

**CONTRIBUTION OF EXTENSION SERVICES TOWARDS SWEET POTATO  
UTILIZATION AMONG PRODUCERS AND CONSUMERS IN HOMABAY AND  
KISUMU COUNTIES, KENYA**

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for the Master of Science Degree in Agricultural Extension of Egerton University**

**EGERTON UNIVERSITY**

**AUGUST, 2023**

## DECLARATION AND RECOMMENDATION

### Declaration

I hereby declare that this research thesis is my original work that has not been presented previously for an award of any degree or diploma in any university or institution.

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### Recommendation

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## **DEDICATION**

This thesis is dedicated to my beloved parents Hoffman Owage and Benter Awuor, my siblings, my daughter Mabel Jane, and my son Joe Ryan for the fountain of my inspiration, support and encouragement.

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## ABSTRACT

Sweet potato has sparked global debate due to its unique dietary benefits and characteristics, such as tuber storage, growth at different times of the year, and flesh colour variation. Sweet potatoes have been proposed as a food crop to aid in the reduction of food insecurity in Kenya. Both consumers and farmers currently consume the crop in various ways, including boiling, steaming, roasting, and frying the fresh roots. Aside from the traditional sweet potato norm, various value additions have emerged, resulting in an increase in demand in Kenya over the years. However, despite its importance in both mitigating food security and providing dietary nutritional benefits, sweet potato consumption in the country remains low. However, it is unknown whether what farmers produce corresponds to what consumers demand, and the role of extension in bridging any demand-supply gaps that may exist. This begs the critical question of whether both farmers and consumers are aware of its benefits and various value-added processes, which are solely the responsibility of extension service providers. As a result, the study evaluated the role of extension services in promoting sweet potato product utilization among farmers and consumers in Kenya's Homabay and Kisumu counties. The study specifically looked into the different sweet potato value-added products produced by farmers and available to consumers, traits which influence the production and utilization of sweet potato products by producers and consumers and the role of extension system in utilization of sweet potato products by farmers and consumers in Homabay and Kisumu counties. The study employed a descriptive research design, with a sample of 120 respondents (52 farmers and 68 consumers of sweet potato). Data from a semi-structured questionnaire were cross-tabulated, and responses were tested for significance using an independent samples t-test. The information gathered through key informant interviews was used to triangulate the results. SPK 004 and SPK 20 were found to be the most planted and consumed varieties. Higher percentage of farmers (73%) considered colour when selecting varieties for domestic sale and consumption, a similar percentage (43%) of consumers preferred colour and taste. The study's key findings were that extension influenced the production, marketing, and consumption of sweet potato products by farmers and consumers. Consumer demand for sweet potato products corresponded to products produced, sold, and consumed by farmers. Existing value-added products, however, are primary value-added products, implying a low uptake of tertiary value addition. As a result, extensionists should be strengthened in order to effectively promote and disseminate desirable sweet potato varieties and value-added products to both farmers and consumers.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

<b>BUGS</b>	Board of Undergraduate Studies
<b>CIP</b>	International Potato Centre
<b>FAO</b>	Food Agricultural Organizations
<b>FGD</b>	Focused Group Discussion
<b>GDI</b>	Gross Domestic Income
<b>GoK</b>	Government of Kenya
<b>IFAD</b>	International Funds for Agricultural Development
<b>ILRI</b>	International Livestock Research Institute
<b>MT</b>	Metric Tonnes
<b>NACOSTI</b>	National Commission for Science, Technology, and Innovation
<b>NGOs</b>	Non-Governmental Organizations
<b>OFSP</b>	Orange Fleshed Sweet Potatoes
<b>SP</b>	Sweet potato
<b>SPSS</b>	Statistical Package for Social Science
<b>SSA</b>	Sub-Saharan Africa
<b>VAD</b>	Vitamin A Deficiency
<b>VAP</b>	Value Added Products

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background Information

Sweet potato (*Ipomea batatas* L) is the seventh most important crop in the world and one of the most important root crops (FAO, 2016; Makini *et al.*, 2018). The crop originated in Latin and Central America, and by the sixteenth century, it had spread throughout the world. During the American Civil War, it was the main food crop and a staple of the slave population's diet in the southern states (Loebenstein & Thottappilly, 2009). Global sweet potato production in 2020 was 89 million tons from 7.4 million hectares of land (FAOSTAT, 2022a). However, sweet potato production was dismally low, with 139.7 million tons harvested from 9.8 million in 2000. China is the world's largest sweet potato producer (48.9 million tons), accounting for approximately 55% of global production. Sub-Saharan Africa's sweet potato production was 31 million tons in 2020, accounting for 31% of global production (FAOSTAT, 2022). Six Sub-Saharan African countries are among the top ten sweet potato producers in the world. Malawi is the largest producer of sweet potatoes in Sub-Saharan Africa and the world's second largest producer. Tanzania, Nigeria, Angola, and Ethiopia ranked from third to sixth place in a row (FAOSTAT, 2016; Rybicki, 2015). Sweet potato is a major food crop in these and other regional countries.

Sweet potato is used in a variety of ways around the world, with food being the most important application. In 2019, food consumed 62% (56.4 million tons) of the 90 million sweet potato output (FAOSTAT, 2022b). 28 million sweet potatoes were used as animal feed in 2019, accounting for 31% of global sweet potato output. Sweet potato is processed for human consumption as dried sweet potato chips or canned and frozen for longer-term storage in addition to starch production (Akoetey *et al.*, 2017). Post-harvest processing is also emerging as an important route to other types of sweet potato utilization (Vithu *et al.*, 2019). About 1% of sweet potato produce was processed globally. Loss accounted for 7% of the sweet potato out at global level with other forms utilization being seed and another non-food uses (FAOSTAT, 2022b). Proportion of utilization of sweet potato as food was higher than global proportion consumed as food; 17 million tons of sweet potato output, representing 64% of SSA production was consumed as food and 22% (5.9 million tons) was utilized as feed and the remainder as food losses, seed, and processed production. The statistics profile sweet potato as critical food security crop in sub-Saharan Africa.

Kenya is Sub-Saharan Africa's tenth largest producer of sweet potatoes. Sweet potato is an important staple crop in Kenya's agro-ecologies. The increasing land allocation and harvested quantities from the 1960s to the present demonstrate the crop's importance. Sweet potato land was allocated from 25 thousand ha in 1961 to 30 thousand ha in 1971, 36,400 ha in 1981, and 37,070 ha in 1991. Sweet potato hectares increased further in Kenya, reaching 66,520 ha in 2001 and 77,821 ha in 2009 before falling to 54,007 ha in 2020 (FAOSTAT, 2022a). The period also saw significant increases in sweet potato output. Harvested amounts increased from less than 150 thousand tons in 1961 to 405,444 tons in 1991 and 976,691 tons in 2019. Kenyan sweet potato production peaked in 2015, with 1.2 million tons produced. The general upward trend in sweet potato production in Kenya indicates the crop's potential contribution not only to farming households' livelihoods, but also to food and nutritional requirements of producing and consuming households.

Sweet potato in Kenya is utilized mainly as food. According to FAOSTAT (2022b), 826,031 (92% of total output) tons of sweet potato were utilized as food in 2020 compared to 763,277 tons in 2011. In general, there is an upward trend in sweet potato utilization as food since 2010. Sweet potato utilized as food increased from 791,810 tons in 2011 to 907,547 tons in 2015, coinciding with the peak year of sweet potato production (FAOSTAT, 2022). Utilization of sweet potato as food was highest in 2016 when 934,875 tons were consumed. The consumption trends in sweet potato over the last decade position the crops as important to both rural and urban food plates, especially a time that Kenya is struggling to combat food security menace.

The use of sweet potatoes is a great way to improve nutritional outcomes in Kenya (Githunguri & Njiru, 2021). Sweet potato is useful for food security because crop production and consumption can be staggered throughout the year, making food readily available to farming households and markets. Sweet potato is used in a variety of ways in Kenya; young shoots are sometimes eaten as greens, whereas roots are boiled, steamed, fried, or roasted, and roots can also be processed into value-added products (VAP) such as flour, which is used in baking cakes or bread. Alternatively, they can be steamed and mashed to make a puree, which can then be used in baking.

Sweet potatoes are primarily grown in the Lake Victoria region, Rift Valley, coastal, and central parts of Kenya, and they come in a variety of flesh colors such as white, cream, yellow, orange, and purple. They thrive in a variety of agro-ecological zones (Sugriet *et al.*, 2012). Rachuonyo South, Rachuonyo East, and Ndhiwa sub-county are the major producing areas in Homabay County, with Rachuonyo South, Rachuonyo East, and Ndhiwa sub-county being the major producing areas (Ochieng *et al.*, 2017). Kisumu County is one of the major cities in Western Kenya with sweet potato markets.

Kisumu and Homa Bay counties benefit from agricultural extension services that ensure timely dissemination of knowledge, technologies, and practices for attaining and maintaining high yields. As a result, extension service is a critical component in increasing agricultural productivity and increasing farmer and consumer awareness of the nutritional importance of sweet potato production. The definition of extension services has evolved over time. Although technology transfer remains an important role of extension, more emphasis is being placed on expanding farmers' skills and knowledge, improving rural livelihoods, achieving food security, and developing more competent food products that meet market demand (Swanson, 2008). Information and knowledge are used to optimize the use of limited resources for the production of market demanded value added products (Kingiri, 2020).

However, the current consumer demands and farmer production in the two counties are insufficient. While consumers require various varieties/flesh of sweet potato tubers, farmers produce the sweet potatoes to earn a living. Farmers have been less concerned with the precise needs of consumers, resulting in a large demand gap and post-harvest losses for both consumers and farmers. This translates to a lack of proper information creation and dissemination among county residents. While agricultural extension is intended to create and disseminate such information to both producers and consumers, little has been done on the ground (Mulwa *et al.*, 2022).

The importance of extension service providers has not been recognized. Farmers can use them to make decisions that will help them meet customer demands while also increasing their income and productivity, thereby reducing food insecurity. Consumers, on the other hand, can be made aware of the available sweet potato products, their nutritional benefits, and where to source them. With many producers pursuing value addition of the sweet potato

product, extension service provision is critical in ensuring the value addition process is of high quality and carried out correctly in order to meet the needs of consumers (Mulwa *et al.*, 2022).

Value-added products can help farmers capture a larger market share by opening up new markets as consumers appreciate farm produce. Market research is required in product development to understand the target audience. As a result, extension service providers must analyze what consumers think of a given value-added product, gather feedback, and interrogate existing technologies that can respond to market demand. Extension agents do this by providing current market information to producers in order to ensure that what is produced matches what is demanded by end users of agricultural products. This approach to extension demonstrates that the role of extension extends beyond technology transfer and the development of farmers' technical skills (Swanson, 2008) to sensitizing farmers about the nutritional value of producing and consuming food, as well as marketing crop produce by matching production to market demand.

Despite the ability of sweet potatoes and other root and tuber crops to alleviate hunger, malnutrition persists in the two counties. As a result of the dire food and nutritional security, the Kenyan government, through the ministry of agriculture, partnered with research organizations and the private sector to promote sweet potato production and consumption (Ndolo *et al.*, 2017). To disseminate information about Orange-fleshed sweet potato (OFSP) varieties in major sweet potato production and consumption hubs, an elaborate extension system was set up (Ndolo *et al.*, 2017). For example, the sweet potato Action for Security and Health in Africa (MAMA SASHA) promoted the production of SPK004 and Zapallo OFSP varieties in Western Kenya after moderate consumer acceptance of the varieties (Girard *et al.*, 2017; Ndolo *et al.*, 2017). To reach farmers and consumers, extension information was disseminated through a variety of channels. In anticipation of increased production, value addition technologies were introduced alongside the intervention in order to increase utilization by producers and consumers.

OFSP promotion began nearly 15 years ago, but reports indicate that farmers in western Kenya counties have not received full value for their output. At the same time, despite rapid expansion that targeted producers and consumers in the region, sweet potato value added products remain scarce in rural and urban markets in western Kenya. Nonetheless, there is



little data on the role of extension in increasing sweet potato utilization at the farm and consumption levels in western Kenya. Against this backdrop, the study focused on sweet potato product utilization at the farm and consumer levels, as well as the role of extension in matching supply and demand for sweet potato products. Agricultural extension activities of the women in Agriculture unit involved are farming problem identifications, advice on household management advice and nutrition, provision of information and dissemination of innovation on sweet potato farming systems. Women participating in agriculture had greater knowledge and they can easily access training and technologies in sweet potato production. However their participation in sweet potato products utilization is slow, hence there need to be an involvement of consumer along the value chain of sweet potato especially in utilization (Odebode, 2010).

### **1.2 Statement of the Problem**

Sweet potatoes are nutrient-dense and have distinct characteristics such as diverse maturity cycles, broader agro-ecological adaptation, and underground storage ability, which allows for flexible harvesting duration. As a result, sweet potatoes have the potential to help the country's food security. Sweet potatoes are used in a variety of ways, including boiled, steamed, roasted, and baked goods and often the characteristics influences the type of product or application. Furthermore, when consumed at regular intervals, they provide medicinal benefits that help to prevent dietary-related diseases such as obesity and diabetes. Farmers, on the other hand, may be unaware of the traits that are of particular interest to consumers and, as a result, produce varieties they prefer without taking into account consumer preferences for sweet potato products. Furthermore, there is little evidence linking what farmers produce and what consumers want. Furthermore, the role of the extension system in connecting farmers and consumers through the provision of nutrition information about sweet potato products is missing. As a result, it is critical to comprehend consumer utilization of sweet potato in comparison to sweet potato products produced, marketed, and consumed by farming households, as well as the role of the extension system in bridging the gap between what producers supply and what consumers demand.

### **1.3 Purpose of the Study**

To contribute to utilization of sweet potato products, food and nutritional security in Kisumu and Homabay counties by exploiting and strengthening the role of extension system.

#### **1.4 Objectives of the Study**

- i. To identify different sweet potato value-added products produced by farmers and available to consumers in Homabay and Kisumu counties.
- ii. To determine traits which influence the production and utilization of sweet potato products by producers and consumers in Homabay and Kisumu counties
- iii. To determine the role of extension system in utilization of sweet potato products by farmers and consumers in Homabay and Kisumu counties.

