacy), was similarly assessed using 10 items. The items aimed to assess farmers' *perceived knowledge/skills* regarding cultivating or utilizing OFSP as compared to the WFSP. The assessed belief areas mainly covered agronomic practices, including: *site selection and preparation, vine selection, planting methods, timely carrying out of field operations like planting, weeding, disease control, harvesting and vine preservation, and post-harvest handling of roots (root storage and cooking)*.

Perceptions of one's or household member's health risk

Farmers' perceptions of one's or household member's health risk were assessed along two dimensions: 1) perceived risk of VAD and; 2) `perceived effectiveness of OFSP to control VAD. Perceived risk of VAD was captured using six items on farmers' beliefs regarding the *likelihood of contracting VAD* (susceptibility) and 30 items on the *seriousness of VAD once contracted* (severity). Items for the likelihood of contracting VAD assessed farmers' beliefs regarding the likelihood of *the four youngest children and both of the decision-making farmers* bearing VAD symptoms. The youngest four children were targeted

to offer decision-makers a basis for assessing the risk perceptions, given that the HarvestPlus project which provided the context of the study was itself promoting OFSP as an intervention to mitigated VAD among children of pre-school age (0 to 7 years of age). The items used for perceived *seriousness of VAD once contracted*, focused on assessing the beliefs of farmers regarding the undesirable health effects of VAD on the *emotions, expenditure, mobility, income, and abilities to fulfil the expected duties of household members* if either of the four youngest children or the decision-making farmers in the household individually presents VAD symptoms.

Perceived effectiveness of OFSP in controlling VAD was captured using 28 items, which surveyed the perceived relative benefits of OFSP compared to WFSP in meeting decision makers' food and health goals. The items covered the range of the sweetpotato value chain and the health benefits of OFSP. They were used to access farmers' beliefs regarding: 1) agronomic attributes (*ease of vine access and preservation, resilience in the field, yields, maturity period, and harvesting methods*); 2) palatability (*preference by children and adults in household, dry matter content, colour, flavour, sugar content, cooking time, fibre and texture*); 3) marketability (*ease to market, root size and shape appeal, and root storage life*) and; 4) health benefits (*health value*).

2.3.1b Part II: OFSP acceptance (dependent variable)

Part two of the interview schedule addressed 'acceptance' of OFSP. This was assessed as an intensity of OFSP adoption based multi-stage process.

OFSP acceptance stages

Acceptance of OFSP was measured on a three-point rating scale of an ascending order of progress into acceptance, adapted from Prochaska *et al.* (2013). The respondents were required to pick the option that best described the OFSP production stage they were at. The

three points of the scale corresponded to 'underconsideration' = 1, 'trial action' = 2, and 'maintenance' = 3. Nine (9) follow up seven-point ranking scale items were responded to by farmers in either 'Underconsideration' or 'Trial' stage, and four (4) items for those in 'Maintenance' stage. The follow up was done to generate the indices that were used to validate the self-reported stage of OFSP production. A farmer would be retained in a self-reported stage, if his/her average score on follow up items was ≥ 75% than the expected maximum score.

'Underconsideration', characterized farmers who were not involved in any activity related to the growing of OFSP at the time of data collection. The 'trial' stage was the description of farmer engagement in OFSP cultivation activities for up to six months (≤ 6 months). Thus the cut-off point for the 'maintenance' stage was engagement in OFSP cultivation activities for at least six months (≥ 6 months). Six months were considered as the cut-off point because it represented at least one season of sweetpotato growing, beyond which the process would be considered as stretching to two or more contiguous seasons (Bashaasha *et al.,* 1995). Thus, acceptance was assessed as the act of considering, trying and/ or growing OFSP varieties for more than two seasons.

OFSP adoption intensity

Information regarding the share of the total area under sweetpotato production devoted to OFSP cultivation (adoption intensity in terms of percentage intensity) was also captured. This was assessed through actual enumeration of mounds of OFSP and WFSP in each farmer's field, rather than through the area allocated to OFSP or WFSP. The former was considered more accurate than the latter in determining adoption because farmers in the study area are known to cultivate sweetpotato using varying intercropping strategies (Uganda Bureau of Statistics and Ministry of Agriculture, Animal Industry and Fisheries, 2010).

2.3.1c Part III: Socio-demographic characteristics

Part III of the instrument solicited for information about the respondents and their households, specifically the respondent's educational attainment, status of sweetpotato in the household diet, wages of the respondent and experience of VAD. Respondents' experiences of VAD were captured using a binary scale (*no = 1 and yes* = 2) that focused on accessing the perception of VAD prevalence in ones' own household and in the proximate community. Income, measured on a metric scale computed as average monthly earnings (USD/month) in bad, normal and good cash flow months, multiplied by the total number of months with bad, normal and good income in a typical year respectively and thereafter divided by 12, as shown in the formula below:

$$\textit{Average Monthly Wage} = \frac{(Y\ bad \times M\ bad) + (Y\ normal \times M\ normal) + (Y\ good \times Mgood)}{12\ (Total\ numbers\ of\ months\ in\ years)}$$

Where:

Y bad, means: ……..... income in bad months

M bad, means: ……number of months with bad cash flow.

Y normal, means: ……..…income in normal months

M normal, means: ……..number of months with normal cash flow

Y good, means: ……..…income in good months

Mgood, means: ……..…..number of months with good cash flow

The average wage was collapsed into four equal interval categories (*1 = US$ 30 or less, 2 = US$ 30.1 ≤ 60, 3 = US$ 60.1 ≤ 90 and, 4 = US$ 90.1 or more than);* a strategy that aimed to peg income status of respondents against World Bank's poverty of indicator of one

dollar a day. The status of sweetpotato in the household diet, was assessed by asking the farmers to first list the food eaten in the six months that preceded the survey and then ranked by assigning each a number, that is one being the most eaten food, two the next, and so on. The education attainment of the respondent was obtained through self-reported actual level at which the respondent had stopped. Education attainments were later collapsed into four categories; none = 1, primary = 2, secondary = 3, and post-secondary = 4, to cater for those who only had a few responses and to correspond to the Ministry of Education and Sport (MoES) national education levels. MoES education presupposes similar competences among citizens who have been exposed to its curricula for a specific numbers of years who accordingly are subjected to the same examination, such as primary, "O" and "A" level.

2.3.1d Questionnaire validity and reliability

Content validity

A panel of five experts, three senior academics at Makerere University, an OFSP program delivery expert and one nutritional consultant at HarvestPlus, checked the survey instrument for content validity. Each panel member was asked to rate instrument items for their clarity and relevancy in measuring the underlying constructs as per their theoretical definitions, and their dimensions. The rating was done on a 4-point ordinal scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant], 4 = highly relevant) for clarity as well as relevance. Content validity index (CVI) for relevancy and clarity of each item (I-CVIs) was computed by dividing the number of content experts into the number of those judging the item as relevant or clear (rating 3 or 4). Following the rule of the thumb suggested by Davis (1992) that an I-CVI > 79% would be judged appropriate, while that between 70 and 79% would need revision all items with I-CVI < than 70% item were eliminated, *Table 2.2*.

Table 2.2 Scale content validity indices by S-CVI/Ave for itemized constructs (attitude, subjective norm, control beliefs, self-efficacy, perceptions of risk and acceptance)

Construct	Number of items (i)	Relevant $\sum[i_{3,4}xj_{3,4}]$	Not relevant $\sum[i_{1,2}xj_{1,2}]$	[∑(I-CVI)/i]	Interpretation
Approval of significant others (Subject norm)	4	16	4	0.800	*Appropriate*
Valuation of cultivating OFSP (attitude)	5	25	0	1	*Appropriate*
Perceived control over production assets (Control beliefs)	10	42	8	0.840	*Appropriate*
Easiness/ difficulty of cultivation (Self-efficacy)	10	39	11	0.780	Needs revision
Likeliness to contract VAD	6	26	4	0.867	*Appropriate*
Seriousness of VAD when contracted	30	142	8	0.947	*Appropriate*
Perceived effectiveness OFSP to control VAD	28	122	18	0.871	*Appropriate*
OFSP acceptance stages	27	121	14	0.896	*Appropriate*

Number of judges = j = 5. $i_{3,4}$*= total number of items judged relevant,* $xj_{3,4}$ *= total number of judges who rated the items to be relevant,* $i_{1,2}$*= total number of items judged not relevant*$j_{1,2}$*= total number of judges who rated the items as not relevant.* [∑(I-CVI)] = sum of item content validity indices, [∑(I-CVI)/i]= *average of I-CVIs.Interpretation of* [∑(I-CVI)/i]*: If higher than 79% = appropriate; between 70 and 79% = needs revision and less than 70% = eliminated.*

Scale content validity index (S-CVI) was also assessed, to make a determination of the "the proportion of total items judged content valid". A two-step average method was used to calculate the S-CVI. First, the four-point scale was reduced to a dichotomous one by

recoding scores of '3 or 4'to "relevant' and '2 or 1' to "not relevant", and the sum of judges who considered the item relevant [∑(I-CVI)] obtained. Subsequently, the total number of items used to measure a construct was divided by the sum of I-CVIs, to obtain the SCVI [∑(I-CVI)/Ave]. As recommended by Davis, (1992), any scale exhibiting an 80% agreement or higher among judges was considered as having sufficient content validity.

Internal reliability

Prior to use, the instrument was piloted on 16 smallholder farmers in Nsambya, a remote village in Rakai, to assess its reliability, suitability and validity. Nsambya was selected for two reasons: 1) it was part of the 'Dissemination and Delivery of Bio-Fortified Crops' project which had been launched in 2012, meaning that the experiences from the pilot interviews were likely to be rather similar to those of the target population and; 2) its remote location from the study sub-counties (60 kilometres for sites in Kirumba and 420 kilometres for Bugaya), would minimize the probability of contaminating the main sample. Following the recommendation of Taber (2018), indicator variable items with Cronbach's alpha coefficients greater than .70 were retained in the final questionnaire (*see chapters 4 and 5*). The coefficients for control beliefs, self-efficacy, subjective norm and attitude were .85, .90, .71 and .84 respectively. That of perceived effectiveness of OFSP to control VAD was .85, perceived risk of VAD registered .83 while that of perceived severity was .931. Thus the scales constituted by the various batches of study variables had reasonable internal consistency and reliability.

2.3.2 In-depth Interview guide

An interview guide was used to collect in-depth data. The focus was on having a 'researcher-respondent's' dialogue that spontaneous stimulates sharing of stories and reasons

behind an individual's OFSP acceptance outcome. To ensure that the flow of the dialogue was open and focused on OFSP acceptance, Network effect-related concepts (*take-off expectation, stay power, exchangeable value, complementary products and coping strategies*) was adopted as a basis for question formulation, *see ANNEX V*. This was based on Bergman and Coxon (2005) recommendation that qualitative researcher should declare the lenses upon which they collect and organize qualitative data. This, Bergman and Coxon observe, displays transparency in peer circles regarding what were regarded as data and the context upon which meanings were assigned to such data; which instils quality in the qualitative research. To ensure that the questions would generate the desired descriptive responses, they were mostly started with words like what, who, where, when or how.

Coverage and relevance

Coverage and relevance of the content of the formulated guide was ensured by subjecting the guide to internal testing, expert assessment, and field-testing (Chenail, 2011). For internal testing, one interviewer assumed a participant role as another would be interviewer conducted the interview. This provided information about the general overview of the guide. It also pointed to any possible interviewer bias and question areas that were likely to constitute ambiguities and inappropriate stating, so required further editing. Expert assessment involved subjecting the preliminary interview guide was exposed to three specialist who appraised the guide. These were (acceptance and qualitative researchers) outside the research team. The experts, interviewers and the researchers, discussed about the relevance of the questions, which was helpful for the interviewers to understand the reasons for sticking to the wording and the arrangement of the questions.

Field-testing exposed the interviewers to at least three (3) real context 'participant-interview' sessions. This provided insights that helped to tailor the guide, so that an interview

session could be finalized in the range of 45 minutes. It also helped to determine whether the guide would truly draw out a participant's perceptions and experiences (Kallio *et al.,* 2016).

2.4 Data collection and ethical considerations

2.4.1 General data collection

The Community Resource Persons were used to identify as well as reach the farmers in households that had been selected as study units. They also helped to mobilize farmers to the central points where the interviews were conducted; especially for villages where selected households were relatively distant from each other. This was done in order to bring fieldwork activities within manageable budget and to reduce intervals between interviews. The survey and the in-depth interviews were conducted in the first growing season (April to May, 2017). Fieldwork was deliberately timed to coincide with the growing season to provide cues to recall of field decisions and activities implemented in previous seasons. The timing also made possible to sketch the place of OFSP within farmers' cropping systems. Five thousand Uganda shilling (UGX 5,000) was given to each participant as a token appreciation of the time and transport costs incurred at a time when most of these farmers would otherwise be busy working in their fields.

Aware that respondents lived in areas with known high illiteracy rates (UBOS, 2016), the instruments were administered by trained interviewers in respondents' working languages (Lusoga and Luganda) in face to face sessions. Trained interviewers were used in order to reduce disparities in interviewing and recording techniques among the several numerators and interviewers deployed for survey and the in-depth interviews.

2.4.1a Survey data collection

Three hundred forty one (341) out of the 400 (85%) farmers originally sampled, fully completed the survey. The gender composition of the respondents stood at 55% female and 45% male. Information from 59 farmers could not be used because it had several missing responses. For all items that required the comparison of OFSP against WFSP that was done using a seven-point rating scale; each farmer was required to simultaneously allocate '7 balls' into two tins, one 'orange, representing the OFSP' and the other 'white, representing the WFSP', to reflect his/her perceptions about OFSP and WFSP. Thus, where OFSP scored zero, WFSP scored seven, where OFSP scored one, WFSP scored six, and so on. For equal ratings, one ball would remain unallocated, and a score of 3.5 was assigned to each variety. The strategy of having the mostly illiterate farmers rate items through a non-committing play system, was deemed appropriate for gaining access to farmers internal perceptions than having had them to ordinarily rate items as though they were in an examination.

Before conducting the data analysis, survey data were subjected to a data cleaning and editing process that was guided by a pre-designed scheme, *see ANNEX IV*.

2.4.1b In-depth interview data collection

The in-depth interviews followed the questioning system that explored the main themes/content of the research subject, one at a time. A participants was encouraged to speak freely about his/her perceptions and experiences on the theme generically, first. This, allowed the participants to fully relax (Cridland *et al.,* 2015). Then interviewing could be advanced to in-depth questions, before moving to the lighter contexts of a new main theme again.

Follow-up questions were often used to clarify a participant's response and to keep the dialogue directed to the study subject. This helped to ensure that obtained information was accurate and optimal (Barriball and While, 1994). Pre-set and/or spontaneous questions

were used as follow-up questions. The determinant of follow-up question type was the response that had been given by a participant. Pre-set questions could be used to increase interviewing consistency across different interviewers and interviews. These included use of phrases such as, '*please tell me more about the specific reasons for your view'*, and '*please give detailed explanation*'. Questions of the spontaneous nature were used in cases where it were deemed necessary to interrogate insights of interesting nature that could pop up in an interview session. Verbal and non-verbal probes were used throughout each interview. The verbal probes involved, for example, repeating or paraphrasing of an insight given by a participant whereas non-verbal probes involved unexpected silent moments that could prompt the participant to reflectively think aloud on an issue under discussion.

2.4.2 Ethical considerations

Prior to data collection, written permission to use project sites and to engage project beneficiaries as study participants was obtained from the relevant NGOs (Harvest Plus at the national level, CEDO in Kyotera, and VEDCO in Buyende), *see ANNEX VI and VII*. All of the respondents were informed of the study's purpose, and their rights as participants. They were also assured that the information they were about to share would be treated confidentially. Each participant also signed a consent letter. All information that could identify the respondents was later destroyed. For data from the in-depth interviews where the use of quotations from farmers was necessary, 'real names' were replaced with ' an abstract first name' in order to obscure respondents' identities. This was deemed important since it is likely for someone's identify to be unmasked via the analysis of language 'beyond the sentence', which could ultimately expose a respondent to potential risks.

2.5 Limitations of the study

This study collected data from subjects selected from households that were targeted by OFSP promotional program, which could limit the generalization of results. For example, the perceptions farmers held may not have been totally independent from the strength of the implementation fidelity used to execute the program's activities. Thus, studying participants within a single program may inherently have carried the weaknesses or even strengths associated with the implementation fidelity into the results of an empirical study. It is from this context that the results could potentially be less generalize-able to programs that may have used a different implementation fidelity or theory of change. Future studies could use a longitudinal design where non-intervention communities are used as comparison groups.

As noted, *in section 2.2*, households with a single decision-maker (male or female only and/or orphaned) were excluded from the sample, this may have been a missed learning opportunity since single headed households are becoming an expanding demographics even in traditionally conservative rural Uganda.

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CHAPTER THREE

FARMERS' BELIEFS INFLUENCING ORANGE-FLESHED SWEETPOTATO ACCEPTANCE AMONG SMALLHOLDER FARMERS IN UGANDA

3.0 Background

This chapter is associated with a published journal article by *Ndaula, Matsiko, and Sseguya (2019) in the Advances in Agricultural Sciences.* The chapter explores the role of farmers' comparative beliefs about the orange-fleshed sweetpotato (OFSP) and the conventional white-fleshed sweetpotato (WFSP) on OFSP acceptance, premised on the assumption that substitution of food people routinely subsist on scribes to habitual behaviours and could depend on adopters' beliefs about the new food itself. The chapter consists of; an introductory section that situates the study within the concepts of belief science, a conceptual framework, a supplementary research design concerned with chapter specific data analysis, results, discussion, conclusions and recommendations, and the list of references.

3.1 Introduction

Beliefs correspond to subjective judgments of self or of the world that reflect a particular viewpoint regarding events, causes, agency, and objects (Underwood, 2009). From a philosophical stance, a belief represents a "propositional attitude" that carries a specific meaning, expressed in a form of a sentence representing one's mental stance on the validity of the proposition (Chen, 2008; Schwitzgebel, 2010; Connors and Halligan, 2015). More specifically, beliefs have been defined as a disposition to agree/act in accordance with some proposition (Sperber, 1996; Reynolds *et al.,* 2014). So, beliefs entail at least two features: (i) representative content and (ii) the assumed truth (Stephens and Graham, 2004).

The importance of beliefs in technology acceptance lies in the belief formation process. Beliefs are broadly formed following two pathways, one's personal experiences, and/or through accepting what others say to be the truth, for example about objects and events. According to Shermer (2011), people ordinarily form beliefs first and then look for evidence in support of the formed beliefs, afterwards. The brain thus becomes invested in the beliefs, and reinforces them by looking for supporting evidence while blinding itself to anything contrary. This "belief-dependent realism", as referred to by Shermer (2011), suggests that what individuals believe determines what they deem as reality, not the other way around.

The obvious pragmatic importance of beliefs is that, they provide the basis for people to understand the world and act within it (Halligan, 2006). In a more precise sense, beliefs allow people to interpret and appraise their ongoing experience, as well as to situate experiences within a wider meaningful context involving the past and future. In so doing, beliefs present a basis for action by offering a framework for representation of their environment in their decision-making, a framework in which goals and actions are pursued (Tullett *et al.,* 2013). That way, beliefs allow individuals to pursue goals, avoid threats, and regulate their behaviour in the ever-changing environment. Tullett *et al.* (2013) posit that a single action a person takes is grounded in an intricate web of beliefs and goals.

Noteworthy, given the dependence of experience on beliefs, dysfunctional beliefs or those beliefs deemed to be inconsistent with scientific advances have been the target of psychosocial interventions (Hofmann *et al.,* 2012; Kronemyer and Bystritsky, 2014; Connors and Halligan, 2015). Since scientific advance or the 'objective beliefs', have also been subject to change as new streams of scientific discoveries and the means for measuring objectivity emerge (Connors and Halligan, 2015); technology acceptance is centred around

beliefs about the new technology held by targeted user (Kim and Mauborgne, 2005). Extending the preceding argument, where the goal of technology acceptance is structured to occur through replacement, such as that of WFSP with OFSP. Acceptance is likely to involve comparison decisions on a set of beliefs regarding the attributes of the well-known base technology (WFSP) in adopters' contexts with those of the new comparison technology (OFSP).

Additionally, on an average day, people's beliefs are taken to be what the people themselves declare. The vast majority of beliefs, however, tend to be neither conscious or reportable (Young, 2003). While such beliefs are sometimes contingent on a person's behaviour, they mostly remain unconsciously/involuntarily enacted. This automaticity applies to the formation of new beliefs as well as old ones (Connors and Halligan, 2015). Thus, where there is an incongruity between a person's verbal declarations and behaviour; their behaviour provides clearer evidence of the held beliefs, since it is these representations of their situation that tend to guide the actions (Connors and Halligan, 2015). This suggests that contrary to Ajzen's (2015) assertion that beliefs constitute the perceptive mechanisms such as attitudes, norms, self-efficacy that influence the formation of intention which in turn trigger behavioural change, for automated behaviours it may not always be the case.

Jensen *et al.* (2012) argued that if the decisional balance involves habitual behaviour (such as food related behaviour), intentions may not be sufficiently powerful to change behaviour because people tend to be unaware of decisions they make when it comes to habitual behaviours. Accordingly, breaking these automatically cued behaviour patterns would require actions that either make people more aware of their behaviours or interruption of the beliefs that underpin the habitual patterns (Mackie *et al.,* 2015).

Some of the decisional balances may be strongly linked to affective and emotional responses. For example in the case of VAD, decision-makers' beliefs about VAD as a health risk to their children or spouse have been associated with fear-based behavioural patterns (Jensen *et al.* 2012). Literature (see Shikuku *et al.,* 2019) conceptualises the acceptance of any single new idea as linked to multiple related beliefs whose contribution to decisional balance complement, supplement or compete with each other within the decision-maker's belief system. Most studies, however, strongly conclude that decision outcomes of health-related foods are primarily a trade-off between health benefits and dietary attributes (Verbeke, 2006; Lagerkvist *et al.,* 2016). Thus, sometimes a decision-maker may ignore a given belief within their belief system in order to finalize a given decision outcome (Rogers, 1983). Moreover, the decision arena for food in most rural households operates in an incomplete market structure, where production, marketing and consumption decisions are inseparable (Graeub *et al.,* 2016). Therefore, although farmers' socially construed perceptions regarding the agronomic attributes of OFSP are undoubtedly important for its cultivation, marketability and consumption related beliefs associated with the attributes of new foods, such as colour and taste, mutually matter for them to be accepted in farmers' fields (Birol *et al.,* 2009).

Rogers's (1983) seminal work revealed the importance of engaging change agents that are familiar with client beliefs, for programs aimed at bringing about behaviour change. Similarly, several studies (e.g., Wang *et al.,* 2009; Fanou-fogny *et al.,* 2011) have established that farmer beliefs influence farmer acceptance of new technologies. Previous studies, however, predominantly focus on describing or predicting behavioural intention (e.g., Yanggen and Nagujja, 2006; Shikuku *et al.,* 2019). Talsma *et al.* (2013) for example examined sensory and cultural acceptability antecedents for intentions to consume Vitamin A

rich cassava among a sample of 30 children (7–12 yr) and 30 caregivers (18–45 yr) in primary schools in eastern Kenya. They concluded that consumption and health-related beliefs are strong predictors of caregivers' intentions to feed the children on the vitamin rich cassava. However, little is known about the role of beliefs in OFSP acceptance decisions among smallholder farmers. Valuable insights could be revealed by focusing on the role beliefs held by the farmers play in OFSP cultivation within smallholder farming households, since the acceptance of OFSP is likely to involve switching from a habitual behaviour. As noted earlier, intention may not always predict habitual behaviour, such as the ones involving switching from one food type to another. Moreover, current studies mostly focus on simple technologies with articulated easy to measure functions and tend to focus on individuals working in formal context. In this study, rural household decision-makers' acceptance of OFSP was assumed to go through various milestones of decision points that are influenced by different beliefs related to agronomic, marketing and consumption of OFSP in relation to the WFSP, within their belief systems. Therefore, this study assesses the role of agronomic, marketing and consumption related beliefs on acceptance decision process of smallholder farmers drawn from a sample of OFSP adopting rural smallholder farmers. In doing so, this study seeks to develop a belief-based characterization of the OFSP acceptance process in order to guide variety development and delivery efforts.

3.2 Conceptual Framework

Acceptance of new technologies is probably more meaningfully explored, when seen as a process, rather than as a binary outcome (where an individual is deemed to either accept or reject a new behaviour). To that end, Prochaska and DiClemente (1982) offer the stages of change (SoC) model, which was deemed appropriate in this study because it sub-divides

adopters between categories that represent different milestones, or 'levels of motivational readiness' (Heimlich and Ardoin, 2008), along a continuum of behaviour change.

From a SoC perspective, acceptance behavior may be viewed as a five-stage process involving pre-contemplation, contemplation, preparation, action, and 'maintenance'. Pre-contemplation and contemplation may be deemed as the first stage, where one is still 'under-consideration' (matching behavioural intentionality) because a person mentally applies a new idea to his or her present or expected future state before deciding whether or not to try it (Rogers, 1983). Preparation and action relate to 'trial' activities, in which one experiments with the new idea before deciding to maintain it (Vet *et al.,* 2007). The stage combination was premised on the assumption that cultivation activities start from crop-oriented field preparations until when the crop is harvested. In the context of this study, the cut-off time for decision-makers in 'trial' and 'maintenance' stage was six months. On average, six months represent at least one season in sweetpotato growing cycle, beyond which would be two or more contiguous seasons (Bashaasha *et al.,* 1995). Inter-stage transition is an outcome of decisional balance, where relapsing is also common (Armitage *et al.,* 2004), even among farmers who have reached sustained cultivation. This is so, since switching from one growing season into another involves intentional renewal decisional balances; where the farmer may opt out, increase or reduce the cultivation intensity. The rationale behind a staged model is that adopters at the same stage should face similar challenges and/ or barriers, and thus can be helped by the same type of intervention (Morris *et al.,* 2012). Therefore, this study adopted a three-staged SoC-based (acceptance) dependent variable, which sequentially starts with 'underconsideration', through 'trial' and finishes in the 'maintenance' stage (*Fig. 3.1*).

Decisions to transition between the stages (represented by gapped green line numbered 1 to 3*, Fig. 3.1*) can be argued to be motivated by the beliefs farmers hold within

their belief system (represent by perforated circle in the middle, *Fig. 3.1*) that are associated with that particular inter-stage. Besides, the cultivation of bio-fortified foods through acceptance stage, could potentially be associated with a set of beliefs (related to health-risk and production, marketing and consumption of OFSP and farmers' normative, control-related and behavioural beliefs) due to the health and nutrition role of OFSP (Shikuku *et al.,* 2019).

