INFLUENCE OF SELECTED SOCIO-ECONOMIC FACTORS ON COMMERCIAL PRODUCTION OF AFRICAN INDIGENOUS VEGETABLES AMONG SMALLHOLDER FARMERS IN BOBASI SUB-COUNTY, KENYA

HYVONNE WINNIE KEMUNTO

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EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

I hereby declare that the Thesis is my original work and has not been presented for any award of diploma or degree in any other tertiary institution.

Signature…… Date: 4/10/2024

Hyvonne Winnie Kemunto

ESM12/01011/19

Recommendation

This thesis has been submitted for examination with our approval as the University Supervisors

Signature:…… Date: 4/10/2024

Dr. Agnes Oywaya-Nkurumwa, PhD

Department of Agricultural Education and Extension

Egerton University

Signature ……. Date: 4/10/2024

Dr. Lydiah Mbula Kitonga, PhD

Department of Agricultural Sciences

Kisii University

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DEDICATION

This thesis is dedicated to my mother Sophiah Bonareri Mageka, and my siblings, Dr. Cliffland Mosoti, Hindrah Sylviah and Brandy Daizy, for their unwavering support and motivation that made the master journey a success.

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ABSTRACT

African Indigenous vegetables (AIVs) play a significant role among smallholder farmers by promoting food and nutrition security and improving income. Despite the benefits, the production of AIVs in Bobasi Subcounty, is fairly low as most farmers primarily produce for subsistence. This study focused on selected socio-economic factors that may have an influence on the commercial production of African indigenous vegetables among smallholder farmers in Bobasi. The purpose of this study was to determine the influence of age, income level, size of farm, and education level on the commercial production of AIVs. A descriptive survey research design was used. The study targeted 6,341 smallholder commercial AIVs farmers from two wards in Bobasi Sub-County. The accessible population was 2,363 Commercial AIV farmers. Proportionate random sampling was used to select 154 commercial AIVs farmers from two purposively selected wards. Data was collected using a semi- structured questionnaire, key informant interviews and focus group discussion which were validated by research experts from the Department of Agricultural Education and Extension of Egerton University and Department of Agricultural Sciences of Kisii University. Reliability of the instruments was determined through a pilot study that was conducted in Kitutu Chache South Sub-County, Nyakoe Ward, where a questionnaire was administered to 30 smallholder commercial AIVs farmers. Cronbach Alpha was used to estimate the reliability. An alpha coefficient of 0.745 was obtained and accepted, as it met the minimum threshold of 0.7 recommended for social sciences. Descriptive statistics were used for data analysis using Statistical Package for Social Sciences (SPSS) version 25. The study found that 49.4% of farmer respondents perceive education as a significant factor in influencing the decision to participate in AIV commercial production, 71.4%, agreed that their education significantly influenced their capability to analyze market demand trends. The study also found that 71.4% perceived that income level influences farm size for AIV production, 85% acknowledge that farm size significantly influences choice to engage in commercial AIV production and 64% acknowledge age's positive influence in regard to AIV production. Based on the study's findings, education level, age, income level and farm size positively influence commercial production of AIVs. It is therefore recommended that private and public stakeholders should collaborate to provide training aimed at improving farmers' knowledge, Extension officers should organize knowledge sharing sessions between younger and older farmers, county should establish value-adding projects, market links, and financial services accessibility, Policy makers should formulate policies that will increase market demand, manage resources, and make informed decision regarding farm size.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIVs: African Indigenous Vegetables

EU: European union

FAO: Food and Agriculture Organization

FGD: Focus Group Discussion

GDP: Gross Domestic Product

KNBS: Kenya National Bureau of Statistics

SPSS: Statistical Package for Social Sciences

SGDS: Sustainable Development Goals

TPB: Theory of Planned Behavior

PU: Perception of Usefulness

TA: Technology adoption

CHAPTER ONE

INTRODUCTION

Background Information

The production of African Indigenous Vegetables (AIVs) holds significant importance in promoting food and nutrition security and improving income among smallholder farmers. This is particularly is critical in Sub-Saharan Africa, where the population is expected to grow by 2 billion people by 2050 (Bremner, 2012). Therefore, most African countries have laid efforts to promote food security and reduce malnutrition without excessive gain in body weight by promoting sustainable agriculture farming practices like use of organic farming in production of African indigenous vegetables (Weller *et al.,* 2017).

Many African indigenous vegetables (AIVs) have high nutritional and medical value thus linking between agricultural production and improved community nutrition and human health. The nutritional importance of AIVs is undeniable if well preserved. For instance, fermented AIVs have improved minerals, vitamins, and proteins. In addition, they increase synthesis of important blood pressure regulators that protect the body against cardiovascular diseases and cancer (Lara *et al.,* 2020). Proper post-harvest care and storage of the vegetables can increase their shelf-life and health benefits.