#### **1.5 Research Questions**

- i. Which sweet potato value-added products are produced by farmers and available to consumers in Homabay and Kisumu counties?
- ii. What are sweet potato traits that influence production and utilization of sweet potato among producers and consumers in Homabay and Kisumu counties?
- iii. What is the role of extension system in utilization of sweet potato products by farmers and consumers in Homabay and Kisumu counties?

#### **1.6 Significance of the Study**

Sweet potato is a starchy root crop with a potential of alleviating food and nutrition security problem in Kenya. Farmer and consumer sensitization on the usefulness and nutritive value of sweet potato should be the starting point for encouraging utilization of sweet potato as food and processed products. This would not only create employment, but also contribute to commercialization of the crop. In addition, the demand for food in Kenya remains unsatisfied and pressure is mounting on government to rapidly increase production of neglected crops such as sweet potato to help address the food insecurity and malnutrition burden. Thus, the study sought to determine the contribution of extension services towards promoting sweet potato production and consumption among producers and profiled sweet potato products and identifying consumer needs and preferences.

The results of this study informs demand-led breeding programs with recommendations on market demanded sweet potato products. The potential contribution of extension services towards shaping producer and consumer preferences were investigated. Furthermore, results of are relevant to future policies and development of programs targeting to use extension services to encourage production and utilization sweet potato. It underpins the relevance of

and need of strengthening the extension systems for delivery of sweet potato products that benefit farmers and consumers. This study would also contribute towards achievement of sustainable development goals number one and two, that is, zero poverty and hunger, respectively.

### **1.7 Scope and Limitations**

Sweet potato farmers and consumers in Rachuonyo East, Rachuonyo South, and Ndiwa in Homabay County, and Kisumu Central in Kisumu County, were studied. The study was designed to identify and correlate consumer needs with the specific product attributes of sweet potatoes and no other crop product. The study focused on the various varieties (traits) of sweet potato products in Homabay and Kisumu counties, as well as the potential contribution of extension services to improved utilization. The limitation of the study is that it relied on a relatively small sample size for each category of participants, which may have limited the strength of the study. Nonetheless, because the total sample size is greater than 100, the results generated from the collected data are meaningful.

### 1.10 Operational Definition of Terms

**Consumers:** are people or organizations that purchase products or services (Arslan & Zaman, 2015). In this study, consumers mean one who buys products for consumption and not for sale or commercial purposes. Farmers who use the sweet potato at the household level are considered as consumers in this study.

**Contribution:** is a part played by a person in bringing about a result. In this study it means a specific support mechanism towards achieving sweet potato utilization such as technical research, advisory inputs, communication, and input support.

**Demand-led breeding:** is the process of selecting varieties with the most desirable qualities to yield offspring with good traits based on consumer preference (Anthony & Persley, 2017). From the study, demand-led breeding means the production of varieties that are of market preference.

**Extension services:** is process of offering advice and information to help solve problem within a rural population to improve their livelihood (FAO, 2016). In this study the term extension service means linking the farmers and the consumers by giving them information on the sweet potato traits.

**Market:** is an actual place where forces of demand and supply operate, and where buyers and sellers interact to trade goods, services, for money or barter (Kirschen & Strbac, 2018). In this study, the market means a place where buyers and sellers gather to facilitate the exchange of goods and services.

**Profiling:** is a detailed description of products and grouping them as per characteristics they possess. In this study, it means obtaining information about a product to better serve the need of the consumer.

**Traits:** Characteristics of sweet potato that producers and consumers consider before planting and purchasing, respectively.

**Utilization:** food products are properly used, after proper food processing and storage techniques are employed to focus on nutrition (Trimigno *et al.*, 2015). In this study improve utilization means increase intake of food products because of its nutritional benefits.

**Value-added products:** Products that have been changed or transformed from their original state to a more valuable state (Oluoch, 2016). According to this study, value-added products mean products of enhanced value with the focus on consumer appeal for it and willingness to pay.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter reviews the literature relevant to the product profiling for the sweet potato value-added products in meeting market demand and the contribution of extension for improved utilization of sweet potato. The theoretical and conceptual frameworks are discussed to show the basis of the study and the relationship between the dependent variable and independent variables.

#### **2.2 Agriculture and Rural Development**

The agricultural sector is the backbone of many national economies globally, providing the basic needs to mankind and raw material for industrialization. Agricultural activities ranging from production to marketing contribute to the growth of national per capita income and food security in a country (Cristea & Dorina, 2017). The rise in demand for food products has an adverse impact on the growth of agriculture hence it is of great importance in economic growth. Agriculture also has a substantial contribution to employment creation, earning foreign exchange and infrastructural development (Eichsteller *et al.*, 2022). Sweet potato is among the staple foods contributing to national income and it plays a key role in developing countries (Laurie *et al.*, 2015).

Sweet potato production is mainly done by women from smallholder families varying between 0.01 to 0.1 hectares. Commercialization of sweet potato is mainly performed by small holder farmers particularly women in the rural areas. The excess production of sweet potato come from farmers in the villages and resell them at a wholesaler and retailer market in the municipalities. The process of commercialization in rural areas is carried out by local sweet potato producers who do not possess opportunities to sell all their products to traders and consumers in the cities (Naico, 2009).

#### **2.3 Importance of Sweet Potato in Food and Nutrition Security**

Sweet potato is a food security crop and is prevalent among small scale farmers with limited resources. It is increasingly being recognized as having a vital role in both improving national and household food security, health and livelihoods of underprivileged families (Antaryami *et al.*, 2012; Fetuga *et al.*, 2013). The contribution of the staples to dietary consumption depends

not only on the quantity of food eaten but the form in which the staple crop is consumed, either processed or unprocessed. Most consumers are increasing their consumption of sweet potatoes, particularly because of its health and wellness properties such as high dietary fibre, which aids in weight loss (Laurie *et al.*, 2015).

The major contribution of sweet potato, the orange and yellow-fleshed variety in particular, to human nutrition, is the supply of antioxidants in the form of pro-vitamin A, and vitamin C (Laurie *et al.*, 2015). In Southeast Asia, children who die under the age of five because of VAD account for 8 percent of infant mortality. Close to 6 percent of the deaths of children under five years in Africa is due to Vitamin A deficiency (WHO, 2011). In the two continents, 33 percent of children mostly suffer from Vitamin A deficiency (WHO, 2014) which has several effects such as severe visual impairment, blindness, increased risk of severe illness and death from common infections such as diarrhea and measles in preschool-age children; night blindness, increased risk of death in pregnant women (Wakeel *et al.*, 2018).

The purple-fleshed sweet potato contains high levels of polyphenols such as anthocyanins (Grace *et al.*, 2014; Li *et al.*, 2019). Extracts from purple fleshed sweet potato have been known to display health benefits such as liver protection (Hwang *et al.*, 2011) antioxidant activity, and memory-enhancing properties (Lu *et al.*, 2010). Sweet potato is also rich in iron and zinc, which are related to common nutrition deficiencies (Wakeel *et al.*, 2018). Micronutrient deficiencies such as VAD result in hidden hunger, which affects more than 2 billion people globally (FAO, 2014). They are difficult to overcome in developing countries, such as Kenya using dietary diversification alone since it is hard for underprivileged communities to access healthy food (Wakeel *et al.*, 2018). Fortification of food has been done, for instance in cooking oil, but is more effective for urban consumers than it is for rural consumers, as they have more access to fortified foods (Wakeel *et al.*, 2018).

There has been global challenges in combating food insecurities. Sweet potato has a multiple nutrients, the implementation of affordable stable food. Different varieties of sweet potato e.g. purple, orange and white fleshed contain substantial quantities of essential micronutrients for women at the age of giving birth or young children. Sweet potato has benefits like beta-carotene and retinol (vitamin A) can evade individuals from progressive blindness,

anthocyanins can guard elderly patients against malignant tumours triggering bladder cancer. High-starchy sweet potatoes are used produce biofuels for renewable energy system hence they play a role in establishing fossil fuel economies. African counties dedicate are dedicating to increase subsistence agriculture since it has a high impact in the county's economic status and in feeding the rural communities (Tedesco *et al.*, 2023).

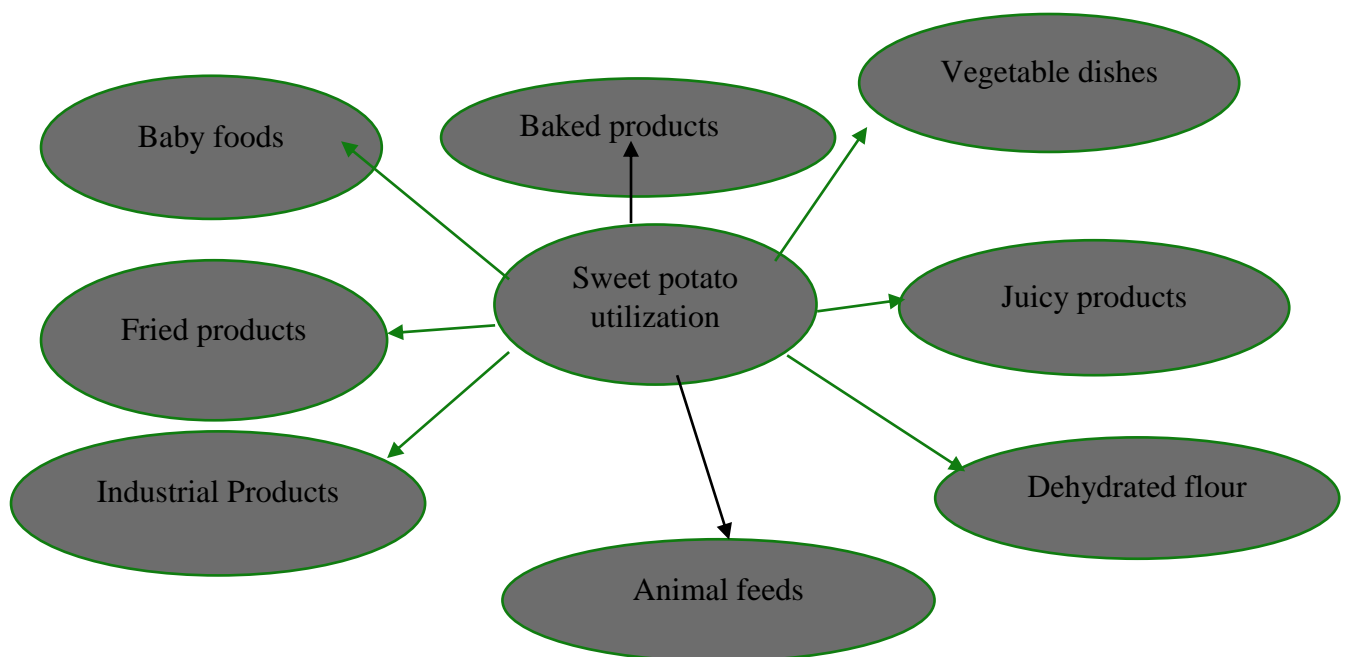
Farmers in sub-Saharan Africa region have limited technology, finances and education to cultivate sweet potato for staple crop for human nutrition hence reducing social vulnerability. Sweet potatoes can acclimatize to challenging environments, such as drylands and soils with low fertility. Even though they can satisfactorily advance to edible tuberous roots for consumption and commercialization under hostile conditions to their growth and development, farmers may require accessing high-throughput genotypes. Large scale producers in Chinese provinces can fabricate nearly 1 ton of bioethanol from 7.5 tons of feedstock. However, they consume a large quantity of fertilizer and machinery to attain adequate feedstock for processing into biofuel. In addition, they can purposefully reutilize agro-industrial waste for bio fertilization and energy generation, reducing the costs and undesirable environmental effects on surrounding ecosystems those conditions are crucial to generating a circular economy(Tedesco *et al.*, 2023).

According to Wabwile (2016), Fluctuating food insecurity is the cause of short term ever changing production and consumption at the household proceeds and availability of food. It is thus a indicator of temporary lack of access to adequate amount of food. Food security has a long past in research contributes to poverty, low living standards and income. Rural food consumption patterns are significantly more diverse. It comprise utilization of several crops such as cassava, sorghum, millet, rice, bananas, maize. Access to food includes physical and economic aspect. Physical access to food involve both to the adequacy of supply and efficiency in storage, preservation, transport, marketing and processing. Economic access to food relates to the capability of people to start rights over vital amount of food.

#### **2.4 Utilization of Sweet potato Products**

Sweet potato has various utilization options either as value-added products or as raw materials, all of which provide health benefits. Some of the products processed from sweet potato parts like leaves, roots, and vines are illustrated in the figure below (Issah *et al.*, 2017).

Sweet potato has a potentiality for reducing global food insecurity and improving nutritional status of people in the world. This is because of its biochemical, nutritional, bioactive and functional properties. The crop has antidiabetic properties i.e. the capability to lower blood glucose level and improve glucose tolerance. White skinned sweet potato have antioxidant, radical scavenging and antimutagenic properties. It has been associated with reducing liver damage and lower blood pressure. The stem and leave of sweet potato contain bioactive phytochemicals for example chlorogenic acid, which has been known to improve glucose tolerance in human body and high level of polyphenolics which act as protection against diseases associated with oxidation such as cancer and cardiovascular infections. The starch from sweet potato has industrial uses such as in making sweeteners, citric acid, beverages, manufacturing of noodles, production of industrial alcohol, ethenol, fuel and produce products as maltose. In animal feeding sector sweet potato leaves are used as a good source of protein for growing pigs, goats and chicken and for increasing ruminants' urea utilization. Sweet potato is economically competitive source for improving human health, industrial application and in animal feeding system and to an extent play a key role in renewable energy source throughout the world. Orange-fleshed sweet potato (OFSP) because it contains satisfactory quantity of nutrients in form of Vitamins B and C as well as beneficial amounts of other micronutrients (Bovell *et al.*, 2010).



**Figure 2.1.** Sweet potato Utilization Options



Although the leaves are edible, the starchy storage roots are the most important product (Sugri *et al.*, 2017). The roots are mostly boiled, fried, roasted, or baked for their rich source of dietary energy and quite recently for their beta-carotene and vitamin A content in the orange-fleshed varieties (Bidzakin *et al.*, 2014). White-fleshed cultivars have already been contributing to household food security, but orange-fleshed cultivars now have the potential to alleviate vitamin A deficiency when incorporated into familiar foods. Industrial uses, such as the production of starch, alcohol, and partial flour substitute, are further utilization options that can be explored. Another option is sweet potato fodder and silage for livestock feeding, which has high protein and digestibility values. Some of the sweet potato products can be stored in different forms for future use or mixed with other ingredients and used in making products such as flour which can be stored in this form or mixed with flour from cassava, millet, or sorghum for making porridge, biscuits, cakes or *ugali* depending on consumer preferences (Orinda, 2013).