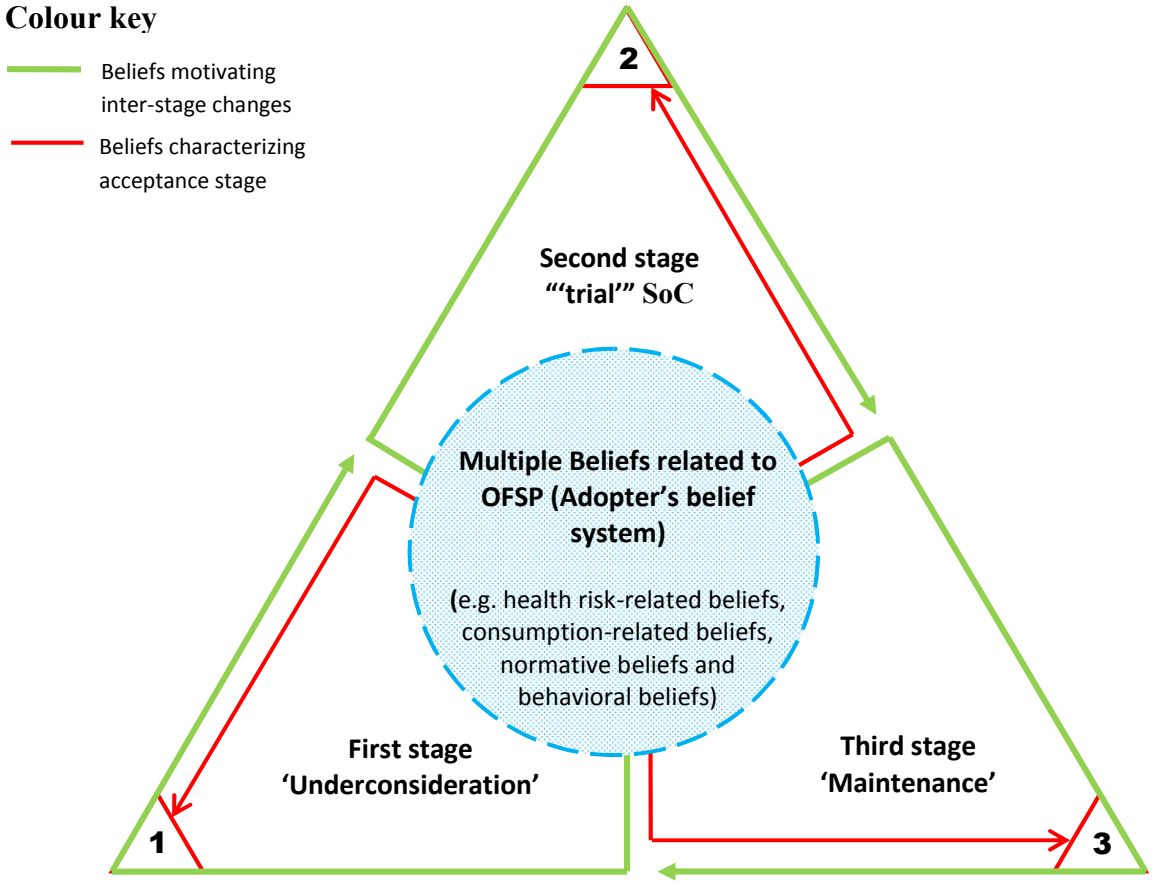

Fig.3.1: The study conceptual framework

Three health related beliefs are likely to affect behaviour: 1) the perceived likelihood to contract a health condition (susceptibility); 2) beliefs concerning the seriousness of health conditions if contracted (severity); and 3) beliefs concerning the benefits or barriers

associated with the proposed intervention (appropriateness of intervention) (Rosenstock, 1974). As noted earlier smallholder farmers' are known to consume what they produce, selling off the surplus (Graeub *et al.,* 2016). The appropriateness of bio-fortified crops as a VAD intervention could thus be affected by farmers' beliefs regarding the new crop's ability to match the production, consumption and marketing needs of the household.

At the same time, Ajzen and Sheikh (2013) suggest that behaviour changes (such as changing from WFSP to OFSP) can be affected by whether individuals: 1) perceive nearby peers to approve of or carry out the new behaviour themselves (normative beliefs); 2) perceive themselves as having control over required assets for them to engage in the behaviour and; 3) evaluate being involved in the new behaviour positively or not (behavioural beliefs). This study assumes that variations in predominant beliefs held by farmers' (represented by a red arrow from belief systems to an individual stage) account for a farmer's being characterized as being at either 'underconsideration' (first stage), 'trial' (second stage) or 'maintenance' (third stage) and subsequently explained their advancement from one acceptance stage to another. Therefore, this study aimed to test two hypotheses; H1: beliefs regarding OFSP cultivation held by the farmers significantly differed across the stages of acceptance and H2: beliefs positively and significantly explain decision makers progressing from 'Underconsideration through the 'Maintenance' stages.

3.3 Research design

The data pertaining to this chapter were of quantitative type and were gathered as part of the larger survey whose methodology is described in *chapter 2.* This chapter concerned farmers', consumption, health, marketing, production, normative, internal and external

inclined self-efficacy and behavioral, related beliefs regarding OFSP relative to the base WFSP varieties and OFSP acceptance stages, *section 2.2.1 a and b.*

Data analysis

The data analysis was done in three steps using the Statistical Package for Social Scientists (SPSS) version 16. First, frequencies, percentages and ANOVA were generated for acceptance stages. The ANOVA was conducted to compare the acceptance stage means of the two study districts. This was done to evaluate whether data from farmers drawn from Kyotera districts merited to be pooled together with that obtained from their counterparts drawn from Buyende district. Second, one-way ANOVA was performed to *locate the* beliefs that were associated with/explained farmers' progressing to the different stages. According to Filed (2013), ANOVA involves four main steps: 1) stating the null hypothesis H0 and alternative hypothesis Ha; 2) deciding on the significance level, α; 3) computing the value of the test statistic to determine the p-value and 4) interpreting the result of the hypothesis test. The rule of the thumb is that, if $p \leq \alpha$, reject H0 and accept Ha; otherwise, do not reject H0. H0 presupposes significant differences in the means of the variables across the groups under which comparison are being done whereas Ha offers a none-significant difference hypothesis. However, if the comparison involve more than two groups, ANOVA would supply the magnitude and sign of the difference but it would be an insufficient test for revealing where the differences exist. Post hoc tests were done in the third step to locate the source of mean differences, revealed in one-way ANOVA as suggested by (Field, 2013).

3.4 Results

Preliminary descriptive

In this study, acceptance was conceptualized as a three-stage process, 'Underconsideration', 'Trial' and 'Maintenance'. It was methodological hypothesized that the level of acceptance of OFSP in Kyotera district which was drawn from low VAD incidence region did not significantly differ from that of Buyende district that represented high VAD incidence regions. This was based on the observation that OFSP remained with a low profile in major local markets that are the central destination for fresh food produced across the country (*see section 1.5: problem statement).* Descriptive outputs revealed that out of 341 respondents of this study, 238 (70%) of the farmers had maintained OFSP cultivation, 63 (19%) were at 'trial' stage while 40 (11%) were still considering to start cultivating OFSP.

Table 3.1, column three, shows that the sample of farmers of this study, had comparably more farmers in the 'Underconsideration' and 'Trial' stage in Buyende than Kyotera district. Kyotera had more farmers in the 'Maintenance' stage, in numerical terms, however, the statistical comparison of the means along the acceptances stages of the two district showed the differences to be non-significant (*Table 3.2, column 7*). This suggested that the level of acceptance of OFSP in Buyende and Kyotera, did not differ within the two subsamples. So, subsequent analyses pooled data from Buyende and Kyotera district into one.

Table 3.1: Mean differences related to acceptance stages and districts covered in the study.

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
'Under consideration'	Buyende (n =25)	182	.1374	.38634	.02864	.1248	.2378
	Kyotera (n = 15)	159	.0943	.20580	.01632	.0118	.0763
	Total (n = 40)	341	.1158	.32225	.01745	.0830	.1516
'Trial'	Buyende (n = 33)	182	.1813	.41892	.03105	.1640	.2865
	Kyotera (n = 30)	159	.1887	.34637	.02747	.0841	.1926
	Total (n = 63)	341	.1850	.38867	.02105	.1434	.2262
'Maintenance'	Buyende (n = 114)	182	.6263	.07412	.00549	-.0053	.0163
	Kyotera (n = 124)	159	.7799	.17507	.01388	.0040	.0589
	Total (n = 238)	341	.7031	.13167	.00713	.0036	.0316

Table 3.2: Comparison of Means of acceptance stages in two study districts using ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
'Underconsideration'	Between Groups	1.600	1	1.600	16.087	.051
	Within Groups	33.708	339	.099		
	Total	35.308	340			
'Trial'	Between Groups	.641	1	.641	4.284	.067
	Within Groups	50.720	339	.150		
	Total	51.361	340			
Maintenance	Between Groups	.057	1	.057	3.319	.079
	Within Groups	5.837	339	.017		
	Total	5.894	340			

Beliefs in OFSP acceptance decisions

This study hypothesized that positive/ or negative beliefs related to OFSP held by rural smallholder farmers (household level decision-makers) influence these farmers'

decisions to accept OFSP. A one-way between subjects ANOVA was conducted to compare the effect of beliefs regarding health-risk and production, marketing and consumption of OFSP, and peers reaction towards OFSP, perceived levels of control over production assets and behaviour on OFSP acceptance.

As show in Table 3.3, most of the beliefs considered in this study had positive association with acceptance. Regarding production-related beliefs which included: beliefs about ease of vine access, vine preservation, crop resilience, yields, storage root size and maturity period, there was a significant positive association of ease of access to OFSP vines ($F(2, 338) = 13.7$, $p \leq .001$), ease of vine preservation ($F(2, 338) = 6.72$, $p \leq .01$), crop resilience in the field ($F(2, 338) = 2.95$, $p \leq .05$), storage root size ($F(2, 338) = 5.00$, $p \leq .01$) and early maturity ($F(2, 338) = 3.61$, $p \leq .05$) on acceptance. The association of yield was positive, although not significant. This suggests that vine access, ease of vine preservation, crop resilience, storage root size and early maturity of the OFSP positively and significantly related with farmers' evaluation of their option to switch to cultivation of OFSP.

Among consumption related beliefs, there was a significant positive association of OFSP preference in a household ($F(2, 338) = 4.03$, $p \leq .05$) and dry matter content ($F(2, 338) = 6.45$, $p \leq .01$) with acceptance. Beliefs on harvest method (piecemeal duration), health benefits and the fibres content of the OFSP, positively associated with acceptance but not significantly. There was also a significant positive association of beliefs regarding the marketability of surplus OFSP storage roots ($F(2, 338) = 3.18$, $p \leq .05$) with acceptance of OFSP.

Table 3.3: Mean differences related to decision-makers' beliefs and acceptance stages

Beliefs categorization		**Mean score[b]**						
Dimension	**Beliefs**	**Stage 1 (N=40)**	**SD**	**Stage 2 (N = 63)**	**SD**	**Stage 3 (N = 238)**	**SD**	**F-vlaue**
Production	Ease vine access	1.75	0.95	2.00	0.82	2.70	1.45	**13.7*****
	Vine preservation	2.69	1.47	2.98	1.30	3.49	1.53	**6.72****
	Resilience in field	2.56	0.97	3.00	0.97	2.84	0.87	**2.95***
	Yield	3.42	1.14	3.56	0.83	3.69	0.84	1.93
	Storage root size	4.73	1.55	4.98	1.00	5.23	0.89	**5.00****
	Early maturity	5.01	1.32	5.00	0.85	5.29	0.84	**3.61***
Consumption	Piecemeal duration	3.88	1.79	4.06	1.34	4.19	1.46	0.775
	OFSP preference	2.85	0.60	3.11	0.69	3.18	0.69	**4.03***
	Dry matter content	2.85	1.64	3.75	1.55	3.71	1.38	**6.45****
	Health benefits	5.36	0.92	5.44	0.94	5.40	0.85	0.115
	Fiber content	4.15	1.56	4.48	1.25	4.05	1.42	2.28
Market	Marketability	3.17	0.95	3.28	0.76	3.48	0.82	**3.18***
Health risk	Susceptible (decision-makers)	3.01	1.69	2.70	1.45	2.76	1.58	0.54
	Susceptible (children)	4.21	0.98	4.60	1.16	4.07	1.39	**4.16***
	Serious (decision-maker)	5.85	0.89	5.96	0.92	5.95	0.82	0.25
	Serious (children)	4.64	0.93	4.09	1.18	3.97	1.18	**5.75****
Attitude	General	4.55	1.45	4.56	1.23	4.95	0.97	**4.80****
	Affective	4.90	1.28	4.90	1.08	5.11	0.83	1.82
	Evaluative	5.30	1.07	4.99	1.17	5.19	0.82	1.64
Social	Others' action	1.55	0.81	1.94	1.04	3.12	1.36	**41.37*****
	Other approval	2.98	1.66	3.57	1.68	3.57	1.45	**7.53****
Control	Timely labor	2.46	1.57	2.90	1.28	3.01	1.16	**3.38***
	Access vines	1.45	0.83	1.58	0.93	2.24	1.30	**13.19*****
	Access other farmers	1.45	0.78	1.52	0.67	2.15	1.25	**12.73*****

** P ≤ 0.05, ** P ≤ 0.01 and *** P ≤ 0.001*

[b]*Stage 1 = Underconsideration, stage 2 = Trial and Stage 3 = maintenance.*

Regarding VAD health risk-related beliefs, the mean scores were higher for 'under-consideration' and lower for 'maintenance' stage regarding decision-makers' beliefs about

susceptibility to VAD ($F(2, 338) = 4.16$, $p \leq .05$) and seriousness of VAD ($F(2, 338) = 5.75$, $p \leq .01$) among children in the adopting household. This suggests that the association of VAD health risk related beliefs with acceptance is negative and significant. The susceptibility and seriousness of VAD among the decision-makers was negative but not significant, suggesting that decision-makers' health risk beliefs did not matter in acceptance.

Similarly, affective and evaluative behavioural attitudes were positively associated with acceptance, although not significantly. However, among the behavioural beliefs including evaluative, general and affective beliefs, there was a positive significant association of general attitudinal belief towards OFSP ($F (2, 338) = 4.80$, $p \leq .01$) with acceptance. Further, the association of social approval (normative beliefs) with acceptance, was positive and significant for both the beliefs about actions of peers ($F (2, 338) = 41.37$, $p \leq .001$) and approval of peers ($F (2, 338)=7.53$, $p \leq .001$). This suggests that beliefs about peers' actions and endorsements regarding OFSP cultivation mattered for farmers' acceptance of OFSP. Lastly, beliefs about control over production assets mattered for acceptance with a positive significant association of control, over access to, timely labour ($F (2, 338) = 3.38$, $p \leq .05$), OFSP vines ($F (2, 338) = 13.19$, $p \leq .001$) and other OFSP cultivating farmers ($F (2, 338) = 12.73$, $p \leq .001$) with OFSP acceptance stages.

Beliefs in inter-acceptance stage transition

This study further hypothesized that beliefs related to OFSP held by decision-makers positively motivated decision-makers to advance from one acceptance stage to another. Inter-stage transitions considered were, 'underconsideration' to 'trial', 'trial' to 'maintenance' and 'maintenance' to 'underconsideration'. Post hoc comparisons using the Bonferroni test was used to compare the mean differences for beliefs in each acceptance stage with all other

stages. This was done in order to find out which inter-stage transition(s) mean differences significantly differed, for beliefs that were significant in the ANOVA analysis. Beliefs regarding vine access, ease of vine preservation, crop resilience, storage root size, early maturity of the OFSP, OFSP preference in a household, dry matter content, marketability of surplus OFSP storage roots, susceptibility to and seriousness of VAD among children in the adopting household, general attitudinal belief towards OFS, beliefs about peers' actions and endorsements regarding OFSP cultivation as well as control over access to, timely labour, OFSP vines and other OFSP cultivating farmers significantly associated with acceptance.

Post hoc tests did not reveal mean scores for beliefs about early maturity and marketability of surplus OFSP storage roots to be significantly different for any of the three inter-stage transitions as earlier revealed by ANOVA analysis (*Table 3.4*). The results suggest that early maturity and market access are necessary in the acceptance of OFSP, but do not matter in farmers' efforts to progress or relapse within acceptance stages. The mean score differences for other beliefs significantly differed between one or two inter-stage transition, as shown in the following section.

'Underconsideration' to 'trial' transition

Post hoc comparisons indicated that the mean score for farmers' at 'trial' stage for beliefs about OFSP resilience in the field (MD = 0.442, $p \leq .05$), dry matter content (MD = 0.90, $p \leq .05$) and control over timely access to labour (MD = 0.45, $p < .05$) were significantly different from those of farmers in 'underconsideration' stage (*Table 3.4*). Taken together, these results suggest that high positive evaluation of these beliefs in the production, consumption and control over production assets domains actually do have an association with 'underconsideration'- 'trial' inter-stage transition. Specifically, the results suggest that when

delivered OFSP varieties are believed by the farmers to be resilient to adverse conditions, have high dry matter content and not require timely planting, farmers are likely to try out cultivating them.

'Trial' to 'Maintenance' transition

The transition from 'trial' to 'maintenance' stage of cultivating OFSP was associated with beliefs regarding production, health risk, general attitude, social approval and control over production assets. However, consumption and market related beliefs seemed not to have mattered (*Table 3.4*). Post hoc comparisons test indicated that the mean score for farmers in 'maintenance' stage concerning ease of vine access (MD = 0.70, $p \leq .05$) and storage root size (MD = 0.50, $p \leq .05$) were significantly different than those of farmers in 'trial' stage. The test for mean score of susceptibility of children to VAD (MD = -0.54, $p \leq .05$) and seriousness of VAD in children (MD = -0.67, $p \leq .01$) were significantly lower for farmers' in 'maintenance' stage than those in 'trial'. Furthermore, the Post hoc test indicated the mean score for 'maintenance' stage regarding beliefs about general attitudinal (MD = 0.39, $p \leq .05$), actions of peers regarding OFSP cultivation (MD = 1.57, $p \leq .001$), and control over access to, timely labour (MD = 0.55, $p < .05$), vines (MD = 0.80, $p < .001$) and other OFSP cultivating farmers (MD = 0.63, $p <. 001$) to be positive and significantly different from those in 'trial' stage. These specific results suggest that high positive evaluation of ease of access to vines, storage root size, general attitude, action of peers and control over product assets are likely to result into farmers progressing from the 'trial' to sustained cultivation of OFSP.

Table 3.4: Mean differences between acceptance stages

Belief categorization		Inter-stage Mean difference and significance[b]		
Dimension	Beliefs	Stage1—>2	Stage2—>3	Stage1—>3
Production	Ease vine access	0.25	**0.70***	**0.95***
	Vine preservation	0.30	0.50	**0.80***
	Resilience in field	**0.442***	-0.166	0.276
	Storage root size	0.26	**0.50***	0.24
	Early maturity	-0.01	0.29	0.28
Consumption	OFSP preference	0.26	0.07	**0.33***
	Dry matter content	**0.90***	-0.04	**0.86***
Market	Marketability of excess	0.12	0.19	0.30
VAD risk	Susceptible (decision-makers)			
	Susceptible (children)	0.40	**-0.54***	-0.14
	Serious (decision-maker)			
	Serious (children)	-0.55	**-0.67****	-0.12
Attitude	General	0.01	**0.39***	0.40
Social	Others' action	0.39	**1.57*****	**1.17*****
	Other approval	0.60	0.36	**1.00****
Control	Timely labor	**0.45***	**0.55***	0.10
	Access vines	0.13	**0.80*****	**0.67*****
	Access other farmers	0.07	**0.63*****	**0.70****

** P < 0.05, ** P < 0.01 and *** P < 0.001*

[b]*Stage 1->2 = Underconsideration to Trial, Stage 2->3 = Trial to Maintenance and;*

Stage 1 - >3 = Underconsideration to Maintenance.

'Underconsideration' to 'Maintenance' transition

The Post hoc comparisons for this inter-stage transition indicated that there was a positive significant mean score difference for farmers in the 'maintenance' stage of growing OFSP compared to these in the 'underconsideration' stage regarding their beliefs about easiness of vine access (MD = 0.95, $p \leq .05$) and easiness of vine preservation (MD = 0.80, $p \leq .05$). The means score for beliefs about OFSP preference (MD = 0.33, $p < .05$) and dry matter content (MD = 0.86, $p < .05$) were found to be significant and positively different at this inter-stage too. Furthermore, the transition from 'underconsideration' to 'maintenance' was associated with positive significant mean score differences for beliefs about actions (MD

= 1.17, p < .001) and approval of peers (MD = 1.00, p < .01), and control over access to, timely labour (MD = 0.67, p < .001) and other OFSP cultivating farmers (MD = 0.67, p < .001). These results suggest that high positive evaluation of easiness to access and preserve OFSP vines, consumption beliefs concerning OFSP preference in household and dry matter content, social approval and control over production assets are important for the farmers to sustainably cultivate the new varieties. This is important, given that for every new growing season, farmers have to renew their intentions to continue with OFSP cultivation.

3.5 Discussion

This study was designed to assess which multiple beliefs characterize OFSP acceptance among farmers in the two districts, Kyotera and Buyende, in Uganda. The study assessed the role of beliefs on acceptance decision process of smallholder farmers drawn from a sample of OFSP adopting rural households. It sought to develop a belief-based characterization of the OFSP acceptance process in order to guide variety delivery efforts.

The study presents a case of bio-fortified orange sweetpotato to protect rural households from vitamin A deficiency related health challenges. Although, attempts have been made to understand the factors that promote the delivery of bio-fortified crops such as OFSP among VAD affected communities in developing countries, very few studies have demonstrated the link and significance of beliefs that are behind the acceptance of these new varieties. This study aimed to fill this knowledge gap. An assessment of the association between a set of multiple beliefs in the domain of production, consumption, marketing, health risk, behavioural, normative and control over production assets and acceptance of OFSP reveals beliefs to be vital in the acceptance of OFSP (*Fig. 3.4*). Unlike previous studies that conceptualized acceptance in terms of likelihood to grow (e.g., Shikuku *et al.,* 2019) and

willingness-to-pay for the new varieties (e.g., Mogendi *et al.,* 2016), this present study examined acceptance as a three-level staged process that starts from 'underconsideration' through cultivating OFSP for more than six months of uninterrupted seasons.

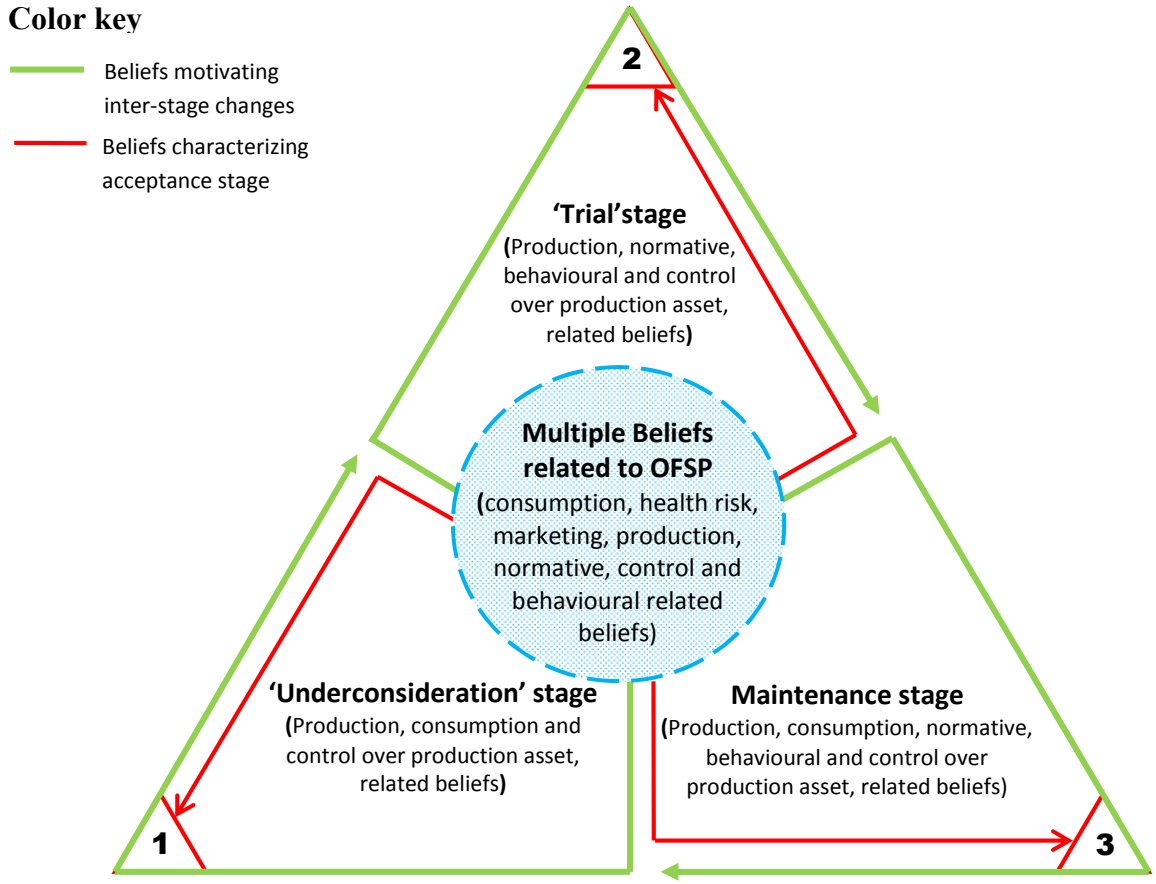

Fig. 3.2: The study empirical association between beliefs and acceptance

The findings of the present study revealed farmers' transition from the 'under-consideration' stage of OFSP acceptance to the 'trial' stage to be positively associated with production related beliefs, including 'OFSP resilience in the fields', 'high dry matter content' and 'control over access to timely labour'. According to Mwanga and Ssemakula (2011) and Low *et al.* (2017) the OFSP varieties delivered to farmers under DDBC project had 'good to excellent' production and consumption related characteristics (e.g., yield potential, maturity

time, acceptable taste, dry matter content and health value) beyond those possessed by the conventional WFSP. These findings are consistent with several previous studies (e.g., de Brauw *et al.,* 2015; Shikuku *et al.,* 2019) that found production-related beliefs to influence the acceptance of bio-fortified varieties. Shikuku *et al.* (2019) particularly established that yield, disease-resistance, storability of roots in the field and early maturity were linked to farmer likelihood to cultivate OFSP varieties. Similarly, Low *et al.* (2017) note that while farmers in Uganda and Kenya appreciated that many of OFSP varieties introduced in the region were early maturing and highly yielding than the conventional varieties, many of them did not accept to cultivate the new varieties due to susceptibility to high virus pressure. Regarding dry matter content, Mwanga and Ssemakula (2011) and Low *et al.* (2017), confer that dry matter content is linked with OFSP acceptance decisions; noting for example, that for many of the Asian and east African countries where attempts were done to introduce OFSP in the 1980s, failed actually due to the low dry matter content of the varieties used other than due to any other factors.

In order for farmers to transition from 'trial' cultivation of OFSP (that is, to move their OFSP agricultural activities beyond one growing season) to sustained cultivation (cultivation of OFSP for two and more growing seasons), beliefs about control over production assets including access to vines, timely labour and control over access to other OFSP farmers) were revealed to be important beliefs. The results corroborate previous studies (e..g. Wallston, 2015; Surmann *et al.,* 2017) that indicate that for an individual to accept a new idea, one, among other things, must believe that the tasks associated with the implementation of the idea are manageable. Rogers (1983) suggested that where the farmers typically work in an interactive environment, peers engage in some kind of social snowballing with the new technology in their network and that a few farmers that accept a

technology offer a new stimulus to the remaining ones who have not been so experimental. This could probably explain why transitioning into 'maintenance' from 'trial' stage might have been associated with having access to or interacting with other OFSP cultivating farmers. Similarly, Hummel *et al.* (2018) in a study conducted in central and southern Malawi among 270 adults and 60 children, revealed that social pressure and the beliefs farmers have about the behaviour are the best predictors of caregivers' preparation of OFSP for their children. This study, similarly finds that farmers who have a general positive attitude towards OFSP and whose close peers also grow OFSPs will most likely advance from 'trial' stage to 'maintenance' stage. The results echo the conclusions of Rogers (1983) and Wani and Ali (2015) who found that the consideration of a new idea does not go beyond the knowledge function if someone does not define the information as relevant to his or her situation. Consistent with Yanggen and Nagujja (2006) who described the acceptance of OFSP as linked to vine access and storage root size, this study found beliefs about the ease of access to vines and the size of OFSP storage roots to be associated with decisions to sustain OFSP cultivation. Storage root size may be associated with acceptance because sweetpotato is generally grown for its ability to 'insulate' cultivating households against hunger (Bashaasha *et al.,* 1995). Given that sweetpotato is a vegetative crop, the effect of attitudes, actions of peers regarding OFSP growing and control over access to other OFSP cultivating farmers, could potentially be directly contributing to the importance of vine related beliefs in acceptance.

