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**SOCIOECONOMIC FACTORS FOR ORANGE FLESHED SWEETPOTATO  
ADOPTION IN THE SMALL HOLDER FARMING SECTOR NORTHERN**

A dissertation presented to

**FACULTY OF AGRICULTURE**

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## **DEDICATION**

I dedicate this research dissertation to my family, more so to my dear mother Mrs. Adoch Rose Openda who has supported psychologically during the entire time of my study upgrade. My children; Stanley, Tairah and Triumph, the very reason for my toil, my brothers and sisters who are my strong pillar of encouragement and my late dad who never got tired of speaking words of wisdom to me. Your memory lives on dear Dad.

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## **LIST OF ABBREVIATIONS**

FAO:	Food and Agricultural Organization
MENU:	Meals for Nutrition
OFSP:	Orange Fleshed Sweet Potatoes

## ABSTRACT

**Background:** The introduction of the improved Orange fleshed sweet potato (OFSP) into the smallholder farming sector was predicated on the premise that the types are important due to their nutritional benefits, are suitable for the farming system, and will be readily adopted by the farmers. However, there are numerous other issues, some of which are under the farmers' control and others of which are not, that may hinder the adoption of this technique.

**Objective:** Examine the socioeconomic elements that influence the adoption of orange fleshed sweet potato in northern Uganda's small holder farming sector.

**Methods:** This cross-sectional community-based study was done among 399 farmers in northern Uganda. Data was collected using a semi structured questionnaire and analyzed through descriptive and inferential statistics. Binary logistic regression analysis was employed to assess socioeconomic factors associated with adoption of OFSP varieties,  $p < 0.05$  was considered statistically significant.

**Results:** Out of the 399 farmers, 383 fully participated in the study. Majority 227(73.9%) were female, 134(43.6%) aged 36 to 59 years, and 228(74.8%) married. The adoption rate of orange-fleshed sweet potato variants was 21.5% and was associated with getting information for agricultural extension workers (AOR: 4.087, 95% CI: 1.354, 12.336,  $p=0.012$ ), being in a community group (AOR: 2.065, 95% CI: 1.105, 3.860,  $p=0.023$ ), keeping records (AOR: 0.324, 95% CI: 0.144, 0.727,  $p=0.006$ ), and not engaging in other activities (AOR: 2.072, 95% CI: 1.121, 3.828,  $p=0.020$ ). Most of the farmers 75(98.7%) were market vendors, 64(84.2%) sell products in form of tubers, and 17(22.4%) sell to individual customers.

**Conclusion:** The present study indicates that one in five of small-scale farmers in northern Uganda practice OFSP cultivation. The study also indicates that farmers practiced OFSP farming for home consumption using local technologies and practices that are easily accessed to them. These results necessitate continuous provision of more information to scale up and sustain production and consumption of the OFSP.

**Keywords:** adoption, farmer, multiplication, orange fleshed sweet potatoes

## CHAPTER ONE

### GENERAL INTRODUCTION

#### 1.0 Introduction

This chapter presents the background of the study, statement of the problem, objectives and research questions, study scope, study significance and justification, definition of operational terms and conceptual framework.

#### 1.1 Background of the study

Sweet potato currently ranks at 7th position of world's most important crops. Uganda is the 3rd producer worldwide after Nigeria and China respectively and before Indonesia and Tanzania. It should also be noted that Asia accounts for about 76% of production while Africa follows at 19.5%. (Sugriet *al.*, 2017)

Botanically, sweet potatoes or Spanish potatoes are referred to as *Ipomoea batatas* (L.) Lam, are a member of the morning glory family Convolvulaceae, and are native to South America. Following wheat, rice, maize, potatoes, barley, and cassava, sweet potatoes are the seventh most significant crop in the world. Globally, more than 133 million tons are generated annually.

In the past, sweet potatoes have served as a lifesaving catastrophe crop, such as when Japanese rice fields were destroyed by typhoons and it kept millions from starvation in famine-plagued China in the early 1960s and in Uganda, when a virus ravaged cassava crops in the 1990s rural communities depended on sweet potatoes to keep hunger at bay. Sweet potatoes are high in carbohydrates and vitamin 'A' and can produce more edible energy per hectare per day than wheat, rice or cassava, FAO (2013). It has abundant uses, ranging from consumption of fresh roots or leaves to processing into animal feed, starch, flour, candy and alcohol. The crop can be grown in poor soils with little fertilizer and has hardy nature and broad adaptability. Uganda is the main sweet potato-growing country in Africa Anon (2002), with production of over 2.7 million tones, mostly for human consumption and the second leading producer after China at 117 metric tons globally FAO (2003).

Millions of young children die each year as a result of vitamin A deficiency, which is a major public health concern in underdeveloped nations. The inadequacy of necessary critical vitamins and minerals in the diets of many children and adults was made clear by nutritionists in various developing countries. In order to combat the issue of vitamin A deficiency, the biofortified Orange-Fleshed Sweet Potato is currently emerging as a significant member of the tropical

tuber crops with a tremendous potential for adoption as a regular diet of the consumer food chain. Orange-fleshed sweet potatoes are a great source of Beta-carotene and a cheap source of energy. This crop is also gaining importance as the cheapest source of antioxidant having several physiological attributes like anti-oxidation, anti-cancer and may help in protection against liver injury and coronary heart disease. Orange fleshed sweet potato is the most suiting as biofortified crop to combat micronutrient malnutrition in small and marginal farming community (Lakhawat, 2018).

Food fortification serves as a crucial strategy to fight malnutrition. Numerous of food fortification programs have been implemented to combat malnutrition, particularly in mothers and children (Wee et al., 2016)

The fortification of commonly eaten foods with micronutrients is one of the main strategies that can be used to improve micronutrient status. Fortification should be viewed as part of a range of measures that influence the quality of food including improved agricultural practices, improved food processing and storage, and improved consumer education to adopt good food preparation practices. Today, in developed countries where there is a high dependence on processed foods and industries are streamlined and automated, food fortification has played a major role in the health of these populations over the last 40 years, and several nutritional deficiencies have been eliminated. In the developing countries too, fortification is increasingly recognized as a measure to improve the micronutrient status of large populations. When fortification is imposed on existing food patterns, it may not necessitate changes in the customary diet of the population and will not call for individual compliance. Thus, fortification can often be implemented and sustained over a long period. It can, therefore, be the most cost-effective means of overcoming micronutrient malnutrition. The food industry is playing an increasingly critical and complex role throughout the world. In the developed countries, changes in living and marketplace patterns have stimulated changes in food industry practices, resulting in a diversity of food-processing technologies and ever-changing numbers and types of foods on the market shelves. As the food industry is increasingly driven by market forces into the global marketplace it is faced with a significantly different scenario. In marked contrast to the developed world, most developing countries are grappling with fundamental issues of providing adequate food supplies to feed their expanding populations. Simple nutritional and technological solutions to the problems of micronutrient malnutrition exist but are often complicated by economic, social, and political factors. Intervention strategies must take these factors into account. This is the challenge, as well as the opportunity, for the food industry to play a key role in improving the physical, social, and economic well-being of billions of people

The primary evidence for the effectiveness of biofortification comes from orange sweet potato (OSP). Effectiveness was assessed through a randomized control trial in both countries. The pilot delivery project described above resulted in a 68% increase in the probability of OSP adoption in Mozambique and a 61% increase in Uganda (Hotz et al., 2012a, Hotz et al., 2012b). OSP adoption resulted in substantial substitution of other sweet potato varieties in terms of area under cultivation.

#### Consumer acceptance and farmer adoption

In the pilot delivery programs in Mozambique and Uganda, when beneficiaries were provided information (i) that consumption of orange sweet potato could protect their children from the consequences of vitamin A deficiency and (ii) that orange sweet potato varieties were just as high yielding as white varieties, these households produced and consumed orange varieties—commensurately lowering their production and consumption of white sweet potato.

This variety of sweet potatoes is consumed as food but also used in many different other forms such as in confectionary, bakeries and in juice processing. Deficiency of Vitamin A is a major nutritional problem in little economies like Uganda. Orange Fleshed sweet potato is biofortified with Vitamin A and is cheap alternative to on market fortified foods such as flour and oils which are unaffordable by the most rural poor. All orange-fleshed sweet potatoes included in flat bread samples were determined to be rich in B-carotene and to satisfy between 61.63 and 86 percent of the recommended daily allowance for preschoolers, according to an analysis based on proximate data (Tadesse, Nigusse and Kurabachew, 2015).

Orange fleshed sweet potatoes OFSP can be consumed in boiled form but this is for a moment, therefore processing of the sweet potato into flour helps to utilize the crop sustainably. OFSP flour is used in the processing /confectionary such as bread and biscuits. Puree from the potatoes is also used in dish making and in the baby foods. Sweet potatoes make products such as the cookies which are considered to be the most desirable products for all ages due to their low manufacturing costs, long shelf -life, convenience and good eating quality (Omran and Hussien, 2015).