Value addition encompasses all the activities that changes the form of sweet potato products more advanced products of a greater value. Sweet potato are usually processed and consumed in different ways for both households utilization and for marketing purposes. Sweet potato has been of greater value both to animal and livestock consumption. Some of its products can be preserved for future uses as an additive or used alone as it is. The preservable products also address storage problems that are normally encountered by farmers and industrial sectors. This ensures the availability of food during scarcity. There has been traditional storage method done by most farmers this include leaving the roots in the soil and only harvesting quantity required at that particular time. According to Orinda (2013), it revealed that both sweet potato tuber and leaf contain micro nutrients which are necessary for healthy body growth. The processed products of sweet potato offers opportunity for exploiting different human and livestock utilization methods(Orinda, 2013).

The potential new products of sweet potato expand animal feeding industry. It is therefore an ideal crop for livestock feeding industry since the roots provide a source of energy while leaves are sources of protein and both fresh and dried or fermented are processed into silage. Juice from Sweet potato offer the highest return on investment. Sweet potato juices being produced are of different types and methods, especially 100% sweet potato mixtures are done with oranges, passion and pineapples. This has proven potential in opening new market

according to research done by CIP and KALRO scientists through developing various recipes. Processing has substantiated to be cost effective since it involve use of locally available resources hence this gives the products a competitive edge. It has shown a lot of benefits to the farmers through creating better markets and take part in integrated production-processing marketing to add value to their sweet potato output (Orinda, 2013).

The use of sweet potatoes in the food industry often involves processing of the roots into purees that can be subsequently frozen, canned or packaged in aseptic conditions to produce shelf-stable products for year-round availability of the produce. The introduction of sweet potato based enterprises to low income farmers and marginalized smallholder farmers increased their income. Increase income generation from sweet potato has enable the farmers to cater for household basic needs like medical expenses, paying school fees. Other benefits included employment creation, improved nutrition through consumption of sweet potato products and improved social status. There has been an increased in the commercial value of sweet potato, expanded uses of the crop have attracted many consumer s especially in urban areas (Orinda, 2013).

#### **2.4 Sweet Potato Production**

Currently, China accounts for more than half of total sweet potato output globally at approximately 48.9 million MT annually (Table 2.1). Sweet potato is an important food crop in sub Saharan Africa where it is second most widely grown root and tuber crop. The edibility of its roots and leaves makes it popular in the region. The tuber and leaves are good source of energy, essential minerals like zinc and vitamin A. Sweet potato allow for many multiple harvest and thus guarantee food security and income to rural households. Besides it's a resilient crop which require less soil fertility. Its yield in Africa smallholder farmers is between 5 – 25 tonnes per acre, this shows the potentiality of sweet potato in Africa.

The Democratic Republic of Congo (DRC) is one of the chief producer and consumer of sweet potato in Africa. In 2018, its overall production was 384,350 tons from 76,809 ha and sweet potato is the second best root and tuber crop after cassava and used for human consumption, animal feeds and processing. Over 40% of the DRC national sweet potato production come from the North- and South-Kivu province. However, the full potential of

this crop is yet to be exploited as the Congolese yields are low ( $5 \text{ t ha}^{-1}$ ) compared to the African potential.

Malawi has a total production of 6.9 million MT of sweet potato harvested in 2020. Tanzania and Nigeria produced 4.4 and 3.9 MT of sweet potato in 2020. The crop is utilized in porridge, fermented drinks, and boiled for consumption. Angola and Ethiopia are other leading sweet potato producing countries in sub-Saharan with 1.7 and 1.6 MT as of 2020, respectively. Kenya ranks in position 18 globally and is in the tenth position in sweet potato production in the region, below Uganda, Rwanda, Madagascar, and Burundi, with 686 thousand MT. Most of sweet potato harvest in Kenya (fresh roots) are steamed and mashed for consumption. In Ethiopia, sweet potato is consumed in form of stews, porridge, and also used in processing sweets, cakes, desserts, and as sweet potato puffs (Rybicki, 2015). Sweet potato is one of the major substantial crop in Kenya, its production contributes to country's food security and growth in the economy. The crop is a major source of income for small scale farmers especially in rural areas. Different sweet potato varieties take a range of duration in the field to mature from 3-6 months.

**Table 2.1**

*Annual Sweet potato Production in The Leading Countries*

Country	Quantity produced (MT)
1 China, mainland	48,949,495
2 Malawi	6,918,420
3 Tanzania	4,435,063
4 Nigeria	3,867,871
5 Angola	1,728,332
6 Ethiopia	1,598,838
7 United States of America	1,558,005
8 Uganda	1,536,095
9 Indonesia	1,487,000
10 Viet Nam	1,372,838
11 Rwanda	1,275,614
12 India	1,186,000
13 Madagascar	1,130,602
14 Burundi	950,151

15	Brazil	847,896
16	Japan	687,600
17	Papua New Guinea	686,843
18	Kenya	685,687
19	Mali	573,184
20	Democratic People's Republic of Korea	556,246

**Source:** FAOSTAT (2022)

## **2.6 Market Demand and Consumer Behaviour towards Sweet potato Products**

The shift from traditional to evolving drivers is not driven by age, region or income (Deloitte, 2016) but the value placed on the evolving drivers may be higher in the middle-class community due to their higher purchasing power. According to Ncube *et al.* (2011) consumer spending in Africa by the middle class reached an estimated \$680 billion in annual expenditures in 2008 which is nearly a quarter of Africa's GDP based on 2008 purchasing power parity. The middle-class consumers have a higher purchasing power, and consequently, the high purchasing power gives the consumers the right to "demand" products that give them the sense that they are getting value for their money (Ncube *et al.*, 2011). For instance, in a study conducted on consumer profiling of sweet potato puree bread in Kenya, it was found that some consumers are willing to pay more for the bread based on the knowledge of potential health benefits derived from it. These consumers also have more access to social media, mobile applications, and digital sources to acquire information about products or market brands. The high purchasing power is therefore particularly important to the stakeholders in the agricultural and food industry (Wambui, 2017).

Demand for certain products is rising with population growth, urbanization, and changing consumer lifestyles and behaviour. As a result, Africa's agriculture is shifting from subsistence systems to market-led systems. One of the approaches in this transition is demand-led breeding which is target driven and aimed towards the development of demand-led varieties and performance indicators that measure new variety adoption by farmers and their value chains (Persley & Anthony, 2017). Demand-led approaches include all of the key stakeholders in the value chain to develop products that meet the need of the consumers (Persley & Anthony, 2017).

Success in demand-led breeding depends on several factors which include the setting of breeding targets and quantitative goals that reflect clients' preferences and development of new varieties tailored to reach and fulfil consumer expectations (Persley & Anthony, 2017). It involves the identification of market demands, market trends, and drivers through market research, which gives an understanding of the market's preferred traits. With this knowledge, breeders are also equipped with the knowledge and methods to understand clients and their value chains, their needs, what they prefer and are prepared to pay for in a new variety. In the development of varieties that give products with the market-preferred traits, the existing variety design is reviewed, and a product profile developed. These form a basis for the breeding goals and objectives, along with plant traits such as tolerance to abiotic and biotic stresses. The breeders have to strike a balance between basic traits all varieties must have to increase market share and new traits not available in existing cultivars (Persley & Anthony, 2017).

The market behaviour on sweet potato indicates its market elasticity and integration. Demand of sweet potato is inelastic and the price level shows inversely comparative to demanded quantity. Sweet potato is been substituted by rice this is shown by its cross elasticity. The reduction of sweet potato consumption is followed by the increasing in income generation this is negative value income elasticity. Sweet potato market involved in exploiting the potential of sweet potato as functional food by promoting the community education, diversifying different value added products, structuring the market for distributional purposes, market regulation creation ,price stabilization issues policy and market infrastructure improvement (Rozi *et al.*, 2021).

## **2.7 Sweet Potato Product Profiling**

Product profiling is the second step in the product concept development stage during product development. Market research is first done on consumer behaviour, consumer needs and wants, and other factors that influence the consumer's choice. According to Earle and Earle (2001), consumers' total concept of food is related to their characteristics and to the environment in which they buy and eat food. These include the product qualities and the environment, that is, the sociocultural, physical, economic political environment. Product qualities looked at are the appearance, size, and shape, sensory, and nutritional composition. Others include safety, method of preparation, and serving. These comprise the product

profile. Every trait characteristic in each product profile should be analysed, and a decision is taken if the trait and benchmark are likely to remain relevant over time and is required for variety development. The product profiles are then translated into breeding objectives (Persley & Anthony, 2017).

The marked rise in domestic demand has been stimulated by the advancement of the health benefits of sweet potato products and support by the increasing variety of sweet potato products available in markets and for home preparation. Therefore the product profiling of the sweet potato helps consumers in choosing what to buy from the markets (Bond, 2017). Increased demand for differentiated and health-oriented foods has been driven to the development of products with specific nutritional and sensory characteristics. Understanding of attributes responsible for the acceptance of a product is essential for the development of new varieties. Consumers are increasingly describing products according to the benefits they derive from them and the sensory features of the VAP, thus expanding the use of free choice to the VAP of sweet potato (Santos *et al.*, 2015).

Extension on the product serves a segment of the target market and influences the product variety available in the market. Together with the quality, marketing strategy and fit with the current needs, consumer attitude also has a role to play in whether extension services promote their needs. Specifically, extension agents identify people's feelings about products. Product profiling influences customer choice by making products highly noticeable, different, and much valued by ideal target consumers. It makes clear to both the seller and consumers what is offered and why it is important for them. It is therefore important to understand how consumers think and react regarding a product that possesses a high degree of innovation. The extension is pluralistic with a focus on marketing, value addition, and enterprise skills development (Claudiu & Laurențiu, 2014).

User preferences of raw, boiled and steamed sweetpotato, a staple food in Uganda. It involve the state of knowledge review, gendered food mapping, processing diagnosis and consumer testing was used to determine sweet potato profiling. Gender differences in quality characteristic preferences and perceived importance as per the individuals. In analysis it indicate that consumer majored in sweetness and firmness to drive their overall preference. The information from the resultant study was used to support breeding programmes in

meeting specific end users of sweet potato and the use of new varieties (Mwanga *et al.*, 2021).

## **2.8 Role of Agricultural Extension along the Sweet Potato Value Chain**

Christoplos *et al.* (2010) define extension as "all the different activities that provide the information and advisory services that are needed and demanded by farmers and other actors along the value chain in the food systems and rural development. Agricultural extension has a wide range of purposes which include providing information and training along the sweet potato value chain, from production to marketing of the products. Marketing extension also aims at improving the preparation and process of moving agricultural goods/products to the market (Rivera *et al.*, 2001).

Worldwide, agricultural extension agents are tasked with passing across technologies and inventions to farmers. The services cover the provision of information, linking farmers with sources of farming inputs and credit facilities, value addition experts, among others. The fundamental role being the transfer of technology and provision of education services to farmers and other actors in all aspects of the agricultural value chain (Anaeto *et al.*, 2012). The extension role is reliant on several factors related to knowledge, attitude, skills, and technical capability in addition to the socio-economic characteristics of the extension agents. Effective extension services delivery along the crop value chain is therefore dependent on the skillsets of the agents (FAO, 2016).

In Ghana, Aidoo *et al.* (2019) discovered that the majority of the actors in the sweet potato value chain were unaware of the various ways to add value to the products. According to their research findings, the core support service providers were extension service providers who were primarily linked to the Ministry of Food and Agriculture's (MoFA) Extension Unit, research institutes, informal credit suppliers, and rural banks. The creation of knowledge is critical in making both consumers and producers aware of the benefits of sweet potato varieties. Through increased awareness and support, the benefits of value-added sweet potatoes are diverse, resulting in a larger market opportunity for farmers.

Furthermore, it is only through understanding and having access to processing technologies, including equipment, best - practice in production, processing, food safety, packaging, and

labeling, that the full potential of sweet potatoes can be realized, which should be done conclusively by extension service providers (Okello, 2019). This could be accomplished through the creation of knowledge, the distribution of technologies, the provision of training, and the provision of financial services to producers (Aldoo *et al.*, 2019).

According to Munyuli *et al.* (2022) extension service provision was critical in providing farmers with adequate sweet potato farming skills. Furthermore, farmers can see an increase in their household gross margins. Another key finding from their research was the ability to access market information, which increased sweet potato productivity and met customer demands in the Democratic Republic of the Congo. Furthermore, sweet potato producers can only face new sweet potato agricultural challenges, increase production, and gain market access through agricultural extension.

## **2.9 Extension services on Value Added Products**

The amount of value to be added to a farm produce is not limited and farmers could produce or market in different ways. Farmers add value to their crops by processing and marketing their products rather than staying in the same state and trying to increase quantity. By taking greater responsibility for their products as they move to the final consumer, more agricultural producers are attracting profits (Fleming, 2005).

Research and extension services have been disintegrated and ineffective for any technological transformation to take effect. The largest component of agriculture is focusing on the production of commodities which are sold from the farm to be processed into valued added products before arriving to consumers for consumption. Regardless of how and where the products are produced, they are viewed as being undifferentiated. Regularly they are branded and finally sold to consumers as differentiated products. Value addition mostly emphasis on production or manufacturing processes, marketing or services that increase the value of primary agricultural produce, perhaps by increasing appeal to the consumer and the consumer's willingness to pay a premium over similar but undifferentiated products (Fleming, 2005).

In response to reducing net farm income in a competitive global market, through extension agents, producers are being instructed to engage in value added activities to survive. This



approach offers chances to raise net farm income. A careful consideration must be made to identify enterprises suitable for a particular producer (Evans, 2016). There has been renewed emphasis and new approaches to demand-led extension. The expanded role for advisory and information services is seen as central for agricultural growth (Evans, 2016).