The results from the present study, suggest that farmers who think that VAD is a serious condition children are likely to suffer, are less likely to cultivate OFSP. This finding corroborates Sun *et al.* (2006) who revealed a negative relationship between risk related concepts and rural Chinese women's willingness-to-pay for iron fortified soy-sauce, another

health related food. This however was different among urban counterparts. Other studies (e.g., Jensen *et al.,* 2012), however, observe that risk-related beliefs arouse fear which positively affect decisional balance. Thus, there seem to be a dissonance (Rogers, 1983) between risk-related beliefs and OFSP acceptance behaviour. This limits the utility of risk-related beliefs in understanding bio-fortified crop acceptance behaviours. This negative linkage of risk-related beliefs with acceptance of OFSP could be explained by the hidden nature of VAD, which change agent organizations have been trying to create public awareness about through mass media for over two decades. It could be probable that through public campaigns, several farmers appreciated the high level of VAD risk exposure to their household members whereas farmers who adapted OFSP intervention gradually ceased to perceive the threat due to the trust they put in the preventative measure they took to mitigate their households' exposure to the hidden threat.

Lastly, this study revealed that farmers can relapse back into the 'underconsideration' stage even after reaching 'maintenance'. This relapse is connected to the seasonality of sweetpotato, which requires farmers to renew their intention to cultivate or not to cultivate this crop at every start of a new season. The belief set associated with relapsing from 'maintenance' to 'underconsideration' were slightly similar but different from those responsible for the 'trial' to 'maintenance' transition (*Fig. 3.2*). For example, in addition to ease of access to vines, actions of peers and control over access to vines and interaction with other OFSP growing farmers that underlie the 'trial'-'maintenance' inter-stage transition, relapsing into the 'underconsideration' from 'maintenance' is also associated with failure to preserve vines, falling interest in OFSP among household members, low perceptions about OFSP dry matter content as well as falling approval of peers regarding the cultivation of OFSP. The importance of peer influence and approval in sustained cultivation relates to the

sociological narrative put forward by Mackie *et al.* (2015) that a socially oriented person typically has two goals; making effective action and building and maintaining social relationships. Looking up to peers' actions is one important way to effective action when situations are novel, ambiguous, or uncertain. Jolanda *et al.* (2002) suggest that when accepting new ideas, individuals seek for approval from the social groups they ascribe to so that they do not contradict what is socially deemed right by their peers. Further, Low *et al.* (2017) points to potential tensions in household OFSP preferences; where children like varieties with low dry matter content, and the adults the floury, higher dry matter content varieties. This study suggests that adults' preferences are more important in OFSP acceptance, given that dry matter content and household head's preference emerged as important beliefs for sustained cultivation together. Belief about the dry matter content was also linked to transition from 'underconsideration' to 'trial' stage.

3.6 Conclusions and recommendations

This study hypothesized that beliefs related to OFSP held by the farmers associated with OFSP acceptance stages and subsequent transition from one acceptance stage to another. Given the findings that farmers' inter-stage transitions from the 'Underconsideration to Trial', 'Trial to Maintenance' and 'Underconsideration to Maintenance' stage, associated with different belief sets; it can be concluded that farmers' decisions to cultivate OFSP is linked with beliefs they hold regarding production benefits, consumption considerations, social approvals and control over production assets. Conforming to the suggestion offered by Mackie *et al.* (2015), that breaking behaviour patterns that are aligned to the beliefs one holds require actions that either make people more aware of their behaviours or interruption of the beliefs that underpin the habitual pattern itself, this study recommends that:

1) **Policy makers:**

Policy makers should sustain the priority of financing breeding programmes in order to continuously upgrade the technical qualities of OFSP such as dry matter content, resistance to diseases and droughts due to the production related appeal that will relate with beliefs of the farmers, as they evaluate their choice to cultivate OFSP against the convention varieties that they have traditionally been cultivating.

2) Researchers:

Social researchers should closely monitor the changes in the antecedence of beliefs on the acceptance of OFSP to guide breeders. On the other hand, if the OFSP is to progressively replace the WFSP, breeding priorities should be assigned on the OFSP to ensure that in the near future the superior qualities of the OFSP across the entire spectrum of sweetpotato attributes make the OFSP the base and the WFSP the comparison crop.

3) Extension workers:

The findings of this study lead to the recommendation that extension workers should:

i) Pursue social change strategies and campaigns that aim to appeal to farmers' beliefs about OFSP qualities to favour the acceptance of these new varieties. Relevant beliefs to be supported regard farmers' perceptive evaluation of the ease of vine access and preservation, dry matter content, preference in household, control over access to vines and peers cultivating OFSP. It is also important to consolidate perceptions that OFSP is grown by/ or approved to be grown within the farmers' peers' circles;

ii) Targeting to enrol receptive and/ or more influential members of the community to cultivate OFSP first, could ensure that lack of knowledge/ experiences about the qualities of

OFSP is quickly demystified. In the process, a supportive group of community-based adopters is nurtured to offer peer learning for less influential adopters.

iii) The performance of the selected OFSP varieties related to agronomic attributes, consumption considerations, social approvals and control of production assets also should be communicated to help farmers to rethink their belief system regarding OFSP qualities such as dry matter content and vine accessibility, so that they get inspired into 'Trial' cultivation.

iv) Only OFSPs with acceptable drought resistant vines/or ease to preserve vines, resilience in field to diseases, pests and weeds, root size, and dry matter content, should be delivered to reinforce the farmers' beliefs (*Table 3.4*). Any dis-aligned OFSP variety is likely to be counter supportive for the consolidation of the necessary beliefs within farmers' belief system(s) that should have supported them to switch the new OFSP.

v) Supporting farmers to sustain cultivating OFSP seemed to depend on beliefs regarding the approval and actions towards the cultivation of OFSP of a farmer's peers as well as beliefs about the level of control a farmer has to access other OFPS farmers. This leads to the conclusion that extension agents should strengthen networking among OFSP cultivating farmers. This is likely to support sustained cultivation when farmers are renewing intentions to cultivate OFSP for the next season and it should improve access to vines via social exchange, which prevents OFSP cultivation relapsing.

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CHAPTER FOUR

RISK PERCEPTIONS INFLUENCING RURAL SMALLHOLDER FARMERS' DECISION TO GROW ORANGE-FLESHED SWEETPOTATO IN UGANDA

4.0 Background

This chapter is associated with a published journal article by *Ndaula, Matsiko, and Sseguya (2018) in the African Journal of Rural Development*. The chapter dives deeper into the psychological mechanisms behind the negative influence of risk-related beliefs with orange-fleshed sweetpotato (OFSP) acceptance stages revealed in the preceded chapter, through adapting a risk-related conceptual theory to guide the analysis. The chapter consists of; an introductory section that situates the study in risk literature, a conceptual framework, a supplementary research design concerned with chapter specific data analysis, results, discussion, conclusions and recommendations, and the list of references.

4.1 Introduction

Over the last few decades, the concept of 'risk' has gained currency across agriculture related disciplines. The concept is particularly important in social change contexts especially where decisions have to be made based on decision-makers' projections of benefits that are based on data gathered using rudimentary tools. Additional uncertainty is injected into the situation by the decision-makers having little knowledge about the effectiveness of available options that could potentially be used to effect behavioural changes that extend well-being.

The wide application of the concept has implied, and at least in part explains its diverse definitions whose common spine describes it as 'the cause of/or the probability of an unwanted event which may or may not occur'(Habegger, 2008). Crane *et al.* (2013) define a

risk as the chance of loss or an unfavourable outcome associated with an action. So, 'risk' is not predestined, but a result of human agency, that exposes humans themselves and their valuable belongings to loss (Habegger, 2008).

Hillson (2006) posits that social institutions such as marriage, religion, laws, ethics and morality, and organizations like the family, school, hospitals and the army, are structurally designed to deal with one form of 'risk' or another. Extending Hillson's argument, humans can be viewed as having developed sophisticated capabilities to isolate patterns of adverse outcomes and design against such outcomes. However, the trailing of risk by human actions often means that some mitigation measures create new forms of risks, enhances the impact and frequency of existing risks, or expands the spaces and/or people among whom they exist (Pavodani and Tugnoli, 2005).

In Uganda, sustained multi-sector efforts to end VAD have tended to underestimate the risk faced by pre-school children and women living in rural areas (UBOS and ICF, 2018). Consequently interventions such as fortification of processed foods and targeting children with semi-annual distributions of therapeutic vitamin A pills have failed to consistently deliver supplements to rural areas. Experience from elsewhere ascribes this poor performance to logistical challenges (Mogendi *et al.,* 2016) and the tendency for rural people to operate outside the food market system, a niche covered by processed foods (Tanumihardjo *et al.,* 2016; Graeub *et al.,* 2016). Corresponding evidence (e.g. Kyamuhangire *et al.*, 2013; Chen *et al.*, 2019) further suggests that attempts at mitigating VAD through fortified processed foods and therapeutic pills might have life-threatening outcomes. In fact, Chen *et al.* (2019), conclude that nutriental benefits can only safely accrue to individuals who consume foods such as fruits, which are naturally rich in the vitamin. ß-carotene, the raw form of the vitamin in these foods, permits homeostatic regulation against any excesses. Upon the latter

argument, bio-fortified staple food crops have been earmarked as the most plausible mitigations for the health risks posed by VAD (Garcia-Casal *et al.,* 2017). In Uganda the intended conveyor of vitamin A is the bio-fortified OFSP varieties whose ß-carotene, a precursor for the vitamin, has been enhanced through breeding strategies (Low *et al.,* 2017).

Several studies suggest that OFSP could potentially diminish VAD health risks, if accepted by affected communities (e.g., Low *et al.*, 2017; de Brauw *et al.,* 2015). Asare-marfo *et al.* (2013) asserted further that significant or large-scale acceptance of the bio-fortified varieties is only feasible where promoters deliver bio-fortified crops to sweetpotato consuming communities where local varieties already play a significant role as staples. The core of their argument was that a major element of any strategy for entrenching the bio-fortified varieties of the crop should be to build on rather than seeking to undermine the prevailing accepted staples. For Uganda, the arduous task has been to have the popular conventional white-fleshed sweetpotato (WFSP) cede significant ground among rural households (Low *et al.*, 2017).

In the risk management arena, knowledge of the origin, causes and consequences of a risk is vital for designing risk response strategies. The VAD could be categorized as a particular and core risk which tends to be caused by the actions/or inaction of individuals. Such risks are experienced by individuals rather than society and to reverse the occurrence of such a risk, requires individuals to amend own behaviour (Vaughan, 1997). Core and particular risks are better addressed through adjustments to the internal behaviour or processes, such as careful strategic choices rather than through risk transfer (Cienfuegos, 2013). However, because the causes of VAD are also inclined to changes in the environment and the prevailing economic conditions (*see section 1.1, introductory chapter*), it can validly be argued that VAD episodes depend on the evolution of external variables (Vaughan, 1997),

as well. This suggests two things: 1) that VAD occurrence is inclined to remain a relatively unpredictable risk (Pavodani and Tugnoli 2005) and 2) that ultimately VAD is liable to affect a large proportion of society (Vaughan, 1997). This renders VAD the responsibility of both society and individuals, and usually compels governments and development partners to support social and individual responses to adjustments in the environment, and household level food crop selection (Sadgrove, 2006).

Whereas significant progress has been made by governments and government departments, development partners and nongovernmental organizations in directing resources into bio-fortified crop development, wide range of social and behavioural change campaigns, and delivery of crop technologies to farmers, target households continue to be challenged by the hidden nature of the risks and adverse health outcomes associated with the deficiency. As Jin, *et al.* (2006) observed, broad health risk education as an intervention geared toward undermining behaviour, that is conditioned by day-to-day household activities or one that has other welfare implications may be insufficient for successful risk mitigation. Thus, VAD risk should be read and interpreted as a convoluted outcome of a numerous choices made by smallholder farmers regarding the type of crops grown as food (de Brauw *et al.,* 2015). Therefore, even with all its benefits, OFSP has to compete for space and position within the domain defined by the attributes of consumers and the foodstuffs they already consume.

A major moderator of the above process is the acceptance of the OFSP by key household decision-makers. However, a gap in knowledge exists regarding the nature of key decision-makers' considerations of risk outcomes in the acceptance/non-acceptance of OFSP. In extant literature, the focus tends to be on confirming the safety of OFSP for human consumption and its efficacy for combating VAD (e.g., de Brauw *et al.*, 2015). Other related studies focus on food attributes (e.g., Lagerkvist *et al.,* 2016) and conclude that acceptance of

foods with health benefits, such as OFSP are primarily a trade-off between health benefits and dietary attributes, such as taste, dry matter content and colour of OFSP. Acceptance studies have also established that consumers feel as, or even more, positive about the cultivation and dietary characteristics of the OFSP compared to WFSP varieties (e.g.,Chowdhury *et al.*, 2009; Saltzman *et al.,* 2017).

Conventional approaches to risk management rely on aligning decision-makers' responses with their determination of the likelihood of the risk to occur and the impact of its outcomes. For example, a risk that is perceived to be less likely to occur and deemed to have low impact outcomes may be ignored or accepted without much consideration. On the other hand, frequent high impact risks tend to be associated with decision-maker acceptance and/or uptake of various forms of strategies geared at reducing the impact or the odds of an adverse event occuring (Popovici and Veloz-Navarrete, 2016). From this perspective, individuals perceive risk is a priori determinant of their response strategy (Slovic, 1987; Slovic, 1997).

4.2 Conceptual framework

To test the hypothesis that cultivation of VAD mitigating OFSP varieties is significantly influenced by decision makers' perceptions of health risk of VAD, this study adopted the Health Belief Model (HBM) and Stages of Change (SoC) model. Both models are psychosocial explanations of health-related behavioural change.

The HBM explains behaviour as an outcome of individual perceptions of exposure to health risks (*perceived susceptibility* and *perceived severity*) combined with the known available strategies for mitigating that health risk (*perceived benefits* and *perceived barriers*) (Janz and Becker, 1984). *Perceived susceptibility* speaks to beliefs about personal risk to a health danger whereas *perceived severity* draws attention to a person's beliefs about the

seriousness of a health threat. Likewise, *perceived benefits* relate with one's beliefs about health or non-health gains of taking action while *perceived barriers* are linked to one's beliefs about the costs or negative results associated with behaviour. The HBM assumes that there are meaningful contextual factors, such as educational attainment and exposure to information, in the background that might encourage or discourage individuals from responding to their perceptions of risk (Ajzen, 1991). Individuals' views regarding risk are socially nested in relationships, expectations and value systems of members of a typical group (Tansey and O'Riordan, 1999; Olson and Desheng, 2008; Cienfuegos, 2013) and thus dependent on socio-demographic factors such as education, the status of risk and the status of the contexts. Also noteworthy, HBM assumes that the combined levels of susceptibility and severity provide the energy or force to act given that the perception of benefits of the available interventions provides a preferred path of action (Rosenstock, 1974; Janz and Becker, 1984).

The SoC model explains behavioural change as a five-stage process: pre-contemplation, contemplation, preparation, action, and 'maintenance' (Prochaska, 2008). Vet *et al.* (2007) in a longitudinal study examined whether the stages of change were discrete stages and concluded that the stages are a mere categorization of a continuous variable and process. They posit that the SoC stages represent a sub-stage (pseudo-stages) that characterize the vital aspects of a continuous behavioural change outcome, concluding for example, that the disaggregation of the pre-action stages (pre-contemplation and contemplation) is not different from a mere categorization of behavioural intentionality. Extending the findings of Vet *et al.* to smallholder farming, a farmer who is carrying out field activities such as field preparation and seed acquisition (preparation stage) may not be excluded from the experimental action stage. The SoC assumes that the stages constitute a

cycle that is powered by such forces as perceptions of self-efficacy, threat and feelings about the advantages and disadvantages associated with behavioural change, which it shares with the HBM (Sutton, 2002; Noar and Zimmerman, 2005).

This study combined aspects of the HBM and SoC premised on the assumption that household farming activities are largely determined by decisions made by key household decision-makers through weighing perceived net benefits of outcomes against the perceived appropriateness of the activities undertaken to achieve those outcomes. Elements of HBM were employed to assess the potential of OFSP to help households to cope with the perceived health risks of VAD. In particular, the study borrowed the construct of perceived risk as measured by the indicator variables of perception of susceptibility and severity, and perceived effectiveness of OFSP to control VAD, as measured in terms of perceived benefits of taking up OFSP to meet food and health goals (Morris *et al.*, 2012). The SoC was used to establish the status of the acceptance of OFSP as a three-value discrete variable. The SoC's first and second stages (pre-contemplation and contemplation) were combined as the 'under consideration' stage, the third and fourth stages (preparation and action) were combined to form a ''trial action' stage that leads to the third stage ('maintenance') (Vet *et al.*, 2007). Thus, in the context of the two models, this study tested the three hypotheses (H1 through H3) illustrated in Fig. 4.1: H1: perceived risk of VAD is a significant mediator of the relationship between socio-demographics (education of respondents, experiences of VAD and status of sweetpotato in household diet) and OFSP acceptance and; H2: perceived effectiveness of OFSP to control VAD is a significant mediator of the relationship between socio-demographics and OFSP acceptance. It also tested hypothesis, H3 that socio-demographics significantly influence the status of OFSP acceptance.

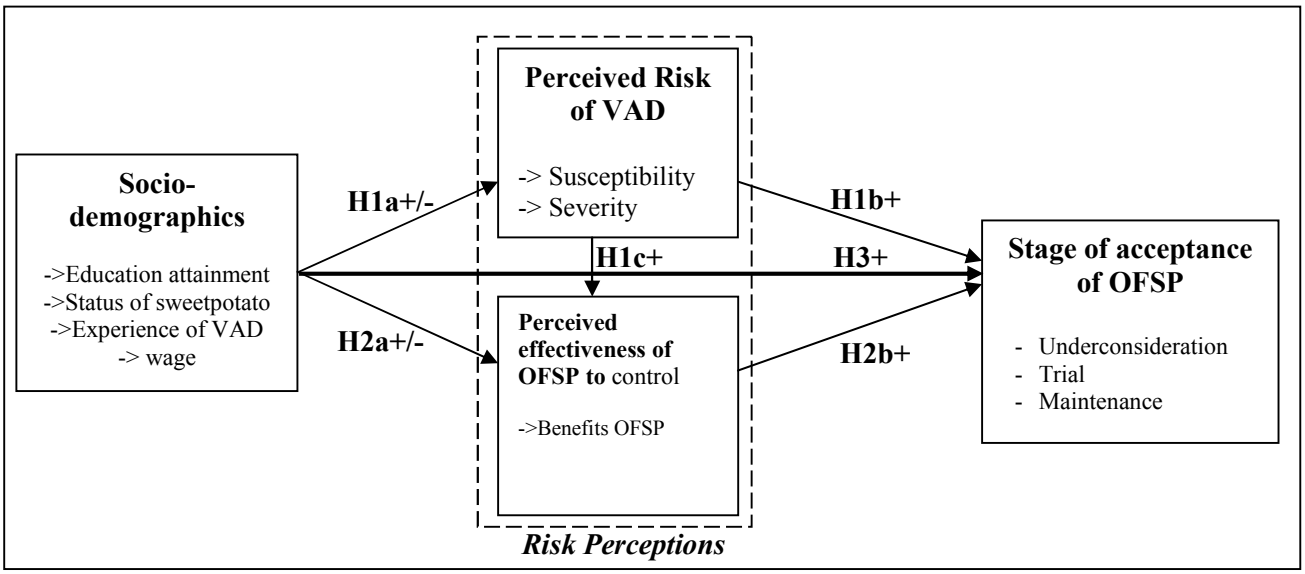

Fig. 4.1: Schematic illustration of the conceptual framework and three hypotheses

4.3 Research design

The data pertaining to this chapter were of quantitative type and were gathered as part of the larger survey whose methodology is described in *chapter 2.* The chapter, specifically concerned with farmers' perceptions regarding the likelihood of contracting VAD (*susceptibility*), seriousness of VAD once contracted (*severity*) and `perceived effectiveness of OFSP to control VAD (perceived relative benefits of OFSP against WFSP), OFSP acceptance stages, and socio-demographic characteristic (*education attainment, status of sweetpotato in household, experience of VAD and wage*), *section 2.2.1 a, b and c.*

Data analysis

The data analysis to test the three hypotheses, presented earlier (*Fig. 4.1)*, was done through three major steps. First, principal component analysis was performed to reduce the number of items and the variables measuring socio-demographics into a parsimonious set. Particularly for socio-demoraphics, before the principal components analysis was done, its indicators (education attainment, status of sweetpotato in diets of households, wages in

USD and VAD experience) were normalized to bring them within a comparable range using the formula below;

$$a^{*}_{ji} = {(a_{ji} - x_i)}/{s_i} \quad \text{..... (1)}$$

Where a^{*}_{ji} is the normalised score of the j[th] variable in the i[th] household, a_{ji} is the indicator score being normalised and x_i is the mean and s_i standard deviation of the indicator score. According to Hair *et al.* (2014), the Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity are the two important indicators for extracting principal components as measures of a construct.

Second, descriptive statistics and bivariate correlations were computed to describe the status of the dependent variable and socio-demographic and to appraise conceptual relationships among variables. Bivariate correlation is a statistical technique that is used to determine the existence of relationships between two different variables (i.e., X and Y); it is used to determine the necessity to include (or not) variables in proceeding multiple regression analyses. Third, multiple regression analyses were performed using the STATA statistical program to test the hypothesized relationships (H1, H2, and H3) shown in *Fig. 4.2.* Mediation effects were determined using the three criteria commonly used in psychosocial studies, since they were first suggested by Baron and Kenny (1986) three decades ago. Baron and Kenny (1986) posit that mediation is said to be established if (i) variations in levels of the independent variable significantly account for variations in the presumed mediator (Path a), (ii) variations in the mediator significantly account for variations in the dependent variable (Path b), and (iii) when Paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables (Path c) is no longer

significant (Lemmens, *et al.,* 2016), see *Fig. 4.2*. In a proper mediation, the correlation between independent and dependent variable need not be significant.

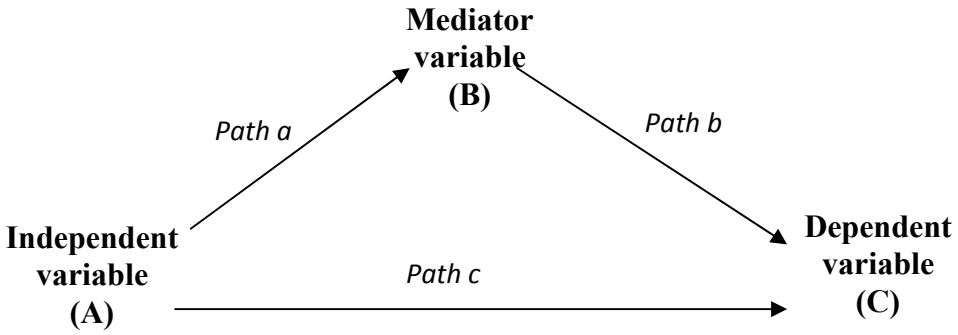

Fig.4.2: Illustration of Baron and Kenny's mediation testing procedure

The multiple regression model was specified as below:

$Y = ß_o + ß_1 (X_1) + ß_2(X_2)..... + ß_n(X_n) + E$ ..... (2)

Where:

Y = dependent variable (Acceptance of OFSP, perceived effectiveness of control and perceived risk)

$ß_0$ = intercept

($ß_1$ ..... $ß_n$) = parameters to be estimated

(X_i ..... X_n) = vectors of the explanatory variables (socio-demograpics, perceived effectiveness of control and perceived risk)

E = The error term

4.4 Results

Descriptive statistics for the socio-demographics and acceptance of OFSP

Table 4.1 presents the status of socio-emographics (VAD experience, educational attainment, wage and status of sweetpotato in household diets), and the acceptance of OFSP. Two of every three decision-makers (67%) did not consider VAD a major problem in their households while 56% did not consider it a major problem for the community.

Table 4.1: Numbers of cases and proportional distributions of the dependent variable, socio-demographics (educational attainment, status of sweetpotato in household's diets, wages, and knowledge of vitamin A deficiency)

Variable	Number of cases		Variable	Number of cases (%)	
Dependent variable (stage of OFSP acceptance, n =341)					
Under consideration	40	(12%)			
'Trial' decision	63	(19%)			
'Maintenance'	238	(70%)			
Independent variable (socio-demographics)					
Household level VAD Experience (n=341)			Average monthly income (USD)(n=341)		
No	227	(67%)	<1	51	(15%)
Yes	114	(33%)	1–3.9	114	(33%)
			4–7.9	81	(24%)
Community level VAD Experience (n=341)			8–11.9	31	(9%)
No	191	(56%)	12–30	3	(15%)
Yes	150	(44%)	>30	11	(3%)
Educational attainment (n=341)			Dietary priority of sweetpotato (n=341)		
None	24	(7%)	First	266	(78%)
Primary	226	(66%)	Second	23	(7%)
Secondary	69	(21%)	Third or higher	52	(15%)
Post-secondary	21	(6%)			

Consistent with the national census (UBOS, 2016), 66% of the respondents in this study had only attained some level of primary education, 21% had attained secondary education, 6%

had attained tertiary education while 7% had not had any formal education. Most of the respondent households (71%) earned US$ 3 or less per day; only 28% earned above US$ 3, implying that virtually all the smallholder farmers lived in extreme poverty (World Bank, 2016). Regarding acceptance of OFSP, 70% of the smallholder farmers had maintained OFSP cultivation for more than six months, 19% were carrying out 'trial' cultivation while 11% were still considering cultivating OFSP varieties.

Statistics of study variables

The results of the explanatory factors extracted via PCA (*Table 4.1*) show that the KMO statistics of the extracted components were greater than the 0.5 threshold (Hair *et al.,* 2014). For all of the variables Bartlett's test of sphericity significance values were less than the 0.05 standard (Field, 2013). The first extracted component of each factor was further assessed for percent of variance explained and by Eigenvalues (*Table 4.2*).

Table 4.2: Factor analysis results using PCA; varimax with Kaiser normalization

Factors[a]	**Number of items**	**Mean (SD)**	**Cronbach's alpha**	**Bartlett's test (KMO)**	**Eigenvalue**	**% Variance explained**
Socio-demographics	5			116** (.507)	1.48	29.7
Perceived effectiveness of control	28	87.4 (15.5)	0.846	2684** (.797)	5.80	20.7
Perceived susceptibility to risk	6	22.3 (7.1)	0.830	1160** (.729)	3.37	56.1
Perceived severity	30	140.5 (27.0)	0.931	9964** (.852)	10.97	17.9

[a]All variables employed seven-point rating scales where 1 = *extremely unlikely* to 7 = *extremely likely*

** = $p < .01$

The first component is always the linear index of all of the items that capture the most information common to items in that construct (Deressa *et al.*, 2008). Percent of variance ensures practical significance for the derived factors by ensuring that they explain at least a specified amount of variance in the study sample (Hair *et al.,* 2014). Eigenvalues were above Kaiser's criterion of 1 and the first factors of interest for each variable explained 29.1%, 20.7%, 56.1% and 17.9% of the variance in data of socio-demographics, perceived effectiveness and perceived susceptibility to risk respectively (Field, 2013).

The bivariate correlations of the study variables in Table 4.3 show that socio-demographics, 'perceived effectiveness of control' and 'perceived risk' were highly correlated with acceptance of OFSP ($p \leq .01$). Perceived risk (susceptibility and severity) negatively correlated with acceptance, and socio-demographics relationship with perceived effectiveness of control was positive and significant ($p \leq .01$).