Additionally, the value of maize stalk as livestock feed is, as with other crop residues, limited by its poor digestibility and low crude-protein and mineral content. There is, therefore, a need for adoption of crops that can be efficiently used for both food and feed, such as sweet potato. Sweet potato grows in marginal conditions, requires little labour and little or no chemical fertilisers. It is a cheap and nutritious solution for developing countries, which need to grow

more food on less area to sustain rapidly growing populations. It also provides inexpensive, high-protein fodder for animals (Mbitheet *al.*, 2016)

This thesis analyses the socio-economic determinants of adoption of improved sweet potato varieties in the smallholder farming sector. This thesis analyses the socio-economic determinants of adoption. Among small scale farmers.

## **1.2 Statement of the problem**

In addition to receiving little credit for its role in ensuring family food security in national statistics, sweet potatoes have played and will continue to play a role in this regard in the nation. In addition to greatly enhancing household food security, the crop has the potential to enhance farmers' incomes if they can raise production and have surplus output for the market (Scott et al, 2012).

Along with the benefits of drought resistance and lower input costs, root and tuber crops are vulnerable to viral infections, which reduces yields. To offer disease-free planting material for the sweet potato, biotechnology approaches like tissue culture have become necessary. As a consequence of the biotechnology, further genetic manipulation has led to introduction of additional nutrients in the sweet potato an example being the orange fleshed sweet potato which is a result of fortification with vitamin A. The enhanced Orange fleshed sweet potato was introduced into the smallholder farming sector under the assumption that the farmers would readily adopt it and that the varieties were important due to their nutritional benefits. However, this has not been as straightforward as was thought. The adoption of this variety despite its advantages has not been very well documented and understood. The researcher therefore seeks to understand the factors influencing the adoption and adaptation of orange fleshed sweet potato variety.

## **1.3 Objectives of the study**

### **1.3.1 General objective**

To examine the socioeconomic factors influencing the adoption of orange-fleshed sweet potatoes in the small-scale farming sector in northern Uganda was the study's primary goal.

### **1.3.2 Specific objectives**

1. To document the farmers and multipliers practices used in the production of orange fleshed sweet potatoes in the small holder farming sector in northern Uganda.
2. To assess the socioeconomic factors for the adoption of orange fleshed sweet potatoes over the others varieties in the small holder farming sector in northern Uganda.

3. To examine the market penetration of orange fleshed sweet potatoes in northern Uganda.

#### **1.4 Research questions**

1. What are the farmers and multipliers practices in the production of orange fleshed sweet potatoes in the small holder farming sector in northern Uganda?
2. What are the socioeconomic factors for the adoption of orange fleshed sweet potatoes in the small holder farming sector in northern Uganda?
3. What is the extent of the market penetration of orange fleshed sweet potatoes in northern Uganda?

#### **1.5 Scope of the study**

The study was conducted in Gulu district and Omoro district between May 2023 to July 2023. The aim of the study was to examine the socioeconomic factors influencing the adoption of orange fleshed sweet potato compared to other sweet potato varieties in the small holder farming sector in northern Uganda.

#### **1.6 Significance of the study**

1. This study provides valuable insights into the adoption rate of orange-fleshed sweet potato (OFSP) cultivation among small-scale farmers in northern Uganda. This data helps understand the extent to which OFSP is being embraced as an agricultural practice in the region.
2. The study also identifies key socioeconomic factors associated with the adoption of OFSP cultivation, and understanding these factors can inform targeted interventions and strategies to promote OFSP adoption.
3. By highlighting the easily accessible technologies for OFSP farming, the study underscores the importance of leveraging existing resources and knowledge. This finding can guide the development of sustainable and context-specific farming practices, ultimately benefiting small-scale farmers and their communities.
4. Insights from this study can inform policies and initiatives aimed at promoting sustainable farming practices that address local dietary needs.
5. The findings of this study have broader implications for agricultural development in the region. By shedding light on the adoption and practices of OFSP cultivation, policymakers, researchers, and organizations can better understand the dynamics of small-scale farming systems and design effective interventions to support farmers, enhance productivity, and foster socioeconomic development.

### **1.7 Justification of the study**

Recent studies have not accounted for the socioeconomic influences on sweet potato varieties conservation, multiplication and distribution.

Harvest Plus with funding from USAID, in partnership with World Vision Uganda implemented the MENU (Meals for Nutrition) project 2017, and the Developing and Delivering Biofortified Crops (DDBC) project 2012-2016 whereby the farmers were selected basing on certain criteria and provided with the planting materials, trained in a farmer field school manner upto harvest and post-harvest management of the OFSP.

With the benefits of the OSP listed in the introduction, there is need to follow up on the producers for the utilization and conservation practices in this era of biodiversity loss

Most studies conducted previously do not segregated the gender but generalize the farmers in the research discussions hence the need to assess the gender based contributions in the OFSP distribution.

### **1.8 Theoretical framework**

This study adopted the Innovation Diffusion Theory (IDT) to assess adoption of orange fleshed sweet potato varieties by smallholder farmers(Kim & Crowston, 2011).Diffusion is the social process that occurs among people in response to learning about an innovation (Dearing & Cox, 2018). The innovation of diffusion theory describes how new ideas, behaviors, technologies, or goods spread through a population gradually. According to its proponents, the main goal of the theory is to understand the adoption of innovation in four elements of diffusion including innovation, time, communication channels, and social systems (Rogers, 2003). The theory states that the individual's behavior to adopt a given technology is determined by their perceptions regarding the relative advantage, compatibility, complexity, trialability, and observability of the innovation, as well as the social norms (Rogers, 2003). The five stages of the diffusion theory include: knowledge, persuasion, decision, implementation and confirmation (Rogers, 2003). The theory has been used by many researchers including in a study in Mozambique where the theory was used to assess progress of adoption and retention of orange fleshed sweet potato varieties in 2015 (Jenkins et al., 2018). However, with the known benefits, the following limitations have been encountered with the theory (Dearing & Cox, 2018):

- It does not foster participatory approach to adoption.

- It does not account for individual resources or social support for an innovation.
- It works better for adoption of behaviors better than cessation.

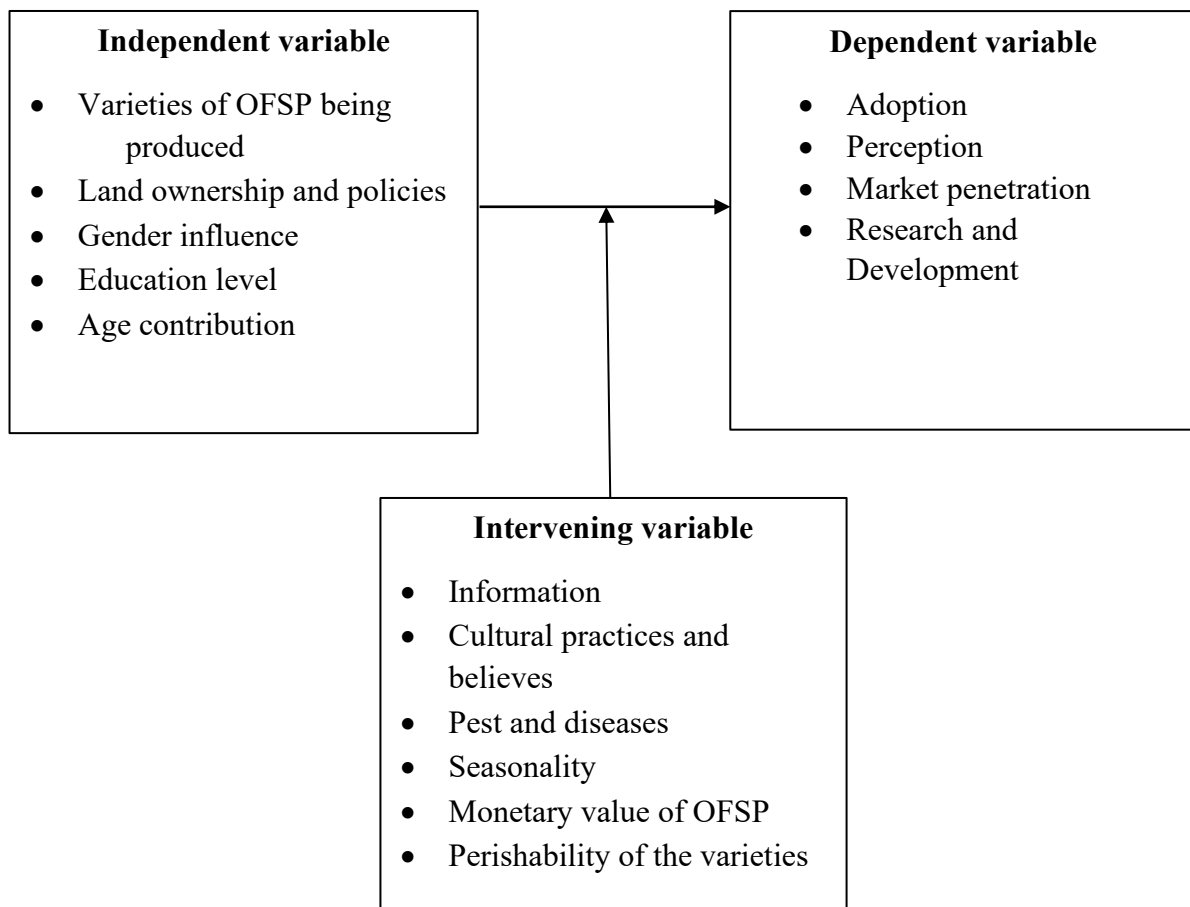
### **1.9 Definitions of operational terms**

**Adoption:** According to this study, adoption means cultivating orange fleshed sweet potato varieties by the farmers.

**Market penetration:** This has been used in this study to mean the different ways of reaching the markets to sell orange fleshed sweet potatoes to the consumers.