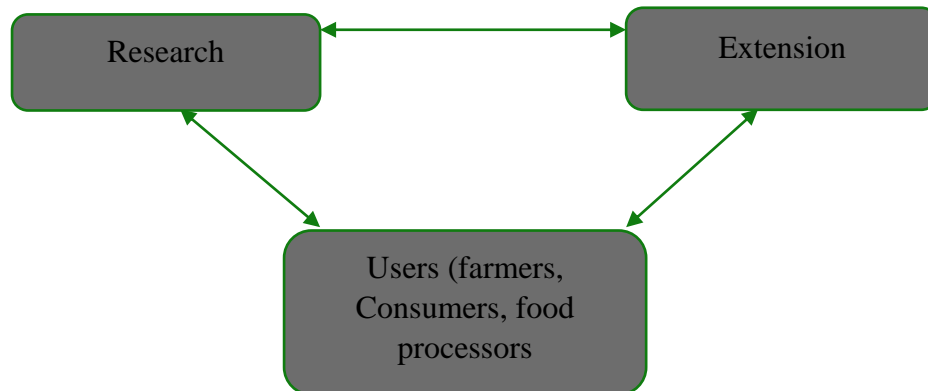
Agricultural extension services has been in the fore front in passing information on varieties and value addition to produce different value added products of sweet potato. In the assessment on the level of awareness of value addition of sweet potato extension services, it has been on the front line. There has been an increase in empowering sweet potato farmers through effective extension training on the use of modern processing techniques in order to increase the level of value addition of sweet potato. Because of the bulkiness and perishability of sweet potato the production and post harvesting system have been affected hence making it desirable and necessary to process sweet potato into storable products forms (Omoare *et al.*, 2014).

## **2.10 Theoretical Framework**

The analysis of this study will be based on two theories, the reasoned model theory and triangular model theory. The theory of reasoned action was postulated by Martin Fishbein and Icek Ajzen in the late 1960s. It focuses on the analysis of the importance of pre-existing attitudes in decision-making process. The principal part of this theory suggests that consumers act on behaviour based on their target of receiving a particular outcome or their needs and preference. Therefore, consumers are rational actors who choose to act in their line of best interest. According to this theory, specificity is critical in the decision-making process (Montano & Karzyk, 2015).

A consumer only takes a definite action when there is a similarly specific result expected out of their decision. Consumers usually take their time to act allowing themselves to change their minds on another different course of action. Therefore, it important to study consumer's behaviour about agricultural products by associating a purchase with a positive result in this case is good sweet potato traits and nutritional values. This theory has been successfully used by different researchers, for example, Axe Body Spray has used it effectively by linking its product to desirability with women. The theory highlights the importance of moving consumers through the sales process. The consumers can understand the lag between initial intention and the benefits derived from the products hence allowing themselves plenty of

time to decide on products to purchase (Montano & Karzyk, 2015). This theory is relevant to the study since it indicates the benefit of studying consumers' behaviour relating them to the products available. Extension service providers play a key role in studying consumers and hence link the information to farmers.



**Figure 2.2.** Synthesis/Triangular Model

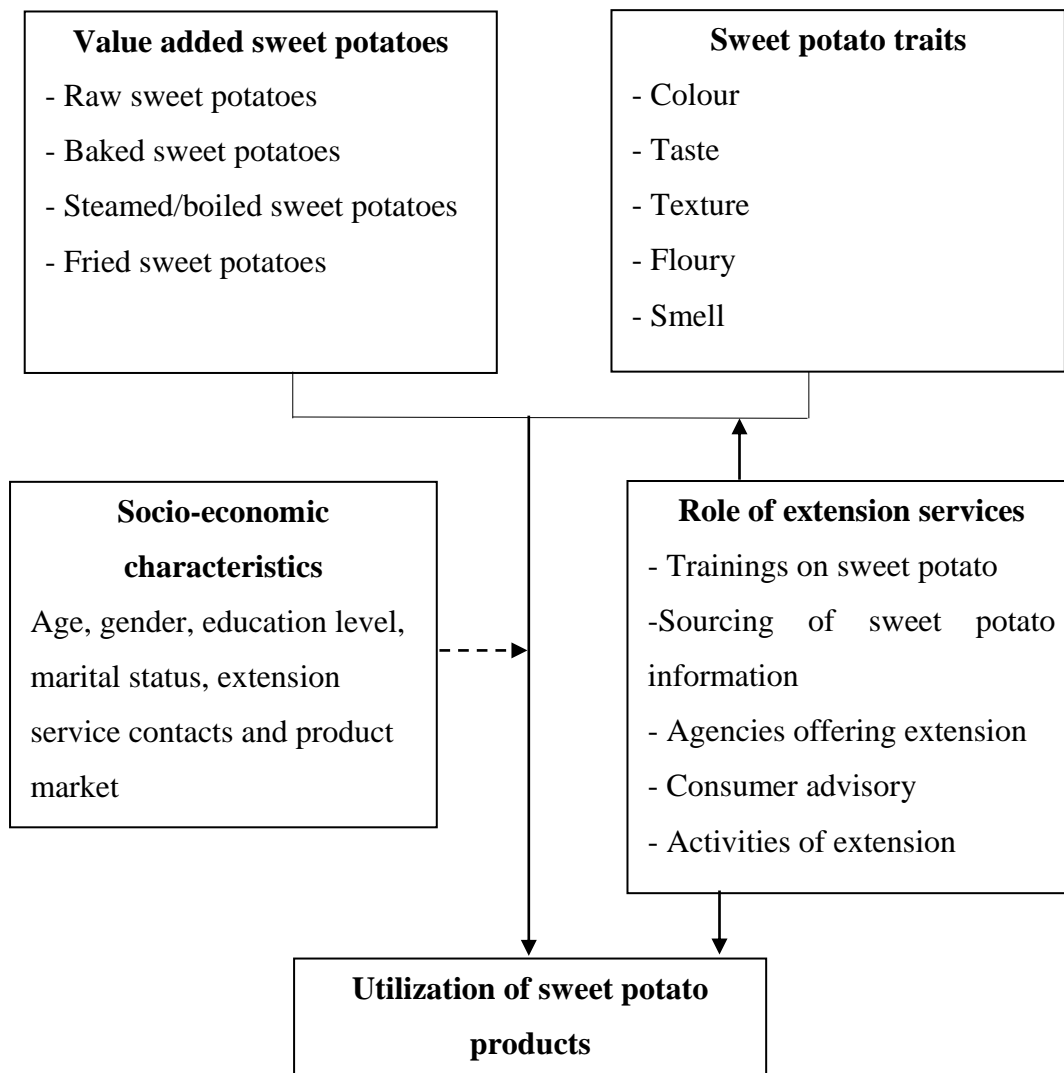
**Source:** Adapted and modified from Lacy (2001)

Similarly, the triangular model (Figure 2.2) focuses on the role of users in creating demand for extension education as well as the role of extension in creating the supply. This model is an interactive system among various participants. Research and extension are conducted in response to users' needs and demands. Whether directly or indirectly users impose on the spectrum of the problem choices which the researcher addresses. The variation of groups and demand along the value chain created for agricultural research is substantial and often competing and conflicting. Therefore, for this model to be successful various participants must have systematic processes for decision making that determines knowledge dissemination and generation (Unger & Polt, 2017).

If networks are structured properly, it can improve the development and delivery of innovations that directly affect the livelihoods of vulnerable households or farmers, making the need for support of the development and delivery of agricultural innovation. This theory was successful in agro-industrial firms where there was a high demand for technologies to enhance the quality of value-added agricultural processing, for new marketable products, and for institutional and infrastructural improvement to enhance supply chain efficiency (Ponniah *et al.*, 2008). This theory is relevant in this study since it shows the link between different actors along the agricultural value chain. Consequently, this is efficient in generating information and providing feedback relevant to a situation at the root level.

## **2.11 Conceptual Framework**

The conceptual framework provides a contextual setting under which extension services contribute towards sweet potato product utilization. In this study, the independent variable is contribution of extension service provision that was measured by, training on value-added products, source of information, agencies offering extension, their activities and consumer advisory needs. The dependent variables are sweet potato product utilization, it was measured by sweet potato varieties, types of products, sensory attributes, and post-harvest losses. The moderating variables are consumers' age, gender, and socio-economic status. These variables influence product profiling and hence affect the relationship between independent variables and dependent variables. From the theory and the model which forms the basis for this study consumers are considered as rational thinkers hence are directly involved in the decision-making process to inflict the aspect of demanding sweet potato product and extension information. This therefore motivate the extension to supply the technologies to the farmers for ensure the sweet potato have the demanded traits. This ensures that consumer receive the products based on their demanded traits of sweet potatoes.



*Figure 2.3.* Conceptual Framework

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter gives a detailed account of the research methodology that was used to meet the stated objectives, it also responds to the important research questions of the identified variables. Precisely, this chapter discusses the research design, the location, target population, sampling procedures and sample size, instrumentation, data collection procedures, and data analysis of the study.

#### **3.2 Research Design**

The descriptive research design was used in the study, which combined qualitative and quantitative data collection methods. Quantitative data was used to determine the status of sweet potato consumption in relation to extension services provided (Kathuri & Pals, 1993). Furthermore, qualitative data was used to gain an in-depth understanding of the underlying reasons and motivations between the variables in the study, thus filling a gap that quantitative data may not have identified. This method was appropriate because it allowed the researcher to provide a detailed description of the sweet potato value chain in order to establish patterns, trends, and relationships and to provide a broad base of insight on which recommendations will be based (Johnson & Christensen, 2019).

#### **3.3 Location of the Study**

The research was carried out in the counties of Homabay and Kisumu, which are located in different geographical regions. Homabay County was chosen as the study's focal point because it is one of the most populous areas in the Lake Victoria region known to produce sweet potatoes and also has a market for the various products (Council of Governors (CoG), 2017). Homabay and Kisumu Counties are located on Lake Victoria's southern shore. Homabay County has a total area of 3,183.3 square kilometers (KNBS, 2019) and is bordered by Migori, Kisii, Nyamira, Kericho, and Kisumu counties. Kisumu County borders Vihiga County, Siaya County, Nandi County, Kericho County, Homabay County, and Nyamira County (Appendix E). Kisumu Central covers the town area which is one of the major cities around Lake Victoria basin where most sweet potato products are sold (County, 2018).

The majority of people in the two counties are farmers who grow maize, sugar cane, rice, millet, sweet potatoes, and vegetables. They are also livestock keepers and fishermen. Tourism is another industry that generates revenue in both counties. Both counties have an inland equatorial climate, with temperatures ranging from 17.1°C in the coolest month to 34.8°C in the hottest months. The annual rainfall in Homabay County ranges between 250mm and 700mm. Homabay County is located between 1200 and 1400 meters above sea level (Ochieng *et al.*, 2017). Kisumu County receives relief rainfall ranging from 1200 to 1300 mm per year (Okayo *et al.*, 2015).

### **3.4 Target Population**

The target population is the entire collection of cases or units from which the researcher wishes to draw conclusions (Wambugu & Ombui, 2013). The study's target population was 1,686,217 people from Homabay and Kisumu Counties. Males make up 52% of the population in Homabay County, while females make up 48% (CoG, 2017). Kisumu County's population is made up of 49 percent men and 51 percent women (Republic of Kenya, 2009). The study's accessible population were 639,586 people from Rachuonyo East, Rachuonyo South, Ndhiwa, and Kisumu Central. The two, Rachuonyo East and Rachuonyo South were chosen because they have good soils that favor sweet potato growth and there are sweet potato outlets everywhere. Furthermore, Kisumu Central Sub County was chosen due to its high population and thus potential market for sweet potato. Farmers and consumers were chosen at random as respondents for data collection. Seven key informants were chosen to provide information about sweet potato products in the two counties. Sub-County Crop Development Officers, research organizations, and social economists from the two Counties were among the key informants.

### **3.5 Sampling Procedure and Sample Size**

The study targeted smallholder sweet potato farmers and consumers in Homabay and Kisumu counties. The study defined a farmer as an economic agent that produces and utilizes sweet potato at home and sells in case of surplus production. The primary purpose of for sweet potato production is home consumption. Consumer is defined as households or individuals who largely but depend on the market to supply of sweet potato products. Consumer, especially in Kisumu city, may time to time farm on open spaces to supplement household food supply from the market. Targeted farmers in Homabay were in Rachuonyo East,

Rachuonyo South, and Ndhiwa, while consumers were drawn from areas classified as urban and peri-urban area in the county. Consumers in were from Kisumu Central which has Kisumu city as the urban area.

Lists of farmers in Homabay were obtained from ward agricultural extension officer, while village administrators provided list of households in urban area. The respondents were either household heads or spouses because they control food budget and have monopoly over household production and consumption decisions. The two sets of lists formed sampling frames for farmers and consumers. Samples of farmers and consumers were randomly selected from the list using the RAND function in Excel. Probability proportional to size was used to apportion the number of farmers from sub-counties and villages. A total sample size of 120 was obtained: 52 farmers and 68 consumers.

**Table 3.1**

*Sample size*

<b>Sub Counties</b>	<b>Population</b>	<b>Proportion</b>	<b>Respondents</b>
Rachuonyo East	121,233	0.1896	24
Rachuonyo South	130,212	0.2036	25
Ndhiwa	217,549	0.3401	43
Kisumu central	170,592	0.2667	33
<b>Total</b>	<b>639,586</b>	<b>1</b>	<b>125</b>

**Source:** KNBS (2019)

### **3.6 Instrumentation**

Data was collected through a semi-structured questionnaire, focus group discussion guide, and key informant interview guide to collect both quantitative and qualitative data in line with the objectives, and research questions of the study. The questionnaire and focus group discussion guide were translated into Luo languages to enable the respondents understand the items on the instruments. Key Informant Interview was administered in English to respondents (Appendix D). Data was collected using tools whose items were developed by the researcher. The researcher-administered questionnaire helped clarify specific items pertinent to the study and assist in achieving comprehension of the items among respondents with low literacy levels.

The questionnaires were semi-structured in nature with a combination of closed-ended and open-ended items to obtain information about sweet potato varieties, traits, and products available for consumers (Appendix A and Appendix B). The justification for the semi-structured questionnaires was to enable for capturing of both qualitative and quantitative data for the study. On the other hand, key informant interview schedule assisted in triangulating data on the variables relating sweet potato varieties which the farmers are cultivating in Homabay County. The key informant interview was used to collect data on the status and activities of extension service delivery on sweet potato from the four sub-counties. These involved persons having advance knowledge on sweet potato from crop development experts and research organization officers.

### **3.6.1 Validity**

Validity is the degree to which data analysis results accurately represent the phenomenon under study (Sürücü & Maslakç, 2020). The content validity of an instrument refers to how representative the items in it are in relation to the domain of content being measured while the appeal and appearance of the instrument are referred to as face validity. The questionnaire and interview schedule were tested to check its content, construct and face validity and to ensure they measure the variables in the study. Peers were engaged to ensure the instruments accurately measure the variables. In addition, pre-test was done before the actual interview to ascertain the validity of the instrument. Additional qualitative and quantitative data through key informants was used to test for validity of the instruments.