Globally, the production of AIVs is gaining traction as these crops are recognized for their resilience and adaptability to local climates, particularly in Africa and parts of Asia. While the global production remains largely localized, smallholder farmers in Africa account for the majority. These vegetables contribute significantly to food security and income generation in many African countries, where they are cultivated both for subsistence and commercial purposes, contributing to local economies (Pagano *et al.,* 2021)). Moreover, AIVs serve an important role in promoting biodiversity and sustainable agriculture practices in these regions.

In Kenya, the production of AIVs is significant, with various species being cultivated across the country. Priority species such as African nightshade (Solanum scabrum), leafy amaranth (Amaranthus spp.), spider plant (Cleome gynandra), cowpeas (Vigna unguiculata), mitoo (Crotalaria ochroleuca and C. brevidens), and pumpkin leaves (Cucurbita maxima and C. moschata) are not only grown for home consumption but also for sell in rural and urban areas (Kebede & Bokelmann, 2017). Despite the importance of AIVs, their production has faced challenges, leading to decline in both area and volume from 98,940 hectares in previous years to 54,235 hectares in 2020 (Agriculture Food Authority, 2020).

This decline has also affected the market value of AIVs. The total production has decreased from 374,489 tons to 303,666 tons between 2019 and 2020, reflecting a decline in

both area and volume. The reduction in production has also led to a decrease in the market value of AIVs, from Ksh 10.25 billion to Ksh 8.94 billion during the same period (Agriculture Food Authority, 2020).These trends highlight the challenges facing the commercial production of AIVs, despite their importance for food security and income generation in the region. Climate variability, market accessibility, and limited farming resources all contribute to the sector's downfall, demanding targeted efforts to resuscitate.

Most farmers growing indigenous vegetables in Kenya are in rural areas and majority grow the vegetables for commercial purposes whereby they sell locally to neighbors or transport to urban areas for sale (Abukutsa, 2017).Women have been found to have more knowledge and skills in conducting agronomic practices on AIVs as compared to men and youth. Therefore, marketing of the vegetables is dominated by women (Dinssa *et al.*, 2016). The youths in Kenya majorly participate in exotic vegetable farming due to the perception that the AIVs are meant for women.

The youth have limited skills in managing and planning for commercializing some AIVs like the spider plant especially during harvesting. Due to the delicate foliage of spider plants, harvesting them requires certain abilities, including trimming and knowledge of plant anatomy to determine the proper cutting locations. (Mwema & Crewett, 2019) noted that most youths perceive some AIVs to be bitter thus they opt to produce exotic crops for commercial production .The shift toward exotic crops indicates a need for youth-focused training and support to improve skills in AIV growing and commercialization.

Despite these challenges, Kisii and Nyamira Counties remain pivotal in AIV production. According to Agriculture Food and Authority (2020), these Counties contributed significantly to the production value of AIVs with Kisii and Nyamira leading at 16.8 and 13.3 percent of the total value in 2020, respectively. Although, the area and value of Spider plant in 2020, decreased by 8 and 2 percent respectively. The overall acreage increased by 3 percent from 35,295Ha in 2019 to 36,436Ha in 2020. The good rainfall in the main production areas of the Nyanza region is attributed to increase in acreage.

Spider plant is gaining popularity especially in urban areas partly because the crop does not require use of pesticides making the consumers consider it safe and healthy. According to (Agriculture Food and Authority, 2019), in 2020, Kisii and Nyamira counties led in production value of spider plant with 36436Ha producing 160,000 tons valued at Kshs.1.5 billion Black night shade, also experienced a notable production level with 3,228Ha producing 38,175 tons valued at Kshs.831.1 million. Leaf Amaranth, known for its high iron content, saw a decrease in production with an acreage of 2,500 hectares and a yield of 25,000 tons valued at Kshs. 550

million. Cowpeas, valued for their protein content, had an area of 2,600 hectares, producing 26,000 tons valued at Kshs.650 million. This represented a decrease in acreage and value by 19, 30 and 37 percent respectively compared to 2019.

Communities have relied on AIVs as a significant source of livelihood since the beginning of time (Wemali & Ed, 2014). The advantages of AIV production include, short production cycles, the need for a small number of purchased inputs, adaptability to local tastes, resistance to pests and diseases, and able to grow in less rich soils are advantages (Ekesa *et al.*, 2009). Additionally, AIVs generate large yields with a significant nutritional value and are ideally suited to the small plots and limited resources of village residents (National Research Council, 2006).

In addition to these agricultural benefits, socio-economic factors such as education level, age, income level, and farm size play a crucial role in the commercial production of AIVs. Age, for instance, significantly influences commercial production outcomes, with younger farmers being more open to new technologies. They also have better access to modern information channels such as social media. For instance, a study in Germany on exploring the adoption of agricultural practices revealed that younger farmers have greater access to farming technologies compared to older farmers, who rely more on traditional information sources from other farmers (Barnes *et al.,* 2019).

Young and formally educated farmers in the Netherlands were found to be great up-takers of agricultural skills, since they were found to be aware of market risks and make decisions in opportunity costs (Barnes *et al.*, 2019). Conversely, in China, the commercial production of the Litchi crop is influenced by the age and education level of the farmers. In this case, the majority of the farmers (90%) were aged above 47 and had around 22 years of experience in Litchi production. Older farmers with extensive experience were more inclined towards the commercial production of traditional crops like Litchi (Li *et al.,* 2019).