Table 4.3: Bivariate correlation matrix showing co-efficiencies for OFSP acceptance, socio-demographics and risk perceptions

	Variable					
Variable	**1**	**2**	**3**	**4**	**5**	**6**
1. Stage of acceptance of OFSP						
2. Socio-demographics	.237**					
3. Perceived effectiveness of control	.169**	-.016				
4. Perceived Risk	-.167**	-.233**	.224**			
5. Perceived Susceptibility to Risk	-.087	-.239**	.218**	.750**		
6. Perceived Severity	-.166**	-.113*	.127*	.750**	.124*	

* = $p < .05$, ** = $p < .01$, two-tailed tests of significance

The correlation of socio-demographics with perceived effectiveness of control was not significant. These relationships implied that: 1) the mediator effect of perceived effectiveness of control could be through the influence of socio-demoraphics on perceived risk and; 2) the hypothesized relations (*Fig. 4.1*) were probable and merited further testing with regression analyses.

Effect of risk perceptions on OFSP acceptance

Table 4.4 shows the results of the regression analyses used to test the hypothesized relationships (*Fig.4.1*). The variance inflation factors of all of the independent variables in all of the regression models (*Table 4.4*) indicated little to no multicollinearity among the constructs. The relationships were tested for statistical significance and all of the models were statistically significant at the 99% level of confidence. The analyses were done in three steps:

The first step involved testing the relationship between the independent and mediator variables via H1a and H2a and among the mediator variables H1c (*Fig. 4.1*). The effects of socio-demographics on perceived risk were weak but statistically significant (β = -.214, t (df: 1, 336) = -4.40, $p \leq .001$); supporting hypothesis H2a regarding significance, and the direction of the relationship (Model 4). The effect of socio-demographicson perceived effectiveness of OFSP to control VAD tested in Model 3 was positive but not statistically significant. However, H1c that stated that perceived risk of VAD significantly influences the status of perceived effectiveness of OFSP to control VAD, was found to be statistically significant (β = .529, t (df:1, 336) = 4.27, $p \leq .001$) in the same model. Thus, this study established that H1a and H1c met the first criterion for establishing mediation namely, that variations in levels of the independent variable significantly account for variations in the presumed mediator.

Step 2 estimated the relationship between independent, mediator and dependent variables H1b, H2b and H3 in model 2. Hypothesis, H2b that stated that perceived risk of VAD significantly influenced the status of OFSP acceptance was supported (β = -.110, t (df: 3, 333) = -3.08, $p \leq .01$). This implies that acceptance of OFSP was associated with low perceived levels of health risk. H2b which stated that perceived effectiveness of OFSP to control VAD significantly influences the status of OFSP acceptance was statistically significant (β = .061, t(df: 3, 333) = 3.08, $p \leq .001$). Accordingly, H1b and H2b met the second criterion for establishing mediation, namely that variations in the perceived effectiveness of OFSP to control VAD significantly account for variations in OFSP acceptance.

The last step estimated the mediation effect through comparing the tested effects of the independent variable (socio-demographics) on the dependent variable (OFSP acceptance) in Model 1 and Model 2. The results of hypothesis H3 that stated that socio-demographics significantly influence the status of OFSP acceptance, found a positive significant influence in both Model 1 (β =.189, t (df: 3, 333) = 3.58, $p \leq .001$)and model 2 (β =.119, t(df: 3, 333) = 3.72, $p \leq .001$). However, H3 did not meet the third criterion for establishing full mediation, namely that "when paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables (Model 1) is no longer significant (Model 2), with the strongest demonstration of mediation occurring when Path *c* is zero", *see Fig. 4.3*.

This implies that even after controlling for perceived risk and perceived effectiveness of control over VAD, both of which met the first and second criteria for establishing mediation, a significant 3.2% of the variance in smallholder farmer acceptance of OFSP probably continued to be accounted for by mediators currently not included in the study's conceptual model. However, the magnitude of the coefficients reduced in the second model,

suggesting that risk perceptions partially mediate the influence of socio-demographics on the status of OFSP acceptances.

Table 4.4: Results of hypothesis tests; multiple regression analyses

							Sample (n = 341)					
	Model 1: OFSP acceptance			**Model 2: OFSP acceptance**			**Model 3: Perceived effectiveness of control**			**Model 4: Perceived risk**		
Variables	**B**	**t-value**	**VIF**	**B**	***t*-value**	**VIF[a]**	**B**	***t*-value**	**VIF**	**B**	***t*-value**	**VIF**
Perceived risk				-.110**	-3.08	1.12	.529**	4.27	1.06			
Perceived effectiveness of control				.061***	3.98	1.05						
Socio-demographics	.187***	3.58	2.20	.119***	3.72	1.06	.083	0.73	1.06	-.214***	-4.40	1.00
Adjusted R^2	.032***			.102***			.046**			.052***		

** = $p < .01$, *** = $p < .001$

Fig.4.3: Illustrates the results of the regression analyses performed to test H1 through H4.

4.5 Discussion

This study explored the role of risk perceptions in determining the extent to which rural smallholder farmers grow OFSP varieties with the intent to alleviate VAD. Risk perceptions were assessed in terms of perceived risk of VAD at household level and perceived effectiveness of OFSP to control VAD. Overall, 70% of the smallholder farmers had reached the 'maintenance' stage, 19% were in the 'trial' stage, and 12% were considering OFSP cultivation (*Table 4.2*). The decisions to consider, try, or sustain OFSP cultivation

were weakly though significantly explained by the farmers' risk-related beliefs (*Fig. 4.3*).

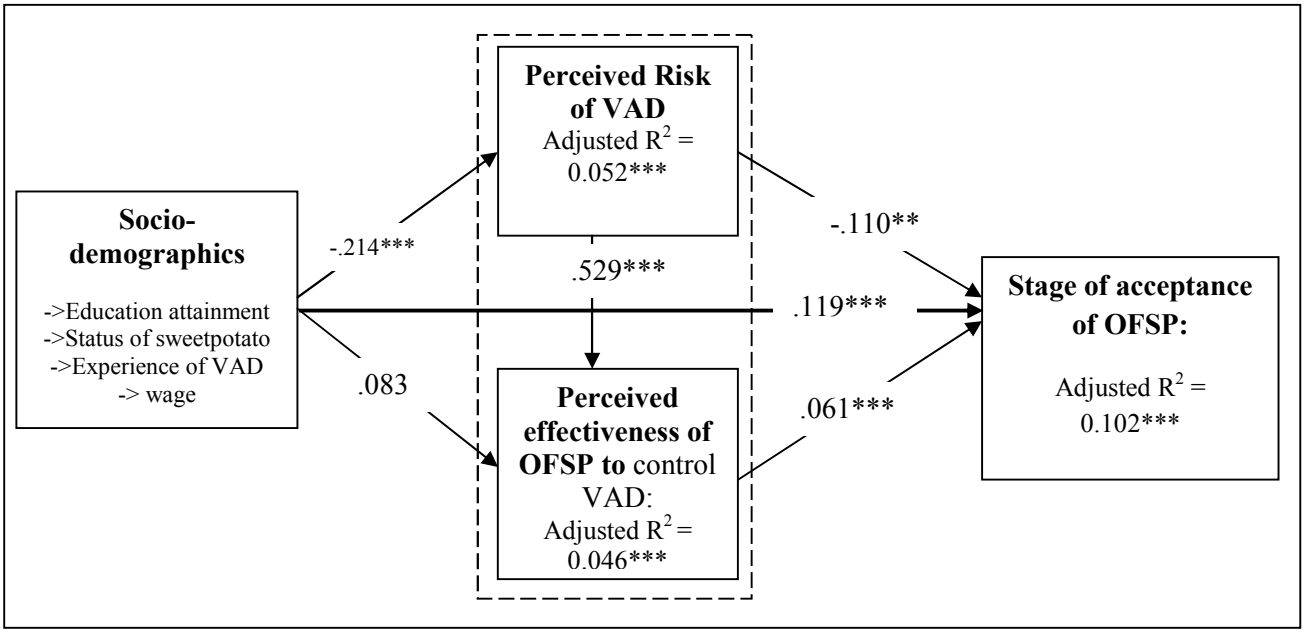

*Fig.4.3:Empirical framework (n = 341), ** = p< .01, *** = p< .001*

Specifically, the extent of the participants' perception of a risk of VAD and status of OFSP acceptance was expected to be determined by socio-demographics (*Fig. 4.1*). Although, the relationship between socio-demographics and perceived risk of VAD was weak, it was significant (β = -.214) and it had a negative direction. The relationship of socio-demographics and decision makers' perceived effectiveness of OFSP to control VAD was positive but not significant (β = .083). Taken together it can reasonably be expected that a right socio-demographic mix might lead to farmer confidence in the power of OFSP to control VAD to influence whether they may or may not take up OFSP cultivation. High social status, however, may make a farmer less sensitive to VAD, which tends to be lumped together with other food deficiencies of the poor. This finding agrees with Jin *et al.* (2006) who in their study regarding the hidden health risks caused by in-door household pollution due to use of coal energy sources within rural communities in China, observed that socio-

demographics such as education, and experience of VAD affect access to, and interpretation of risk related information. They shape decision-makers' actual or perceived capabilities and constraints for adopting new behaviours. So, given that VAD risk is construed as a form of 'poor feeding' in communities where this research was conducted, it is possible that the abundant evidence notwithstanding, families may underreport risk to own family out of defensiveness or ignorance (Douglas and Wildavsky, 1983).

On the other hand, the effect of socio-demographics on the status of OFSP acceptance was weak though positive and significant, both in the control (Model 1) and mediated (Model 2) models. Consequently, a state of complementary mediation pertains (β = .119). These findings may mean that there are other additional mediators, whose effect is positive *(Zhao et al., 2010)*. This would not be far-fetched, given that OFSP is a dual-purpose crop that serves the food security and health goals. For example, while OFSP might partly have been accepted on account of perceptions of VAD risk, other factors that influence the choice of household grown staple may have been carried over to the OFSP acceptance calculus. The finding also aligns with conclusions drawn by Oparinde *et al.*(2014) in a field experiment study conducted among rural farmers in Rwanda who had been supported to take up iron-bio-fortified bean, that even without nutritional information some farmers were likely to accept the bio-fortified varieties. This could be because of the many attributes of OFSP shared with WFSP (de Brauw *et al.,* 2015) or the euphoria among innovators that often follows introduction of any new technology (Roger, 1983).

Further, in this study, the extent of the participants' perceptions of a risk of VAD was expected to motivate them to act, and the perceived effectiveness of OFSP to control VAD was expected to open a path to the cultivation of OFSP. Similar to Sun *et al.* (2006), this study found the direct effect of perceived risk on acceptance of OFSP to be negative and significant ($p < .001$). Sun *et al.* found a negative effect of perceived risk on behavioural

intentions ('Underconsideration') to buy fortified soy sauce among rural Chinese women that was not found among their urban counterparts. This finding suggests that OFSP acceptance was associated with lower levels of risk perceptions. This is in tandem with conventional wisdom, given that if one adopts an intervention for a challenge; one may acquire trust in the intervention and gradually stops to see the challenge as a threat to own situation. However, some studies on acceptance (e.g., Talsma *et al.*, 2013; Mogendi *et al.*, 2016) found that perceived risk positively and directly explained participants' behaviours to buy or consume nutritional foods.

The effects of perceived risk on the effectiveness of OFSP to control VAD were positive and statistically significant ($p < .001$), although previous studies had not analysed it despite Rosenstock (1974, p. 332) earlier argument in his contributions to the health belief model that, *in the absence of barriers, perceived risk motivates action and perceived benefits provide a preferred path of action*. This is also consistent with the factors considered in be broad-based risk response framework extended by Popovici and Veloz-Navarrete (2016). Moreover, the effect of perceived risk on perceived effectiveness of OFSP to control VAD was moderate ($\beta = .53$), which subsequently had positive weakly significant influence on the status of OFSP acceptance ($\beta = .061$) (*Table 4.4*). Thus, the findings of this study confirmed that, unless an individual who perceives significant risk also perceives OFSP to be a feasible and an efficacious action available to respond to that risk, that individual is likely to resist cultivating the OFSP (Janz and Becker, 1984).

4.6 Conclusions and Recommendations

This study adds to the acceptance literature by considering household decision-makers' risk beliefs that might explain decisions to sustainably grow the VAD alleviating OFSP varieties. Socio-demographic attributes that directly promote the cultivation of OFSP,

may also discourage decision-maker self-reporting of perceived VAD risk. Further, perceived risk of VAD contributes to farmers' appreciation of the effectiveness of OFSP to control VAD to subsequently encourage sustained cultivation of OFSP.

The above findings lend support to the following recommendations:

For policy makers:

a) Given that the drivers of nutrition related risk extend beyond the individual into the social arena, **policy makers** should develop the necessary framework within which smallholder farmers can be supported to overcome both cognitive and social barriers to introducing new technologies into well-established crop production systems.

For extension workers

b) **Given the** multi-dimensionality of the information required to address issues linked to VAD related health risk mitigation, multi-disciplinary resources are indispensable for packaging and disseminating knowledge about OFSP as a VAD remedy. Similarly, because trust about information regarding medical intervention may best be optimized if delivered within the health delivery system, agricultural and health community workers should work closely together when promoting technologies such as OFSP.

For researcher:

c) Given the hint provided in this study that significant direct effect of socio-demographic attributes on acceptance, future research needs to explore the possibility of additional mediators. In particular, the positive direction of the

effect hints at probable addition mediator(s) that are likely to enhance our understanding of OFSP acceptance.

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CHAPTER FIVE

SOCIAL-COGNITIVE FACTORS INFLUENCING SMALLHOLDER FARMERS' DECISIONS TO GROW ORANGE-FLESHED SWEETPOTATO IN UGANDA

5.0 Background

This chapter is associated with a published journal article by *Ndaula, Matsiko, and Sseguya (2020) in the Journal of Agricultural Extension*. The aim was to pursue additional mediators to orange-fleshed sweetpotato (OFSP) acceptance; the preceded chapter pointed to additional mediators other than risk perceptions whose effect was likely to enhance OFSP acceptance. The chapter is structured to present; an introductory section that situates the study in social psychological literature, a conceptual framework, a supplementary research design concerned with chapter specific data analysis, results and discussions, conclusions and recommendations, and the list of references.

5.1 Introduction

The compatibility of perceptions in acceptance behaviour is well-anchored in the social psychological domain of social cognition. In particular, the social cognitive perspective positions personal decisions, such as a farmer's decision to cultivate OFSP, within the enduring core of the dynamic interaction of personal and environmental influences. Within this interaction framework, the personal domain is constituted by the individual's personality and the relatively more fleeting cognitive and demographic attributes of an individual (Taherdoost, 2018). The environmental domain is comprised of the tangible and the socially construed factors all of which are external to the decision maker (Kulviwat *et al.,* 2014). The social cognitive environment impacts the behaviour of individuals through their reactions to the changes they perceive to have occurred in both the internal and external environment

(Rana and Dwivedi, 2015). The environment thus shapes outcome expectations and self-efficacy expectations (Kulviwat *et al.,* 2014). The influence of individuals' outcome expectations is premised on the tendency by such individuals to engage in behaviours they deem to be aligned to their goals. Similarly, self-efficacy owes its influence to people's tendency to pursue tasks they deem they have the capabilities to perform satisfactorily. Following the preceding logic, it can reasonably be argued that sustained outcome expectations and farmer self-efficacy should offer bio-fortified varieties the edge leading to the progressive replacement of conventional varieties by the former. Acceptance would be expected where behavioural perceptions or attitudes and perceived capabilities of the targeted individual are inclined towards favouring the innovation (Taherdoost, 2018). So, even though conventional wisdom suggests that OFSP, where eaten regularly, provides 100% of the daily VA needs and that a 500m^2 plot of OFSP is adequate for meeting the annual needs of the vitamin of a family of five (Low *et al.,* 2017), OFSP has to compete for space and position within the domain defined by the attributes of consumers and the foodstuffs they consume.

A major moderator for the OFSP uptake process is its acceptance by key household decision-makers. However, a dearth of knowledge exists regarding the decision-makers' calculus; key elements of which include its suitability and the practicality of its cultivation. In extant literature, relevant studies tend to be descriptive and focus on technology awareness and the channels for effective delivery of planting materials (e.g., Lukonge *et al.*, 2015). Other related studies (e.g., Oparinde *et al.,* 2014), are concerned with consumer willingness to pay for or consume bio-fortified staples. Low *et al.* (2017) asserted that, since rural smallholder farmers mainly grow their own food, OFSP cannot be expected to feature prominently in household diets except where it is cultivated domestically. Valuable insights may thus be gained by focusing on the chain of decisions smallholder farmers make in the period preceding uptake of bio-fortified staples.

This chapter discusses the extent to which farmers' beliefs about OFSP cultivation and their valuation of the status of relationships they enjoy with actors they deem important influence their acceptance of OFSP. It also explores the role of smallholder farmers' desire for social approval and self-perceived capability as mediators of OFSP acceptance.

5.2 Conceptual framework

The Theory of Planned Behaviour (TPB) and Stages of Change (SoC) model are psycho-social explanations of health-related behavioural change. Icek Ajzen initially advanced the TBP in 1991 positing that behavioural decisions (such as acceptance of OFSP) are not made spontaneously, but rather are a result of reasoned processes that are predicated by the decision-makers intention to engage in the specified behaviour (Ajzen, 2015). Under the TPB, behavioural intention is regarded as an intermediate output founded on the decision-makers' beliefs about whether important people approve or disapprove of the behaviour (subjective norms), overall positive or negative evaluation of the behaviour (attitude) and level of perceived control over performing a behaviour (perceived behavioural control).

The SoC model describes a five-stage process involving pre-contemplation, contemplation, preparation, action, and 'maintenance'(Prochaska *et al.,* 2013). Pre-contemplation and contemplation can be deemed to feed 'behavioural intention' as described in the TPB, whereas preparation and action relate to 'trial' activities, in which one experiments with the new behaviour, before deciding to maintain it (Prochaska *et al.,*2013).

This study combined TPB and SoC on the premise that acceptance of OFSP in households is guided by a psychosocial process that integrates main decision-makers' cost-benefit determinations and the desire not to compromise their status in the social groupings they subscribe to. The two models were deemed compatible since considerations of social approval and perceived capabilities, as envisaged under TPB, can arguably feed decision-

makers' evaluations that in turn influence decisions to transition through SoC stages. Besides, since an individual mentally applies a new idea to his or her present or likely future state before deciding whether or not to try it, intention could be considered as the SoC's starting point.

The study adopted a SoC-based dependent variable, acceptance. Additionally, elements of TPB were used to generate indicators of the farmers' perceptions about their capability to pursue the advantages and opportunities nested in OFSP and their predisposition to adopt VAD alleviating variety in the face of social pressures to stick with conventional sweetpotato varieties. The study tested the hypothesis that acceptance of OFSP among smallholder farmers in Uganda is a distal dependent variable that is significantly influenced by farmers' socio-demographic characteristics (*see H3 in Fig.5.1*).

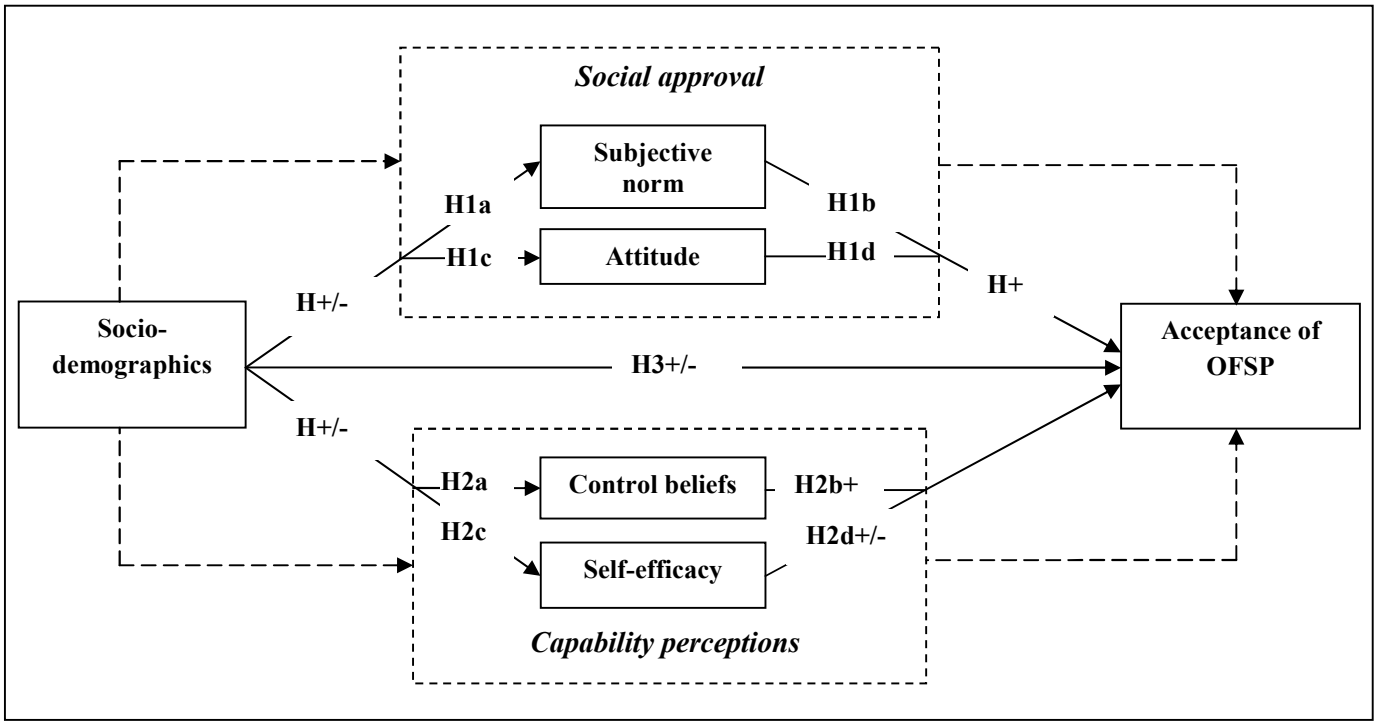

Fig.5.1: Schematic illustration of the conceptual framework for acceptance

It also tested the hypotheses that the influence of socio-demographic attributes on acceptance is significantly mediated by two key decision-makers' socio-cognitive considerations; approval of their behaviour by significant others (H1) and their calculus of own capability to take up the technology (H2).

5.3 Research design

Quantitative data gathered as part of the larger survey whose methodology is described in *chapter 2* were used in this chapter. The concern of the chapter was on, approval by significant others (subjective norm), farmers' valuation of cultivation behaviour (attitude), perceived control over production assets needed for cultivating OFSP (external control beliefs) and farmers' valuation of the level of ease or difficulty of cultivating OFSP (internal control beliefs/self-efficacy) compared to cultivating the WSFP, OFSP acceptance stages, and socio-demographic characteristics (education attainment, experience with VAD and monthly wage), *see section 2.2.1 a, b and c,* respectively.

Data analysis

Data analysis was done in three steps. The first step involved Principal Component Analysis (PCA). The Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity, with Eigen values set at 1 was performed to reduce the number of items into a parsimonious dataset as suggested by Field (2013). Secondly, descriptive statistics and bivariate correlations were computed to describe the variables and appraise conceptual relationships. Thirdly, hierarchical regression was performed with SPSS version 16 (using 'enter method') to determine the major predictors of OFSP acceptance. Mediation effects were determined using the three criteria commonly used in psychosocial studies, as they were first suggested by Baron and Kenny (1986) three decades ago. Baron and Kenny posit that mediation is said to be established if (i) variations in levels of the independent variable

significantly account for variations in the presumed mediator (Path a), (ii) variations in the mediator significantly account for variations in the dependent variable (Path b), and (iii) when Paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables (Path c) is no longer significant (Lemmens, *et al.,* 2016), see *Fig. 5.2*. In a proper mediation, correlation between independent and dependent variable need not be significant.

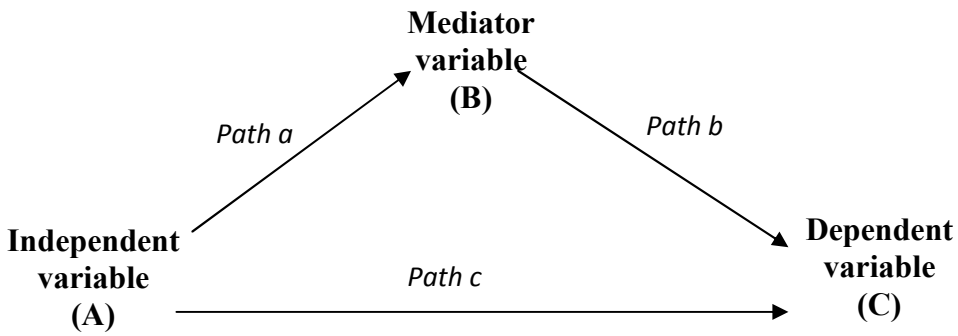

Fig.5.2: Illustration of Baron and Kenny's mediation testing procedure

The multiple regression model was specified as below:

$$Y = ß_o + ß_1 (X_1) + ß_2(X_2)..... + ß_n(X_n) + E \quad (2)$$

Where:

Y = dependent variable (Acceptance of OFSP, subjective norm, attitude, control beliefs and self-efficacy)

$ß_0$ = intercept

($ß_1$ ..... $ß_n$) = parameters to be estimated

(X_i ..... X_n) = vectors of the explanatory variables (socio-demograpics (education, experiences with VAD and wage), subjective norm, attitude, control beliefs and self-efficacy)

E = The error term

5.4 Results and Discussion

Descriptive statistics for the socio-demographics and acceptance of OFSP

The socio-demographic factors examined were the decision-makers' VAD experience, educational attainment and average monthly income. Two of every three decision-makers (67%) did not consider VAD a major problem in their households while 56% did not consider it a major problem for the community. A plausible explanation for the discrepancy, as suggested by Ndaula *et al.* (2019), is that the communities are not sufficiently sensitized about VAD to be able to associate patient symptoms with their VAD status. The farmers may also have under-reported VAD experience in their households because it is socially more acceptable to do so. Consistent with the national census (UBOS, 2016), 66% of the respondents in this study had only attained some level of primary education, 21% had attained secondary education, 6% had attained tertiary education while 7% had not had any formal education. Most of the respondent households (72%) earned US$ 3 or less a day; only 28% earned above US$ 3/day, implying that virtually all smallholder farmers lived in extreme poverty (World Bank, 2016).

Regarding acceptance, 70% of the smallholder farmers had maintained OFSP cultivation for more than six months, 19% had been cultivating OFSP for less than six months ('trial' level) while 11% were still considering starting to cultivate OFSP varieties. Six months were considered as the cut-off period because it represented at least one season of sweetpotato growing; beyond the six months the farmer would be considered as having grown the crop for at least two contiguous seasons. It is also noteworthy that most of the smallholder farmers at 'maintenance' stage had OFSP covering less than 20% of the acreage under sweetpotato.

Statistics for capability perceptions and social approval

The PCA revealed three factors as underlying control beliefs (*Table 5.1*). Perceived household control over timeliness of labour, general labour, financial resources outside the household and financial resources within the household loaded highly (factor loadings over .7) under Component 1. Perceived household control over the fertility of soils and adequacy of soil water loaded highly (factor loadings over .8) under Component 2. Perceived control over access to OFSP vines and access to other farmers growing OFSP loaded highly (factor loadings over .8) under Component 3. Given that an extracted component is primarily a measure of the factor with which it is most strongly correlated (Field, 2013), the components were labelled as perceived control over access to: timely labour, soil fertility and vine access. Self-efficacy and subjective norms and attitudes in social approval domain had only one factor each extracted; thus, all retained their original variable labels.