After the pre-test data collection instruments were designed in accordance with the research objectives, they were thoroughly examined to determine their validity. Comments were used to adjust and improve the instruments so that they produced valid data from which appropriate, meaningful, and useful inferences could be drawn (Middleton, 2021). Two supervisors and Egerton University senior lecturers from the Faculty of Education and Community Studies and experts from the International Potato Centre (CIP) reviewed the questionnaires and interview schedule, and their input was incorporated into the final draft. Their feedback was used to adjust and improve the instruments so that they produced valid data from which appropriate, meaningful, and useful inferences could be drawn.



### **3.6.2 Reliability**

The degree to which research findings are consistent and replicable in another context is referred to as reliability. A pre-test was performed to determine the instrument's reliability. The triangulation method, which combines theories, methods, or observations, was used for the pre-test. Triangulation was useful in this case because there were few extension officers, key informants, and targeted consumers.

The instruments were tested in a pilot study in Kisii County using similar questionnaires, a focused group discussion guide, and a Key Informant interview to ensure their reliability. Connelly (2008) considers at least 30 respondents to be an acceptable size for a pilot study because they can demonstrate normal distribution. As a result, 30 samples were used in this study for the pilot study to provide unbiased results. This was to see if the items were stated clearly and could be interpreted correctly by all respondents in the same way. The questionnaires were subjected to a Cronbach alpha reliability test, and a reliability threshold was established. The instruments met the reliability threshold of 0.7 or higher and were deemed trustworthy for the actual study. Two extension service providers and two crop development officers were used as test subjects for the interview schedule.

Reliability test results indicated an alpha value of 0.78. The rule of thumb requires that the Cronbach alpha be 0.7 and above for the scale to be reliable. The alpha value of 0.78 was greater than 0.7 hence the scale items included in the questionnaire had high internal consistency. Therefore, the instrument was reliable.

### **3.7 Ethical Consideration**

The researcher sought consent from sampled respondents before administration of face-to-face interviews. Interviews were done to the key informants in the two counties. Focused group discussion was held comprising of all gender in one group per Sub-County. The respondents were requested to participate willingly. An introductory letter was obtained from Egerton University through the Board of Post Graduate studies (BUGS). Permission from National Commission for Science Technology and Innovation (NACOSTI) was sought out before proceeding to the field for data collection in Homabay and Kisumu Counties. Authorization from County and Sub Counties directors was accorded. The contract with

sampled respondents' consent to participate in the study was sought. Interviews were done to the key informants in the two counties.

### **3.8 Data Analysis**

The data were coded and entered in Excel and imported into Statistical Packages for Social Science (SPSS) Version 22 for analysis. Both descriptive and inferential statistics were used in analysis. Descriptive statistics involved frequencies and percentages, and measures of central tendency (mean) and dispersion (standard deviation). Inferential statistics involved chi-square test of independence and Fisher's Exact Test for categorical variables and t-test for integer and continuous variables. The inferential analysis determined whether there were significant differences in distribution of responses provided by producers and consumers. Analysis outputs were interpreted and presented using tables and charts for ease of interpretation. Table 3.2 presents types of statistics and analysis that were performed and visualization of the results.

**Table 3.2***Summary of Data Analysis with Research Questions*

<b>Research Questions/description</b>	<b>Dependent Variable</b>	<b>Independent Variable</b>	<b>Statistics</b>
Socioeconomic variables	Not applicable	Age, Marital status (1=Married, 2=Single, 3=Divorced), Gender, Education (1=No formal education, 2=Primary, 3=Secondary, 4=College and higher), type of respondent (1=Farmer, 2=Consumer)	Frequencies, percentages, means, standard deviation, chi-square test of independence, Fisher's exact test and independent samples t-test
<b>RQ1.</b> What are the sweet potato traits that influence production and utilization of sweet potato among producers and consumers in Homabay and Kisumu counties?	Sweet potato traits (1=Colour, 2=Taste, 3=Texture, 4=Floury, 5=Smell) Sweet potato varieties (1=SPK 004, 2=SPK 20, 3=Kemb 20, 4=Sura Mbaya, 5=Amina, 6=Kalam)	Type of respondent (1=Farmer, 2=Consumer)	Frequencies, percentages, Fisher's exact test, chi-square test of independence
<b>RQ2.</b> Which sweet potato value-added products are produced by	Sweet potato value-added products (1=Raw, 2=Boiled, 3=Steamed,	Type of respondent (1=Farmer, 2=Consumer)	Frequencies, percentages, Fisher's exact test, chi-square test of

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farmers and available to consumers in Homabay and Kisumu counties?	4=Fried, 5=Baked)		independence
<b>RQ3.</b> What is the role of extension system in bridging the gap between what is supplied and demanded in the market?	Number of respondents accessing extension, percentage of respondents visited by extension officers, and type of information received from extension officers	Type of respondent (1=Farmer, 2=Consumer)	Frequencies, percentages, Fisher's exact test, chi-square test of independence

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## **CHAPTER FOUR**

### **RESULTS AND DISCUSSIONS**

#### **4.1 Introduction**

This chapter presents the results of the analysis from the study according to the data obtained. It has been sectioned into sections according to the objectives of the study. The discussion of outcomes is presented while making a comparison of the findings with those of other related studies.

#### **4.2 Demographic Characteristics**

The results of analysis of characteristics of participants in the study disaggregated by respondent type and county are presented in Table 4.1. The p-values for categorical variables (sex, marital status, and education levels) were obtained from chi-square test of independence and Fisher's exact test. Independent sample t-test was used to test whether there existed difference in average age of farmers by respondent type and counties. About 58% of participants in the study were male and 42% were female. Disaggregation of sex of participants by type of respondents showed that 77% and 23% of 52 farmers that participated in the study were male and female, respectively. On the other hand, 56% and 44% of consumers were female and male, respectively. The percentages of male and female farmers and consumers that participated in the study were statistically significantly different ( $p < 0.01$ ).

About 59% and 41% of surveyed respondents in Homabay were farmers and consumers respectively, all respondents (32) in Kisumu were consumers. This result was expected because Kisumu City, a major regional economic hub located in Kisumu County, is characterized by rapid industrialization and urbanization. In contrast, Homabay County is a largely rural county dominated by agriculture as the main economic sector. The rise in urban population and changing consumer behaviour towards traditional and healthy foods are causing a rise in demand for root and tuber crops as substitute foods for processed wheat and maize products that are often unaffordable.

**Table 4.1***Demographic characteristics of respondents disaggregated by respondent type and county*

	Respondent Type			<i>p</i>
	Total (N=120)	Farmers (n=52)	Consumers (n=68)	
<b>Percentage of respondent (%)</b>				
Farmer	43.33			
Consumer	56.67			
<b>Sex of respondent (%)</b>				
Male	58.33	76.92	44.12	0.000
Female	41.67	23.08	55.88	
<b>Average age of respondent</b>				
	45.74 (12.23)	43.23 (11.03)	47.66 (12.82)	0.049
<b>Marital status (%)</b>				
Married	81.67	92.31	73.53	0.018
Single	12.50	3.85	19.12	
Divorced/separated	5.83	3.85	7.35	
<b>Education level (%)</b>				
No formal education	20.83	25.00	17.65	0.06
Primary school	23.33	13.46	30.88	
Secondary school	35.00	44.23	27.94	
Collage and above	20.83	17.31	23.53	

*Note:* Standard deviation provided in parentheses

Furthermore, results in Table 4.1 show that the average age of participants in the study was 46 years. The difference between the average ages of consumers (48 years) and farmers (43 years) was statistically significant ( $p < 0.05$ ), suggesting that consumer respondents were older than farmer. The significant difference in age by respondent type is critical in understanding possible role of experience in participation in sweet potato value chain, which is an important dynamic in explaining possible differences in access to extension information on importance of production and utilization of sweet potato products.

The results in Table 4.1 also show that most respondents (82%) were married, 13% were single, and 6% were divorced and separated. Disaggregation of marital status by respondent

type results show that 92% of farmers compared to 74% of consumers were married. The difference in marital status of farmers and consumers was statistically significant at 5% level. Marital status is critical in extension work for it influences who can be targeted to attend extension sessions. In the context of study area and MAMA SASHA project, women were most targeted because of they are mostly responsible for sweet potato production and utilization at household levels, and the most affected by malnutrition. However, gender roles disproportionately burden women and limit their mobility which has an implication on venues and timing of extension meetings when such events involve married women (Girard *et al.*, 2017; Ndolo *et al.*, 2017). In contrast, single or separated women may also have greater mobility and may generally participate extension in meetings or make consumptions decision independently.

From the result in Table 4.1, it shows that the marital status is a crucial consideration in extension services for it influences inclusion or marginalization of social groups of farmers. Specifically, marital status may influence the capacity of smallholder farmer to innovate due to differences in mobility that is necessary in attending extension meetings or going to the market. For instance, older married women may have relatively higher mobility to attend extension meetings or visit markets than young married women.

Analysis of educational attainment of participants revealed that 35% of respondents had secondary education level. About 21% and 23% of the respondents had no formal educational qualification and primary school level education, respectively. The percentage of respondents with post-secondary educational qualification was 21%. Extension is a package of services that besides creating farmers' awareness of farm technology and contributing to increased farm productivity also assists farmers to learn about market trends in terms market-demanded products thereby enhancing farm revenues and minimizing food insecurity.

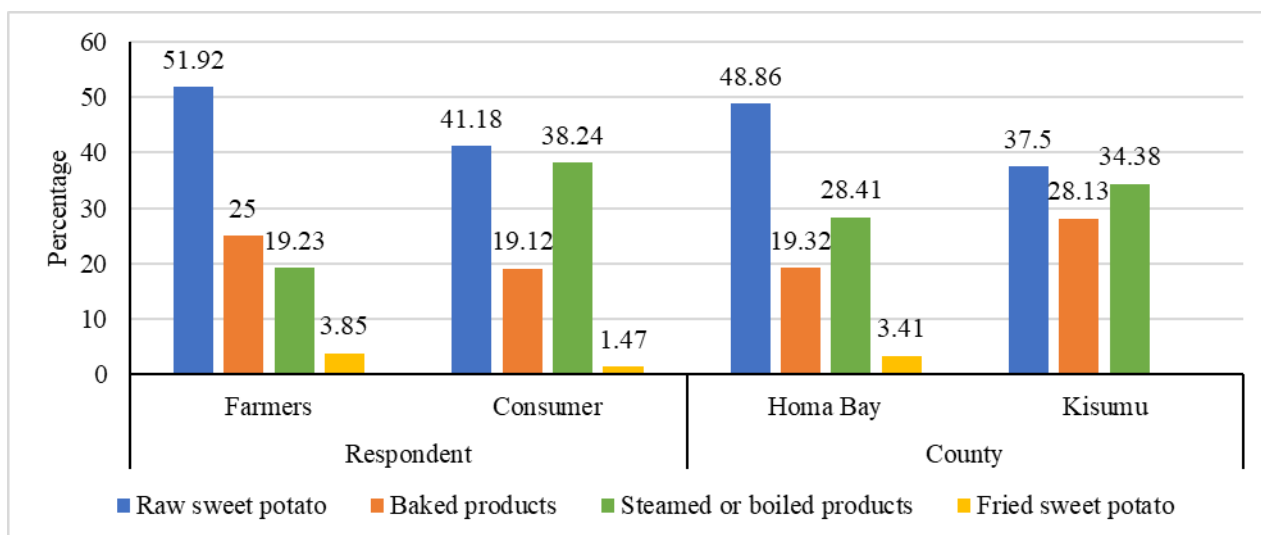
Education is an important determinant of farmer's awareness of possible sources of information and knowledge that is critical to making informed production, marketing, and consumption decisions. The type of information demanded by educated farmers and consumers could be critical in adoption of market-demand technologies and product. Gido *et al.* (2015) found evidence that educational attainment increased farmers' demand for extension education, extensionists can leverage existing opportunities in terms on literate

farmers to improve adoption, production, marketing, and consumption of sweet potato varieties and sweet potato products. Maake and Antwi (2022) reported that education level of farmers positively influenced their perceptions of effectiveness of extension and advisory services, meaning that they can trust messages they receive from extension officers with respect to sweet potato products.

#### **4.3 Sweet Potato Value-Added Products Produced by Farmers and Available to Consumers**

Comparison by respondent type revealed raw sweet potato as the most produced product for farmers (52%) and the most bought (41%) products by consumers as indicated in Figure 4.1. One-quarter of farmers produced baked sweet potato products compared to 19% of consumers who bought baked sweet potato products. This show that some of the farmers embraced value addition of OFSP that was availed during the MAMA SASHA project. While 19% of farmers produced steamed/boiled sweet potato product, 38% of consumers bought the raw sweet potato. About 4% of farmers and 1% of consumers produced and bought fried sweet potato product. The proportion of farmers that produced and bought sweet potato products did not significantly differ from what? as shown by statistically not significant Fisher's exact probability values, 0.118. This result implies that farmers produced met market-demand sweet potato products. The result suggests that farmers produce sweet potato products that match market or consumer demand for sweet potato products. Therefore, as observed by Shepherd (2007) farmers' choice of products to produce should be based on market demand.





**Figure 4.1.** Sweet potato products produced by farmers and consumed by consumers by type of respondent type and county (Respondent type: Fisher's exact p-value = 0.118; County Fisher's exact = 0.498)

The distribution of sweet potato products by county is shown in Table 4.1. According to the results shown, 49% and 38% of participants in Homabay and Kisumu counties, respectively, and 52% and 41% of farmers and consumers, respectively, produced and purchased raw sweet potato. Baked sweet potato products were purchased by 19% of participants in Homabay and 28% of participants in Kisumu. While 28% and 3% of respondents in Homabay produced steamed/boiled and fried sweet potato products, respectively, 28% and 34% of respondents in Kisumu purchased the same products. Fisher's exact test of proportions test statistic ( $p=0.498$ ) was not statistically significant, indicating that no differences in sweet potato products produced and consumed in the two counties were observed. This shows that farmers are producing sweet potato products that meet products demanded by consumers regardless of county they reside.