**Multiplying:** According to this study, multipliers mean the different modalities employed in increasing the production of orange fleshed sweet potatoes.

### 1.10 Conceptual frame work



*Figure 1: Conceptual framework*

## CHAPTER TWO

### LITERATURE REVIEW

#### **2.0 Introduction**

The literature review on the adoption of orange-fleshed sweet potatoes in Uganda and other countries is presented in this chapter. The literature has been organized in accordance with the study's objectives.

#### **2.1 Farmer and multiplier practices for sweet potatoes**

There is limited literature on the sources of planting material in Uganda. However, one of the studies conducted in Uganda among banana farmers reported that those who obtained the planting material from formal sources such as extension workers got improved supplies but those who got from informal sources had poor varieties (Kilwinger et al., 2020). In a similar study among potato farmers along Lake Victoria, most of them reportedly obtained vines from informal sources with more than 56% getting vines from their own farms (Adam et al., 2018). This is however dangerous because it has been reported that improved varieties such as orange fleshed sweet potatoes are very prone to pests and diseases, and therefore farmers could easily plant infected material (Okonya et al., 2014).

According to a farm survey report in Uganda, sweet potato is commonly sole-cropped, also occasionally cropped with beans, maize and other crops. A similar study in Tanzania reported that farmers usually planted mono-cropped sweet potatoes. However, a few intercropped them with pigeon peas and cassava, and crop rotated it with rice and maize (Ngailo et al., 2015). A similar study in Uganda also reported similar findings (Zawedde et al., 2014). Like studies have reported, most farmers do mono-cropping of sweet potatoes, and this likely leading to exhaustion of nutrients as well as experience of pests and diseases.

There are many ways that farmers use to conserve sweet potato vines. A study in Tanzania reported that 94% of the farmers reported that drought rides them off planting materials implying that their main conservation source is living them in the garden (Ngailo et al., 2015). A recent publication described that for orange fleshed sweet potatoes, farmers plant vines not seeds and usually employ the "Triple S" method (CGIAR, 2018). In this method, farmers store sweet potato roots in dry sand after harvesting, plant them in nursery beds before the rainy season, when rain is soon, they water them to sprout so that they can be planted in the rainy season.

A study across Africa reported that orange fleshed sweet potato varieties are seen as a main stream in fighting food security because they are drought-resistant, highly adaptable and nutritious (Girard et al., 2021). Experiences from Malawi indicate that farmers entered orange fleshed sweet potato multiplication because of its market potential (Van Vugt, 2017). Similarly, studies have also reported that many people consume orange fleshed sweet potatoes. In a recent survey in Zambia. 30.2% of the households consumed orange fleshed potato varieties more than four times in a week (Sakala et al., 2018). However, there is still limited consumption and marketing of the sweet potato varieties and studies have recommended advocacy efforts and integration of the varieties in national policies and food programmes (Low & Thiele, 2020).

## **2.2 Factors for adoption of orange fleshed sweet potato varieties**

Decisions about adoption depend on the type of technology and are influenced by a variety of social, demographic, ecological, and institutional factors (Kaguongo *et al.*, 2012).

Millions of young children die each year as a result of vitamin A deficiency, which is a major public health concern in underdeveloped nations. The inadequacy of sufficient critical vitamins was made clear by dietitians in various developing nations.

Minerals in the diet of many children and adults. In order to address the issue of vitamin A deficiency, orange-fleshed sweet potatoes are already establishing themselves as a significant component of tropical tuber crops with a tremendous potential for adoption as a regular diet of the consumer food chain. Orange-fleshed sweet potatoes are a great source of B-carotene and a cheap source of energy. This crop is also gaining importance as the cheapest source of antioxidant having several physiological attributes like anti-oxidation, anti-cancer and may help in protection against liver injury and coronary heart disease. Orange fleshed sweet potato is the most suiting as biofortified crop to combat micronutrient malnutrition in small and marginal farming community (Lakhawat, 2018).

Increase in the demand for cash crops has detrimental effect on the food crops. This phenomenon causes food crisis resulting into shortage of major food crops in the local market. Several factors are also involved in the malnutrition such as food insecurity, poor health, poor maternal and child care practices and poor choices or lack of food diversification. Therefore, there is need to diversify cultures and diets by encouraging the populations to grow and consume nutritious foods rich in micro and macro nutrients such as the OFSP (Edith *et al.*, 2018).

The OFSP blends well with other cereals such as rice, cowpea and Soya in the formulation of

infant food. This provides a wider market and alternative use to the crop. OFSP when provided to children of 6-12 months could prevent the adverse effects of Vitamin A deficiency (Pobeet *al.*, 2017).

Variety adoption is also facilitated by the ability of the crop to withstand drought and seed sharing. Farmers who borrow seeds can adopt it if the traits of such seed much their interests (Nuijten and Almekinders, 2020).Vine preservation, managing pests and diseases, market development, storage, and processing are additional barriers to adoption (Jenkins, Shanks and Houghtaling, 2015).

There is widespread production and utilization challenges such as low yields, use of local cultivars, poor access to vines, field pests and diseases as well as post-harvest storage, preservation and utilization. The African sweet potato weevils (*Cylas brunneus* F. and *C. puncticollis* Boheman) pose the most threat, followed by the sweet potato butterfly (*Acraea acerata* Hew.) and the clearwing moth (*Synanthedon* spp.) (Sugriet *al.*, 2017).

A study conducted in Malawi showed that farmers (late adopters) were attracted to growing the OFSP because the early adopters had made higher incomes and various investments; due to the visible changes in the lives of the early adopters (Mudege, Mayanja and Muzhingi, 2017).

### **2.3 Market penetration of orange fleshed sweet potatoes**

Orange-fleshed sweet potato (OFSP) root is a diverse food with significant nutritional value, according to studies. However, most developing nations do not make good use of this root.

Orange-fleshed sweet potato is a seasonal crop, perishable that cannot be stored for a long period of time unless preserved in some way. These varieties are full of nutrients such dietary fiber, vitamins, minerals, and antioxidants like phenolic acids, anthocyanins, tocopherol, and beta-carotene. They are an excellent source of vitamins A and C, B-vitamins (B2, B3, and B6), potassium and copper.

It is also stated that chips, cookies, breads alcoholic and non- alcoholic beverages can be developed from the OFSP with or without flavoring with juices and spices (Mamo, Mezgebe and Haile, 2014).

Availability of adequate quality planting materials at the on- set of the rains leads to early planting and increases the volume of fresh roots which are raw materials for the development

of other products and are also for marketing. Drought limits the availability of marketable roots (Mcewan and Mayanja, 2013).

Smallholder farmers in Uganda are challenged with market access such as the sweet potato producers (Akello, B., Lusembo, P., Mugisa, I., Nakyagaba, W. & Nampeera, 2010). These farmers are increasingly marginalized as urban markets demand for better quality, quantity and sustainable supply of agricultural commodities.

Research and development actors are also challenged with how to position farmers to benefit from the existing market opportunities.

Sweet potatoes are eaten in the period when other crops are not mature. Farmers will produce if a ready market is available (Sindi and Ndirigue, 2015).

Radio talk shows are avenues for marketing the OFSP, planting materials could also be accessed through the markets as suggested by the farmers through calling in during the talk shows (Lydia Kimenye and Margaret McEwan, 2014).

Consumers' willingness to pay for the OFSP products is influenced by their demographic characteristics such as age, sex, family size, education, knowledge of information about the product among others (Bocheret *et al.*, 2019).

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.0 Introduction**

This section comprises the study procedures, tools, techniques and modalities used to carry out the study.

#### **3.1 Study design**

This was a descriptive cross-sectional study that will involve collecting quantitative and qualitative data. Quantitative data will be collected using pretested semi structured questionnaires. Qualitative data will be collected using key informant interview guides.