Table 5.1: Rotated factor loadings underlying control belief

	Rotated factor loadings		
Perceived control over access to:	Control (Timely labour)	Control (soil fertility)	Control (OFSP vine)
Timely labour	.807		
General labour	.792		
Finances outside household	.781		
Financial saving within household	.744		
OFSP experts/ trainers	.542		
Fertile soils		.881	
Soils with adequate water		.825	
Land for OFSP production	.494	.564	
OFSP vines			.866
Other OFSP producing farmers			.820

Extracted using Principal Component Analysis. Rotation converged in 5 iterations.

KMO measure of sampling adequacy obtained for the extracted factors were equal to or higher than the recommended .5 and the Bartlett's test of sphericity were also significant ($p \leq .001$) (*Table 5.2*). Eigenvalues were above Kaiser's criterion of 1 and the factors explained 66.5%, 52.4%, 54% and 61% of the variance in data of control belief, self-efficacy, subjective norm and attitude respectively; it was thus acceptable to proceed with the analysis (Field, 2013).

Table 5.2: Summary of explanatory factors

Factors	Number of items	Mean score	Variance	Bartlett's test	KMO	Eigenvalue	% Variance explained
Experience with VAD	2	1.4	.025	49.0***	.500	1.37	68.4
Approval of significant others (AS)	4	3.2	.393	342***	.493	2.16	54.0
Valuation of cultivation behaviour VC)	5	5.1	.019	639***	.823	3.05	61.0
Perceived control over production assets	10	2.8	.214	1375***	.802	1.08	66.5
➔ Access timely to labour	5	-		-		4.30	31.0
➔ Access to fertility soils	3	-		-		1.28	19.8
➔ Access to OSFP vine	2	-		-		1.08	15.7
Easiness/ difficulty of cultivation (E)	10	3.1	.014	1611***	.907	5.24	52.4

*** = $p \leq .001$

Bivariate correlation of the study variables showed that five variables: education, VAD experience, average monthly income, approval by significant others, and perceived control over access to vine were highly correlated with acceptance of OFSP ($p \leq .01$) (*Table*

5.3). Farmers' valuation of cultivation behaviour (attitude), farmers' valuation of the level of ease or difficulty of cultivating OFSP (self-efficacy) and perceived control over access to labour), and fertile soil were not. Among the independent variables, self-efficacy was outstanding in being correlated ($p \leq .01$) to all the other variables except education. These relationships imply that self-efficacy is probably mediated by other variables given that it does not significantly associate with acceptance.

Table 5.3: Correlation matrix for study variables

Variables	1	2	3	4	5	6	7	8	9	10
Stage of acceptance of OFSP										
Education level of respondent	.163**									
Experience with VAD	-.184**	-.073								
Monthly income of respondent	.170**	.361**	.073							
Approval of significant others (AS)	.369**	.127*	-.045	.201**						
Valuation of cultivation behaviour VC)	.084	-.013	.072	-.019	.173**					
Perceived control over production assets (timely labour)	.049	.012	.148**	.240**	.128*	.227**				
Perceived control over production assets (soil fertility)	-.054	.003	.065	.051	.001	.167**	.000			
Perceived control over production assets (vine access)	.284**	.126*	.016	.166**	.355**	.031	.000	.000		
Easiness/ difficulty of cultivation (E)	.105	.011	.175**	.251**	.216**	.311**	.596**	.271**	.220**	

* = p≤ .05, ** = p≤ .01, two-tailed tests of significance

Effect of Socio-Demographics and Socio-Cognitive Factors on Acceptance

The results in Table 5.4 show the hierarchical regression analyses conducted to test the influence of the three main predictors of acceptance, hypothesised earlier in this chapter (*Fig.5.1*). Models 1-4 tested the relationships between independent and mediator variables in H1a and H1c and H2a and H2c. The first hypothesis (H1a) proposed that socio-demographics are related and influence approval by significant others (subjective norms) and as shown in

the first model, the hypothesis was supported (R^2 = .046, F = 5.4, $p \leq .01$). The second hypothesis (H1c) stated that socio-demographics are related and influence farmers' valuation of cultivation behaviour (attitude) towards OFSP cultivation. As shown in the second model this hypothesis was not supported. This implies that socio-demographics were not significant predictors of positive or negative attitudes towards OFSP among decision-makers in the study. Further, the third hypothesis (H2a) which stated that socio-demographics relate and influence perceived control over production assets needed for cultivating OFSP (external control beliefs) was supported as indicated by the third model (R^2 = .032, F = 3.7, $p \leq .05$). Lastly, the fourth hypothesis (H2c) which asserted that socio-demographics influence farmers' valuation of the level of ease or difficulty of cultivating OFSP (internal control beliefs/self-efficacy) was supported as suggested by the fourth model (R^2 = .093, F = 11.4, $p \leq .001$). Thus, this study established that H1a, H2a and H2c met the first criterion for establishing mediation namely, that variations in levels of the independent variable significantly account for variations in the presumed mediator. This is consistent with psychosocial studies (e.g., Rivera and Pérez, 2015) that indicate that the context in which a decision-maker operates is important in the formation of the latent beliefs on which most salient psychosocial variables, such as self-efficacy, depend.

Model 6 was used to test four hypotheses (H1b and H1d and H2b and H3d), which focused on the relationships between the independent**,** mediator and dependent variables. Overall, this model was supported by the data (R^2 = .206, F = 12.3, $p \leq .001$). Specifically, the hypothesis that stated that subjective norms positively influence acceptance of OFSP (H1b) was supported ($\beta = 0.182$, $P \leq .001$). However, H1d that stated that attitude positively relates with acceptance of OFSP was not supported. Accordingly, Model 6 met the second criterion for establishing mediation, namely that variations in the mediator significantly

account for variations in the dependent variable. Thus, subjective norms significantly predicted acceptance of OFSP, but attitude did not.

Table 5.4: Hierarchical regression results for mediators and acceptance of OFSP

Decision-makers (n = 341)							
Variables	Mediators[a]				***Acceptance of OFSP***		
	Model 1 (AS)	Model 2 (VC)	Model 3 (PC)	Model 4 (E)	Model***5*** ***(socio-demo)***	Model***6*** ***combined***	**VIF**
Socio-demographics (Independent variables)							
Education level of respondent	.083	.002	.114	.110	.097	.069	1.180
Experience with VAD	-.055	.074	.012	.150**	-.129***	-.124***	1.051
Monthly income of respondent	.139**	-.017	.103*	.202***	.076*	.039	1.280
Mediator variables							
Approval of significant others (AS)						.182***	1.228
Valuation of cultivation behaviour VC)						.036	1.148
Perceived control over production assets (vines access) (PC)						.114**	1.190
Easiness/ difficulty of cultivation (E)						.007	1.285
R^2	.046	.006	.032	.093	.074	.206	
Adjusted R^2	.038	-.003	.024	.085	.066	.189	
F	5.4**	.638	3.7*	11.4***	9.0***	12.3***	

* = $p \leq .05$, ** = $p \leq .01$, *** = $p \leq .001$

[a]*Dependent variable for model: 1(Approval of significant others = subjective norm), model 2 (Valuation of cultivation behaviour = attitude), model 3 (Perceived control over production assets = external control beliefs) and, model 4 (Easiness/ difficulty of cultivation = internal self-efficacy).*

These findings conform with those of social norm studies and the norm descriptive narrative (e.g., Mackie *et al.*, 2015; Cislaghi and Heise, 2018), which established that changing a socially embedded behaviour requires a critical mass of community members to believe that

enough near-peers are accepting or expect them to accept the novel behaviour; otherwise, attitude becomes an inadequate predictor. Arguably one cannot have tenacious attitudes about ideas that he/she has not fully experienced; hence before an adopter tries out a technology, the attitude one holds is likely to be an outcome of external influence and unaligned with their behaviour.

Hypothesis H2b, which stated that perceived control over access to vines positively relates with acceptance of OFSP, was supported ($\beta = 0.114$, $P \leq .01$) while hypothesis H2d which stated that self-efficacy relates to acceptance of OFSP was not supported. Accordingly, H2b also met the second criterion. The status of this relationship between control beliefs on access to vines and acceptance of OFSP conforms with the findings of previous studies that used TBP e.g., Talsma *et al.* (2013). Talsma *et al.* (2013) found control beliefs on food purchase decisions to be a vital predictor for caregivers' intentions to feed children on orange-fleshed cassava in Uganda. This highlights control over production inputs required by smallholder farmers to cultivate OFSP as a core element of decision-makers' calculations in deciding whether to accept or reject the technology.

Insignificant evidence was found regarding the association between self-efficacy and acceptance of OFSP. Accordingly, H2d did not meet the second criterion for establishing mediation. Vancouver and Purl (2017) assert that self-efficacy is clearly positively affected by past performance, implying that its effect on behaviour can be negative, unrelated, or positive. By extension of this logic, self-efficacy may not have effectively predicated OFSP acceptance in this study because self-efficacy beliefs about the OFSP were probably confounded by experience with sweetpotato varieties previously grown by the respondent households. Nezami *et al.* (2016) also reported that the ability of self-efficacy in explaining behavioural changes may be limited by lack of activity specificity to which self-efficacy is referenced. In this study, self-efficacy was measured following the sweetpotato value chain

activities (from site selection to cooking), which was presumed sufficient to eliminate the measurement effect.

Model 5 tested the relationship between the independent and dependent variables in H3 hypothesis which stated that socio-demographics had a significant and direct influence on acceptance of OFSP ($R^2 = .074$, $F = 9.0$, $p \leq .001$). Accordingly, H3 did not meet the third criterion for establishing mediation, namely that "when paths *a* and *b* are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path *c* is zero". This implies that even after controlling for subjective norms and perceived control over access to vines, both of which met the first and second criteria for establishing mediation, a significant 7.4% of the variance in farmers' acceptance of OFSP probably continued to be accounted for by mediators currently not included in the study's conceptual model.

The study revealed subjective norms (in the social approval domain) and control beliefs (in the capability perceptions domain) to significantly mediate the acceptance of OFSP, since almost all coefficients of the socio-demographic variables (Model 5) reduced and became insignificant, on introducing in the mediator variables in the model. Only the coefficients of farmers' experience with VAD remained constant and significantly related with acceptance, implying that this relationship could be mediated by some other variables such as perceived health risk posed by VAD, given that the deficiency manifests as a hidden challenge.

5.5 Conclusions and Recommendations

This study was designed to examine the role of *social-cognitive factors in farmers' decisions to cultivate orange-fleshed sweetpotato among rural households in Uganda.* Two

factors were found to be associated with acceptance of OFSP: subjective norms in the social domain and control beliefs related to production assets under capability perceptions.

The following recommendations arise out of the above findings:

1. To **Extension workers**
   a) Beyond individual capability of decision-makers, it is vital to seek to alter the perceptions held by the near-peers especially those actually cultivating OFSP and have the capacity to lean on by peers to do the same. This can, for example, be achieved through variety endorsements (e.g., by community and cultural leaders), or through targeting the most motivated and connected members of the community first, when designing OFSP dissemination campaigns.
   b) Farmer groups should be strengthened to better support members to grow OFSP.
   c) Farmers should be trained in sweetpotato value chain activities such as vine preservation and production sequencing between seasons to increase access to OFSP planting materials.
2. **To Researchers**

   Given the significant direct effect of socio-demographic attributes on acceptance established by this study, future research should explore the possibility of additional mediators. In particular, the positive direction of the effect hints at probable additional mediators whose effect is likely to be positive.

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CHAPTER SIX

NETWORK EFFECTS: A MECHANISM FOR SMALLHOLDER FARMERS' ACCEPTANCE OF ORANGE-FLESHED SWEETPOTATO AMONG RURAL HOUSEHOLDS IN UGANDA

6.0 Background

This chapter is associated with a published journal article by *Ndaula, Matsiko, Sseguya and Miiro (2021) in the Journal of Agricultural Research, Development, Extension and Technology*. Based on the findings of the preceded *chapter 5*, that suggested mediation effects of social approval and farmers' perceptions of capability to cultivate orange-fleshed sweetpotato (OFSP) on OFSP acceptance, this chapter aimed to bring out the reasons behind these mechanisms. The chapter consists of; an introductory section that situates the social psychological context in OFSP acceptance in network effects literature, a conceptual framework, a supplementary research design concerned with chapter specific data analyses, results and discussions, conclusions and recommendations, and the list of references.

6.1 Introduction

Network Effects, commonly used to explain how telecommunication innovations such as mobile telephony, flickr, whatsApp and facebook rapidly gained acceptance, can offer vital insights into understanding the mechanisms involved in the acceptance of bio-fortified crops. The Network Effects, also known as Metcalfe's Law, may manifest directly and/or indirectly (Fisk, 2020). Direct network effects refer to the inherent feature of some innovations' likelihood to be accepted increasing with the number of potential adopters (Zhou *et al.,* 2020). These effects are relatively more pronounced for socially-oriented innovations where the value to users tends to increase as family, friends and acquaintances join a network

(Wirtz *et al.,* 2019). Indirect network effects, on the other hand, occur where the likelihood of acceptance of an innovation in one user group increases when a new user joins a different user group with which the former is linked (Zhou *et al.,* 2020).

A unique characteristic of innovations, whose dissemination is usually associated with network effects, is that their acceptance hinges on rapid attainment of the minimum number of adopters or user groups within the 'community' from which each adopter derives the value that is linked to network effect (Lechman, 2014). This minimum number describes the necessary conditions for collective action to emerge and become self-perpetuating (Ndaula, 2019). Noteworthy, network effects are primarily associated with new products or those that significantly differ from existing ones. This is mainly because a mature system would have already assembled the minimum number of users, making solitary rather than group recruiment of new users feasible (Wirtz *et al.,* 2019). Similarly, innovations that involve incremental upgradings of existing products do not require major user behaviourial adjustments or establishment of new product user systems (Allen, 1988).

The orange-fleshed sweetpotato (OFSP), a batch of relatively new crop varieties, have been widely promoted in Uganda since 2000. These varieties have been bio-fortified with ß-carotene, a precursor to vitamin A, and continue to be promoted for their ability to reduce child mortalities and acquired blindness linked to the vitamin's deficiency (Low *et al.,* 2017). Central to the associated promotional strategies is working with communities that predominantly produce and consume conventional energy-dense white-fleshed sweetpotato (WFSP) for purposes of progressively replacing them with bio-fortified ones (Asare-marfo *et al.*, 2013). Proponents of OFSP varieties maintain that because they are vegetatively propagated, planting materials can be easily shared (Low *et al.,* 2017). Thus, OFSP impact is likely to spread out relatively cheaply beyond targeted smallholder farmers via vine footprints and social exchanges, especially where there is a tradition of vine exchange (Yanggen &

Nagujja, 2006) or community access to OFSP via gifts (de Brauw *et al.,* 2015). Several exploratory studies covering several farming communities and major local food markets in Uganda, though, continue to provide anecdotal evidence indicating OFSP to have a low profile in farmers' fields and markets.

So, suited as it may sound, OFSP would have to compete for space and position in the domain defined by the attributes of consumers, since it significantly differs from WFSP due to its distinct orange colour, a less sweet flavour and high moisture content (Lagerkvist *et al.,* 2016). A major moderator for the OFSP acceptance process, at least within a limited range, is likely to be network effects. However, a dearth of knowledge exists regarding the role of technology-related network characteristics in OFSP acceptance. Of the extant related literature, the focus tends towards harnessing the power of networks, for example, into technology transfer and peer learning (Sseguya *et al.,* 2014), marketing performance (Ochieng *et al.,* 2018) and information delivery about new micronutrient varieties (HavestPlus, 2011; Thuo *et al.,* 2013). In the case of biofortification, networks have been actively used for fundraising for breeding programs at global level, attainment of uniform varietal delivery outcomes where more than one organization has been involved in country level delivery programs and at grassroots level social networks (family, friends, neighbors) have been utilized for their known role as the main source of information for farmers to deliver information to farmers regarding the new micronutrient varieties, such as iron-rich beans and millet (Yanggen and Nagujja, 2006; HavestPlus, 2011; Low *et al.,* 2017).

The central emphasis, where networks have targeted to benefit the farmers, has been put on cumulatively increasing pressure on individuals to accept an innovation through the activation of peer networks about an innovation in a social system (Wani and Ali, 2015). Valuable insights may thus be gained by studying how network effects affect decision-making processes regarding OFSP acceptance, particularly because collective action counts

for the acceptance of innovations with network effects, mainly after the critical numbers of users have been assembled. Thus, this study sought to describe the role of network characteristics on OFSP cultivation behaviour among rural households in Uganda.

6.2 Conceptual framework

Vanberg (2006) describes network effect as the utility derived from the number of other users of an innovation. This utility is vital in acceptance decisions for innovations. Where network effect exists, the growing size of the network progressively creates some utility for each of its users as new adopters join (Economides, 1996; Zhou *et al.,* 2020). The utility makes it easier for later adopters to accept the technology (Katz and Sharpiro, 1985). Once the critical mass of users is attained, acceptance continues without the need for external intervention (Lechman, 2014). If early users are not reinforced, they are likely to discontinue thus decreasing benefits for the remaining users encouraging further defection.

Gallaugher (2008) described the value created by network effects as coming from three inter-reliant sources: 1) an exchangeable feature such as OFSP vines and harvest; 2) perception about the potential of the innovation to stay, that is not to leave adopters stranded and; 3) the existence of complementary benefits or opportunities for other innovators to offer value around an innovation. Accordingly, the crucial issue for dissemination is the underlying incentives structure that attracts someone to accept such innovations with network effect at initial stages. As Markus (1987) argued, initially individuals experience low network value and high relative acceptance costs. Consequently, acceptance decisions are made on predictions of the new product taking off. The adopters base their choice on how they expect like-minded people to act vis-à-vis the new technology (Allen, 1988). Mackie *et al.* (2015) likewise assert that in assessing the likely response of peers, people tend to observe the

responses of the reference group and those of the valued individuals to assess whether the reference group and enough of the people one values are accepting the new idea.

For switching decisions, such as the decision to substitute a dominant WFSP variety with OFSP, the new offering has to be perceived as being better than the one it supersedes (Gallaugher, 2008). This margin is what Rogers (1995) describes as the innovation's relative advantage. Acceptance decisions, at technology delivery, are thus linked to farmers' predictions regarding the likelihood of OFSP taking off within the farming community. The 'take-off expectations' may be directed toward: 1) the relative advantage of the innovation and 2) the likely response of the peers. The expectations exert their influence through individual network effect components – exchange power, stay power and complementary benefits (Gallaugher, 2008).

Initial acceptance assumes prevalence of individual efforts that are characterised by efforts by individual users to establish their own means to manage an innovation prior to attainment of the critical mass of users. These coping strategies are intended to help individual adopters benefit from a technology before a critical mass is assembled. The strategies nurture a wave of short-term stimuli for individuals who subsequently get influenced to accept an innovation through interpersonal exchanges and social modeling (peer-oriented learning) (Rogers, 1983). Individuals may also distance themselves from an innovation as a coping strategy (Long, 2001; Mango, 2002), not as a sign of innovation rejection, but to protect themselves from the risk of being left stranded with the innovation, if it were not to get accepted in peer circles (Gallaugher, 2008).

To avoid relapsing by adopters, critical mass must be attained rapidly (Lechman, 2014). Getting to critical mass is, therefore, not a fixed obstacle for delivery. To the contrary, it is a special quality for innovations with network effects that demands the use of special strategies that implant the expectation that the innovation is likely to takeoff (Ndaula, 2019).

Hence the vital issue in innovation delivery becomes establishing whether network effects exist, their likely source and how such effects could benefit the delivery campaign (Gallaugher, 2008).

Against the above background, this study used network effect concepts to describe the processes underlying OFSP acceptance. Specifically, the study sought to establish whether network effects impacted the status of OFSP acceptance. In keeping with the network effects study tradition, take-off expectation was hypothesized to affect acceptance through coping strategies and network value (*Fig. 6.1*). 'Take-off Expectation' was assessed in terms of relative advantage and likely peer response while 'coping strategies' were assessed in terms of acceptance related innovations (pro and against OFSP delivery) deployed before the minimum user group size is obtained. The reference group farmers ascribed to and valued peers were used as a context for assessing peer predisposition to OFSP cultivation. In so doing it was recognized that membership to the groups used to deliver OFSP in the study area was rather close knit.

This study explored two main questions: RQ1); Does 'take-off expectation' influence OFSP acceptance outcomes through 'coping strategies'? RQ2); Does 'take-off expectation' influence OFSP acceptance outcomes through 'network effect value'? The major constructs in the conceptual framework were operationalized as follows: (i) 'take-off expectation' – relative advantage and likely response of the peers; (ii) 'coping strategies' – innovations related to acceptance before the minimum user group size is attained; and (iii) 'network value' – 'exchange power', 'stay power' and 'complementary benefits' (*Fig. 6.1*).

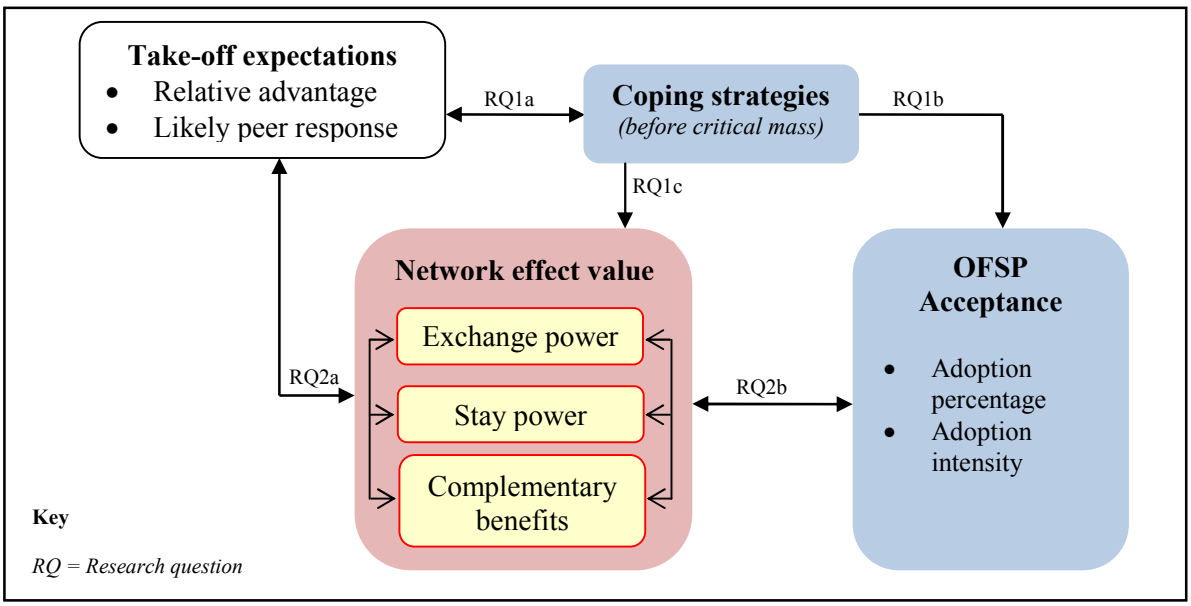


Fig. 6.1: Schematic illustration of the conceptual framework

6.3 Research design

Both quantitative and qualitative data were used in this chapter. The data were gathered in the larger survey and subsequent in-depth interviews using protocols already described in the general methodology, *see chapter 2.* Specifically, the chapter benefits from survey data concerning aspects extracted from the section on approvals by peers, relative advantage of OFSP, and the OFSP adoption intensity, *see section 2.2.1 a and b.* It also pertains data on *take-off expectation, stay power, exchangeable value, complementary products and coping strategies* that were obtained from the farmers using the in-depth interviews, detailed in *section 2.3.2 and 2.4.*

Data analysis

The survey data were analyzed using mean perception scores and percentages. Individual farmers'/decision-makers' scores were transformed by dividing the product of 'rated items and farmers' rating of the importance of each item in making sweetpotato

cultivation decisions' by seven (7), the maximum expected score of the scale used, as detailed in the formula below:

$$\textit{Perceived Relative advantage} = \frac{\textit{Item rating x Importance of item content in cultivation decisions}}{\textit{7 = maximum point of the scale.}}$$

This was done in order to bring individual perceptions within a comparable range. Thereafter, means scores were calculated in SPSS and used to analyse survey data.

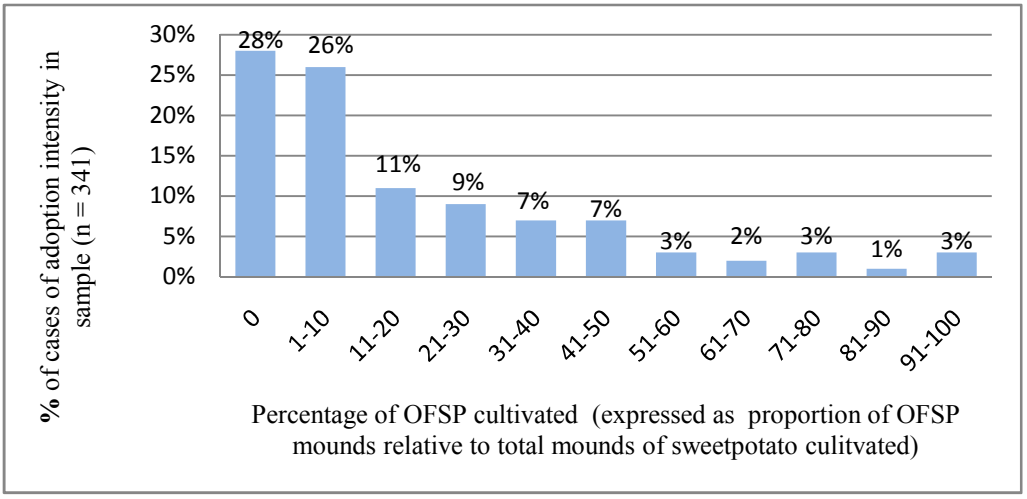
Qualitative data from interviews were analyzed through content analysis. Content was sorted out and organized into themes using concepts adopted from network effects (exchange power, stay power, complementary benefits, and coping strategy). Network effects-related concepts were used in order to lend rigour to the qualitative processes used in this study as suggested by Bergman and Coxon (2005). Bergman and Coxon observed that researchers' declaration of the lenses used to organize qualitative data demonstrates transparency and gives other researchers an opportunity to understand the context in which meanings were assigned to obtained information. All transcripts of individual interviews were individually reviewed for presence/absence of predetermined structural codes as recommended by Guest, MacQueen and Namey (2012). Related or synonymous words were combined into a single code (e.g., 'susceptible to drought' 'Not likely to stay' and 'Vines dry up easy' were combined as 'stay power') and frequencies determined within each stage and among the acceptance stages using a matrix. This was done in order to determine the prevalence of the resultant codes within and variation among the acceptance stages.

6.4 Results and discussion

OFSP acceptance outcomes

A major aspect of the study was describing the role of network characteristics in OFSP cultivation behaviour among rural households in Uganda. Acceptance outcomes were derived from the level of adoption (percentage intensity) by each farmer. *Fig. 6.2* shows the proportion of total sweetpotato cultivation devoted to OFSP. The survey revealed that 28% of the sweetpotato farmers were not cultivating OFSP, while 26% and 11% were cultivating 1% to 10% and 11% to 20% OFSP, respectively. Overall only 12% of the farmers were cultivating more OFSP than WFSP.

Fig 6.2: Adoption intensity of OFSP in study area (n = 341)



The preceding findings show that OFSP were widely accepted but adopted at relatively low intensity compared to the conventional white-fleshed sweetpotato it aimed to replace. The low intensity of adoption favoured the self-perpetuation of the conventional sweetpotato which dominated the farmers' plots (Lechman, 2014). The findings are consistent with those of Yanggen and Nagujja (2006) and Mwanga and Ssemakula (2011) which indicated that sweetpotato farmers while seemingly accepting of the OFSP varieties

tended to abandon them over time. A plausible way of interpreting these findings is that acceptance rather being an event, the activities involved in the iterative acceptance decision making process could be at the core of protracted acceptance overtime.