Farmers and consumers were also asked to report varieties that they planted and consumed and results of analysis of their responses are presented in Table 4.2. Pooled results show that SPK 004 was the frequently grown and consumed sweet potato followed by SPK 20 (23%), Kemb 20 (17%), and Sura Mbaya (10%). Other planted and consumed varieties were Amina and Kalam as reported by 8% and 7% of the respondents, respectively. However, there were no statistically significant differences in varieties planted by farmers and consumed by consumers as indicated by  $p$ -value of 0.414 that was not significant at 5% level. Comparison

of results by county revealed the same patterns with most farmers in Kisumu (41%) and Homa Bay (34%) planting SPK 004, followed by SPK 20. About 19%, 17%, 11%, 10%, and 8% of farmers while farmers in Homabay planted and consumed SPK 20, Kemb 20, Sura Mbaya, Amina, and Kalam respectively compared to 34%, 16%, 6%, 0%, and 3% of farmers in Kisumu County, respectively. Nonetheless, there were no significant ( $p < 0.221$ ) differences in proportions of respondents that planted the varieties between the two counties.

**Table 4.2**

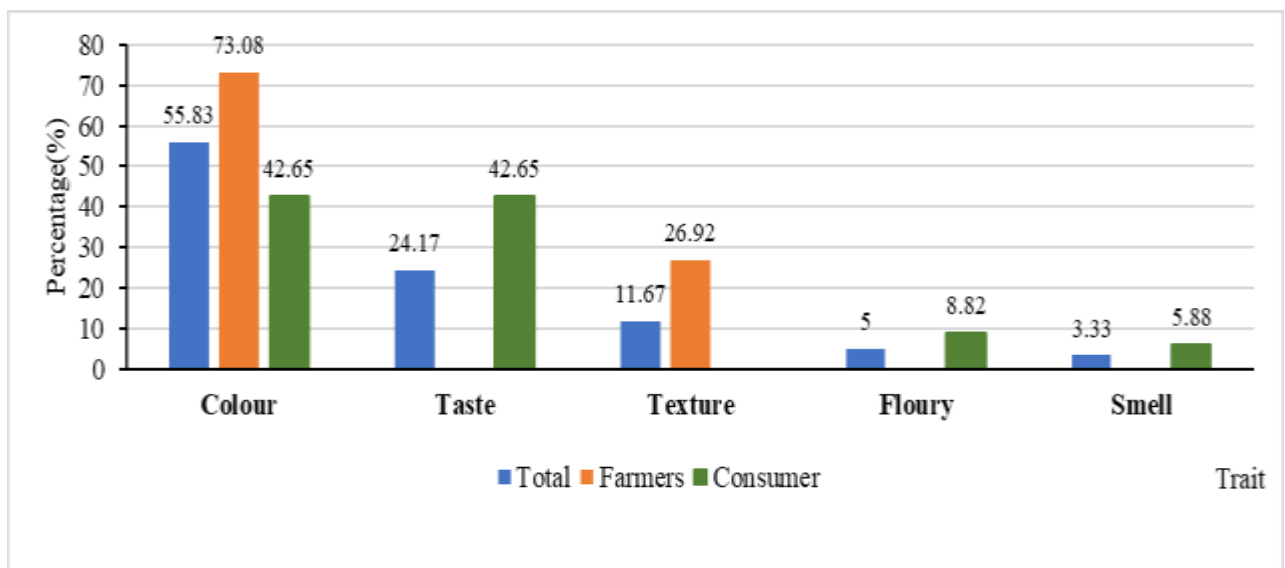
*Sweet potato varieties grown and consumed by consumed*

Variable	Total (N=120)	Respondent Type		<i>p</i>
		Farmers (n=52)	Consumers (n=68)	
Variety planted and consumed (%)				0.414
SPK 004	35.83	32.69	38.24	
SPK 20	23.33	23.08	23.53	
Kemb 20	16.67	11.54	20.59	
Sura Mbaya	10.00	15.38	5.88	
Amina	7.5	9.62	5.88	
Kalam	6.67	7.69	5.88	

#### **4.4 Traits Influencing Utilization of Sweet Potato Products by Producers and Consumers**

Furthermore, respondents were asked to state traits that they considered when selected sweet potato products to consume. The results presented in *Figure 4.2* show that farmers considered the sweet potato varieties for utilization principally because of colour (56%). Other critical traits considered by respondents were taste (24%) and texture (12%) while fringe traits were floury consistency (5%) and smell (3%). There were statistically significant ( $p < 0.01$ ) differences in traits preferred by consumers and farmers. While farmers considered only two sweet potato traits (colour, 73%: texture: 26%), consumers considered diverse traits, including colour (43%), taste (43%), floury consistency (9%), and smell (6%). The statistically significant differences in traits of sweet potato traits considered by farmers and consumers can be explained within the realms of theory of the producer-consumer household.

According to Maruyama and Sonoda (2011) a household, especially an agricultural household, engages in both production and consumption decisions. Therefore, they are both producers and consumers of products. In this study, farmers' sweet potato production and consumption decisions were possibly inseparable. Specifically, farmers planted varieties that met their production and consumption considerations which narrowed their choice set of traits. In contrast, consumers' preferences of sweet potato products differ because they only must make consumption decision from available products. Consequently, consumers had a wider array of traits to select from than farmers.

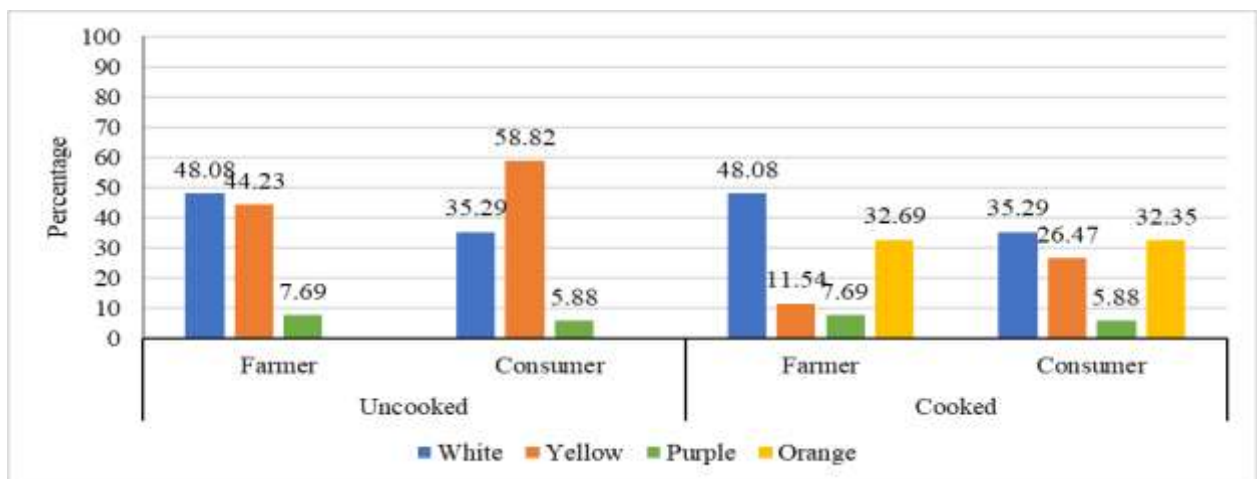


**Figure 4.2.** Sweet potato traits considered by producers and consumers (Respondent type: Fisher's exact p-value = 0.000; County Fisher's exact = 0.001)

Comparison of traits considered by respondents by geographical space revealed that while 63% of respondents in Homabay considered colour of sweet potato varieties, half of those in Kisumu focused on taste (Figure 5). While taste (15%) was the second most frequent sweet potato trait considered by participants in Homabay, colour was the second most considered traits by about 38% of respondents in Kisumu County. Respondents in Homabay also considered, floury consistency (22%), and smell (1%), while 9% and 3% of respondents in the Kisumu considered smell and floury consistency, respectively (Figure 4.2). These responses were statistically significant at 1%, meaning that traits considered by respondents vary over space. As earlier indicated in Table 1, Homabay had both farmers and consumers as respondents, while Kisumu had only consumers. Therefore, the statistically significant

results were expected because the sample size in Homabay was heterogeneous with diverse trait consideration.

Colour was the most considered trait of sweet potato products produced and consumed by participants as shown in Figure 4.3. However, sweet potato varieties are often distinguished by colour of the root (Shepherd, 2007). Therefore, it was critical to understand whether colours of sweet potato products produced and bought by respondents were the same for uncooked and cooked sweet potato. Most farmers reported that uncooked sweet potato was white (48%) in colour, followed by yellow (44%), and purple (8%). In comparison, 35%, 59%, and 6% of consumers said uncooked sweet potato were white, yellow, and purple, respectively. The proportions of farmers and consumers that reported that the colours of uncooked sweet potato were not statistically significantly different ( $p=0.273$ ). For cooked sweet potato, 48% of farmers compared to 35% of consumers indicated that the colour of cooked sweet potato was white. 12% and 26% of farmers and consumers reported that cooked sweet potato was orange, respectively. Purple colour for cooked sweet potato was reported by 8% of farmers and 6% of consumers. Almost one third of farmers and consumers said that the colour of cooked sweet potato was orange. Also, the colour of cooked sweet potato did not significant differ by county ( $p=0.193$ ). These findings indicate that colour of sweet potato produced and bought does not vary depending on respondent type irrespective of transformation (value addition) in type of product.

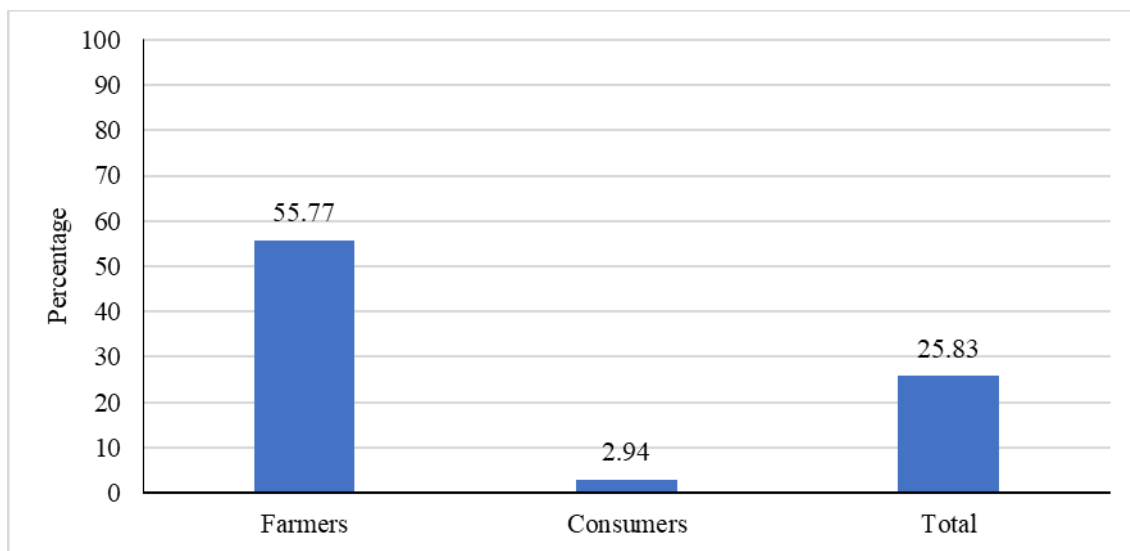


**Figure 4.3.** Colour of sweet potato varieties produced and consumed by type of respondent type (Uncooked: Fisher's exact  $p$ -value = 0.273; Cooked Fisher's exact = 0.193)

## 4.5 Role of Extension System in Utilization of Sweet Potato Products

### 4.5.1 Extension Visits

The study presents result of the role of extension in sweet potato utilization. Farmers and consumers were asked to report whether they were visited by extension officers and the results are shown in Figure 4.4. The results show that 25% of respondents were visited by extension officers. Fisher's exact test shows that statistically significantly ( $p < 0.01$ ) higher percentage of farmers (56%) than consumers (3%) was visited by extension officers. This result could be explained by extension system in Kenya being farmer oriented. Meeting the changing demand patterns of farm products by consumers is complex constraints, including weak linkage to the market caused by limited or lack of market information. Agricultural extension workers can not only assist farmers identify buyers, but also advise them to develop new or improved products to meet consumer demand for products (Leite *et al.*, 2022). This observation highlights the critical role of extension services in linking farmers to buyers (Eaton & Shepherd, 2001; Ferris *et al.*, 2014).



**Figure 4.4.** Percentage of respondents visited by extension officers (Fisher's exact p-value = 0.000)

### 4.5.2 Activities of Extension Service Providers

Table 4.3 presents sources of extension information by respondent type and county. Pooled results show that country government was the most frequent (45%) source of extension information by respondents followed by community groups (16%), media (8%), research organizations (8%), and other sources (23%). In Homabay County, sweet potato is among the

key food security crop and this has attracted more research organization to carry out research on different varieties hence close contact with the farmers this support the highest percentage of research organizations offering extension advice on sweet potato. This research organization include International Potato Centre (CIP), and Kenya Agricultural and Livestock Organization (KALRO). Other sources of information included lead farmers, private companies, and NGOs. While county government was the most frequent sources of extension information for farmers, consumers frequently received extension information from other sources. There were significant differences in percentages of farmers and consumers who received extension information from different sources. The percentage of farmers (81%) who received information from county government was statistically higher than consumers who received from the same sources. In addition, significantly higher proportion of farmers received information from research institutions, consumers received from community groups.

Sources of extension information also differed by country. Whereas county government (51%) was the most frequent sources extension information in Homabay, respondents in Kisumu frequently received extension information from community groups. 28% of consumers reported county governments' sources of information in Kisumu, followed by other sources and the media. In contrast, other sources (24%), research institutions (10%), and community groups were frequent sources of information for participants in Homabay. These proportions were also statistically significant indicating differences in sources of extension information between Kisumu and Homabay.

Additionally, the role of access to extension services in the adoption of agricultural innovations remains poorly documented in the target area (Homabay and Kisumu counties). Yet, there is a link between farmers' perceptions and adoption of agricultural innovations and consumer value addition for value added products. This study, therefore, attempts to fill this gap by providing supporting data to organizations involved in agricultural extension services. Knowledge of farmers' attitudes and associated socio-economic characteristics would be crucial for guiding efforts by sweet potato farmer support structures in the region.