#### **3.2 Study area**

In this study, the primary data were collected from Acoyo Parish, Koro Sub county, Omoro district and in Parts of Gulu District/city, especially the market penetration survey.

#### **3.3 Study population, study units and study respondents**

The study population consisted of farming households who previously benefited /received the Orange Fleshed Sweet Potatoes planting materials and grew them for at least one season. Study units were household heads (male or female) in the selected households.

Study respondents were the household heads (male or female), Seed/ vine multipliers, Traders of any sweet potato varieties and the orange Fleshed Sweet Potatoes.

KIIs were conducted with opinion leaders; selected sub county Extension workers, INGO extension workers, District Agricultural Officers, Researchers, Multipliers/ producers of Orange Fleshed Sweet Potatoes.

#### **3.4 Sampling procedure**

##### **3.4.1 Sample size**

This study used Yamane formula (1967) to calculate the sample size for household survey. According to him, for a 95% confidence level and  $p = 0.5$ , size of the sample should be:

$$n = \frac{N}{1 + Ne^2}$$

Where: n is sample size

N is population

e is precision.

Find sample size, n when:

N is at 7,684 households (UBOS 2019)

Sample size,  $n = \frac{7,684}{1 + 7,684 \times 0.05^2} = 380$  households

Considering a non-response rate of 5%

$n = 380 + 19 = 399$  households. Therefore, n is 399 respondents.

### **Key Informant Interview**

To sample key informant interview respondents, the study used snowball sampling: Snowball sampling is a nonprobability sampling technique where existing study subjects recruit future subjects from among their acquaintances. Thus, the sample group is said to grow like a rolling snowball. This sampling technique can be used to explore an issue in a bit more in depth way without focusing on 'usual suspects' which are often a list of Key Informants.

### **3.4.2 Sampling Procedure**

To sample the households a simple random sample of parishes was selected from a larger list of sub counties, and then a simple random sample of household will be selected from each parish. Every 19<sup>th</sup> household will be selected and interviewed. That is to say 7,684 households by a sample size of 399 households.

### **3.5 Inclusion and exclusion criteria**

#### **Inclusion criteria**

- All household heads living in Northern Uganda's selected districts, 18 years and above were included in the study.

#### **Exclusion criteria**

- Household heads, living in Northern Uganda's selected districts, 18 years but they have not lived in the area for more than 7 years were excluded from the study.

### **3.6 Data collection tools and instrument**

Quantitative data was collected using a semi structured questionnaire administered to farmers through face-to-face interviews. Qualitative data was collected through interviews using key informant interview guides.

### **3.7 Quality control measures**

There was quality control by using scientifically proven ways of making data collection pure.

1. The data collection tools were developed through thorough literature review and given to experts for review to ensure content validity.
2. The data was collected using an app which ensures that GPS coordinates of the place of data collection is captured.
3. The research assistants were trained on data collection and taken through the tools to ensure that they have a level of understanding of the tool before they go to the field for data collection
4. The Research Assistants paired up and conducted pre- test of the tool to manage on -field issues that would arise if the tool is not pre-tested.
5. The reliability index and content validity index were computed to ensure that all the questions are relevant and adequate to achieve the research question.

### **3.8 Data management and processing**

Data cleaning was done during data collection and before performing statistical analysis. The responses in the questionnaire used were coded to ensure easy handling. After collection, data cleaning was conducted in Microsoft Excel before being exported to STATA version 17 software for formal analysis. Data analysis was performed as descriptive and inferential statistics. To determine the level of adoption and characterize farmers and multiplier practices, and market penetration, descriptive analysis was performed. Categorical variables were summarized as frequencies and proportions, whereas continuous variables were summarized as appropriate measures of central tendencies and dispersion. Logistic regression analysis was used to assess socioeconomic factors associated with adoption of OFSP by farmers. Binary logistic regression analysis was performed after careful assessment of the underlying assumptions. For statistical significance, a  $p < 0.05$  was considered.

### **3.9 Ethical considerations**

**Ethical approval:** The protocol was approved by the ethics committee for Uganda Martyrs University. Introductory letter was also provided by the faculty; this was presented to the local

authorities of the study site for site clearance.

**Informed consent form:** Before recruiting participants, they were asked to voluntarily participate after taking them through the purpose, benefits, risks and conditions for participating into the study.

**Confidentiality and privacy:** All respondent's information was kept confidential in a way that no unique identification information such as names, telephone numbers were used without seeking permission from the respondents. Likewise, interviews were conducted from places suggested by the respondents.

**Respect for persons:** The participants were treated with respect, their time consumed per respondent was less than half an hour hence not warranting for compensation. All information was collected electronically therefore eliminating risks of not protecting personal data by littering.

### **3.10 Limitations of the study**

- Limited geographic coverage; initially the study was designed to cover at least 3 districts; however, this was narrowed down to 2 districts so as to cover them within the provided time span.
- Time constraint, the research was conducted within a short period of time hence limiting the geographic scope.
- The study did not have a perfect response rate as some of the farmers were not willing to respond to some of the questions.

## CHAPTER FOUR

### PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

#### 4.0 Introduction

This section presents the results per the study objectives. The study had three objectives including documenting the farmers and multipliers of orange fleshed sweet potatoes in Northern Uganda, assess factors affecting adoption of OFSP varieties, and examine market penetration for OFSP in Northern Uganda. Out of the sample of 399, 383 fully filled the questionnaires generating a response rate of 95.9%.

#### 4.1 Findings of the study

##### 4.1 Documentation of farmers and multiplier practices

##### 4.1.1 Farmers practices

Table 1 shows that most of the farmers 271(88.3%) obtain the planting material from their own farms, 187(60.9%) do not keep records, and 176(57.3%) are not engaged in any other activity apart from farming. Majority of the respondents 287(93.5%) practiced subsistence farming, 279(90.9%) practiced mono-cropping, and 127(41.4%) conserve potato vines through planting in swamps.

*Table 1: Farming practices of respondents (N=307)*

Practices	Frequency (n)	Percentage (%)
<b>Source of your planting material</b>		
Market	33	10.7
Own farm	271	88.3
Other	3	1.0
<b>Length of time for vines to sprout</b>		
3 to 5 days	5	1.6
6 to 8 days	156	50.8
9 to 11 days	13	4.2
12 to 24 days	13	4.2
15 days and above	120	39.1
<b>Keep farm records</b>		

No	187	60.9
Yes	120	39.1
<b>Engaged in any other activity apart from farming</b>		
No	176	57.3
Yes	131	42.7
<b>Reasons for growing sweet potatoes</b>		
Commercial	20	6.5
Subsistence	287	93.5
<b>System of farming practiced</b>		
Intercropping with tree crop	2	0.7
Intercropping with food crop	26	8.5
Mono-cropping	279	90.9
<b>Ways to conserve and multiply sweet potatoes</b>		
Fencing	18	5.9
Leaving them in the garden	83	27.0
Off season planting	31	10.1
Planting in swamps	127	41.4
Put in shade	23	7.5
Watering	13	4.2
Other	12	3.9

#### 4.1.2 Agricultural technologies

Table 2 shows that most of the farmers 224(73.0%) practiced mulching, and 192(62.7%) crop rotation. Only 5(1.6%) practiced intercropping and 64(20.8%) practiced spacing. However, majority of the respondents 243(79.2%) do not apply fertilizer, and 291(94.8%) do not use tractors or oxen.

**Table 2: Agricultural technologies employed in cultivating sweet potatoes (N=307)**

<b>Agriculture technology</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Mulching</b>		
No	83	27.0
Yes	224	73.0
<b>Crop rotation</b>		
No	115	37.5
Yes	192	62.5
<b>Intercropping</b>		
No	302	98.4
Yes	5	1.6
<b>Fertilizer application</b>		
No	243	79.2
Yes	64	20.8
<b>Plant spacing</b>		
No	243	79.2
Yes	64	20.8
<b>Early planting</b>		
No	91	29.6
Yes	216	70.4
<b>Ox-ploughing or tractor</b>		
No	291	94.8
Yes	16	5.2

#### **4.1.3 Gender and access to land and resources**

Table 3 indicates that mostly women 159(51.8%) prepared the land for cultivation, 282(91.9%) did weed management, 276(89.9%) harvesting and post-harvest handling, 286(93.2%) sales marketing and 239(77.9%) conserving potato vines. Most men 204(66.4%) engaged in heaping and 119(38.8%) land preparation for cultivation.