'Take-off expectation' and acceptance of OFSP.

A key question that this study sought to answer was, "How does 'take-off expectation' affect OFSP acceptance?". In this study, 'take-off expectation' was operationalized as the farmers' valuation of OFSP's relative advantage against the conventional white-fleshed sweetpotato as well as the perceived peer propensity to grow the new variety. The discussions with farmers from the survey and indepth interviews revealed that farmers were accepting the OFSP more for social reasons than on the basis of technical or economic calculation. As many farmers at the 'maintenance' stage emphasized, farmers were inclined to base their choices on what they figured their near-peers to be doing regarding OFSP cultivation. In the words of one male respondent:

> *"Most farmers devote less than 10% of their sweetpotato gardens to OFSP; even some of the Community Resource Persons who promote OFSP do not, themselves, grow these varieties at all" (John, farmer interview, Kyotera May 2017).*

The above farmer's account was supported by survey results (*Table 6.1*), which indicated that most of the farmers perceived that valued peers did not grow OFSP altogether (13.2%) or if they did, it was at low intensity (38.2%). They also perceived members of the groups they ascribed to, to be nominal OFSP growers (54.8%). The proportion of farmers recognized, by peers (65.4%) or members of groups they ascribed to (69.7%), as OFSP growers was moderate. This may be due to inverse dissonance in light of which a farmer's OFSP related activities are rated low by others while the farmer thinks valued peers approve of what they are not doing themselves.

Table 6.1: Perceived social response of peers regarding OFSP agriculture.

Social influence centre	Average percentage perceptions (N=341)			
	Zero (0)	**Low (1-2)**	**Moderate (3-4)**	**High (5-6)**
Peer pressure				
What proportion of OFSP do you think farmers you value are growing in their sweetpotato garden?	13.2%	38.2%	27.6%	21.1%
What proportion of OFSP do you think farmers you value approve you to grow in your sweetpotato garden?	13.2%	21.5%	33.5%	31.9%
Group pressure				
What proportion of OFSP do you think members of your group are growing in their sweetpotato gardens?	4.1%	54.8%	26.8%	14.4%
What proportion of OFSP do you think members of your group approve you to grow in your sweetpotato garden?	4.1%	26.1%	27.8%	41.9%

The close similarity of perceived adoption intensity by peers discussed above and the actual adoption intensity observed among the study population shown in *Fig. 6.2*, suggests that farmers (knowingly or unknowingly) used peers as referents. These findings conform with Allen (1988). Allen's seminal work regarding case study research of MiniTel that focused on how network effects on create demand, suggests that initial acceptance of innovations with network effects is characterized by mutual observation. Mackie *et al.* (2015) also posit that in observing each other's actions, socially oriented persons aim to fulfil two goals related with optimizing decision-making outcomes: 1) making effective action and 2) building and maintaining social relationships. Looking up to peers' actions and approvals is one important way to effective action when situations are novel, ambiguous or uncertain, and helps

individuals to keep away from opposing what is socially deemed right by their peers (Jolanda *et al.,* 2002). The observed intensity of cultivating OFSP (*Fig. 6.3*) can thus be interpreted as an effort by the farmers to align their cultivation behaviour with the perceptions they hold about their peers.

Young (2015) identified four main reasons why individuals comply with social influence: 1) people desire to achieve a goal that is well coordinated with actions of group members; 2) in anticipating social rewards or social penalty for their compliance and non-compliance, individuals try to achieve the former and avoid the latter, even when they may have preferred otherwise; 3) individuals' actions are a symbol in themselves that signal their membership in a given group to self and/or to others and; 4) benchmarking may be used as a means to reaching effective decisions. A plausible interpretation of Young's observations is that effective response to social pressure depends on the motivation occasioned by the value one attaches to individuals and/or groups one ascribes to, and the existence of socially oriented reasons that guide one's response.

The survey findings presented in *Table 6.2* show further that most of the farmers assign high value to peers (80%) and the groups they ascribed to (84%) when making farming decisions. Peer perceptions were found to be influenced through social rewards and reprimands and/or through fear that one would compromise one's position within their group. Cislaghi and Heise (2018) also observed that compliance to valued people's approvals and/or disapprovals follows not so much from application as from anticipation of sanctions.

As shown in *Table 6.3*, most farmers were prone to social pressure because they did not want to be left out of the information loop constituted by valued peers (48%) and the groups farmers ascribed to (31%). The fear of being expelled by a group one identifies with (23%) and payment of fines/penalties due to non-compliance (13%) were also important reasons that motivated farmers to comply with social pressure. So, the reasons farmers try to

match their own behaviour with that of those they believe to be important others regarding OFSP cultivation were mainly inclined to be anticipative rather than empirical.

Table 6.2: Importance farmers attach to groups and peers when making farming decisions

	Average percentage ranking with 7 denoting highest importance and zero not (N=341)				
Centre of influence	**0**	**1 to 2**	**3 to 4**	**5 to 6**	**7**
Rank the importance of the group(s) you ascribe to when making decision about farming your household.	3.5%	6.7%	5.9%	65.7%	18.2%
Rank the importance of the farmers you value in when making decision about farming in your household.	12.3%	8.8%	7.9%	55.7%	15.2%

Table 6.3: Farmer motivation to comply to social pressure

What happens if you don't comply to members'/ individuals' expectations	Level of importance (percentage, N=341)	
	Peer pressure	Group pressure
I would be left out of the information flow	**47.50%**	**31.10%**
I would be expelled from the group	**-**	**22.70%**
I would be asked to pay fines/ penalty	**-**	**12.60%**
Members would become demoralized	7.70%	9.20%
Members would lose trust in me	7.30%	9.10%
Members would not share vines and/ or harvest with me	3.00%	7.10%
Would be taken to the group's disciplinary committee	-	5.90%
Members would proclaimed hunger on me and my family	5%	4.10%

Additionally, in-depth interview findings indicate that farmers who accepted to grow OFSP, would periodically receive gifts, such as t-shirts, tours, bicycles, calendars, baseball caps and free seed, which were distributed by technology dissemination agents (HarvestPlus, through VEDCO and CEDO) through their social and/or development groups. The social groups were either extant or originated by the technology promotion agencies and composed of male and female household decision-makers operating in contiguous locations that were targeted by OFSP delivery activities. Non-OFSP growers had been excluded from receiving any input. Field observations conducted during this study also revealed that many of the farmers were nurturing a few symbolic mounds of OFSP in a typical garden of over 400 mounds of sweetpotato, which they could quickly display. Twenty five (25) of the 30 farmers talked to during in-depth interviews under the 'trial' and 'maintenance' case study, noted that being involved in some kind of OFSP activity was used as a channel for receiving inputs supplied via their farmers' groups. It was also observed as a mechanism for pacifying peers in groups and relatives to farming families, as exemplified by the following narrative from one of the female farmers:

> *"If you do not plant OFSP at all you get rejected or scolded by other farmers that you want to starve your family" (Rehma, farmer interview, Kyotera, April 2017).*

Edward an emigrant from Rwanda who worked together with his wife, on a Sub-county Chief's, cultivated OFSP because their boss considered the storage roots of the new varieties to be the best foodstuff for the health of their four young children. A community resource person (CRP) in Kirumba sub-county, another socially important person for OFSP delivery, noted that "*the problem with OFSP 'anyiwamangu";* meaning that one gets fed up quickly with eating OFSP. *"So, one cannot prefer OFSP for food*". The CRP acknowledged cultivating OFSP at a very small scale because, as a community resource person, he

considered aligning his actions with what he, as a leader, tells others to be the right response to social crises. Correspondingly, HarvestPlus (2011) reported social networks (family, friends, neighbours) as influencing the uptake of pearl millet in Pakistan and bean varieties in Rwanda, mainly due to the role those networks play as farming information flow conduits.

This study also revealed that relative advantage gained importance because OFSP was being promoted by change agent groups for its nutritional and economic advantage over the conventional WFSP. Some tensions were also detected in decision-makers'/farmers' perceptions regarding relative advantage of the OFSP and their decisions to cultivate these new varieties (*Table 6.4*). For example, 10 of the 12 farmers interviewed in one case study, the 'under-consideration' farmers, did not perceive OFSP to have relative advantage over conventional varieties, as exemplified by a male farmer who observed that:

> *"The OFSP storage roots do not resist pests and are not floury when cooked. The dried sliced storage root chips (Obukeke) made from OFSP also turn black when used for making amaboya (a mashed dish made out of preserved dried sweetpotato)" (Abdul, farmer interview, Buyende, May 2017).*

Fourteen of the farmers interviewed under the 'trial' stage case study were in a state that could be characterized as 'partial appreciation' of the relative advantage of OFSP. This may, at least in part, be attributed to their attitude towards the new varieties having been significantly influenced by secondary information obtained through peers (Ndaula *et al.*, 2020).

Table 6.4: Content analysis summary on perceived relative advantage of OFSP and coping strategies

Case study	'Under-consideration' (n=12)		'Trial' (n-14)		'Maintenance (n=16)	
Concepts	**Issue**	**No. cases**	**Issue**	**No. cases**	**Issue**	**No. cases**
Relative advantage	➔ Negative (e.g., low dry matter and susceptible to diseases, droughts and rots)	10/12	➔ Some (e.g., health benefits)	14/14	➔ More than one (e.g., health, field performance, yield and consumption benefits)	16/16
					➔ Selective acceptance (used as a currency for accessing inputs)	9/16
Coping strategies	➔ Avoidance (opted out of growing the new varieties)	10/12	➔ Selective acceptance (used as a 'currency' for accessing inputs)	14/14	➔ Proactive acceptance (cared for vine preservation plots to guarantee access to planting materials. Some restricted access to their gardens).	7/16

Unlike their counterparts at the 'under-consideration' stage, farmers at the 'maintenance' stage and key informants attributed the blackening of dried potato to the use of poor drying methods. Additionally, farmers at the 'maintenance' stage observed that OFSP were better than the conventional varieties, except for the broad-leafed variety which was deemed as resistant to drought and to be high yielding but simultaneously badly flavoured and of very low dry matter content. Most farmers fed storage roots of this variety to pigs. Many of them also observed that no farmer would be inclined to grow OFSP, if he/she

initially grows the broad-leafed type. Key informants corroborated this finding, and traced the variety to OFSP community varietal evaluation activities earlier implemented in Rakai district by the National Agricultural Research Organization (NARO). Mwanga and Ssemakula (2011) and Low *et al.*(2017), noted that the gene for dry matter and ß-carotene (orange colour in OFSP) had a strong negative correlation for which reason they were separated in 2007 under Uganda's potato breeding program. This was done in order to match farmers' dry matter expectations in any new sweetpotato variety, given that earlier rejections of OFSP in the early 1980s in southern Asia and some countries in eastern Africa, including Uganda were reported to be due to low dry matter more than any other factors (Low *et al.,* 2017). Thus, before the two genes were separated, OFSP most likely featured among farming communities as a less tasty (low dry matter) sweetpotato. Based on the farmers' narratives, under-desired OFSP varieties continue to endure adverse attitudes to survive alongside improved ones. This could probably be confounding farmers' perceptions of the improved disease resistant and tasty (higher dry matter) OFSP, that is Kabode and Vita, that were extensively delivered to farmers interviewed in this study (Low *et al.,* 2017).

The above misgivings notwithstanding, the rest of the OFSP varieties were regarded by farmers who had cultivated the new varieties for more than six months as having relative advantage over the conventional varieties. The farmers, for example, observed that OFSP is as floury especially when left to reach maturity at 3.5 to 5 months; noting that at 2.5 months OFSP roots are still immature, even though the storage roots would have attained mature size. Arising out of this, efforts to curve a niche for OFSP based on early maturity (Mwanga and Ssemakula, 2011; Low *et al.,* 2017), risk having farmers fail to fully appreciate other major qualities, such as dry matter and low fibre content, for acceptance. The survey findings shown in Table 6.6 substantiated the findings of the farmers' in-depth interviews.

Table 6.5: Perceived importance of various traits on decisions regarding cultivation of orange-fleshed sweetpotato (OFSP), and the relative advantage of OFSP against white-fleshed sweetpotato (WFSP) by stage of acceptance and overall.

	Importance attached criterion		Mean score of OFSP against WFSP by acceptance stage[b]							
			Under-consideration (n = 40)		Trial (n = 63)		Maintenance (n = 238)		Total (n = 361)	
Technical criteria	Mean score[a]	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Easiness to preserve last season vines	5.83	1.11	2.12	1.4	2.28	1.14	2.66	1.32	2.53	1.31
Easiness to access vines	5.71	1.01	1.42	0.91	1.68	0.79	2.17	1.23	1.99	1.16
Health benefits/value	***5.62***	***1.16***	***4.51****	***1.16***	***4.21****	***1.25***	***4.37****	***1.2***	***4.35****	***1.2***
Yield quality	***5.58***	***0.93***	***3.88****	***1.47***	***3.84****	***1.14***	***4.1****	***1.07***	***4.03****	***1.14***
Early maturity	***5.57***	***0.95***	***3.82****	***1.28***	***4.06****	***0.92***	***4.25****	***1.1***	***4.17****	***1.1***
Storage root size	***5.46***	***1.06***	***3.64****	***1.45***	***3.95****	***1.08***	***4.12****	***1.17***	***4.03****	***1.2***
Piecemeal harvesting duration	5.29	0.98	2.92	1.51	***3.06****	***1.3***	***3.21****	***1.34***	***3.15****	1.35
Lowest susceptibility to disease	5.26	0.92	2.48	1.16	***3.25****	***1.17***	2.98	1.13	2.97	1.16
Lowest susceptibility to pests	5.25	0.99	2.66	1.35	***3.1****	***1.29***	2.87	1.06	2.89	1.15
Dry matter content	5.21	1.14	2.06	1.28	2.82	1.39	2.8	1.25	2.71	1.3
Lowest fibers in cooked roots	5.21	1.14	2.99	1.26	***3.32****	***1.12***	***3.04****	***1.37***	***3.09****	***1.32***
Likable sugar content	5.16	1.01	2.99	1.54	***3.07****	***1.16***	***3.06****	***1.28***	***3.06****	***1.29***
Likable smell	5.09	1.18	2.79	1.46	2.93	1.29	***3.15****	***1.28***	***3.07****	***1.31***
Acceptable harvest when planted late	5.08	1.09	2.77	1.2	2.93	1.08	2.97	1.26	2.94	1.22
Marketability of surplus	5.05	1.26	***3.03****	***1.4***	2.92	1.36	2.97	1.37	2.97	1.37
High hardness	4.92	1.13	1.83	1.22	2.17	1.17	2.24	1.25	2.18	1.24
Less field operations	4.89	1.20	2.34	1.09	2.69	1.11	2.7	1.08	2.66	1.09
Susceptibility to weeds	4.86	1.29	2.54	1	2.67	1.15	2.67	1.12	2.65	1.11
Likable shape	4.78	1.40	2.74	1.28	2.92	1.21	***3.16****	***1.29***	***3.07****	***1.28***
Likable size	4.74	1.45	2.86	1.26	2.8	1.24	***3.14****	***1.31***	***3.04****	***1.3***
Volume of wasted vines for animal feeds	4.70	1.51	2.3	1.5	2.42	1.4	2.41	1.42	2.4	1.43

[a]*Least score = 1, highest score = 7,* *equal or more than 3

[b]Least score = $\frac{0.14\ (1 = \text{minimum importance x1} = \text{minimum rating})}{7 = \text{maximum point of the scale rating})}$

[b] Highest score = $\frac{6\ (7 = \text{maximum importance x } 6 = \text{maximum rating})}{7 = \text{maximum point of the scale.}}$

Table 6.5 shows that farmers across all the adapted SoC stages generally did not find OFSP to be superior to the conventional sweetpotato in several technical/ physical domains farmers deemed necessary for choosing which sweetpotato variety to grow (*Means < 3, n = 341*). The domains where OFSP was deemed to perform below the conventional types included taste (dry matter and firmness), ease of accessing and preserving vines, varietal performance when planted late, necessary operations when the crop is in the field, marketability of storage roots and varietal resistance to weeds, diseases and pests. This is at odds with the technical studies (e.g., Chowdhury *et al.,* 2011; de Brauw *et al.,* 2015), which maintain that OFSP is superior to the conventional varieties regarding these attributes.

The survey findings also point to some consensus across the three acceptance stages that OFSP was superior to the conventional sweetpotato regarding yield quality (mean = *4.03, sd = 1.14, n = 341)*, health value (mean = *4.35, sd = 1.2, n = 341*), early maturity (*mean = 4.17, sd = 1.1, n = 341*) and storage root size (*mean = 4.03, sd = .2, n = 341*). Mixed feelings were expressed by farmers regarding duration of harvesting, fibre content and adequacy of sugar content, which were found to be superior in OFSP among farmers at the 'trial' and the 'maintenance' stages but not among those at the 'under-consideration' stage. Similarly, only farmers who had grown OFSP for more than two seasons (maintenance stage) rated OFSP storage root size to be superior to that of the conventional sweetpotato (*mean = 3.14, sd = 1.31, n = 238*), likability of shape (*mean = 3.16, sd = 1.29, n = 238*) and pleasantness of smell (*mean = 3.15, sd = 1.28, n = 230*).

As argued in the preceding discussion, the appreciation of the relative advantage of OFSP is gradually acquired through experiential cultivation as elaborated by one female farmer:

> *"Compared with the traditional varieties, OFSP is very susceptible to dry conditions. Farmers who do not cultivate on swamp fringes fear growing a lot*

of OFSP due to erratic weather, which can result in a total loss", (Summaya, farmer interview, Kyotera, April 2017).

Rogers (1983), observed that one cannot meaningfully evaluate an innovation if he/she has not previously encountered it. This can be a major challenge for OFSP delivery because while most farmers focus on the physical/technical features of the conventional varieties (e.g. dry matter content and resistance to pest and diseases), they limit their own involvement with OFSP to experimenting with it or using it as a bait to access supplies. This lack of involvement denies the farmers the opportunity to appreciate the new variety's relative advantages. Whereas Gallaugher (2008) argued that new varieties must outperform their conventional forerunners and should not be imitable for them to be accepted by farmers, key informants in this study observed that several qualities of OFSP, such as high yielding potential are not unique to the new variety. Noteworthy, the disparity between the conventional sweetpotato and OFSP varieties has recently been narrowed by national sweetpotato breeding program at NARO through continual release of improved varieties of both categories of sweetpotato (Mwanga *et al.,* 2016). The upgrading of the conventional varieties may result into conventional varieties based user/farmer network growth making a switch to favoured bio-fortified varieties increasingly difficult (Gallaugher, 2008).

Mediating effect of the social network effect on the acceptance of OFSP

This section seeks to address the question of whether the relationship between 'acceptance' and farmers' predictions of the odds of peer acceptance of OFSP ('take-off expectation') is significantly mediated by social network effect. As illustrated in the conceptual framework (*section 6.2*), exchangeable power (such as OFSP vines and harvest), stay power which was assessed as complementary benefits and the feeling that the new variety will not maroon adopters, and the opportunities for other innovators to offer value

around an innovation, were hypothesized as factors that explain the role of network effects. As shown in Table 6.6, because farmers largely believed that the new varieties were susceptible to droughts and lacked markets, none of the interviewed 'under-consideration' stage farmers thought OFSP was likely to stay.

Twelve (12) out 14 farmers at 'trial' and 6 out 16 farmers at 'maintenance' stage were partially convinced of OFSP's staying power. They considered OFSP to be high yielding but also susceptible to droughts. They further observed that farmers who picked interest in the high yielding potential were also likely to hold onto the vines of the new varieties. Alternatively, 10 out the 16 farmers who were interviewed under the 'maintenance' stage case study, especially those in Kyotera were positive that OFSPs would stay, primarily because these varieties had a superior yield quality as noted by a female farmer:

> *"With the rampant famines, no farmer will have any option but to grow OFSP, because it is high yielding and grows fast", (Sarah, farmer interview, Kyotera, May 2017).*

Regarding, OFSP offering opportunities for other innovators to offer value around it (complementary benefits, such as being used as a baking raw material, marketing of storage roots and vine multiplication) no farmers at the 'under-consideration' stage envisaged any potential partners to engage with. These farmers indicated that they had lost interest in cultivating OFSP due to lack of access to markets and value addition trainings as had been promised by the change agents. In the words of one farmer;

> "*Old varieties can easily be sold. For OFSPs only farmers living along the road are able to find market", (*Solomon, a farmer interview, Kyotera, April 2017).

Table 6.6: Content analysis summary regarding network effect on OFSP acceptance

	Under-consideration (n=12)		Trial (n=14)		Maintenance (n=16)	
Concepts	**Issue**	**No. cases**	**Issue**	**No. cases**	**Issue**	**No. cases**
Stay power	➔ Not likely to stay as staple food variety in the community (drought susceptibility, no market for storage roots)	12/12	➔ Partially convinced due to drought susceptibility but favoured for its high yielding	12/14	➔ Likely to stay as a staple food variety in the community for its yield potential	10/16
					➔ Partially convinced due to its drought susceptibility but favoured for its high yielding	6/16
Complementary benefits	➔ None	12/12	➔ Hopeful for markets, value additional but vines not grown by seed multi-pliers	14/14	➔ Multiplicity (value addition and markets, but vines not grown by seed multi-pliers)	14/16
Exchangeable value	➔ None	12/12	➔ Some (vines)	12/14	➔ Some exchanged vines	9/16
					➔ Some exchanged both storage roots and vines	7/16

In corroboration, the Program Director for VEDCO, a national Non-Governmental Organization, noted that market access and value addition awareness raising activities, were done at the initial stages, although they continued to attract the interest of farmers at the time of the study. Most of the farmers interviewed in Buyende district indicated that there was market for fresh OFSP while conventional varieties tend to have greater demand when sliced and dried. Given that 'amaboya' (sliced dried storage roots) is mainly domestically consumed by the sweetpotato-growing households, it may be assumed that OFSP was accepted in

Buyende as storage roots intended to be sold to external marketers rather than being targeted at the household's domestic consumption.

All the farmers at the 'Trial' stage were optimistic that they would access markets and value addition facilities but were concerned that vine vendors did not deal in OFSP vines. Field observation conducted during this study and researcher interaction with the vendors and farmers, who were found transporting vines into the study area, confirmed that conventional sweetpotato vine vendors did not deal in OFSP vines ostensibly because the varieties did not have market within the villages targeted by the vendors (*see Photo 6.1A to 6.1D*). All farmers at 'maintenance' stage noted that OFSP had several complementary benefits. Most of them noted that they had accessed high value markets through specialized buyers, such as schools, and actors who were knowledgeable in processing OFSP into value added products such as doughnuts and pancakes. The farmers also observed that commercial sweetpotato vine multipliers and vendors were not dealing in OFSP varieties due to low demand for the new varieties in the region compared with the conventional varieties. The balance of evidence suggests that complementary benefits are poorly developed on the side of suppliers (vines) and buyers (excess storage roots); so sweetpotato value chain players were not involved in OFSP advancement efforts within the study area at the time.

Regarding exchange power, farmers at the 'underconsideration' stage were not engaged in vine or storage roots exchange. As noted by a male farmer operating in Buyende,

> "*Farmers who are not growing OFSP do not deserve our kindness during harvest because they always abandon OFSP vines to be wasted at distribution centres*", (Ivan's, a male farmer interview, Buyende, May 2017).

Photo 6.1A: Long distance vine vending truck sales to local distributors in Buyende district in April 2017

Photo 6.1B: Motorcyclists vending vines from other districts into Buyende district in April 2017

Photo 6.1C: A group of women buying vines from long distance vine vending truck in April 2017

Photo. 6.1D: Mini-buses travelling from Kamuli district main tax park to Buyende district with vines in 2017

Similar sentiments were expressed by another farmer hailing from Kyotera who opined, "*At the time of harvesting, we do not gift storage roots to any farmer we do not consider a grower of OFSP,*" (Jane, a farmer interview, Kyotera, April 2017). Consistent with the foregoing narrative, 12 farmers at 'trial' stage indicated they had received gifts in

form of storage roots and/or vines from peers at 'maintenance' stage while farmers at the 'maintenance' stage mostly exchanged vines (9 out of 16) and storage roots (7 out of 16) with peers at the same stage. As a farmer from Kyotera narrated:

> "e*xchanging vines and storage roots preserves the vines of desired varieties and ensures continuous access to the sweetpotato even if potatoes in one's garden are not mature or are already harvested*", (David, a farmer interview, Kyotera, April 2017).

Accordingly, an increase in the number of farmers who consistently grow OFSP increases the number of farmers with whom individual farmers can exchange vines and storage roots. Correspondingly, this expansion in the network of farmers growing OFSP offers each potential adopting farmer increased opportunity for acquiring the vines they need to sustain own decision to cultivate OFSP without undue reliance on external vine distribution arrangement (Lechman, 2014).

The findings also suggest that storage root exchange is central to social validation of variety quality and the associated vine preservation. As noted by one female farmer;

> *"It is difficult to obtain enough vines from the two, ten or even twenty mounds of OFSP that most farmers are cultivating. Also, unlike for conventional varieties, no one can allow you to obtain vines in their OFSP garden without restrictions. Some farmers even ask for money in exchange of vines!",* (Annet, a farmer interview, Kyotera, May 2017).

The above narrative was substantiated by a farmer who was found returning from a vine seeking trip together with her children, *see photo 6.2;* the farmer told the researcher that of the vines she had acquired, OFSP was not among, because the farm that offered the vines did not have OFSP among the sweetpotato that was being cultivated.

Photo 6.2: A woman and her children returning from seeking for vines from friends, April 2017

This suggests that farmers could be willing to take up whatever is available of the sweetpotato vines among trusted friends and peer farmers once the growing season has set in. Allen (1988) posited that where an adopter's network is originally small or farmers find it difficult to access network-based utility due to network shrinkage, lack of positive reinforcement can encumber early users' ability to sustain adoption. All the farmers in this study linked the challenge of access to vines to the characteristics of OFSP. For example, OFSP matures early and the vines are less tolerant to dry conditions and thus store poorly in the field (Mwanga and Ssemakula, 2011). Furthermore, sweetpotato is harvested piecemeal till the entire garden is uprooted (Yanggen and Nagujja, 2006). Thus, as an early maturing variety, OFSP needs a longer vine preservation period for the subsequent season. As a female farmer noted;

> *"OFSP matures early, making it difficult to keep its vines into a new season. Remember a time comes when the entire sweetpotato garden is harvested in one operation. And because it is grown on small scale, this makes efforts to preserve its vines into the next season very difficult. OFPS vines, unlike the conventional varieties that stay in the fields longer, end up succumbing to droughts"*, (Justine, farmer interview, Kyotera, May 2017).

Mediating effect of coping strategies on acceptance of OFSP

This section looks at the following question, "Is the relationship between acceptance of OFSP and 'take-off expectation' significantly mediated by 'coping strategies'?''. Farmers

assessed the period of low intensity adoption differently (*Table 6.6*). Ten (10) out of the 12 farmers interviewed about the 'under-consideration' stage, had not fully appreciated the relative advantage of the new OFSP varieties and consequently avoided taking up the varieties. Several farmers in this category, for example, observed that they did not receive any OFSP vines from distribution centres because they did not consider them better than their conventional varieties. Given that all the farmers who participated in the study had received OFSP vines in 2013; the responses by the 'under-consideration' category were probably coloured by their earlier negative encounters with these new varieties. As noted earlier in this discussion section, insufficient experimentation may have constrained farmers' ability to fully appreciate the varieties' features. Similarly, all the 14 farmers who were at the 'trial' stage and 9 of the 16 farmers interviewed under the 'maintenance' category had had a superficial acceptance of OFSPs varieties. They mainly attributed this to the limited buy-in for OFSP promotion programme with the result that the primary incentive for participation was accessing stores, such as caps, t-shirts, free bean seed, calendars, and bicycles, distributed through the social groups by HarvestPlus. These farmers often took token quantities of OFSP vines from distribution centres. Large quantities of OFSP vines were often left at the distribution shed, due to low farmer enthusiasm (*see Photo 6.3*).