**Table 4.3***Sources of extension information by respondent type and county*

Source	Total		Respondent type (%)		Sig.	County (%)		Sig
	Freq.	Percent	Farmers (n=52)	Consumers (68)		Homa Bay (n=88)	Kisumu (n=32)	
County government	54	45.00	80.77	17.65	0.000	51.14	28.13	0.001
Community groups	19	15.83	1.92	26.47		10.23	31.25	
Media	10	8.33		14.71		4.55	18.75	
Research institutions	9	7.5	17.31			10.23		
others	28	23.33		41.18		23.86	21.88	

The findings in Figure 4.4, show that 55% of people got information on sweet potato production, 25% discussed marketing, 15% value addition and 5% on pricing of value-added products. From the findings, extension service providers mostly offer advice on sweet potato production, marketing and little focus is placed on value addition and pricing of value-added products. Key informant interviews revealed that information on sweet potato is passed to the consumers through the farmers since consumers had minimal visits to the centres where the extension services are offered. This explains why farmers make huge losses when selling their produce without value addition. The advantage lies to those farmers who are consumer since as they visit the extension, they receive information and used it for both utilization and production of sweet potato.

**Figure 4.4.** Type of agricultural information obtained on sweet potato

The Table 4.4 shows that 44% identified advice on variety multiplication, 27% mentioned helping improve sweet potato production, 10% cited linking farmers with value addition

experts, 7% training on making marketable products, 5% marketing value added products. The results further showed that 4% stated demonstration on food utilization while 3% mentioned exhibitions on sweet potato. These findings were further triangulated by key informants who indicated that the extension services have majorly helped farmers on improving production of sweet potatoes. Informants further reported that that extension service is more skewed on sweet potato variety multiplication and limited on valued addition and valued added products utilization.

**Table 4.4**

*Types of information and service received by respondents from extension agents*

<b>Role</b>	<b>Percentage</b>
Advise on variety multiplication	44%
Training on sweet potato production	27%
Linking farmers with value addition experts	10%
Training on making marketable products	7%
Marketing value added products	5%
Demonstration on food utilization	4%
Organize exhibitions on sweet potato	3%

From the findings, it shows that the activities done by extension officers were mostly on farmer's needs and not much focus is placed on consumer consumption patterns and utilization of sweet potato value-added products. Informants attribute this finding to extension being demand driven where farmers are mostly seeking for the advisory services on sweet potato production hence the technologies that aim at improving production are disseminated to them. Informant interviews also showered that farmers who visit the extension offices were also considered as the consumers since most farmers were also consuming the sweet potato. Therefore, farmers received passed the information they received from extension officers to the consumers who had no access to extension. Table 4.4 shows the relationship between farmers and consumer. There is a group of persons who practice both farming and consumption of the sweet potato and value-added products.

The information delivered by extension agents is critical in enabling farmers make production decisions and consumer to make product choice decisions. In literature, farmers are reported



to be persuaded to demand extension services to access sweet potato products (Antwi-Agyei & Stringer, 2021). As a result, extension agents receive specialized training to effectively promote and dissemination sweet potato varieties and products with desirable traits (Ngailo *et al.*, 2016). Particularly, the study analysed participant responses regarding whether extension covered sweet potato products and traits. A fruitful dissemination of sweet potato varieties involves an insight consideration of target farmers’ and consumer attitudes, preferences and socio-economic status. This increases its utilization of the value added products.

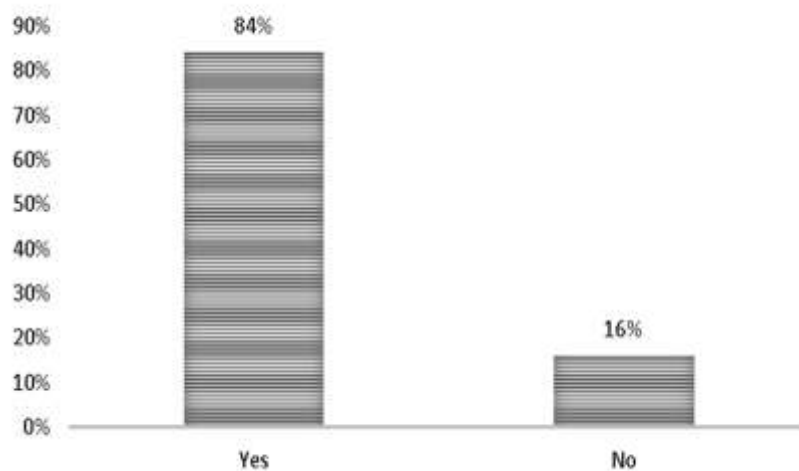
The results in Table 4.5 show that 68% of participants that that were visited by extension officers received information about sweet potato products and traits from the agents. Further analysis revealed that 73% of farmers that were visited received information about sweet potato products and traits. On the other hand, 1 out of 2 consumers that were visited by extension officers received information about sweet potato products and traits. The percentages of farmers and consumers who received information about sweet potato products and traits was statistically significantly ( $p < 0.041$ ) higher than those who did not receive. However, the percentage of participants in that reported that they were informed by extension officers about sweet potato products and traits did not significantly differ by county. These results possibly mean that whereas extension packaging of extension information about sweet potato and traits may depend on type of client, access to similar information is uniform across the two geographic area.

**Table 4.5**

*Percentages of responses to whether extension training covers sweet potato products and traits by respondent type and county.*

	Yes	No	p-value
Total	68.33	31.67	
Respondent type			0.041
Farmers (n=52)	73.07	26.93	
Consumers (n=68)	64.71	35.29	
County			0.167
Homa Bay (n=88)	57.95	42.05	
Kisumu (n=32)	43.75	56.25	

On the advisory services, the sought to determine whether respondents needed training on sweet potato. The results in Figure 4.5 show that 84% of respondents agreed that extension service on sweet potato utilization methods was necessary to consumers. 16% indicated other sources of training such as Mass media, television program, magazines, radio program and from neighbour farmers. This was because some of them were probably unaware of possible products prepared from sweet potato and the available varieties together with the health benefits of the crop to the human body.



**Figure 4.5.** Consumer Training on Sweet potato

Respondents mentioned the kind of information they require to improve sweet potato product utilization. The responses are recorded in the Table 4.6. The result shows that, 30% of the respondents would require value addition techniques on sweet potato, 24% needed information on agronomic practices, 20% on health benefit, 18% on nutritional benefit and 8% on sweet potato new varieties. Farmers and consumers demonstrated need to be taught different value addition techniques to reduce post-harvest loses. The findings explain that majority of consumers require information on product utilization methods.

**Table 4.6***Information needed on sweet potato*

<b>Information</b>	<b>Percentage</b>
Value addition	30%
Agronomic practices	24%
Health benefits	20%
Nutritional benefits	18%
Sweet potato new varieties	8%

### **4.5.3 Role of Extension in Utilization of Sweet Potato Products**

The results that were used to answer the third research question are presented in Table 4.7. Comparison of sweet potato products bought by farmers who were visited by extension agents and those who were not visited reveal that those who received extension information produced more products (4) than those who were not visited (3). 69% of farmers that received extension services produced raw sweet potato for sale compared to 30% of those that were not visited. 48% and 22% of farmers who did not receive extension services produced baked and steamed/boiled products for sale compared to 7% and 17% of farmers that were visited by extensionists, respectively. Another 7% of farmers who were visited by extension officers produced fried sweet potato for sale. These results reveal that extension-farmer linkage influence the number and type of sweet potato products that farmer produce. The percentage of sweet potato products produced by farmers who received extension visits were significantly different from those that were not visited. The results conform to finding reported by Mudombi (2013) who noted the production intensity of sweet potato product was positively associated with extension service. Therefore, extension does not only influence the type of products produced but the level of production and the exposure of consumers to different forms of technologies used in value addition.

**Table 4.7***Role of extension of visits on products produced and bought by farmers and consumers*

Product	Farmers (n=52)		p-value	Consumer (n=68)		p-value
	Yes	No		Yes	No	
Raw sweet potato	68.97	30.43	0.002	40.91	53.18	0.014
Baked products	6.9	47.83		39.39	0.00	
Steamed or boiled	17.24	21.74		18.88	39.39	
Fried sweet potato	6.9	0.00		0.82	7.43	

Furthermore, comparison of consumer results by status of access to extension services showed recipients of the services bought more (4) sweet potato products than those non-recipient consumers (3 products). About 53%, 39%, and 7% of consumers that did not receive extension visits reported that they bought raw, steamed/boiled, and fried sweet potato, respectively. In comparison, of the 2 consumer recipients of extension services bought raw, baked, steamed/boiled, and fried sweet potato. The sweet potato products were statistically significantly different, meaning that consumers who received extension visits bought different products compared to those who were not visited by extension officers. This finding indicates that extension has a strong link with sweet potato bought by consumers. Therefore, making extension and advisory services sensitive to drivers of consumer demand for sweet potato is critical to delivering appropriate message about available products that can match consumer needs. The adoption of new technologies and value addition techniques is negatively effected by the consumers since they are of different age groups and cultural backgrounds.

## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents the research study's summary, conclusions, and recommendations. It summarizes the key findings on the study objectives and then draws conclusions from each of the research questions. Following that, the study's recommendations are discussed. Finally, the areas for future research are described in detail.

#### **5.2 Summary of the Study**

The study findings revealed relevant demographic characteristics that extension agents should consider when designing extension sessions in order to effectively reach the targeted participants in their programs. Age and marital status differed significantly by respondent type, implying that extension officers must profile their trainings and advisory services in order to reach the targeted people based on demographic characteristics. The study also reveals that men dominate agricultural production roles while women dominate consumption roles. This is supported by the fact that women were required to seek permission from their husbands, who owned the land. Since sweet potato is allied with female farmers the attitudes of old farmers outshined between gender and resource ownership and between gender and education level in the study area. In rural areas of Homabay, women practice mostly subsistence crops in contrast to their male counterparts who are mostly interested in cash crops. Also, women have generally less land and financial resources than men, and thus, unable to venture fully in sweet potato production.

The study also found that SPK 004 was the most frequently grown and consumed sweet potato followed by SPK 20 (23%), Kemb 20 (17%), and Sura Mbaya (10%). Other planted and consumed varieties were Amina and Kalam as reported by 8% and 7% respectively. The study concludes that farmers considered only two sweet potato traits (colour, 73%: texture: 26%), while consumers considered diverse traits, including colour (43%), taste (43%), floury (9%), and smell (6%).

Raw sweet potato as the most produced (52%) and bought (41%) by farmers and consumers compared to other products such as baked, steamed, or boiled products. Consumers in Kisumu considered baked products most compared to those in Homabay County. Colour was the most considered trait of sweet potato products produced and consumed by participants.

Farmers (56%) than consumers (3%) were mostly visited by extension officers and the focus was on production decisions and consumer to make product choice decisions respectively. Therefore, extensionist could offer specialized training to effectively promote and dissemination sweet potato varieties and products with desirable traits both to farmers and consumers. The extension-farmer linkage influences the number and type of sweet potato products that farmer produce besides level of production.

The sources of extension services included NGOs (58.4%), Research Institutions (16.7%) and Media. The study however, established that the county governments featured as the least source of information to the farmers about better farming practices and product utilization. The extension service providers focused on sweet potato production, marketing, value addition and pricing. The extension service providers also played a role in giving advice to farmers on sweet potato variety multiplication, training on sweet potato production, linking farmers with value addition experts among others. However, there was little done on product utilization. It was further noted that the activities on sweet potato `was not much related to consumer consumption patterns but mostly on the farmer's needs.

The study findings revealed that majority of respondents (84%) agreed that there is need for consumer training on sweet potato. However, 16% did not see the need for training instead they opted for other sources of extension services e.g. radio and television programs and media. The results further revealed that the respondents needed information on sweet potato along value chain including methods of processing new products of sweet potato. The areas they cited were: health and nutritional benefits (38%), development of new recipes (16%) and making livestock feeds (14%). Other responses included cultivation of sweet potato vines, advantages of growing sweet potatoes, available varieties, more yielding variety and recommended soil types which ranged between 8% and 5%.

The study established that even though consumers had information on sweet potato, product utilization was still low among them. This was explained by the fact that despite most farmers had the ability to produce sweet potato; extension officers from the county governments did reach out to educate farmers on the traits of sweet potato that consumers liked most. Farmers ended up making losses after harvest. The findings further revealed that consumers got extension services mainly from NGOs. The focus point was on sweet potato production. The cost of technologies involved in value addition was a hindrance to consumers. It is worth

noting that consumers got information on extension services from farmers, they did not visit the centres where extension services are offered. Many consumers echoed the need for training on sweet potato. The findings show that consumers needed information related to product utilization. Consumers also considered colour when buying sweet potatoes. The African Union's Agenda 2063 appeals for a five-fold increase in agricultural productivity per capita and an increase in food crop production of at least 10% per year by 2030. To achieve these goals, the development and adoption of more productive crop varieties and the use of good agricultural practices are needed. Efforts are being made by local and international organizations to introduce high yielding sweet potato varieties with resistance to pests and diseases and high nutritional value (mainly high beta-carotene content) in eastern Africa. For the effective variety dissemination strategy in Homabay and Kisumu Counties requires a deep understanding of target farmers' socio-economic status.

This study highlights the need to reinforce and empower organizations aligned with agricultural extension dissemination. It is one of the rare studies that report the role played by consumers in utilization of sweet potato value added products. This aspect has long been neglected by agricultural studies in the counties, even though it may be one of the core reasons for lower utilization of agricultural products. The results of this study are in line with the African Union's Agenda 2063, in particular the objectives of increasing agricultural production and productivity, as well as the preservation and sustainable use of biodiversity to address food security issues. It has been shown that sweet potatoes play an important role in maintaining food security and reducing poverty in rural Africa. There is, therefore, a need to increase yields and quality of sweet potato products through the use of improved cultural practices and sweet potato varieties

### **5.3 Conclusions**

The following conclusions are made based on the findings of the study:

- i. Colour is the most critical trait considered by producers in their decision to plant and consume sweet potato products. Consumers equally ranked colour and test as the traits they consider when making sweet potato consumption decisions.
- ii. The common sweet potato products for consumers were raw sweet potato, baked products, and steamed and boiled products. Ranked in the order of frequently bought, raw sweet potato, steamed/boiled, and baked products were most frequent among consumers. These are primary value-added products.

- iii. Extension agents play a critical role in bridging sweet potato supply-demand gaps. Visits by extension officers and information received by farmers from extension officers enables producers to consume sweet potato recommended by extension officers as well as produce products that match products demanded by consumers.

#### **5.4 Recommendations**

The study makes the following recommendations based on the study conclusions.