**Table 3: Roles of the different genders in cultivating sweet potatoes (N=307)**

<b>Access items</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Land preparation for sweet potato production</b>		
Boys	19	6.2
Elders	4	1.3
Girls	6	2.0
Men	119	38.8
Women	159	51.8
<b>Heaping</b>		
Boys	20	6.5
Elders	1	0.3
Girls	3	1.0
Men	204	66.4
Women	79	25.7
<b>Weed management</b>		
Elders	2	0.7
Girls	15	4.9
Men	8	2.6
Women	282	91.9
<b>Harvesting and post harvesting</b>		
Boys	3	1.0
Elders	2	0.7
Girls	19	6.2
Men	7	2.3
Women	276	89.9
<b>Sales marketing</b>		
Boys	3	1.0
Elders	4	1.3
Girls	8	2.6
Men	6	2.0
Women	286	93.2
<b>Conserving vines</b>		
Boys	1	0.3
Elders	14	4.6
Men	53	17.3
Women	239	77.9

#### 4.1.4 Age and access to land and resources

Table 4 shows that all the activities regarding potato cultivation including land preparation 105(34.2%), Heaping 129(42.0%), weed management 119(38.8%), and harvesting and post harvesting 120(39.1%) were done by those aged 19 to 25 years.

**Table 4: Roles of the different age groups in cultivating sweet potatoes (N=307)**

<b>Access items</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Land preparation for sweet potato production</b>		
12 to 18 years	23	7.5
19 to 25 years	105	34.2
26 to 35 years	92	30.0
36 to 50 years	60	19.5
Above 51 years	26	8.5
Below 12 years	1	0.3
<b>Heaping</b>		
12 to 18 years	3	1.0
19 to 25 years	129	42.0
26 to 35 years	115	37.5
36 to 50 years	48	15.6
Above 51 years	12	3.9
<b>Weed management</b>		
12 to 18 years	13	4.2
19 to 25 years	119	38.8
26 to 35 years	95	30.9
36 to 50 years	60	19.5
Above 51 years	20	6.5
<b>Harvesting and post harvesting</b>		
12 to 18 years	10	3.3
19 to 25 years	120	39.1
26 to 35 years	99	32.2
36 to 50 years	57	18.6
Above 51 years	20	6.5

Below 12 years	1	0.3
<b>Sales marketing</b>		
19 to 25 years	95	30.9
26 to 35 years	119	38.8
36 to 50 years	71	23.1
Above 51 years	21	6.8
Below 12 years	1	0.3
<b>Conserving vines</b>		
19 to 25 years	82	26.7
26 to 35 years	110	35.8
36 to 50 years	80	26.1
Above 51 years	35	11.4

#### 4.2 Socioeconomic factors and adoption of OFSP

Table 5 shows that getting information for agricultural extension workers (AOR: 4.087, 95% CI: 1.354, 12.336,  $p=0.012$ ), being in a community group (AOR: 2.065, 95% CI: 1.105, 3.860,  $p=0.023$ ), keeping records (AOR: 0.324, 95% CI: 0.144, 0.727,  $p=0.006$ ), and not engaging in other activities (AOR: 2.072, 95% CI: 1.121, 3.828,  $p=0.020$ ) had statistically significant relationship with adoption of orange fleshed sweet potatoes.

**Table 5: Association of socioeconomic factors with adoption of OFSP (N=307)**

Variables	Frequency (n)	OFSP adoption	
		No n(%)	Yes n(%)
<b>Sex</b>			
Female	227(73.9)	184(76.3)	43(65.2)
Male	80(26.1)	57(23.7)	23(34.8)
<b>Age category</b>			
36 to 59 years	124(40.4)	115(47.7)	19(28.8)
Above 60 years	134(43.6)	36(14.9)	13(19.7)
Below 35 years	49(16.0)	90(37.3)	34(51.5)
<b>Level of education</b>			
No formal education	63(20.5)	50(20.7)	13(19.7)
Primary	124(40.4)	105(43.6)	19(28.8)
Secondary	105(34.2)	77(32.0)	28(42.4)
Tertiary	15(4.9)	9(3.7)	6(9.1)
<b>Marital status</b>			
Married	228(74.3)	175(72.6)	53(80.3)
Separated	12(3.9)	10(4.1)	2(3.0)
Single	33(10.7)	26(10.8)	7(10.6)
Widowed	34(11.1)	30(12.4)	4(6.1)
<b>Period for potato growing</b>			
1 to 5 years	49(16.0)	38(15.8)	11(16.7)
6 to 10 years	45(14.7)	174(72.2)	39(59.1)
11 years and above	213(69.4)	29(12.0)	16(24.2)
<b>Source of information</b>			
Extension workers	51(16.6)	46(19.1)	5(7.6)
Peer to peer	131(42.7)	44(18.3)	20(30.3)
Radio station	61(19.9)	98(40.7)	33(50.0)
Others	64(20.8)	53(22.0)	8(12.1)
<b>Have a community group</b>			
No	134(43.6)	112(46.5)	22(33.3)
Yes	173(56.4)	129(53.5)	44(66.7)

<b>Size of land for farming</b>			
Large	15(4.9)	11(4.6)	4(6.1)
Small	292(95.1)	230(95.4)	62(93.9)
<b>Selling sweet potatoes</b>			
Don't sell	21(6.8)	14(5.8)	7(10.6)
Local market	179(58.3)	141(58.5)	38(57.6)
Main market	65(21.2)	53(22.0)	12(18.2)
Retail	42(13.7)	33(13.7)	9(13.6)
<b>Keep farm records</b>			
No	187(60.9)	136(56.4)	51(77.3)
Yes	120(39.1)	105(43.6)	15(22.7)
<b>Engaged in other activities</b>			
No	176(57.3)	145(60.2)	31(47.0)
Yes	131(42.7)	96(39.8)	35(53.0)
<b>Reasons for cultivation</b>			
Commercial	20(6.5)	14(5.8)	6(9.1)
Subsistence	287(93.5)	227(94.2)	60(90.9)
<b>Farming practiced</b>			
Intercropping with tree crop	2(0.7)	2(0.8)	0(0)
Intercropping with food crop	26(8.5)	17(7.1)	9(13.6)
Mono-cropping	279(90.9)	222(92.1)	57(86.4)

Table 6 shows that farmers who got information from Community Extension Workers had 4-fold increased odds of adopting OFSP compared to those who got information from other sources. Farmers who were not in a community group had 2-fold increased odds of adopting OFSP compared to those who were in a community group. Also, farmers who did not keep records were less likely to adopt OFSP compared to those who kept records. Finally, farmers who were not engaged in other activities had 2-fold increased odds of adopting OFSP compared to those who were engaged in other activities apart from farming.

**Table 6: Socioeconomic factors associated with adoption among small holder farmers**

Variables	Adoption Yes n(%)	Bivariate analysis		Multivariate analysis	
		X <sup>2</sup>	P value	AOR(95% CI)	P value
<b>Sex</b>					
Female	43(65.2)	3.371	0.066		
Male	23(34.8)				
<b>Age category</b>					
36 to 59 years	19(28.8)	7.565	0.023		
Above 60 years	13(19.7)				
Below 35 years	34(51.5)				
<b>Level of education</b>					
No formal education	13(19.7)	7.535	0.057		
Primary	19(28.8)				
Secondary	28(42.4)				
Tertiary	6(9.1)				
<b>Marital status</b>					
Married	53(80.3)	2.489	0.477		
Separated	2(3.0)				
Single	7(10.6)				
Widowed	4(6.1)				
<b>Period for potato growing</b>					
1 to 5 years	11(16.7)	6.578	0.037		
6 to 10 years	39(59.1)				
11 years and above	16(24.2)				
<b>Source of information</b>					

Extension workers	5(7.6)	11.338	0.010	4.087(1.354, 12.336)	0.012*
Peer to peer	20(30.3)			2.324(0.768, 7.032)	0.136
Radio station	33(50.0)			1.681(0.498, 5.666)	0.402
Others	8(12.1)			Ref	
<b>Have a community group</b>					
No	22(33.3)	3.637	0.057	2.065(1.105, 3.860)	0.023*
Yes	44(66.7)			Ref	
<b>Size of land for farming</b>					
Large	4(6.1)	0.250	0.617		
Small	62(93.9)				
<b>Selling sweet potatoes</b>					
Don't sell	7(10.6)	2.106	0.551		
Local market	38(57.6)				
Main market	12(18.2)				
Retail	9(13.6)				
<b>Keep farm records</b>					
No	51(77.3)	9.452	0.002	0.324(0.144, 0.727)	0.006**
Yes	15(22.7)			Ref	
<b>Engaged in other activities</b>					
No	31(47.0)	3.688	0.055	2.072(1.121, 3.828)	0.020*
Yes	35(53.0)			Ref	
<b>Reasons for cultivation</b>					
Commercial	6(9.1)	0.916	0.338		
Subsistence	60(90.9)				
<b>Farming practiced</b>					
Intercropping with tree crop	0(0)	3.387	0.184		
Intercropping with food crop	9(13.6)				
Mono-cropping	57(86.4)				

#### 4.3 Sweet potato market penetration

Table 7 shows that most of the farmers 75(98.7%) were independent, 73(96.1%) were members of a farmer group, and had stayed for about 12 years in sweet potato farming. Most of the farmers 62(81.6%) reported limited resources and 47(61.8%) reportedly do not store vines.