The level of education significantly influences commercial production. Studies from various regions has shown that farmers with higher formal education are more inclined to participate in commercial production. This is because they have a better grasp of market dynamics, agronomic practices, and the economic value of crops. For example, a study conducted in Nigeria to determine improvement of livelihoods of smallholder indigenous vegetable farming, revealed that commercial production of AIVs was farmer's education level and the farmer's awareness of the nutritive value of vegetables (Olowo *et al.*, 2022).

Farmers with formal education beyond secondary schools can understand market

dynamics and they are always willing to adopt new farming skills. The education level of a smallholder farmer influences the commercial production of AIVs whereas a farmer with secondary and university levels will easily uptake the practice of AIVs since they will be able to analyze agronomic practices, market dynamics and nutritive value (Angeli *et al.,* 2020). In Nigeria, the country is experiencing an increase in demand for food supply and farmers in rural areas are actively participating in the production of indigenous vegetables (Sharma *et al.,* 2020a).

A study conducted in Ethiopia on the role of education in household management revealed that farmers with tertiary education exhibited greater uptake of agricultural practices compared to those with lower educational levels (Melesse, 2018). Education affects farmers' awareness in decision-making. A study in Uganda on the influence of education level on the empowerment of farmers in decision-making revealed that, in households where a man is more educated, he tends to be more empowered, and this influences the decision-making process regarding crop production (Sell & Minot, 2018).

In addition, farmers' access to extension training greatly makes them aware of the high resistance of indigenous vegetables to pests and diseases (Prokopy *et al.,* 2019). Income level also directly influences farmers' ability to invest in and sustain commercial production. Higher-income allows farmers to purchase necessary inputs and incorporate new farming practices, thereby enhancing productivity and market participation. In Zimbabwe, a study on the influence of AIVs on household income revealed that farmers growing AIVs such as cowpeas, pumpkin leaves, and spider plants generated more income per hectare compared to those growing exotic vegetables (Nyaruwata, 2019).

The size of the farm is crucial in determining the scale of commercial production. Larger farm sizes provide more space for agricultural diversification, enabling farmers to produce a variety of crops, including AIVs, for commercial purposes. In Kenya, farmers with larger landholdings were more likely to engage in commercial AIV production as a means of supplementing household income (Hackfort *et al.,* 2023). Increased land availability enables better resource allocation, such as labor and money, which improves productivity and market competitiveness in AIV production.

Access to Extension training plays a role in commercial production. A study in South Africa on understanding adaptive capacity of smallholder AIV farmers revealed that through extension agents, farmers had marketing groups and they were able to share information on production, preservation and consumption (Chepkoech *et al.,* 2020a). In addition, the growth of commercial AIVs have a significant factor in controlling some dietary diseases like anemia

and eye problems which often affects children and geriatrics especially in low-income countries (Nyaruwata, 2019).

Kisii County is among the leading producers of (AIVs) such as African nightshade, spider plant, and leaf amaranth, which significantly contribute to Kenya's agricultural sector (Agriculture Food Authority, 2022). However, the region is currently experiencing a decline in AIV production due to market exploitation by middlemen and other factors affecting production. This decline is negatively affecting farmers' income and productivity (Kisii County Government CIDP, 2020). The reduction in AIV production has also lowered the availability of these nutrient-rich commodities in local markets, affecting both food security and the livelihoods of Kisii County's smallholder farmers.

Bobasi Sub-county in Kisii plays a key role in AIV production, highlighting its importance in the county's agricultural landscape (Kisii County Government, 2018). However, there is limited research on the specific socio-economic challenges faced by smallholder farmers in this area, particularly concerning yield levels and commercialization. Understanding how socio-economic factors such as education level, age, income level, and farm size influence commercial AIV production is crucial. This study focused on these factors because they have been found to significantly influence agricultural production according to existing literature. These factors may affect farmers' ability to shift from subsistence to market-oriented farming.

Statement of the Problem

Kisii County is one of the main producers of African Indigenous Vegetables (AIVs) in Kenya, making it one of the key hubs for AIVs supply in the country. Despite the County's established prominence in AIV production, the commercial production of AIVs in Bobasi Sub-county is fairly low as most farmers produce for subsistence. Various factors have been found to influence the uptake of commercial production of agricultural commodities, among them socio-economic factors. Therefore, this study sought to investigate the influence of selected socio-economic factors namely; education level, income level, age, and farm size on the commercial production of AIVs in Bobasi Sub-county. Understanding the influence of these factors is essential to bridging the existing gap and enhancing the commercial viability of AIV farming in the region.

Purpose of the Study

The study aimed at determining the influence of selected socio-economic factors on commercial production of African indigenous vegetable among smallholder farmers in Bobasi

Sub- county, Kisii County Kenya.