- i. There is urgent need to promotion upgrading of value-added sweet potato products from primary value-added products to secondary and tertiary value-added products such as flours to encourage farmer investment in sweet potato production and consumer demand.
- ii. Plant breeding programs should focus on developing sweet potato products consider traits that are preferred by both producers and consumers to stimulate both farm level and market level demand.
- iii. The extension system be strengthened to deliver market-driven value-added sweet potato processing technologies to farmers to encourage upgrading of sweet potato production at farm-level to meet the dynamic consumer demands.

#### **5.5 Suggestion for Further Research**

The study highlights sweet potato varieties produced and consumed by farmers and consumers, as well as the traits they consider when selecting sweet potato products to consumer. The study also determined the role of extension system in aligning sweet potato production to what is demanded by consumers. However, there are still gaps that the study did not address. Thus, the following areas of future research are suggested by the researcher.

- i. Examine constraints experienced by producers in engaging in on-farm value addition of sweet potato.
- ii. Use regression model to establish influence of socioeconomic and institutional factors extension education on value addition of sweet potato products. Perform gendered preferences of sweet potato.
- iii. Participatory variety selection where farmers and producer participate in selecting preferred traits.
- iv. Evaluation of nutritional components of different sweet potato varieties and their importance in the human diet.



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## APPENDICES

### Appendix A: Questionnaire for Consumers of Sweetpotato

#### Introduction

I am Indah Akoth a student at Egerton University pursuing a Masters in Agricultural Extension, I am conducting a study on *Contribution of extension service provision towards Sweetpotato utilization among consumers*. I hereby ask for your support in giving out the information related to the study. The intention of this study is purely academic. Your response will assist in gearing towards enhancing the utilization of Sweetpotato. Any information shared will be kept CONFIDENTIAL and will only be used for this study.

1. Gender of the Sweetpotato consumer    i) Male [   ]        ii) Female [   ]
2. Age of the Sweetpotato consumer \_\_\_\_\_years
3. County of residence  
  i) Homabay County [   ] ii) Kisumu County [   ]
4. Sub county of residence  
  i) Rachuonyo East [   ] ii) Rachuonyo South [   ] iii) Ndhiwa [   ] iv) Kisumu Central [   ]
5. Marital status of Sweetpotato consumer  
  i). Married [   ] ii). Single [   ] iii). Others (Specify) \_\_\_\_\_
6. Highest level of education of the Sweetpotato consumer  
  i). Never been to school [   ]    ii). Primary School [   ] iii). Secondary School [   ]  
  iv). College and above [   ]
7. a) Variety of Sweetpotato you buy from the market?  
\_\_\_\_\_
- b) What are the colour of the variety?  
  i) Uncooked \_\_\_\_\_    ii) Cooked \_\_\_\_\_
8. What is the reason for choosing the specific Sweetpotato variety  
\_\_\_\_\_
9. What are the trait you consider while buying different Sweetpotato varieties  
  i) Colour [   ] ii) Smell [   ] iii) Taste [   ] iv) Floury [   ] v) Texture [   ]  
  vi) Others (Specify) \_\_\_\_\_
10. Does extension training cover Sweetpotato products and their traits  
  i) Yes [   ]    ii) No [   ]

11. Would you support consumers are to receive training on Sweetpotato varieties, products and methods of preparation?

i) Yes [ ] ii) No [ ]

12. Give reason why you feel it is necessary

13. What information would you wish to receive on Sweetpotato along the value chain to improve its utilization

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14. What should be the focus point for extension service providers along the Sweetpotato value chain to ensure rise in the product utilization

15. a) Tick the products of Sweetpotato that you buy

i) Raw Sweetpotato [ ] ii) Baked products [ ] iii) Steamed or boiled products iv) Fried Sweetpotato products [ ] v) Sweetpotato flour [ ] iv) Others (Specify)

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b) Which method do you use when preparing of the final product?

i) Boiling [ ] ii) Steaming [ ] iii) Roasting [ ] iv) Baking for other products [ ] v) Others (Specify) \_\_\_\_\_

c) What are the cooking characteristics of the Sweetpotato based on cooking characteristics?

i) Cook quickly [ ] ii) Taste sweet [ ] iii) Appealing color [ ] iv) Others (Specify)

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16. Does this products of Sweetpotato satisfy your needs as a consumers

i) Yes [ ] ii) No [ ]

17. What are the reason for your answer in above?

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## Appendix B: Questionnaire for Farmers

### Introduction

I am Idah Akoth a student at Egerton University pursuing a Masters in Agricultural Extension, I am conducting a study on *Contribution of extension service provision towards Sweetpotato utilization among consumers*. I hereby ask for your support in giving out the information related to the study. The intention of this study is purely academic. Your response will assist in gearing towards enhancing the utilization of Sweetpotato . Any information shared will be kept CONFIDENTIAL and will only be used for this study.

1. Gender of the respondents i) Male [ ] ii) Female [ ]
2. County of residence  
i) Homabay County [ ] ii) Kisumu County [ ]
3. Sub county of the respondents  
i) Rachuonyo East [ ] ii) Rachuonyo South [ ] iii) Ndhiwa [ ] iv) Kisumu Central [ ]
4. Age of the respondents \_\_\_\_\_ years
5. Marital status
6. i). Married [ ] ii). Single [ ] iii). Others (Specify) \_\_\_\_\_
7. Highest level of education
8. i). Never been to school [ ] ii). Primary School [ ] iii). Secondary School [ ] iv). Collage and above [ ]
9. What is the total size of your land \_\_\_\_\_ acres
10. What size of your land is under Sweetpotato \_\_\_\_\_ acres
11. Which variety of Sweetpotato do you cultivate  
i) Variety 1 \_\_\_\_\_  
ii) Variety 2 \_\_\_\_\_  
b) What is the flesh/inside color and the skin color?  
i) Variety 1 a) Flesh color \_\_\_\_\_ ii) Variety 2 a) Flesh color \_\_\_\_\_  
b) Skin color \_\_\_\_\_ b) Skin color \_\_\_\_\_
12. What are the reasons for selecting the specific Sweetpotato varieties  
i) Market availability/high demand [ ] ii) High yielding [ ] iii) Perform well in the area iv) Others (Specify) \_\_\_\_\_
13. What is the duration that the specific variety take in the field  
i) Variety 1 \_\_\_\_\_

ii) Variety 2 \_\_\_\_\_

iii) Variety 3 \_\_\_\_\_

14. From your own records which variety are preferred by consumer?

\_\_\_\_\_

15. What are the products you make out of Sweetpotato ?

i) Raw Sweetpotato [ ] ii) Baked products [ ] iii) Steamed or boiled products [ ] iv) Fried Sweetpotato products [ ] v) Sweetpotato flour [ ] iv) Others (Specify)

\_\_\_\_\_

16. Where do you sell the products

i) Local market [ ] ii) Urban market [ ] iii) International markets [ ]

17. a) Indicate the sources of extension services on Sweetpotato

i) County government [ ] ii) Research institutions [ ] iii) Media [ ] iv) Community Groups [ ] v) Others (Specify).....

b) Have you been visited by extension service providers in your farm?

i) Yes [ ] ii) No [ ]

c) How often do you seek advice on Sweetpotato 1= very often 2= often 3=sometimes 4=Never 5 =Not sure

18. What kind of information are normally discussed

i) Production of Sweetpotato [ ] ii) Marketing of Sweetpotato [ ] iii) Sweetpotato value addition techniques [ ] iv) Book-keeping & accounts [ ] v) Others (Specify)

\_\_\_\_\_

19. What are the areas along the Sweetpotato value chain that extension officers should address to ensure improved utilization

\_\_\_\_\_

\_\_\_\_\_

20. From your own opinion has extension played a role in utilization of Sweetpotato products

i) Yes [ ] ii) No [ ]

21. If yes, Please select from below how extension has played this role in utilization?

i) Link farmers with value addition experts [ ]

ii) Advise on the varieties that consumers buy at the market [ ]

iii) Organize market for value added products [ ]

iv) Help in improving production of Sweetpotato i.e. importance of mature roots [ ]

v) Train farmers how to make marketable Sweetpotato products [ ]

vi) Others (Specify) \_\_\_\_\_

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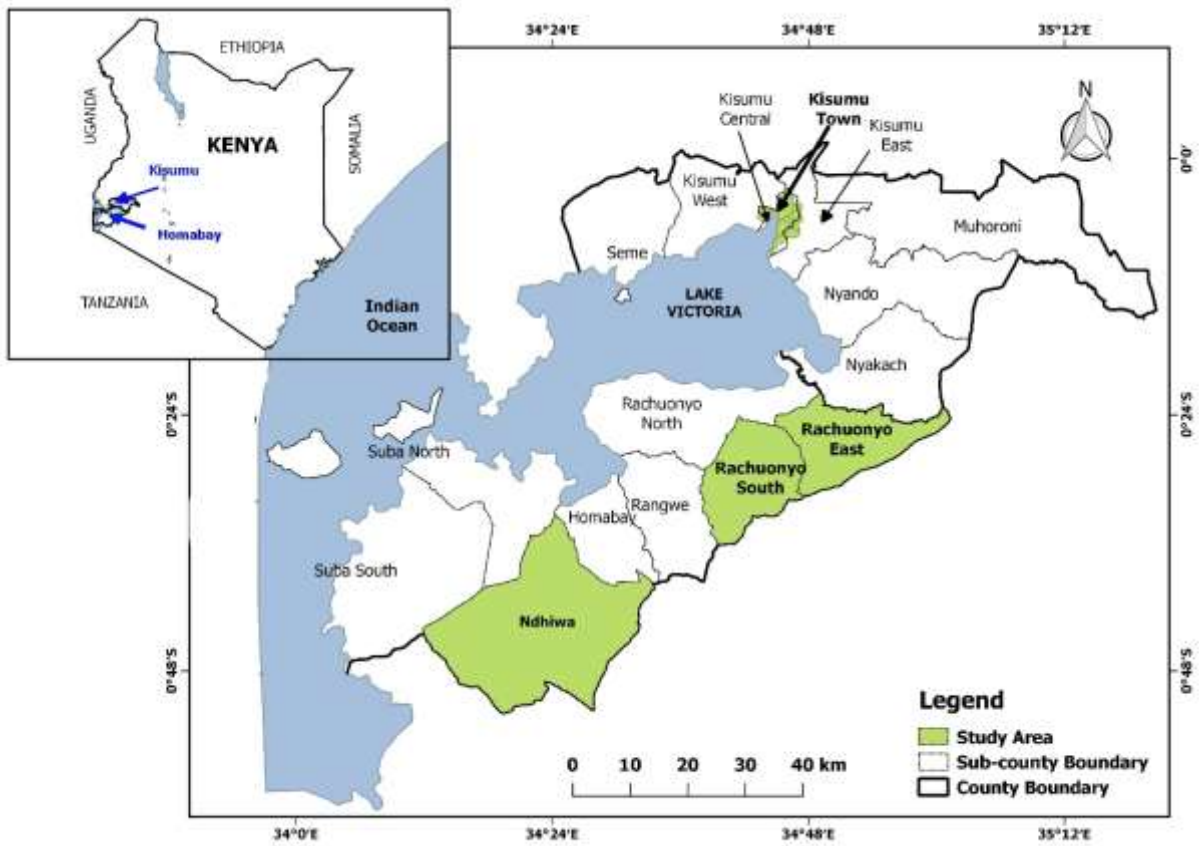


### **Appendix C: Interview Schedule for Key Informants**

1. State your role in the Sweetpotato value chain: \_\_\_\_\_ Period (Years): \_\_\_\_\_
2. a) What are varieties of Sweetpotato that you deal with?  
b) Why that variety (s)?
3. What are the reasons for selecting the specific Sweetpotato varieties:
4. Does what you do relate with the consumers consumption pattern? How?
5. How do you ensure that the consumers receive the results of the work you do to increase the consumption of the Sweetpotato ? If any.
6. Do consumers consider the sensory trait of the Sweetpotato before consuming them? Why?
7. a) Who are the customer or consumer for Sweetpotato  
b) Where do the consumers obtain Sweetpotatoes and the products for those varieties you deal with?
9. a) Indicate source of agricultural extension services on Sweetpotato  
b) What kind of activities that are carried out by extension agents on Sweetpotato ?
8. How do you ensure that farmers receive extension services on Sweetpotato traits preferred by the consumer's?

**Thank you for your time.**

## Appendix D: Map of Homabay and Kisumu Counties



Source; IEBC 2019

## Appendix E; Research permit

  
REPUBLIC OF KENYA

  
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**This is to Certify that Miss.. Idah Akoth Omondi of Egerton University, has been licensed to conduct research in Homabay, Kisumu on the topic: Contribution of Extension Services Towards Sweet Potato Product Utilization Among Consumers in Homabay and Kisumu Counties, Kenya for the period ending : 19/March/2021.**

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## Appendix F; Published paper



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### ABSTRACT

The concept of extension services has changed over time with technology playing a key role, more emphasis is being placed on expanding the skills and knowledge of farmers in achieving food security and creating more proficient food products that meet consumer demand. Farmers and consumers utilize sweet potato in different ways, including boiling, steaming, roasting and frying the fresh roots. However, it remains unknown whether what is produced by farmers align to what is demanded by consumers and the role of extension in bridging the demand-supply gaps if it exists. Thus, the study assessed the role of extension in promoting sweet potato product utilization among farmers and consumers in Homabay and Kisumu County of Kenya. Mixed sampling procedures were applied to select 120 respondents who participated in the study: 52 farmers and 68 consumers of sweet potato. Data collected using a semi-structured questionnaire were cross-tabulated and responses subjected to independent samples t-test and chi-square test of significance. The results revealed SPK 004 and SPK 20 as the most planted and consumed varieties. There were significant differences in sweet potato trait preference between farmers and consumer. While significantly higher percentage (73%) of farmers considered colour when selecting varieties to produce for domestic sale and domestic consumption, equal percentage (43%) of consumers preferred colour and taste. Raw sweet potato was the most produced and bought sweet potato product for consumption with no significant differences by respondent type and county. Salient find of the study was that extension mediated sweet potato products produced, marketed, and consumed by farmers and consumers. Sweet potato products demanded by consumer matched products that were produced, sold, and consumed by farmers. Therefore, extensionist should be strengthened to effectively promote and dissemination sweet potato varieties and products with desirable traits both to farmers and consumers.

**Key words:** Sweet potato products, Extension role, Utilization, Consumer, Farmer, Value-added- products