**Table 7: Sweet potato market penetration (n=76)**

<b>Factors</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Affiliation</b>		
Market vendors	75	98.7
Seed companies	1	1.3
<b>Position in group</b>		
Member	73	96.1
Secretary	1	1.3
Treasurer	2	2.6
<b>Potato products</b>		
Tubers	64	84.2
Vines	7	9.2
Tubers and vines	5	6.6
<b>Potato varieties</b>		
Orange fleshed	1	1.3
Purple fleshed	14	18.4
White fleshed	41	53.9
Yellow fleshed	20	26.3
<b>Potatoes sale</b>		
Orange fleshed varieties	1	1.3
Purple fleshed	14	18.4
White fleshed	41	53.9
Yellow fleshed	20	26.3
<b>Roots provided</b>		
Free of charge	10	13.2
Sold	66	86.8
<b>Source of supply of vines</b>		

Buy from farmers	58	76.3
Produce own	18	23.7
<b>Customers for the sweet potatoes</b>		
Farmer groups	2	2.6
Government	3	3.9
Individual farmers	17	22.4
Other	54	71.1
<b>Source of information about varieties</b>		
Demonstration	27	35.5
Other	1	1.3
Phone	43	56.6
Radio	5	6.6
<b>Channels for information</b>		
Farmer groups	6	35.5
Field days	14	1.3
Markets	43	56.6
Other	13	6.6
<b>Major challenges faced</b>		
High cost of vines	3	3.9
Limited resources	62	81.6
Other	11	14.5
<b>Facilitate new farmers</b>		
Contract to produce seeds	12	15.8
Give free sample	58	76.3
Demonstration gardens	3	3.9
Other	3	3.9
<b>Store vines</b>		
No	58	76.3
Yes	18	27.3
<b>Had loses</b>		
No	47	61.8
Yes	29	38.2

<b>Storage methods for potato vines</b>		
Bagging in store	53	69.7
Put under shade	12	15.8
Stored in sacks	11	14.5
<b>Frequency of receiving vines</b>		
Every 3 years	1	1.3
Every season	2	2.6
Other	73	96.1

#### **4.4 Discussion of findings**

##### **4.4.1 Farmers multiplier practices in production of OFSP**

The study evaluated the multiplying practices of farmers with regard to the origin of planting materials supplies and conservation techniques. The results indicate that most of the farmers 271(88.3%) obtained the planting material from their own farms. This shows that the vast majority of farmers rely on sweet potato vines or tubers cultivated on their own farms as planting materials for subsequent seasons. This may have been the case because extension workers had limited access to high-quality potato vines, or because high-quality planting materials were too expensive. Similar to our findings, a survey along the Tanzanian beaches of Lake Victoria found that the majority of farmers, 349 (56.2%), obtained planting vines from their own farms (Adam et al., 2018). These results also parallel those of an Ethiopian research (Hendebo et al., 2022), according to a study conducted in Mozambique, the usage of planting material from one's own farm is primarily due to lack of access to vines (Jenkins et al., 2018).

My results also indicate that most of the farmers, 127(41.4%) conserved potato vines through planting in swamps followed by 83(27.0%) leaving them in the gardens during the dry seasons. This may be due to the fact that swamps with their waterlogging give a pleasant microclimate, but also include fertile soils with organic matter that can provide a nutrient-rich environment for the vines so they do not dry out. In contrast to our findings, a comparable survey found that the majority of farmers (62.5%) conserve potato vines by leaving them in the fields during dry seasons (Adam et al., 2018). Similarly, a research by Hendebo and colleagues in Ethiopia found that the majority of farmers, 300 (82.4%), left vines in their gardens during the dry seasons. This, however, makes the vines susceptible to pests and diseases (Hendebo et al., 2022). The discrepancies in these study results may be attributable to the climate and physical

circumstances of the various study environments, such as the nature of the land and the existence of flooded areas.

The results also indicate that majority of the farmers 243(79.2%) did not apply fertilizer to the potato vines. This could be attributed to a number of factors, such as a preference for organic fertilizer, the employment of traditional farming techniques, and a belief in the natural composition of the soils where sweet potatoes are grown (Oliveira et al., 2021). In a similar study in Ethiopia, most of the farmers (54.4%) did not apply inorganic fertilizer to the potatoes (Hendebo et al., 2022). In a related study in Ghana, fertilizer application on the sweet potatoes did not have any significant influence on growth and yield parameters of the farms assessed (Darko et al., 2020).

Our study also reports that most of the farmers practiced sustainable farming practices including mulching 224(73.0%) and 192(62.7%) crop rotation. Farmers may be aware that these measures improve soil structure and fertility over time, break pest and disease cycles, and increase soil nutrient content. The results are in line with those of a study in Morocco that reported that most of the farmers (99.67%) practiced crop rotation (Rhioui et al., 2023). A similar study among small scale farmers also reported that farmers were more inclined towards use of Agro-Ecological Intensification (AEI) practices for climate change adaptation (Naazie et al., 2023). Our results also mirror those of a study in Ethiopia (Getnet, 2019).

#### **4.4.2 Socioeconomic factors associated with adoption of OFSP in northern Uganda**

The study indicates that 21.5% of the farmers in northern Uganda cultivated orange fleshed sweet potatoes varieties and the associated factors include getting information for agricultural extension workers (AOR: 4.087, 95% CI: 1.354, 12.336,  $p=0.012$ ), being in a community group (AOR: 2.065, 95% CI: 1.105, 3.860,  $p=0.023$ ), keeping records (AOR: 0.324, 95% CI: 0.144, 0.727,  $p=0.006$ ), and not engaging in other activities (AOR: 2.072, 95% CI: 1.121, 3.828,  $p=0.020$ ).

The study presents a low prevalence of Orange Fleshed Sweet Potato adoption at 21.5% in Northern Uganda. This could be due to a number of issues, including restricted access to high-quality planting seeds, a lack of knowledge of the nutritional benefits of the OFSP, and insufficient knowledge of appropriate agronomic practices, the need to use clean vines coupled with the fact the OFSP is highly susceptible to SPVD requiring the use of tissue culture/ clean vines which are expensive. The study also emphasizes the significance of social networks and farmer-to-farmer interactions in promoting the adoption of OFSP cultivars, as well as the need

for focused extension services and training programs. The prevalence in the current study is higher than 20.8% national prevalence reported in Ghana in 2020 (Adekambi et al., 2020). However, the current prevalence is lower than 28.8% reported of cassava varieties in the Democratic Republic of Congo (DRC) (Mugumaarhahama et al., 2021), 23.6% reported easy access to OFSP varieties reported in Gulu City (Odong, 2021), and 43.2% adoption of new agricultural technologies reported in Ethiopia in 2021 (Massresha et al., 2021). The differences in the results could be due to the time the different studies were conducted, the settings in the different countries and the sample sizes used for each study.

My results indicate that farmers who got information from community extension workers had 4-fold increased odds of adopting OFSP compared to those who got information from other sources. This conclusion may be explained by the fact that radio stations credible sources of information for farmers, whose presence positively affects OFSP adoption. Community extension workers are frequently professional agronomists or agricultural specialists who work directly with local communities to offer advice, technical assistance, and training on improved farming practices (Fabregas et al., 2023). Therefore, farmers who had access to these extension services were more likely to adopt OFSP because they received individualized instruction and support. Similar to this study, a study in Ghana reported that distance to the nearest agricultural officer, as a proxy for access to extension services was associated with adoption of OFSP variety (Adekambi et al., 2020). The study by Jenkins and colleagues in 2018 in Mozambique is also in line with the study results (Jenkins et al., 2018). Also, our result is in line with results reported by studies on adoption of new agricultural technologies. Studies by Ali and Rahut in Pakistan, as well as Xu and colleagues in rural China reported that information from agricultural extension workers played a role in helping farmers improve agricultural productivity in high yields of rice and wheat, and therefore adoption of new agricultural technologies (Jenkins et al., 2018; Xu et al., 2022).

The results also indicate that farmers who were not in a community group had 2-fold increased odds of adopting OFSP compared to those who were in a community group. This data suggests that farmers who did not belong to a community group may have had greater discretion and independence in making decisions regarding OFSP adoption. The results are contradictory to those of research by Jenkins and colleagues in Mozambique, which shown that information exchange within farmer networks enhanced OFSP variety adoption(Jenkins et al., 2018). The current study is also in disagreement with findings of a Malawian study that showed that being in a community group emphasized a culture of sharing potato vines along with essential

information which was key for adoption of OFSP by farmers (CGIAR, 2021). The results in a study by Shikuku and colleagues in Tanzania also mirror those reported in different studies (Shikuku et al., 2019). Based on these studies, it is worth noting that community groups can have a positive impact on farming practices, knowledge sharing, and collective decision making. It is essential to recognize that the impact of community groups on OFSP adoption may vary across areas, farming circumstances, and cultural backgrounds. Therefore, additional study is required to investigate the role of community groups in OFSP adoption.