Photo 6.3: OFSP vines abandoned at delivery centre in 2018 season B and 2019 season A

Seven (7) out of the 16 farmers interviewed under the 'maintenance' category, who had grown OFSP for more than one growing season, seemed to have appreciated the relative advantage of OFSP. They had gone on to devise means of preserving the vines, as elaborated by one female farmer;

"Most of the farmers who mainly grow OFSP; do so at swamp fringes and have small vine preservation plots they nurture intensively between seasons. A few farmers preserve vines under tree-sheds or at the boundaries of upland gardens, where the conditions are cool or the plots are close to the homestead to facilitate irrigation. Others stagger the potato vine planting or continually re-bury vines on old mounds to mitigate the challenges of single operation harvesting", (Saida, farmer interview, Buyende, April 2017.

This narrative was corroborated by a Mabuno,Kyotera based male farmer who had been cultivating OFSP on swamp fringes for over four seasons, who had this to say;

"M*y vine preservation plot is my primary interest. I spray it, irrigate it, and weed it in order to ensure that I will be able to plant OFSP in the next season*", (Mabuno, a farmer interviewed, Kyotera, April 2017).

Overall, the farmers who designed vine preservation strategies shared with those who did not, but needed the vines, by giving the latter access to vines and storage roots. Farmers, however, observed that this support was conditional, as noted by a female farmer;

"Some farmers who cultivate on swamp fringes gift us vines and some storage roots at harvesting time; however the average farmer restricts access to their vine preservation plot and does not exchange vines, hoping to protect their path to vine sellers", (Teo, a farmer interview, Kyotera, April 2017).

The exchange of vines was found to contribute to other farmers' appreciation of the relative advantage and stay power of OFSP as elaborated by a Kyotera based female farmer;

"*I was not into OFSP growing, because many people said it was bad, till my mother in-law started sending me storage root along with a few vines. When I cooked them they were not different from the sweetpotato I knew. They were floury and my children liked the orange colour, which they associated with matooke (cooked bananas). This motivated me to start growing these varieties*" , (Robina, a farmer interview, Kyotera).

As argued by Rogers (1983), efforts such as the coping strategies used by early adopters to preserve vines in swampy spaces can be used to draw individuals who had not initially embraced the technology/innovation. The major attraction would be the access to the vines and peer interest in sharing them courtsey of the interpersonal exchanges and social modeling. The available evidence suggests that the vine preservation strategies offered other farmers vines and learning sites, particularly about vine preservation and experiential opportunity for appreciating OFSP.

6.5 Conclusions and recommendations

The key aim of this chapter was to describe the role of social networks in OFSP cultivation by rural smallholder farmers in Uganda. The study found acceptance of OFSP to be associated with OFSP's relative advantage and proximal farmers' expectations (peer perceptions) regarding the likelihood of OFSP being accepted by the community. Interestingly, farmers were found to accept OFSP more for social reasons than for the conventional, logic based technical/physical performance of the new varieties. By extension of this logic, farmers relied on cues provided by mutual assessment of each other's OFSP acceptance and modelling one's own actions accordingly. In addition, 'stay power', which is the feeling that OFSP would not leave adopters stranded due to its inability to withstand field conditions, complementary benefits, such as participation by other sweetpotato value addition actors and exchangeable value (planting material) were found to be associated with acceptance of OFSP. One plausible conclusion is that network effects play an important role in moderating the effect of farmers' decisions to take up OFSP growing. Correspondingly, the likelihood of OFSP uptake increases as the number of farmers cultivating the new variety at maintenance level increases in the farming community. This implies a need to harness network effects for delivery programs of innovations like the OFSP varieties.

The preceding findings lead to the following recommendations:

a) To the Extension workers

i. The results offer support to strategies that build and reinforce confidence among farming communities that OFSP has stay power. Every effort should thus be made to strengthen adopter networks and establish new ones where these do not already exist. This can be adopting proven, high impact strategies for products with network effects, which help in obtaining the critical mass of user network early enough to avoid defection. Such strategies include enrolling receptive communities and/or prominent members of the community and rewarding early adopters before advancing to less receptive groups/ communities.

ii. Support and scale up farmers' innovative ways for coping with inaccessibility to vines in the period before the critical mass of users is obtained.

iii. Change agents should also support sweetpotato value chain actors such as vine vendors, processors and storage root marketers to incorporate OFSP among their product line portfolios.

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CHAPTER SEVEN

GENERAL DISCUSSION OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

7.0 General summary

Micronutrient deficiencies related to lack of iron, iodine, vitamin A and zinc, have persisted as a major public health burden for sub-Saharan Africa, since 1990s. In response, several countries, Uganda included, have endorsed various bio-fortification techniques as core elements of strategic approaches to fighting the deficiencies. Ironically, the associated new technologies do not yet have wide acceptance among farmers (Sharma *et al.*, 2016). In the case of Uganda, several government departments and nongovernmental organizations have promoted bio-fortified orange-fleshed sweetpotato (OFSP) with a particular focus on fighting vitamin A deficiency. Despite these efforts, farmers continue to cultivate OFSP at very low intensity; yet without cultivating OFSPs, subsistence farmers' diets cannot reasonably be expected to meet their vitamin A needs.

This study took the perspective that the low cultivation of OFSP is an outcome of psychosocial processes, since as argued in the *introductory chapter*, the OFSP varieties have recognized, relative physical advantages over the conventional WFSP (Low *et al.,* 2017). However, the direction and magnitude to which delivery efforts are affected by various dimensions of the socio-cultural context and the cognitive processes of decision-makers are not well understood. Accordingly, the goal of this study was to enhance understanding of the influence of cognitive and socio-cultural contexts on rural household decision-makers' OFSP acceptance behaviour in Uganda. More specifically, the study sought to: (i) determine whether farmers' beliefs about sweetpotato varieties influence OFSP cultivation, *covered in chapter 3*; (ii) assess the extent to which perceptions of health risk correspond to OFSP cultivation, *covered in chapter 4*; (iii) determine whether farmers' perceived control over

production assets and peer approval influence OFSP cultivation, *covered in chapter 5*; and; (iv) to explore the mechanisms for the influence of decision-makers' cognitive-cultural environment on OFSP cultivation outcomes, *covered in chapter 6*. This chapter presents the general overview and discussion of the findings in *chapter 3 through 6*, and concludes with the implications of the findings for the bio-fortified intervention, policy and research communities and a provision of chapter related list of references.

7.1 General overview and discussion of the findings

The findings of this study show that farmers' decisions to cultivate OFSP are positively although weakly influenced by: i) farmers' beliefs about production benefits, for instance resistance to pests, consumption considerations such as level of dry matter content, and control over the production assets necessary for OFSP growing; ii) social approval by peers and capability perceptions regarding OFSP cultivation; and iii) perceptions of VAD related health risk. Network effects positively associated both with acceptance and sustained OFSP cultivation or rejection. The network effect were conceptualized as farmers' predictive perception that OFSP is not likely to disappear and leave adopters stranded (stay power), complementary benefits and exchangeable value. It also included farmers' expectations about the performance of OFSP and peers' reactions to its cultivation. In this study, OFSP acceptance was envisaged as a journey that rural households walk iteratively, from 'under-consideration' through 'trial' to sustained cultivation of OFSP:

7.1.1 Under-consideration to 'trial' stage

The transition from 'under-consideration' to grow OFSP to the 'trial' stage, was positively associated with beliefs regarding the resilience of OFSP in the field. Resilience was conceived as the ability to bounce back from stress occasioned by weeds, pests, diseases,

drought and labour requirements as well as the OFSP storage root dry matter content. Usually, high dry matter means the variety's storage root is less wet. Also, noteworthy, bringing the 'under-consideration' to grow OFSP and the 'trial' inter-stage involves advancing from the cognitive to the practical. This implies that it takes more than OFSP just being truly resilient, having high dry matter content and/or requiring less labour to produce. If the farmers, as decision-makers, do not associate OFSP with these attributes, then they will not try it out but will instead remain inclined to cultivating the conventional varieties. Both theory and conventional wisdom dictate that one cannot have tenacious attitudes about ideas that he/she has not fully experienced. So, beliefs held by decision-makers at the 'under-consideration' to grow OFSP stage may have been an outcome of two self-reinforcing trends: 1) relapsing from subsequent stages ('trial' and/ or 'maintenance'), wherein the stock taking of experiences (the bad and the good) leads to a consolidation of beliefs about the new varieties and/ or; 2) responding to social dialogue and pressure, since farmers were found to use sharing of sweetpotato vines and storage roots as means for varietal validation and subsequent conservation of varieties that were found to match household food quality expectations.

7.1.2 'Trial' stage to the sustained cultivation stage

Beyond the under-consideration stage, transitioning from the 'trial' stage to the sustained cultivation stage of growing OFSP was positively associated with farmers' beliefs about ease of obtaining planting materials, general attitude towards OFSP, yield quality, perceived control over and access to production assets (vines, labour and skills of other OFSP cultivating farmers) and whether OFSP cultivation was considered a socially accepted behaviour. Generally, decision-makers from households that were trapped at the 'trial' stage, considered access to OFSP planting materials to be difficult, yield quality to be

inferior, and OFSP cultivation to be disapproved of by peers and thus considered socially less favoured practice.

7.1.3 From 'Maintenance' back to 'Under-consideration'

This study showed that beliefs explain decision-makers' relapse into under-consideration from the 'maintenance' stage, since as a seasonal crop, sweetpotato requires farmers to renew their intentions to grow OFSP for each succeeding season. Beliefs that were associated with relapse were: difficulty of accessing and preserving vines, unsatisfactory storage root dry matter content, disapproval and dissuasion from OFSP cultivation by peers and lack of control over production assets. From a positive perspective, sustained OFSP cultivation takes place in households with higher valuation of and which are convinced of the ease of access and preservation of vines, storage root dry matter content levels, approval and support of peers and control over production assets.

The major challenge is that during 'trial' and 'maintenance' stage, farmers actually experience the good or bad qualities of OFSP depending on the variety they accessed. This enhances their beliefs system (developed through social cues and external variety promotions) to form a firm cognitive stance about OFSP. This suggests that a farmer's decision to sustainably cultivate OFSP revolves around actual activities or the environment within which these beliefs are held, since over time the belief system may be influenced by experienced reality (Rogers, 1983). For example, a media attempt at implanting the perception that vines are easy to access or preserve or that cultivating OFSP is accepted within the farmer's social environment could be wasteful or even detrimental to acceptance decisions, if there is insufficient overlap between the message being propagated and empirical reality.

7.1.4 'Under-consideration' through sustainable cultivation

This study also established that farmers' compliance with social pressure was a significant positive mediator of decisions to sustainably cultivate OFSP. Mackie *et al.*(2015) observed that in taking decisions socially oriented persons, such as the smallholder farmers, aim to optimize two decision outcome related goals: 1) making effective action and 2) building and maintaining social relationships. Pursuit of social approval is one important path for attaining effective actions that are socially accepted. Thus, 'under-consideration' farmers tended to distance themselves from growing OFSP, while farmers at trial stage and those that continually cultivated OFSP mostly did so at about 10% intensity, because they deemed peers to be doing the same. Furthermore, control belief over production assets such as access to vines and other farmers cultivating OFSP was found to be a mediator of OFSP cultivation. This meant that sustained cultivation of OFSP was likely where farmers had asset based self-efficacy.

Likewise, risk perceptions came out as significant mediators of OFSP acceptance. In particular, perception of VAD as a significant risk positively influenced farmers' valuation of OFSP as a control measure for the deficiency. This implies that sensitization of household decision-makers to the hidden risk inherent in VAD increases farmer propensity to consider OFSP an effective VAD control food stuff. Subsequently, farmers' beliefs about the effectiveness of OFSP in controlling VAD were found to positively influence decision to cultivate OFSP. Farmers' perception of risk of VAD apparently motivated them to cultivate OFSPs as perceived effectiveness of OFSP to control VAD was expected to open a path to action.

Additionally, this study demonstrated that network effect can be an important mechanism linking cognitive factors or knowledge gained to OFSP cultivation. The farmers mostly cultivated OFSP for social reasons rather than on the basis of a technical and/or

economic determination of the performance of the new varieties. Through mutual observation and alignment of individual action with the negative feedback provided by peers, farmers' OFSP cultivation levelled at around 10% adoption intensity. This affected farmers' appreciation of the relative advantage of the new variety and their expectations of likelihood of the OFSP adopter network being realized. Failure to realize the minimum network of adopters in turn affected: 1) their perceptions about the likelihood of OFSP to stay; 2) exchangeability of OFSP vines within farmers' social networks; and 3) the incentives for sweetpotato value chain actors to deal in OFSP. Within the confines of network effect, low staying power, and limited exchangeable value and complementary benefits result into low network value and the attendant defection from OFSP cultivation. Where early adopters are not reinforced and consequently start defecting, the remaining farmers are likely to experience even lower value. Difficulty to access vines, for example, encourages further defections from growing OFSP since farmers' transitioning to 'maintenance' and sustained cultivation rely on the conviction that vines will be accessible. This self-reinforcing loop makes it difficult to obtain the critical mass of users, who would practically engage in the social validation of the new varieties, consequently making it difficult for OFSP cultivation to become self-sustaining (Gallaugher, 2008).

Conventional wisdom intimates that for an adopter to accept a network effect dependent innovation, the performance of the new variety should not be imitable by working with the conventional types it aims to replace. By design, many of the qualities of OFSP, such as the high yielding potential, are not unique to OFSPs mainly because parallel sweetpotato breeding programs at NARO continue to release varieties whose attributes, such as field resilience and dry matter, among things meant to appeal to the end-user (Mwanga *et al.,* 2016). Consequently, both the conventional and the biofortified sweetpotato varieties are gradually coming to share many of what previously used to be regarded as flagship attributes.

Upgrading of the conventional variety alongside the favoured biofortified one, results into further growth of the network of farmers cultivating the conventional variety, making switching to a favoured biofortified variety steadily more difficult (Gallaugher, 2008).

Additionally, this study found cases of adopters who regarded OFSP as having relative advantage over conventional sweetpotato in preserving and accessing vines and who thus did not depend on social vine exchange with other actors. These adopters furthered the social validation of OFSP's relative advantage by offering less experiment oriented farmers learning sites for vine preservation and/or donating to them vines and storage roots. The expanded network of OFSP adopters thus helped the early and new adopters access to vines through social exchange. It also helped attract chain actors to offer OFSP related value innovation, and enhanced beliefs about complementary benefits associated with OFSP and the likelihood of OFSP to stay. In the process an alternative pathway to sustained cultivation was established.

Overall, the study concluded that psycho-social factors do matter for the acceptance of OFSP in Uganda. Different belief sets were associated with each of the different stages farmers go through en route to finally accepting to grow OFSP. Farmers' perceptions of social approval, capability, and risk of exposure to VAD were associated with decisions to cultivate OFSP. In particular, farmers looked to near-peers for approval and models regarding the cultivation of the new varieties. In the end, they aligned their own decisions with what was deemed to be socially correct by the persons they value. Perceived VAD risk motivated decision-makers to cultivate OFSP. Similarly, perceived effectiveness of OFSP to control VAD was an important, feasible pathway to cultivation of the new varieties. Network effects offered the mechanisms through which cognitive factors influenced the acceptance. Through mutual observation decision-makers' response affected perceptions about the stay power, exchange of OFSP vines and the involvement of sweetpotato chain actors in OFSP

dissemination, which later encouraged or discouraged cultivation depending on the cues sent by the environment.

7.2 Implications of the findings for bio-fortified intervention

These results point to a cardinal role for processes that create supportive social and cognitive environments for promoting bio-fortified technologies such as OFSP. The following recommendations should aid in reinforcing these environments:

1) Given that the role of beliefs in OFSP acceptance varied among 'Under-consideration', 'Trial' and 'Maintenance' acceptance stages,
    a) Promotional messages associated with OFSP delivery should follow a serialized scheme that customizes the central message to the OFSP cultivation acceptance stage the targeted communities are at;
    b) Farmers should be supported to create an environment in which OFSP cultivation becomes socially accepted within their reference groups, and be facilitated to access production assets (vines and peer farmers cultivating OFSP for example). This may be achieved through:
        i. Variety endorsements and pro-social messaging by leaders and musicians, or via targeting the most motivated and connected members of the group first, when designing variety delivery campaigns.
        ii. Farmer groups/or peer-peer approach can also be strengthened to support members to grow OFSP,
        iii. Investing in the seed system and supporting value chain actor participation in structures responsible for reinforcing experienced beliefs held about OFSP.

2) Given that risk arousal can constructively be used as a path for sustainably encouraging cultivation of OFSP and ultimately VAD control, efforts should be put into highlighting and emphasizing both the hidden threat of VAD to make it perceptible to rural farmers and the effectiveness of OFSP in rectifying the conditions.

3) Given that the mechanisms by which socio-cognitive factors get aligned with acceptance of OFSP conform to network effects or Metcalfe's Law.
    a) Service providers should adopt relatively high-impact strategies such as giving prize incentives to early users, recruiting potential adopters who are more connected to others or who are high-status users first, or sequencing delivery to start with communities where potential users are most receptive.
    b) Promoters of the new technologies should nurture strategic alliances with value chain actors, such as processors and vine multipliers, for purposes of hooking onto the networks required to increase the relative advantage of new technologies.
    c) Service providers should minimize the need for a speedy attainment of critical mass of adopters by supporting early adopters' efforts, such as their strategies to cope with shortage of vines.

7.3 Implication of findings for policy

The OFSP bio-fortification strategy is well positioned to make a major contribution to Uganda's food and nutrition policy. However, given that most farmers who had sustainably grown the new varieties had done so in wetlands, there is thus need to reconcile the nutrition and food policy with national environment laws to allow controlled rural farmers access to wetlands.

a) Given that ordinarily, within the limits of network effect, early users of technologies with network effect require a lengthy period of use before the adopter can satisfactorily observe the innovation's relative advantage, policy should provide for the protection and reinforcing of early adopters and providers of complimentary products, e.g., processors and seed multipliers. This could be done through tax exceptions, credit facilities, and different forms of subsidies and showcasing of benefits accrued from OFSP acceptance.

b) Given the direct, negative influence of perceived risk on acceptance due to reasons that could be inclined to avoidance of self-blame for feeding one's family poorly, policy should re-orient funding of and take on the responsibility of campaigns for crystallising the links between whole packages of causes of micronutrient deficiencies. The most direct remedies may not necessarily be the most effective remedies.

7.4 Implication of findings for researchers (Areas for future research)

a) One of the unanticipated findings of this study was that farmers' advancement from 'trial' into sustained cultivation was associated with low perceived susceptibility to and seriousness of VAD among children. Future research should accordingly explore the processes leading up to sustained cultivation for possible mediators of the trial-sustained cultivation relationship.

b) This study also did not find the anticipated internal self-efficacy to associate with acceptance of OFSP, future studies may need to ascertain that, within the Ugandan context, there are no variables confounding the relationship between farmer self-efficacy and the acceptance of bio-fortified foods.

c) Future research may quantitatively assess the extent to which network effect influences OFSP acceptance for purposes of furthering our understanding of the role of network effect on acceptance of crops such as the OFSP.

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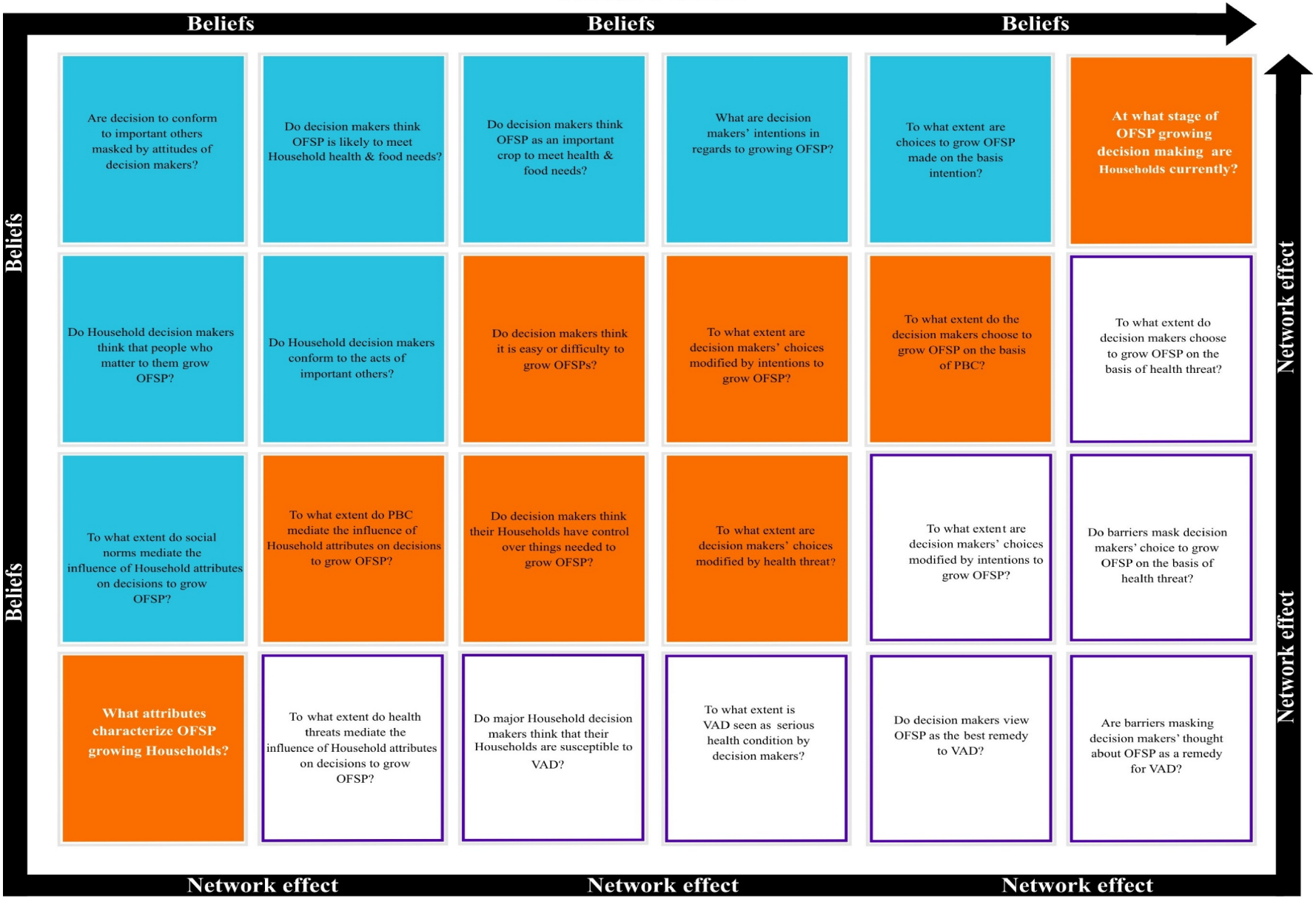
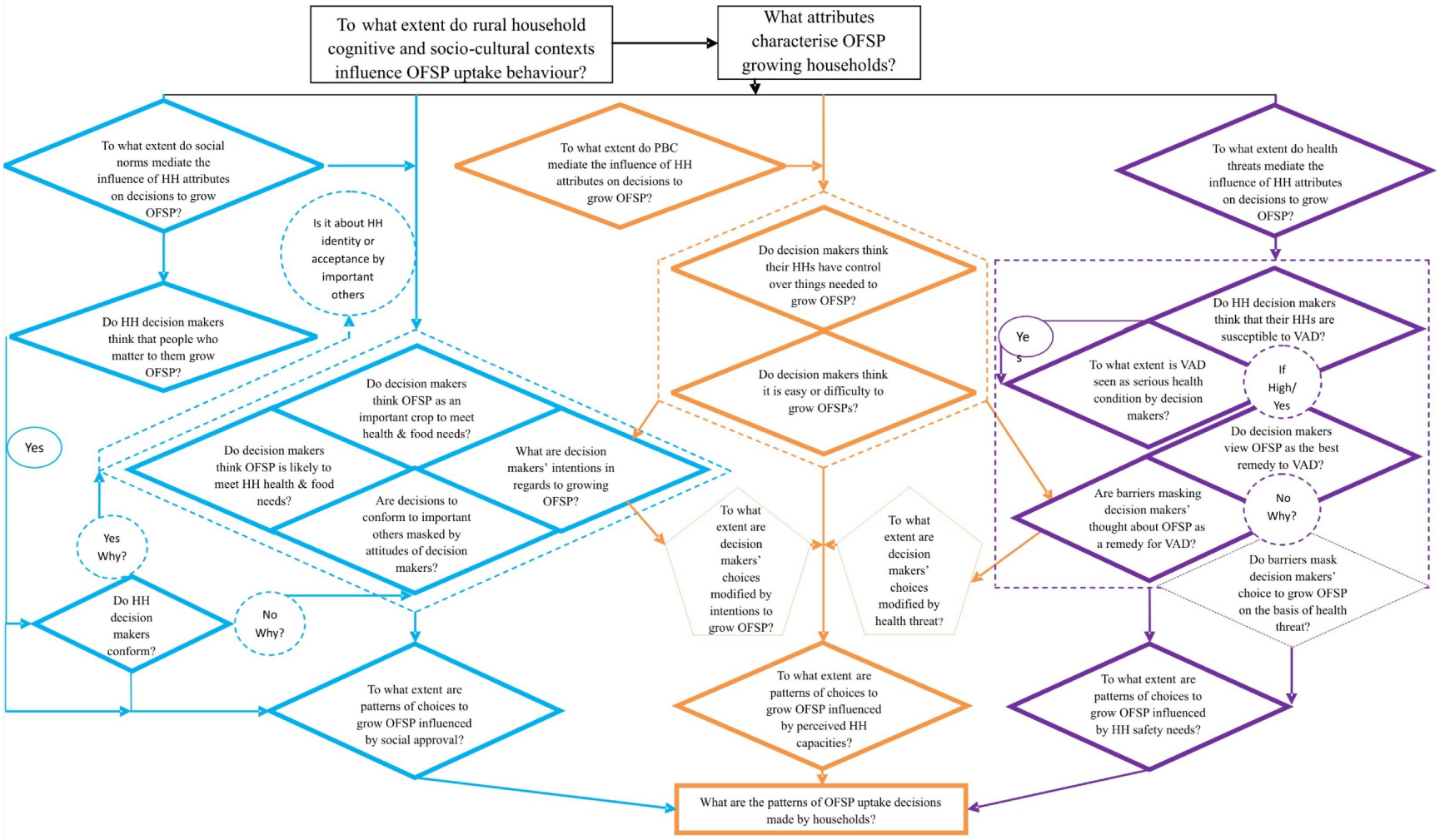
ANNEX I
THESIS PUZZLE



ANNEX II
RESEARCH ANALYSIS PLAN



ANNEX III
SURVEY OF HOUSEHOLD DECISION-MAKERS' PERCEPTION ON THE

GROWING OF OFSP

Research Brief

1) Thank you for taking the time to join this interview. As you know, Harvestplus and ***VEDCO*** / ***CEDO*** have been promoting OFSP growing in your community.

2) Current reports show that the uptake of OFSP varies widely. Some smallholder farmers have taken up the crop as others avoid it. The present study is an independent survey examining the reasons behind smallholder farmers' decisions to grow or not grow the new sweetpotato variety.

3) By sharing your candid opinions with us, you are contributing to a better understanding of the use of food-based means to improve the well-being of rural communities.