Objectives of the Study

The objectives of this study were to determine:

i. The influence of education level on commercial production of African Indigenous vegetables among smallholder farmers in Bobasi Sub-County.
ii. The influence of age on commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County.
iii. The influence of income level on commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County.
iv. The influence of size of farm on commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County.

Research Questions

The following research questions guided the study;

i. How does education level influence commercial production of African Indigenous vegetables among smallholder farmers in Bobasi Sub-County?
ii. In what ways does age influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?
iii. To what extent does income level influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?
iv. What role does size of farm influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?

Significance of the Study

The findings of this study had several implications. Firstly, they are likely to assist extension service providers in understanding how education level affects the commercial production of AIVs. Identifying the specific educational requirements or gaps that may hinder or enhance farmers' ability to engage in commercial AIVs production. Extension service providers are likely to develop targeted educational programs and interventions to address these needs. This may ultimately contribute to the improvement of smallholder farmers' knowledge and skills, enabling them to engage more effectively in commercial AIVs production.

Secondly, the study aimed to explore the influence of age on the commercial production

of AIVs. Understanding how age influenced farmers' involvement in commercial AIVs production may help extension service providers tailor their approaches and recommendations based on the different needs and capabilities of farmers at different life stages. This knowledge is likely to lead to the development of age-specific interventions or support systems that encourage and enable smallholder farmers of varying ages to participate in commercial AIVs production.

Thirdly, the study sort to investigate the influence of income level on the commercial production of AIVs. By examining the relationship between income and farmers' engagement in commercial AIVs production. The study is likely to provide insights into the economic barriers or incentives that may exist. This information is likely to guide the development of financial support mechanisms, access to credit, or market linkages that are likely to help smallholder farmers overcome financial constraints and establish sustainable commercial AIVs enterprises.

Additionally, the study aimed to assess the influence of farm size on the commercial production of AIVs. By examining the dynamics associated with farm size and identifying potential challenges or opportunities related to different land sizes in the context of AIVs production. The study findings informed the development of strategies tailored to the available land resources. This involved optimizing land use efficiency, addressing constraints associated with varying land sizes, and creating an enabling environment that encourages efficient and sustainable AIVs production across different land scales.

Scope of the Study

This study focused on smallholder farmers participating in commercial production of AIVs in Bobasi Sub-County, Kisii County, Kenya. This study location was considered because it was where most AIVs were produced both for subsistence and market purpose. The selected factors were limited to; the farmer’s education level, age, income level, and size of farm. These factors were selected for their potential influence on agricultural productivity and commercialization. Education level was expected to influence farmers' knowledge and uptake of improved agricultural practices, while age may affect farming experience and decision-making. Income level can determine the ability to invest in farming inputs, and farm size directly influences the scale of production The study also focused on commercial production of AIVs as the dependent variable, which was characterized by the amount of money earned from sale of AIVs per acre over the last three months.

Assumptions of the Study

The study assumes that:

i. The smallholder Commercial AIV farmers in Bobasi were willing to provide the required and reliable information.

ii. The AIVs were produced by smallholder farmers in the Sub-county.

Limitations of the Study

This study was limited in the following ways:

i. Difficulty in getting accurate records on production per acre due to poor record keeping by smallholder commercial AIVs farmers. However, the researcher overcame this limitation by including other data collection methods. This included, engaging key informants and conducting focus group discussion. These methods helped establish the credibility of the data and ensured validity of the study findings and were used for triangulation.

ii. The study focused only on smallholder commercial AIV farmers in Bobasi Sub-county; hence, the results could not be generalized to all AIV farmers in Kenya.

Definition of Terms

The following terms were defined in the context of the study:

African indigenous vegetables: African Indigenous Vegetables (AIVs) are plants that are native or whose leaves had been used for long time as vegetables hence becoming part of the culture and tradition of the community (Ngenoh *et al.,* 2019a).This study adopted this definition. In this study, AIVs included Spider plant, Black nightshade, Amaranth, and Cowpea leaves. These plants were grown by smallholder farmers in Bobasi Sub-county to generate income.

Age: Age is the number of years an individual has lived (Ntawuruhunga *et al.,* 2020a). In this study, it referred to the actual number of years which a farmer has lived. The respondents were categorized into specific age groups: children (below 18 years), youth (18-34 years), middle-aged adults (35-64 years), and the elderly (65 years and above). Also, it focused on the duration of involvement in AIV farming.

Commercialization: The process of transforming ideas, knowledge, and innovation into greater wealth for individuals and society at large through tangible goods or services that may be marketed (Flores *et al.,* 2019). In this study, commercialization refers to the transition from producing AIVs primarily for subsistence to producing them with the intention of selling to generate more income.

Commercial production: The production of a product for income generating purposes (Mutisya,, 2014). In this study Commercial production referred to the amount of money earned from the sale of AIVs per acre within a period of three months.

Education level: The formal stages of learning achieved by an individual, ranging from primary education to tertiary institutions (Melesse, 2018). In this study, education level referred to the highest level of formal education attained. It was categorized as no formal education, primary, secondary, college and university levels of education of the respondents.