Results of the study also indicate that farmers who did not keep records were less likely to adopt OFSP compared to those who kept records. This may be due to the fact that farmers who document their farming activities, such as inputs used, yields, and observations, are more likely to make educated decisions. Keeping records also allows farmers to better understand the benefits of OFSP crops, follow its performance, and evaluate its potential impact on their overall agricultural system, allowing them to find areas for improvement and make appropriate adjustments. The study results mirror those of a study in Canada that showed that tracking of an OFSP project influenced good compliance and long term sustainability of the project (Zurbrigg & Van den Borre, 2013). Another similar study conducted in Cameroon reported that proper record keeping was very important in boosting farm productivity (BALLAH & AZIBO, 2023).

Lastly, my results show that farmers who were not engaged in other activities had 2-fold increased odds of adopting OFSP compared to those who were engaged in other activities apart from farming. This study suggests that farmers that devote a substantial amount of time to farming may have more time and money to engage in and implement innovative farming methods, such as OFSP farming. This is therefore likely associated with resource accessibility. A similar study conducted in Tanzania reported that commitment of resources and physical assets was a key decision in the decision to grow OFSP varieties (Okello et al., 2017). In another similar study in Sierra Leone, adoption of OFSP cropping was associated with cultivating for income and having access to land in the upper and low lands (Nabay et al., 2020). Gustafson in her study in 2017 also reported similar results (Gustafson, 2017). It is important to note, however, that while the study demonstrates a correlation between the exclusive practice of farming and the adoption of OFSP, other factors may also be at play. Access to information, the availability of planting materials, and knowledge of agronomic practices and technologies such as OFSP are among these issues (Adekambi et al., 2020; Massresha et al., 2021; Mugumaarhahama et al., 2021).

#### **4.4.3 Market penetration of OFSP in northern Uganda**

Our results indicate that most of the farmers 75(98.7%) are market vendors, 64(84.2%) sell products in form of tubers, and 17(22.4%) sell to individual customers. This shows that the majority of farmers produce for their own consumption and only sell excess tubers to consumers at local markets. This may be due to the fact that the majority of farmers cultivate on a modest scale and so serve the local markets in their immediate areas. These results are similar to those reported in Zambia that indicated that 60.3% of the farmers planted OFSP varieties basically for household consumption (Sakala et al., 2018). In a similar East African report, most vendors of the OFSP varieties obtain them from their own gardens, however, 61% of the consumers were not aware of the OFSP varieties (Mayanja, 2017).

## CHAPTER FIVE

### SUMMARY, CONCLUSION, AND RECOMMENDATIONS

#### 5.0 Introduction

This chapter presents the summaries, conclusion and recommendations of the study for the objectives that were undertaken.

#### 5.1 Summary of findings

Most of the farmers obtained potato vines from own farms (88.3%), were engaged in subsistence farming (93.5%), and practiced mono-cropping (90.3%). Using vines from own farms and practicing mono-cropping indicates that farmers can easily plant vines that are infected with diseases. This is because studies have reported that potato varieties are easily infested with diseases when left in the gardens (Okonya et al., 2014).

Out of the 307 farmers, 66(21.5%) cultivated orange fleshed sweet potatoes and most of them 131(42.7%) cultivated a given variety because of the high yielding characteristic. The socioeconomic factors associated with the adoption include getting information for agricultural extension workers, being in a community group, keeping records, gender in that more female adopted than male and not engaging in other activities. This emphasizes the importance of extension workers in the sensitization and dissemination of information to farmers on the adoption of new methods and technologies.

Most of the farmers 98.7% were market vendors. Similarly, only one farmer reported that they entirely sell the orange fleshed sweet potato variety. According to farmer interviews, the majority of farmers produce for subsistence, selling only a few crops to individual farmers.

#### 5.2 Conclusion

Access to information from Agricultural extension worker, being a member of a community group, keeping records are key factors in the adoption of the OFSP. Gender was not significant in adoption however; more women were found to adopt the OFSP. Poor multiplication practices on the part of farmers can easily lead to disease infestation of potatoes, according to the study. Nonetheless, this emphasizes the need for a steady supply of high-quality planting materials and continuous technical backstopping of farmers.

Similarly, results of the study indicate that only one in five of small-holder farmers in northern Uganda practice OFSP cultivation with information from radio stations as key for adoption.

The survey also reveals that farmers engaged in OFSP agriculture for domestic consumption are utilizing locally available technologies/practices. There is need for the dissemination of further information regarding orange fleshed sweet potato cultivars to farmers through extension in order to enhance adoption and expand production.

Finally, the data a correlation between production and market penetration; there is low adoption at production level and therefore, low chances of finding OFSP vines and roots in the local markets. There is need for community awareness about the OFSP varieties, nutritional benefits, as well as encouraging and, if possible, incentivizing farmers to increase production and consumption and the sale of surplus, intentional large-scale production for marketing within the communities.

## **5.2 Recommendations**

Based on the results and conclusion presented, the following are recommended:

1. By employing more community extension workers and equipping them with the required skills and information regarding the significance of OFSP, it is possible to boost farmers' access to agricultural knowledge and adoption.
2. Encourage small-scale farmers to organize or join associations devoted to OFSP cultivation. These groups can facilitate information sharing, resource pooling, and collective decision-making.
3. Small-scale OFSP cultivators should be educated on the significance of recordkeeping. Productivity can be increased by monitoring progress, detecting impediments, and making informed decisions. Provide OFSP farmers with good agronomic practices training and support/technical backstopping continuously.
4. Highlight the socioeconomic benefits of OFSP planting for small-scale farmers and emphasize how OFSP farming can contribute to greater household food security, improved nutrition, and the potential for additional cash through excess output.
5. More Research and Development of OFSP cultivars that are resistant to the SPVD (Sweet Potato Virus diseases), as it was discovered that they are less resistant, and hence less adopted. Farmers report that it is expensive to get tissue cultured/clean vines each season, resulting in less OFSP adaptability.
6. Additionally, additional research is required to evaluate the parameters connected with the OFSP variety's market penetration in order to promote its use and acquire the accompanying nutritional benefits.

7. Additional study is required to investigate the role of community groups in OFSP adoption.

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## APPENDICES

### Appendix I: Questionnaire & Consent

#### QUESTIONNAIRE FOR THE SWEETPOTATO FARMERS

##### Introduction

Thank you for participating in the study questionnaire. The survey seeks to understand the socioeconomic factors for the adoption of Orange Fleshed Sweet Potatoes in your area. The study is being conducted in partial fulfillment of the conditions for the award of Masters of Science Degree in Agroecology. The study focuses understanding the socioeconomic factors for adoption of OFSP in Gulu/Omoroto Districts. The information collected on will be used solely for study purposes.

I do seek your permission to conduct an interview with you. The information generated from you maybe published in reports and study-related websites for others to learn from it.

Please indicate whether you agree or disagree to the following:

Do you give permission to participate in the interview?(Please tick Yes or No in the box below)

- Yes-I agree to participate in the interview for the assessment.
- No -I don't agree to participate in the interview for the assessment.

#### SECTION A: BIODATA

##### Geographical Location

##### Sex

- Male
- Female

##### Age Range

- a) Below 35 years
- b) 36–59 years
- d) above 60 yrs

##### Marital status

- Married
- Separated
- Single
- Widowed

**Period under sweet potatoes growing?**

- 1-5Years
- 6-10Year
- 11years and above

**Level of Education**

- a) No formal education
- b) Primary
- c) Secondary
- d) Tertiary

To examine the effect of education level as influence for adoption

How do you get information on sweetpotato growing?

Television

Radiostation

Newspapers

Market

Peertopeer

Extension workers

Other (please specify)

Which material do you use to plant sweetpotatoes?

How do you conserve and multiply potato vines during dry season?

How long does sweetpotato vines take to sprout when planted?\*

- 3-5Days
- 6-8Days
- 9-11Days
- 12-14Days
- 15Days and above

Which records do you keep when cultivating sweetpotatoes?

Cash books

Input supply

Annual yields

Market Information

Do not keep records

Other (please specify)

Are you engaged in any other activity apart from farming?

- Yes
- No

Why do you grow sweetpotatoes?

Commercial

Subsistence

What system of farming do you practice?

Mono-cropping

Mixed cropping with food crop

Inter cropping with tree crop

What other crop(s) do you cultivate in addition to sweetpotato?

What do you do to boost the yield of sweetpotato?

State any other way you can conserve and multiply sweetpotato vines

To investigate the effect of gender on the orange sweetpotato adoption in your area?