4) The information that you share will be handled with confidentiality. And it will only be used to accomplish the purpose mentioned above. If at any point, the interview makes you uncomfortable, feel free to call it off totally or for later time.

Consent to participate in study

I _____ of _____ agree to take part in the above explained study. I also authorise the researcher(s) to freely use the information in any away dimed right, such as writing reports or articles in order to deepen the understanding of the use of food-based means to improve the well-being of rural communities.

Signature or thumb prints (in of consent): _____ Dates: _____

Decision-maker's characteristics

Q1. Respondent's gender? *(Male = 0, Female = 1)*

0	1

Q2. What is the highest level of education you have attained? *(Mark as stated by respondent)*

0 = Never	1 = P.1	2 = P.2	3 = P.3	4 = P.4	5 = P.5	6 = P.6	7 = P.7	8 = S.1	9 = S.2

10 = S.3	11 = S.4	12 = S.5	13 = S.6	14 = Tech. Ed	15 = Univer.	Other: ----------

Household Income

Q3a. What is your household main source of income? *(Farm output sales = 1, sell of labour to other farms = 2, remittances from family member living outside HH = 3, professional employment = 4, others-specify = 5.*

1	2	3	4	5: specify----------

Q3b. What is the available income for you?		*Q3c.* In a normal year how many months are:	
i. In a good month		*i.* Good	
ii. In a normal month		*ii.* Normal	
iii. In a bad month		*iii.* Bad	

Level of knowledge of Vitamin A deficiency

Q4. Have you ever been introduced to VAD by any organisation in your area? 0 1
(No = 0, Yes = 1). If YES...: proceed with question 5 - 9 and if NO....: go to question 10.

Q5. From the interactions you have had with the organization(s), what are some of the health related problems one is likely to get due to VAD? *Tick as mentioned by respondent(Sickly child = 1, getting disease easily = 2, slow recovery from diseases = 3, child stunted growth = 4, child not alert = 5, not seeing in dim light/ acquired blindness = 6, before/after birth problems = 7, women become weak = 8, other specify = 9)*

1 2 3 4 5 6 7 8 9-specify: ---------- 66

Q6. What would be the main reason for one to suffer from VAD related health problems? *Tick as mentioned by respondent(Eating food low in vitamin A = 1, Not eating a balanced diet = 2, inability to buy food due to poverty = 3, Other specify = 4)*

1 2 3 4-specify: ---------- 66

Q7a. In the last six months, is there any member of your household who suffered from VAD related health problems? *(No = 0, Yes = 1).* 0 1

If YES...: ***7ai.*** How where you able to know the person was suffering from VAD? *Tick as mentioned by the respondent (sickly most of the time = 1, weak and sleepy = 2, Diagnosed by a medical personal = 3, Diagnosed by experienced elders = 4, other specify = 5)*

1 2 3 4 5-specify: ---------- 66

Q7b. In the last six months, is there any member of your community you know of who suffered from VAD related health problems? *(No = 0, Yes = 1).* 0 1

If YES...: ***7bii.*** How where you able to know the person was suffering from VAD? *Tick as mentioned by the respondent (sickly most of the time = 1, weak and sleepy = 2, Diagnosed by a medical personal = 3, Diagnosed by experienced elders = 4, other specify = 5)*

1 2 3 4 5-specify: ---------- 66

Q8a. What means were used to treat the person who suffered VAD related health problems? *Tick as given by respondent (Fruits = 1, Vegetable = 2, Fish = 3, OFSP = 4, Vitamin A supplements = 5, other specify = 6)*

1 2 3 4 5 6-specify: ---------- 66

Q8b. was the method used successful? *(No = 0, Yes = 1).* 0 1

Q9. What other options, which you know of, would one use to treat VAD health problems? *Tick as given by respondent (Fruits = 1, Vegetable = 2, Fish = 3, OFSP = 4, Vitamin A supplements = 5, other specify = 6)*

1 2 3 4 5 6-specify: ---------- 66

Triggers of action

Q10. In the last four years different OFSP promotion materials have been used by different organisations working in your area: in relation to this, please respond to the questions below:

Q10a. List the materials you accessed?	*Q10b.* Rank each on a scale of 1-7 depending on how it excited members of your HH	*Q10c.* Rank each on a scale of 1-7 depending on how effectively it conveyed OFSP message	*Q10d.* After listening to the message, how did you feel? *1= kept thinking about VAD, 2= emotionally charged to do something to stop VAD, 3 = started activities related to OFSP growing. (multiple response possible)*
OFSP Posters/charts = 1, Calender = 2 T-shirts/ caps = 3, Billboard = 4, OFSP vines = 5, Community drama = 6 My Children radio drama = 7, Radio discussion program = 8, Radio advert/ spot = 9, Expert advice = 10, Others (specify) = 11			

Q11. List the varieties of sweetpotato your HH grew before accessing the promotional materials? *Tick as given by respondent (white = 1, yellow = 2, orange = 3, other = 4).*

1	2	3	4-specify ----------

Access to farming land

Q12a. How much land is your household able to access for farming?_____

Q12b. How much of this land is	Land size	*Q12c.*How much of this land is under	Land size	*Q12d.* How much of this land is under	Mounds
i. Owned by the household		*i.* Perennial crops		*i.* All type of sweetpotato (capture mounts)	
ii. Hired by the Household		*ii.* Seasonal crops		*ii.* Of land under sweetpotato, how much is under OFSP (capture mounts)	
iii. Other (specify)		*iii.* Others (specify)			

Status of sweetpotato in household's fields and diets

Q13. Which food has your household eaten regularly in the last six months? *Listasmentioned by respondent, after prioritize food eaten most by assigning a 1 to the most eaten, then 2 to the next and so on, up to 5.*

No.	*13a.* **Food eaten most in last six months**	*13b.* **Prioritization**
1.		
2.		
Cassava = 1, Sweetpotato =2, Posho = 3, Millet = 4, Rice = 5, Beans = 6, G.Nuts = 7, Banana = 8, OFSP = 9, Other, specify = 10		

Q14. I would like to know more about the main seasonal crops your HH grows in a typical season. Rank the crops in the way your household prioritise them in the different area below. *– if maize receives priority give it 1, the next crop to being prioritized give it 2 and so on, for each of the category)*

a. Types of crops grown in a typical season	*b.* Order of allocation by soil fertility	*c.* Field preparation Order	*d.* Size of land allocation order	*e.*Planting order	*f.* Input use order (manure)	*g.* Order of biggest number of friends growing the crop	*h.* Order of frequency of being eaten in HH	*i.* Order of preference as source of food in HH	*j.* Order of easiness to get money out of harvest by your HH	*k.* Order as actual source of income in HH	*l.* Order of number of ceremonies in which the crop is preferred in HH
Beans = 1, Maize = 2, Sweetpotato = 3, Cassava = 4, G. Nuts = 5, Irish Potato = 6, Vegetables = 7, Y am = 8, Other, specify = 9											

Q15. What is the typical number of people living in your household (HH)?*(Meaning has lived in household for the last six (6) months)*, please record each member's age, gender, and share your thought on each members contribution to labour and how likely they are to suffer from VAD and the likely extent of effects to the household.

HH composition			**Available labour for farming**		**Susceptibility of HH to VAD**	**Perceived Seriousness of VAD to household (**rank each item below on a 1 to 7 scale with 7 highest, depending on respondent's opinion of the extent a household would be affected if member was infected with VAD)				
HH member No.	*a.* Age	*b.* Sex *(Male = 0, Female = 1)*	*c.* Contributes to farm labour *(No = 0, Yes = 1)*	*d.* Approx. days available for farm labour/ week	*e.* How likely is it for this member to get VAD (Rank using 1 to 7 scale)	*f.* Effect on general emotional feelings to household members	*g.* Effect on overall Expenditure of Household	*h.* Effect on household members' ability to move out to meet friends	*i.* Effects on the level of income received by household in a month	*j.* Effect on the ability of HH members to carry out their duties normally

Benefits of OFSP

Q16. In relation to the items below, how would you rank the old sweetpotato varieties against the orange-fleshed sweetpotato in terms of their benefits? *Use a shared scale of 1 to 7 points.*

Item based on key items in the sweetpotato value chain	*16a.* Shared scale of 1 – 7, rank OFSP Vs WFSP		*16b.* What importance do you attach to this item when choosing a sweetpotato crop to grow *(rank on a scale of 1-7)*	*16c.* For items below 3.5 weights, examine - to what extent does the item discourage respondent from growing OFSP? (rank on a scale of 1 -7)
	Old varieties	OFSP variety		
E.g., longest flower	*5*	*2*	*7*	*6*
i. Less labour needed in land preparation				
ii. Easy access to vines				
iii. Does not need timely planting to give good yield				
iv. Low labour needed to manage fields				
v. Low susceptibility to pests				
vi. Low susceptibility to diseases				
vii. Low susceptibility to weeds				
viii. High yield in drought (quantity)				
ix. High yield in floods (quantity)				
x. High yield in normal season (quantity)				
xi. Biggest storage root size				
xii. Matures early				
xiii. Longest length of time of piecemeal harvesting				
xiv. Most likable shape when packing in sacks				
xv. Most likable size when packing in sacks				
*xvi.*Most easier to market surplus				
xvii. Highest susceptibility				

to rotting in fields and store				
xviii. Shortest cooking time of storage roots				
xix. Most likable colour by children in HH				
xx. Most likable colour by adults in household				
xxi. Most likable sugar content of cooked storage roots				
xxii. Most likable smell (flavour) of cooked storage roots				
xxiii. Highest flouriness of cooked storage roots				
xxiv. Highest hardness of cooked storage roots				
xxv. Lowest percentage of fibres in cooked storage roots				
xxvi. Highly preferred by household members				
xxvii. Easiness to preserve last season vines as planting materials				
xxviii. Highest health benefits				
xxix. Highest waste volume of vines for animal feeds				

Self efficacy

Q17. How confident are you about the competency you have to carry out the following activities in orange fleshed sweetpotato garden as compared with carrying out the same activities in the old sweetpotato garden? *Use a shared scale of 1 to 7 points.*

Item based on key items in the sweetpotato value chain	*17a.* Shared scale of 1 – 7, rank OFSP Vs WFSP		*17b.* Level of importance attached to the item when choosing to grow OFSP *(rank on a scale of 1 to 7)*
	Carrying out activities in the OFSP garden	Carrying out activities in the old sweetpotato garden	

knowledge of irrigation	*4*	*3*	*6*
i. Knowledge of site selection			
ii. Knowledge of site preparation			
iii. Knowledge of the best vine for planting (vine selection)			
iv. Knowledge of best time of planting			
v. Knowledge of way of planting the vines (planting methods)			
vi. Knowledge of the right time for field operation e.g weeding			
vii. Knowledge of disease control methods			
viii. Knowledge of the right time for harvesting			
ix. Knowledge of best way to store the storage roots for long use after harvesting			
x. Knowledge of ways of cooking the storage roots			
xi. Knowledge of vine preservation to be used as planting materials in next season			

Control belief

Q18. In your view, rank the level of control (easy or difficulty) you have on the things you would need to grow sweetpotato listed below. Please u*se a shared scale of 1 to 7 points between old sweetpotato varieties and the OFSPs.*

Item based on key capitals needed for sweetpotato growing at household level	*18a.* Shared scale of 1 – 7, rank OFSP Vs WFSP		*18b.* Level of importance attached to the item in relation to growing OFSP *(rank on a scale of 1 to 7)*
	Level of control in the OFSP garden	Level of control in the old sweetpotato garden	
i. Access to necessary labour			
ii. Timely availability of labour			
iii. Access to vine			
iv. Access to money owned by household in order to finance activities			

v. Access to borrowed money in order to finance activities			
vi. Access to Land needed			
vii. Adequate soil fertility			
viii. Adequate water in the soil			
ix. Access to experts to learn from new methods			
x. Access to other farmers growing crop variety.			

Attitude to OFSP growing

Q19. For the statements below, please rank them on a 1 to 7 point scale depending on how best they communicate to what you believe in about OFSPs in relation to old sweetpotato varieties.

Category	Statement about growing OFSP for HH food	Shared scale of 1 – 7, rank OFSP Vs WFSP	
		OFSP	Old variety
Evaluative	*19ai.* It is extremely valuable to grow		
	19aii. It is extremely beneficial to grow		
Behaviour	*19b.* It is generally a good idea to grow		
Affective	*19ci.* It is extremely encouraging to grow		
	19cii. It is expectantly enjoyable to grow		

Subject norm

Q20. I would like to turn our discussion now to people who influence your sweetpotato growing activities. Please list the groups that you belong to, or persons within the community or in your household who influence your decisions, thereafter follow through with the questions for each individual.

20ai. Group name	*20aii.* Number of years in group	*20aiii* Respondents role in the group	*20aiv.* Services received from the group	*20av.* Rank the importance of the group to your HH (on a 1-7 point scale)	*20avi.* Sweetpotato grown by members in group (use shared 1-7 scale to indicate type grown most)		*20avii.* Sweetpotato type members approve you to grow (use shared 1-7 scale to show approved among variety)		*20aviii.* What happens if you don't comply to members'/ individuals' expectations
					OFSP	Old variety	OFSP	Old variety	
20bi. Most influential individuals in the community people you turn to when making major decisions about farming?	*20bii*. Number of years person has been influential in community	*20biii.* What is his/ her role in the community	*20biv.* Assistance respondent receives from the individual	*20bv.* Level of importance	*20bvi.* OFSP	Old variety	*20bvii.* OFSP	Old variety	*20bviii.* What happens if you don't comply to members'/ individuals' expectations
20ci. Most influential member of the family *(in HH and beyond HH)*		*20cii.* Role in household	*20ciii.* Assistance respondent receives from HH member	*20civ.* Level of importance attached to member	*20cv.* OFSP	Old variety	*20cvi.* OFSP	Old variety	*20cvii.* What happens if you don't comply to members'/ individuals' expectations

Now we would like to discuss about your OFSP plans. Please tell me about your five (5) most concrete OFSP intentions for the coming six months. On a scale of 1 to 7 points please rank your view about how likely or unlikely that this plan will happen in the coming six months.

Q21. _____

Extremely unlikely | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely likely

Q22. _____

Extremely unlikely | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely likely

Q23. _____

Extremely unlikely | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely likely

Q24. _____

Extremely unlikely | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely likely

Q25. _____

Extremely unlikely | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Extremely likely

Now we would like to discuss your currently OFSP activities. I am going to read the following statements, please tell me which statement describes "where you are", with the growing of OFSPs.

Q26. In view of your OFSP growing activities, which of the following statements best describes the stage at which your household is at in relation to the growing of OFSP?

a) I am not growing OFSP right now. (.....*Continue with question 27 -32.)* 1

b) I am thinking about starting growing OFSP.(.....*Continue with question 33 - 35.)* 2

c) I am making some preparation for growing OFSP.(.....*Continue with question 36 -40)* 3

d) I have been growing OFSP in the last six months. (.....*Continue with question 41 -44)* 4

e) I have grown OFSP for more than six months. (.....*Continue with question 45 -48)* 5

Below are follow-up questions for each of the responsse given in question (26 a-e) above. Only respond to questions that correspond with the option that best describe your current OFSP activities. *Please rank on the scale of 1 – 7 the extent by which the statement describes you. 1 Extremely not like me and 7 extremely like me.*

.....follow-up statements for option (26.a).

		Rank	N/A
Q27.	As far as I'm concerned, I don't need to grow OFSP.		66
Q28.	I don't grow OFSP and right now I don't care.		66
Q29.	I am satisfied with growing white-fleshed sweetpotato.		66
Q30.	I could grow OFSP, but I don't plan to start yet.		66
Q31.	I don't have the time or labour to grow OFSP right now.		66
Q32.	I think growing OFSP is good, but I can't figure it into my schedule right now.		66

.....follow-up statements for option (26.b).

		Rank	N/A
Q33.	I have been thinking about whether I will be able to grow OFSP.		66
Q34.	I really think I should work on getting started with growing OFSP in the next 6 months.		66
Q35.	I have been thinking that I may want to begin growing OFSP.		66

.....follow-up statements for option (26.c).

		Rank	N/A
Q36.	I have been calling other farmers to find the materials I need to start growing OFSP within the next few weeks.		66
Q37.	I have been contacting extension workers to find the support I need to start growing OFSP within the next few weeks.		66
Q38.	I have set aside a plot that I will be using to grow OFSP in the next few weeks.		66
Q39.	I am preparing to join an OFSP growing group in the next few weeks.		66
Q40.	I have lined up with other farmersto start growing OFSP within the next few weeks.		66

.....follow-up statements for option (26.d).

		Rank	N/A
Q41.	I am finally growing OFSP.		66
Q42.	I have started growing OFSP within the last 6 months.		66
Q43.	Recently, I have started to grow OFSP.		66
Q44.	I have started to grow OFSP, and I plan to continue.		66

.....follow-up statements for option (26.e).

		Rank	N/A
Q45.	I have been growing OFSP for a long time and I plan to continue.		66
Q46.	I have been successful at growing OFSP and I plan to continue.		66
Q47.	I have been growing OFSP for longer than 6 months.		66
Q48.	I have managed to keep growing OFSP through the last 6 months.		66

As we close this interview, I would like to know your view about future activities and output of this

Q49. May we list your name in the Acknowledgements list of our report? *(No = 0, Yes = 1,).* 0 1

If YES what name should we use? _____

Q50. May we contact you, if any additional information is needed?*(No = 0, Yes = 1,).* 0 1

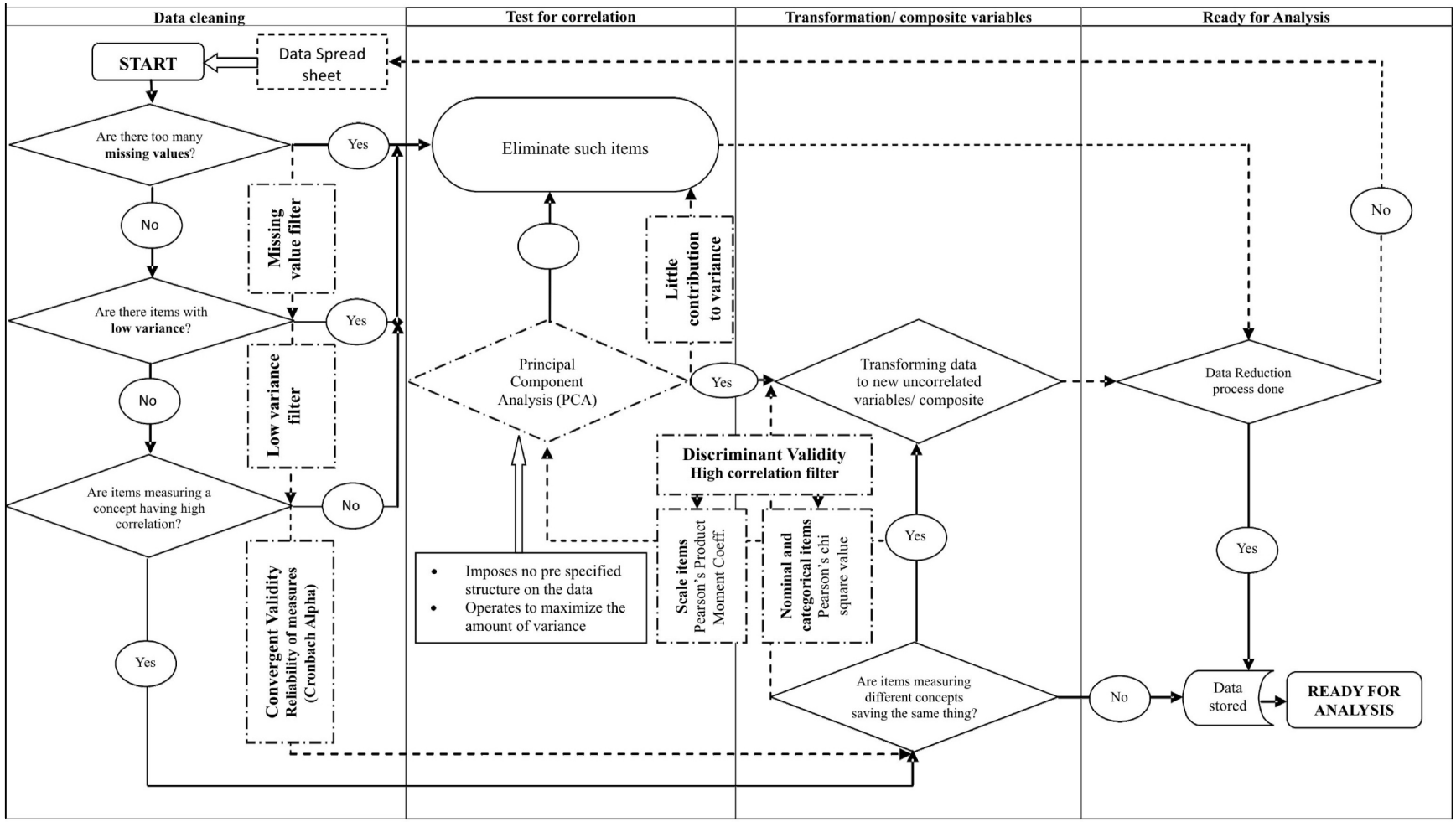
If Yes... please specify contact number: _____

This marks the end of our interview.

Thank you again for your time and contribution.

The information that you have shared will be valuable in addressing Vitamin A Deficiency and related health problems via agricultural means among members of smallholder rural households.

ANNEX IV
TRIMMING THE DATA TO PURPOSE



ANNEX V

GUIDE FOR IN-DEPTH INTERVIEW

Research Brief

5) Thank you for taking the time to take part in this dialogue about the sweetpotato. As you know, Harvestplus and ***VEDCO*** / C***EDO*** have been promoting OFSP growing in your community.

6) Current reports show that the uptake of OFSP varies widely. Some smallholder farmers have taken up the crop as others avoid it. The present study is an independent survey examining the reasons behind smallholder farmers' decisions to grow or not grow the new sweetpotato variety.

7) By sharing your candid opinions with us, you are contributing to a better understanding of the use of food-based means to improve the well-being of rural communities.

8) This discussion will be conducted in a participatory and interactive way. What we share will not be attributed to individuals and will only be used to accomplish the purpose mentioned earlier. If at any point, the discussion makes you uncomfortable, feel free to call it off totally or for later time.

Guiding questions for FDG/ Semi-structured interview

1 Take-off expectations (peer expectation and relative advantages)

1.1. Which people/groups within or outside your community do you work with in your farming activities?

1.2. Which of the above people/ groups do you work with particularly for sweetpotato farming?

1.3. What is the general perception regarding the ability of the OFSP to take-off as an important food within your farming community and among the peoples or groups that help you in your farming activities?

1.4. When you compare the conventional varieties with the new orange-fleshed sweetpotato, which of the two variety is better in your view (please tell me more about the specify reasons for your view)

2 Network effects (stay power, exchangeable value and complimentary products)

2.1. In your opinion, is OFSP likely to survive among your community as a favored sweetpotato variety by smallholder farmers within your farming communities (tell more about your reasons)

2.2. Farmers are known to traditionally exchange sweetpotato vines and harvests, how is the traditional carried out on regarding OFSP in your community. (please give detailed explanation)

2.3. How has the OFSP been accepted among groups of people or organizations, such as marketers of storage roots and vines of the conventional sweetpotato? Beyond the known benefits traditionally obtained from the sweetpotato are there any other products or benefits you solely get out OFSP, please tell more about it?

3 Coping strategies

3.1. You have all been found to belong in*'underconsideration' or 'trial' or 'maintenance' stage* regarding OFSP cultivation. Please tell me about the circumstances (strategies/ conditions) that have kept you in this group?

4 **General**

4.1 Is there anything more you would like to tell me regarding improving regarding the delivery and cultivation of OFSP in your community?

Concluding remarks

This marks the end of our discussion. Thank you again for your time and contribution to this dialogue about the sweetpotato. The information that you have shared will be valuable in addressing Vitamin A Deficiency and related health problems via agricultural means among members of smallholder rural households.

ANNEX VI

APPROVAL TO ACCESS CEDO OPERATED STUDY SITES

HarvestPlus

Breeding Crops *for* Better Nutrition

January 24th, 2017

The Executive Director,
CEDO.

Dear Sir,

INTRODUCTION OF SULAH NDAULA

Sulah Ndaula is a PhD student at Makerere University and would like to study farmers' attitudes regarding Orange sweetpotato; perceptions of Orange sweetpotato benefits, consumption patterns and barriers countering adoption. This will enable him make recommendations that we can use to increase farmer adoption.

Rakai is one of the districts that was randomly selected as a study population and this is to let you know that he will be working within the project area to collect information and will ask Charles Katabarwa to link him to CRPs that can help him meet and interview the farmers.

All support accorded him will be greatly appreciated.

Yours sincerely,

Sylvia R. Magezi
Country Manager,
HarvestPlus

c/o IFPRI,Kampala Plot 15 East Naguru road, Kampala. Tel: +256 287107 Website: HarvestPlus@cgiar.org . www.HarvestPlus.org

HarvestPlus is coordinated by the Centro Internacional de Agricultura Tropical (CIAT) and International Food Policy Research Institute (IFPRI)

ANNEX VII

APPROVAL TO ACCESS VEDCO OPERATED STUDY SITES

HarvestPlus

Breeding Crops *for* Better Nutrition

January 24th, 2017

The Executive Director,
VEDCO.

Dear Sir,

INTRODUCTION OF SULAH NDAULA

SulahNdaula is a PhD student at Makerere University and would like to study farmers' attitudes regarding Orange sweetpotato; perceptions of Orange sweetpotato benefits, consumption patterns and barriers countering adoption. This will enable him make recommendations that we can use to increase farmer adoption.

One of VEDCOs implementation area was randomly selected as a study population and this is to let you know that he will be working within the project area to collect information and will ask Grace Babiryeto link him to CRPs that can help him meet and interview the farmers.

All support accorded him will be greatly appreciated.

Yours sincerely,

Sylvia R. Magezi
Country Manager,
HarvestPlus

c/o IFPRI,Kampala Plot 15 East Naguru road, Kampala. Tel: +256 287107 Website: HarvestPlus@cgiar.org . www.HarvestPlus.org

HarvestPlus is coordinated by the Centro Internacional de Agricultura Tropical (CIAT) and International Food Policy Research Institute (IFPRI)

ANNEX VIII

CURRICULUM VITAE

Sulaiman Ndaula was born in Kampala District, Uganda, where he attended his primary and secondary education. In 1996, he won a government of Uganda meritocratic scholarship to join Makerere University, where he graduated with a BSc. in Agriculture (Hons.) in 2000. In 2002, he joined Uganda Management institute, where he obtained a postgraduate diploma in project planning and management in 2003, which later won him a Belgium Government scholarship to complete a masters in management studies in 2010, majoring in project planning and management. In 2010, he won an African Union scholarship at Amity University, graduating with masters in business administration in 2012, majoring in marketing management. Ndaula has been project leader on a number of knowledge management, multinational program evaluation, and ICT4D delivery projects in collaboration with multinational organizations including: IDRC, Hivos, CTA, Microsoft Corporation, NATOMA group, World Health Organization, University of Washington and Intel Corporation between 2001 and 2015. He has been a panellist on several themes regarding program sustainability among sub Saharan African countries at international conferences across the world. He joined the PhD program in Agriculture and rural innovation at Makerere University in 2015, where he also won a DAAD-RUFORUM and the European Union's intra-ACP mobility scholarships. During the PhD, he volunteered as an assistant lecturer, in the department of extension and innovation studies in the college of agricultural and environmental science, teaching "*introduction to innovation system management*" and "*documenting and dissemination of development information*" at undergraduate level.

He has research interest in the area of innovation commercialization, scaling-up and delivery, focusing on participatory approaches, value chain development, value innovation, and psychological drivers of acceptance.

Ndaula Sulaiman
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