Household: A household was a group of people who lives and eat their meals together, a person or a group of people living in the same compound answerable to the same head (KNBS, a2019). This study adopted this definition.

Income level: The level of household earnings from various sources including wages, salaries, profits and agricultural sales (Olowo *et al.,* 2022). In this study, income level referred to the respondent's household earnings from various sources. It was categorized into three groups as low income, middle income, high income level of the respondents according to their earnings.

Influence: The capacity to have an effect on the character, development, or behavior of someone or something or the effect itself (Liotsiou *et al.,* 2016). In this study, influence refers to the capacity of socio-economic factors such as age, education level, farm size, and income level to shape a farmer's decision to engage in commercial AIV production.

Smallholder farmers: These are farmers who farm on less than 2 hectares (5 acres) of land (Taskin *et al.,* 2021a). For this study, smallholder farmers comprised of common African indigenous vegetable farmers who owned and/or lease land less than 0.8 hectares (2 acres).

Selected factors: Refers to specific variables or conditions that are deliberately chosen for examination in a study because they are believed to influence the outcome (Ngoya *et al.,* 2023a). In this study, selected factors referred to the socio-economic variables used to assess the farmers influence on commercial AIV production among smallholder farmers. They included age of the farmer, size of farm, education level of the farmer and farmers' income level to determine their influence on commercial AIV production among smallholder farmers.

Socio-economic factors: These are aspects of an individual's or group's social and economic conditions that influence their ability to participate in and benefit from economic activities (Tey *et al.,* 2014). In this study, socio-economic factors included age of the farmer, size of farm, education level of the farmer and farmers' income level.

Type of market: This is the classification of markets based on characteristics that distinguish them from one another like product brought and sold there, structure of the market and mechanisms of exchange (Muflikh *et al.,* 2021). In this study, type of market included local market, urban market, middlemen, directly to cities and resellers.

Uptake: This is the continued use of information after individuals of a social system had been introduced to it as part of course action for addressing a particular need (Dzvene *et al.,* 2022a).In this study, it implied the acceptance and sustained growing of African indigenous vegetables commercially by small scale farmer.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provided an overview of recent research related to commercial production of African Indigenous Vegetables (AIVs). The review had been divided into thematic headings which include; The commercialization of vegetables, the importance of African Indigenous Vegetable, Education level on commercial production of African Indigenous vegetables, influence of age on commercial production of African indigenous vegetables, influence of income level on commercial production of African indigenous vegetables and influence of farm size on commercial production of African indigenous vegetables. It also presented the theoretical framework and conceptual framework used in setting of independent variables and the dependent variables for the study.

2.2 Production of African Indigenous Vegetables in Kenya

The production of AIVs in Kenya held significant importance due to their nutritional and agricultural benefits. AIVs are rich in essential vitamins, minerals, and bioactive compounds, making them valuable in addressing malnutrition and dietary deficiencies, especially among vulnerable communities (Bokelmann *et al.*, 2022a)). Additionally, AIVs have the potential to provide a diverse range of essential nutrients necessary for optimal health. Moreover, AIVs have adapted to local climatic conditions over generations, making them resilient crops capable of withstanding adverse weather conditions such as drought or pests. Their ability to thrive in diverse environments and their reduced input requirements compared to exotic vegetables make AIVs well- suited for small-scale farming systems. This enables farmers to produce these vegetables sustainably while minimizing the use of chemical inputs.

However, the production of AIVs in Kenya faces several challenges that influenced its full potential. Access to quality seeds remains a major hurdle for farmers. Traditional seed-saving methods lead to inconsistent yields and limited crop diversity (Owade *et al.*, 2020). Addressing this issue requires the availability and affordability of improved AIV seeds, promoting their adoption and ensuring their accessibility to farmers. Inadequate agricultural practices pose another challenge. Some farmers lack knowledge and training in modern techniques specific to AIV cultivation (Ntawuruhunga *et al.*, 2020b). Improved agronomic practices, such as proper land preparation, crop rotation, irrigation, and pest management, were crucial for maximizing AIV production. Capacity building programs and extension

services play a pivotal role in disseminating knowledge and empowering farmers with the necessary skills. Post-harvest losses and limited market access also hinder AIV production in Kenya (Agnew *et al.,* 2021). AIVs were highly perishable, and inadequate post-harvest handling facilities and infrastructure result in significant losses. Additionally, limited market linkages and value chain development restrict farmers' income and motivation to produce AIVs. Enhancing post-harvest management, establishing efficient distribution networks, and fostering market development were crucial steps to address these challenges.

To boost the production of AIVs in Kenya, concerted efforts were being made. Research and development initiatives involving agricultural research institutions, government agencies, and non- profit organizations focused on developing improved AIV varieties, disease-resistant strains, and climate-smart agricultural practices tailored to local conditions. These efforts aim to enhance productivity, increase yields, and improve the overall resilience of AIVs (Mung'Athia, 2020). Capacity building and extension services were also being provided to farmers. Training programs offer knowledge and skills in AIV production, post-harvest management, value addition, and marketing. Empowering farmers with the necessary tools and information helps them adopt best practices, enhance productivity, and improve the quality of AIV produce and promote commercialization of AIVs.