Which category of people are more involved in these production activities

Land preparation for sweetpotato production

Men

Women

Girls

Boys

Elderly(m/f)

### **Heaping**

- Men
- Women
- Girls
- Boys
- Elderly(m/f)

### **Weed management**

- Men
- Women
- Girls
- Boys
- Elderly(m/f)

### **Harvesting and post harvesting (washing,peeling,sorting)**

- Men
- Women
- Girls
- Boys
- Elderly(m/f)

### **Sales/marketing**

- Men
- Women
- Girls
- Boys
- Elderly (m/f)

### **Conserving vines**

- Men
- Women
- Girls
- Boys
- Elderly (m/f)

To investigate the effect of age on the orange sweetpotato adoption in your area?

Which category of people are more involved in these production activities

### **Land preparation for sweetpotato production**

- Below12Years
- 12-18Years
- 19-25Years
- 26-35Years
- 36-50Years
- Above51years

### **Heaping**

- Below12Years
- 12-18Years
- 19-25Years
- 26-35Years
- 36-50Years
- Above51years

### **Weed Management**

- Below 12 Years
- 12-18 Years
- 19-25 Years
- 26-35 Years
- 36-50 Years
- Above 51 years

### **Harvesting and post harvesting (washing, peeling, sorting)**

- Below 12 Years
- 12-18 Years
- 19-25 Years
- 26-35 Years
- 36-50 Years
- Above 51 years

### **Sales/marketing**

- Below 12 Years
- 12-18 Years
- 19-25 Years
- 26-35 Years
- 36-50 Years
- Above 51 years

### **Conserving vines**

- Below 12 Years
- 12-18 Years
- 19-25 Years
- 26-35 Years

- 36-50Years
- Above51years

Agricultural technologies/practices employed in sweetpotato production

Tick Yes or No to reflect your opinion

Mulching      Yes  No

Handhoe	<input type="radio"/> Yes	<input type="radio"/> No
Croproation	<input type="radio"/> Yes	<input type="radio"/> No
Intercropping	<input type="radio"/> Yes	<input type="radio"/> No
Fertilizer application	<input type="radio"/> Yes	<input type="radio"/> No
Plant spacing	<input type="radio"/> Yes	<input type="radio"/> No
Herbicide use	<input type="radio"/> Yes	<input type="radio"/> No
Earlyplanting	<input type="radio"/> Yes	<input type="radio"/> No
Ox-ploughing/Tractor	<input type="radio"/> Yes	<input type="radio"/> No

What is the source of your planting material?

Own farm

Approved nurseries/seed dealers

Research stations(NARO)

Market

Other (please specify)

What variety of sweetpotato do you cultivate?

Local type

Orange fleshed varieties

White fleshed

Yellow fleshed

Purple Fleshed

Other (please specify)

Why do you prefer this specific variety?

It's cheap

High yielding

Marketable

Resistant to disease and drought

Other (please specify)

What planting material do you use when cultivating sweetpotatoes?

Tubers

Vines

Other (please specify)

If Do you give permission to participate in the interview?(Please tick Yes or No in the box below) is Yes:

To determine access to resources and sweetpotato adoption in your area.

Do you belong to any community group / association?

Yes

No

If Do you belong to any community group / association ? is Yes:

If yes state the activities your group is engaged in?

VSLA

Crop nurseries

Product development

Group marketing

Other (please specify)

How much land do you allocate for sweet potato production in a given season?

Where do you sell the potatoes you grow after harvest?

How much money do you invest in growing sweetpotatoes?

State 3 main constraints affecting potato production

During dry season, what do you do to ensure you have enough vines?

What do you do in case you want to increase sweetpotato acreage in a given season?

How do you mobilize capital to invest in sweetpotato production?

In case of water scarcity, what do you do to make sure you vines can reach next season?

Suggest any remedy to shortages of potato vines in a planting season / at the beginning of rains.

Any other information in relation to sweetpotato conservation ,multiplication and adoption that you would like us know?

### **SWEETPOTATO MARKET PENETRATION SURVEY**

Location

District

Company/Group Name

**Sex**

- Male
- Female

**Age Range**

- a) Below 35 years
- b) 36–59years
- d) Above 60 yrs

**Level of Education**

- a) No formal education
- b) Primary
- c) Secondary
- d) Tertiary

**Period under sweetpotatoes business?**

- 1-5 Years
- 6-10 Year
- 11 years and above

**SEED ENTERPRISE INFORMATION**

**Affiliation**

- Seed dealer/Agro dealer
- Seed producer / multiplier
- Market Vendors
- Seed companies
- Government employee International /local Development Organization  
(e.g.CIP/CIAT,NGO's)
- Other (please specify)

If Company / Group Name was answered:

Current position in the company / group

How many years have you been in sweet potato business?

What sweetpotato products do you deal in?

- Tubers/roots
- Vines
- Vines and Tubers/roots

What type of sweetpotatoes do you primarily produce?(selectone)

- Local type
- Orange fleshed varieties
- White fleshed
- Yellow fleshed
- Purple Fleshed
- Other (please specify)

**Not Applicable**

**What type of sweetpotatoes do you primarily Sell?(select one)**

- Local type
- Orange fleshed varieties
- White fleshed
- Yellow fleshed
- Purple Fleshed
- Other (please specify)

NotApplicable

How are roots / vines provided to farmers?

- Free of charge
- Sold
- As an input to contracted seed producers
- Other (please specify)

Who supplies you primarily with the vines / roots of the sweetpotatoes you sell?

Produce own

Buy from farmers (peer to peer)

Seed producers / multipliers

Seed companies

Research /extension organizations (government, CIAT,etc.)

NGOs/Projects

Other (please specify)

How often do you receive seed from your supplier?

- Every season (twice per year)
- Monthly
- Every 6months
- Every year
- Every 2years
- Every 3years
- Other (please specify)

When do you buy the sweet potato vines / roots you sell?

Who are the customers of the sweetpotato vines / roots you sell?

Individual farmers

Farmers groups / associations

Government

NGOs / Relief agencies / projects

Other (please specify)

How do you make farmers aware of new varieties?

Demonstration (field days,etc.)

Extension services

Radios

TV

News papers

Social media(Facebook, twitter or linked in, WhatsApp group)

Phone (Sms/ bulksms)

Other (please specify)

What channels do you use for providing seed information to farmers?

Farmer groups

Fields days

Media (radio, flyers,TV,etc.)

Markets

Other (please specify)

What are major challenges in providing new sweetpotato roots / vines to farmers?

Limited resources (transportation, etc.)

Low participation of farmers

In appropriate timing of events

Limited knowledge of farmers

High cost of vines / seeds

Other (please specify)

How to you facilitate the availability of new seed to farmers?

Give free samples (starterpacks)

Give seeds to farmers on credit

Contract farmers to produce seeds for you (QDS seeds)

Have demonstration gardens in farmers villages

Collect and buy for farmers

Other (please specify)

On average, what quantity of roots/vines that you deal with perseason?

Quantity stocked (kg)

Quantity sold(kg)

Fate of unsold inventory

Do you store your roots / vines before it is sold?

Yes

No

If Do you store your roots / vines before it is sold? Is No:

If NO, do you store un sold roots/vines?

Yes

No

If NO, do you store unsold roots / vines? Is Yes:

If YES, for how long do you store your roots /vines?

Less than 5 days before planting

Between 6-9 days before planting

Between 10-14 days before planting

More than 15 days before planting

Have you had any losses during roots / vines storage?

Yes

No

If Have you had any losses during roots / vines storage? Is Yes:

If yes, what is the most important source of losses?

Insects

Rodents

Humidity / mold

Other (please specify)

What is your primary method for roots / vines protection?

Do nothing

Pesticides/chemicals

Traditional (underground storage, ash,smoke)

Botanicals (plant extract, etc.)

Other (please specify)

Which protection methods do you use to store vines / roots

If sweetpotato producer / multiplier/ seller, are you involved in any other business?

Yes

No

For OSP, what type of OSP seed do you produce / multiply?

Ejumula

Kabode

Naspot12

Naspot13

Kakamega

Naspot8

Naspot10

Other (please specify)

**Who supplies you with the vines / roots that you use to produce / multiply?**

Government research institutes

Seed companies

International research centers

Other (please specify)

How often do you receive roots / vines from your supplier?

Every season (twice per year)

Monthly

- Every 6months
- Every year
- Every 2years
- Every 3years
- Other (please specify)

Any other information in relation to sweetpotato conservation ,multiplication and adoption that you would like us know?

Take Photos

## Appendix II: Study work plan

Date	Activity	Responsible Person
2nd - 8th July ,2023	Refining of the data tools, installation in the Mwater app and training of the research assistants including pre- tests	Lead Researcher
9th - 15th July, 2023	Collection of the data using 1st tool; Questionnaire for sweet potato farmers	Lead Researcher, Research Assistants
16th - 22	Collection of the data using 2nd tool; Questionnaire for market penetration, data analysis	Lead Researcher, Research Assistants Data analyst
23rd - 29th July ,2023	Report Writing	Lead Researcher
30th July- 4th August, 2023	Submission of 1st draft dissertation	Lead Researcher/ student

**Appendix III: Map of the study area**