2.2.1 Importance of African Indigenous Vegetables

The cultivation of AIVs has a number of benefits to many Sub-Saharan farmers like being a source of income to smallholder farmers, promoting food security, high nutritional value especially vitamins and fiber, medicinal value and a source of employment for especially for women who carry out agronomic practices (Yuan *et al.,* 2021). The AIVs had high levels of minerals especially calcium, iron and phosphorous. In addition, they contain high amount of proteins and vitamins like carotene and ascorbic acid.

In addition to their nutrition advantages, AIVs contained a medicinal value as they were bitter and some were known to treat stomach related ailments. For instance, the African spider plant had been known to aid constipation and facilitate birth while the African nightshade had been found to cure stomachache (Abukutsa, 2017). The economic impact of AIVs is also significant. For instance, in South Africa, AIVs contributes greatly to food security and generating income for many households especially those existing in rural areas. In addition, the AIVs cultivation was associated with the Khoisan community who lived about 120,000 years ago who utilized and consumed AIVs for food, income and medical purposes (Mulaudzi *et al.,* 2019a).

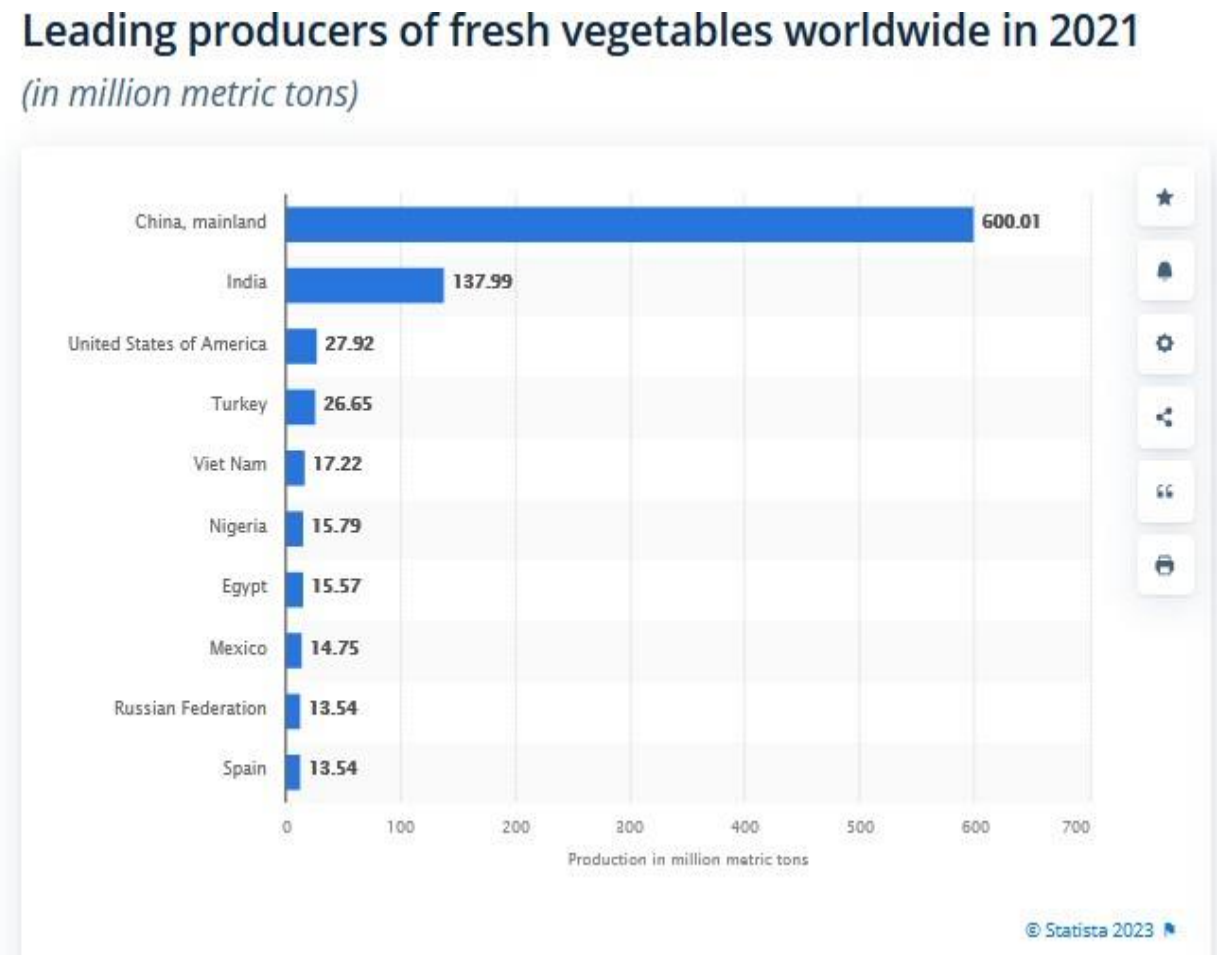
Similarly, in Ghana, agriculture contributes about 27% of Ghana's Gross Domestic Product (GDP) whereby it provides employment to 60% of farmers living in rural areas (Antwi-Agyei & Stringer, 2021). The AIVs growers were able to get their income from selling the vegetables both at community level and at the urban centers. However, majority of the farmers preferred selling the AIVs in the urban areas due to high demand and high prices.

In East Africa (Kenya and Tanzania), about 51% of pregnant and nursing women suffer from anemia while 30% of children of below 5 years were stunted and highly susceptible to infectious diseases. The consumption of African indigenous vegetables (AIVs) such as Africa nightshade, Amaranths, Crotalaria, Spider plant, Jute mallow, and African eggplant has been found to offer protection against non-communicable diseases. These vegetables are rich in micronutrients like iron, zinc, and Vitamin A, as well as non-nutrient substances (Richard *et al.,* 2017).

2.3 Commercialization of Vegetables

The need to achieve the Sustainable Development Goals (SDGs) had increased the demand for foods that helped achieve no poverty (SDG number 1), no hunger (SDG number 2) and good health and well-being (SDG number 3). The commercialization aspect helps reduce poverty and hunger because farmers who produce vegetables had a better livelihood. In addition, the vegetable consumption has high nutrient value thus significant in promoting human health and well-being once supplemented with other delicacies (Ocean *et al.,* 2019). Vegetables were a staple food in many regions of the world and were cultivated in about 200 different nations. The world's varied climates and topography make it possible to grow almost every type of vegetable. In total, the world's vegetable output was predicted to be 486 metric tons. The commercial uptake of vegetables in India stands at 137.99 million metric tons of vegetables each year as indicated by figure 1, making it the world's second-largest vegetable grower.

Figure 1: *Leading countries in Vegetable production globally in 2021*



Source: Statista (2023)

Due to the carbohydrates content they contain, many vegetable commodities may satisfy human calorie needs, and legume crops were an especially excellent supply of necessary amino acids. Vegetables, especially green ones, were an excellent source of nutrients like vitamins, minerals, and fiber (Ramya, & Patel, 2019). The function that vegetables play in improving the nutritional content of meals has the potential to grow. More widespread awareness of these foods' nutritious significance and a shift in eating patterns that benefited all people were two ways to get there, but notably those living on the edge of nutrition security. However, in poor countries, vegetable production was generallya distant second to that of high-calorie cereal crops (Rasul *et al.*, 2018).

Globally, China was the leading exporter of vegetables due to an increase of commercial uptakeof vegetables from 37.2 million in 1992 to 602 million in 2021. Bok choy, the most widely consumed vegetable in China, was known for its subtle sweetness and refreshing

crunch. Similar in appearance celery, this variety of cabbage was distinguished from the type by its loosely clustered leaves (Ji *et al.,* 2020). The leading of china in vegetable production has been favored by the support the government extends to farmers. In addition, the rural household farmers who make up the greatest population of china were actively participating in agriculture (Song & Robinson, 2020). In addition, availability of external markets for agricultural products has favored the Chinese farmers in vegetable production.

In Africa, Egypt ranks the second top country in vegetable production. For instance, in the year 2021, it exported 5.57 million metric tons of vegetables. The primary production of vegetables in Egypt surged from 4.14 million tons in 1972 to 15.6 million tons in 2021, representing an average yearly growth rate of 2.94% throughout that time period (El-Khalifa *et al.,* 2022). The most popular vegetables that Egypt has specialized in for both domestic and international market were eggplant, green peas, leeks, lettuce, chickpeas, beans tomatoes and onions. Farmers use riverbanks of river Nileto access water and the fertile soils, which were deposited in form of silts in their vegetable production (Abdelkader *et al.,* 2022).

A wide variety of vegetables, including onion, tomato, okra, pepper, amaranth, carrot, melon, Corchorus olitorus (ewedu), and Hibiscus sabdariffa (sobo), as well as Adansonia digtata, (baobab leaves were also grown. Despite the acreage Nigeria has in vegetable production, its commercialization has been observed to experience various challenges like land tenure security, low access to agricultural credit, pests and diseases and poor pricing of agrochemicals (Ibeawuch *et al.,* 2018).

Globally, AIVs production was based on conventional traditional production methods; very few farmers apply recommended agricultural practices such as improved seed varieties, irrigation and integrated pest management (Chagomoka *et al.,* 2014). Production of vegetables was carried in rural and peri-urban areas of most cities. AIVs were produced in peri-urban areas in cities like Accra (Ghana), Yaoundé (Cameroon), Kampala (Uganda), Abidjan (Côte d'Ivoire), Nairobi (Kenya) and Cotonou; Benin (Taskin *et al.,* 2021a).

The species of AIVs produced varies in various regions and countries due to differences in ecology and culture. Some species had widespread geographical distribution and were important food to some communities but considered inedible by others (Shackleton *et al.,* 2009). In West and Central African countries, the most common and popular AIVs were pumpkin leaves and wild spinach; in East and Southern Africa the African nightshade and spider plant dominate (Shackleton *et al.,* 2009). In Kenya, the most popular varieties were African nightshade, cow pea, amaranth and spider plant (Abukutsa-Onyango *et al.,* 2006;Mwaura *et al.,* 2014)

2.4 Influence of Education level on production of African Indigenous Vegetables

The level of education among farmers plays a significant role in the production and commercialization of AIVs. Studies revealed that education enabled farmers to engage in commercial production and adopt complex agricultural practices, which are necessary to satisfy market demands. A study conducted in Indonesia observed that the production of AIVs greatly depended on education level of the farmers. Farmers with formal education above secondary school were found to be active in commercial production of vegetables required in retails and supermarkets since they were aware of market demands in terms of the quality of farm produce that gives high returns in competitive markets. In addition, farmers with low formal education were found to produce vegetables, which they sold to their neighbors (Slamet *et al.*, 2017). Farmers with high formal education produce high quality vegetables since they understand signs and symptoms of various pests and diseases and their control. Educated farmers were able to interpret agronomical terminologies used in vegetable production.

In Tanzania, a study conducted in Monduli district by Kansiime *et al.* (2018) revealed that majority of the farmers growing AIVs had access to formal education. However, the women were found to be having an average of 8.8 years in formal education equivalent to lower secondary as per Tanzania education system. Men were found to be having more years of formal education compared to women. In production of AIVs, 78% of women were actively involved in production, consuming and selling their vegetables while for men, only 50% were actively involved in AIVs production.This study indicated a contrary implication on the influence of formal education on AIVs uptake among smallholder farmers.

The production of AIVs in kingdom of Eswatini was found to be influenced by farmer and consumer's education level. For instance, farmers with only primary level of education had a perception on AIVs as being bitter weeds thus they had less production of the same, compared to farmers with secondary and tertiary education level who were found to have more knowledge on AIVs in terms of nutrients and income (Masarirambi *et al.,* 2020). The production of AIVs such as amaranth (*Amarathus spp*.), African nightshade *(Solanum scabrum*), spider plant (*Cleome gynandra L*.), had been found to be influenced by awareness and high educational level of farmers in Zambia (Simon *et al.,* 2020).

These studies taken together, therefore, stress the need for education in promoting the commercial production of AIVs. However, there remains a gap on how the levels of education contribute to AIV commercialization in an area with diverse education background like Bobasi. This study aimed at filling this research gap by analyzing the relationship between farmers'

education levels and the commercial production of AIVs in Bobasi with the view of adding to the existing knowledge on education and agricultural commercialization.

2.5 Influence of Farm size on production of African Indigenous Vegetable

The size of the farm is one of the important factors that determines production and commercialization of AIVs.The relationship between farm size and agricultural productivity is well understood with varying effects observed from region to region and farming environment. A study conducted in Zambia by Ngenoh *et al.* (2019) revealed that farmers with small pieces of land often adopted a strategy of optimizing their limited space by focusing on a selected number of AIVs. This approach was driven by the aim of maximizing farm output and achieving higher returns on their investment. In regions where land resources were constrained, smallholder farmers face the challenge of making the most out of their available plots (Tarfasa *et al.,* 2018). By concentrating their efforts on a specific set of AIVs, these farmers allocated resources more efficiently. This included careful crop selection based on local demand and market prices, as well as implementing intensive cultivation practices.

In contrast, in Zimbabwe, the influence of land size on crop diversification varies widely, with larger land holdings typically linked to increased diversification and commercialization since they have the capability and capacity to allocate the land for different crops (Tarfasa *et al.,* 2018). This trend was often seen as larger farms had the resources and capacity to allocate land to various crops. However, exceptions exist, where larger farms specialize in high-value crops to manage risks effectively as depicted by a study by (Khanal *et al.,* 2020). Furthermore, the uptake of agricultural technology, such as improved farming practices and crop varieties, tends to be positively influenced by both farm size and the number of plots.

According to Kurgat *et al.* (2018)'s study conducted in Kenya, farmers with access to sufficient labour and capital often cultivate substantial areas for AIV production. Such larger-scale operations enable investment in essential resources like quality seeds, irrigation infrastructure, and labour, facilitating efficient management and expansion of AIV plots. Consequently, larger farms achieve greater crop diversity and higher yields, contributing significantly to food security and income generation. In addition, according to Bokelmann *et al.* (2022)'s study in Kenya smaller-scale farmers face resource constraints, limiting the extent of their AIV cultivation.

Despite potentially possessing indigenous knowledge and traditional farming practices, they were more vulnerable to weather and market fluctuations. These smallholders often

maximize productivity within their limited land by selecting AIV varieties tailored to local conditions and market preferences. Farmers who rely on rain fed agriculture frequently reduce their AIV cultivation area during dry periods. Water availability was critical for AIV growth, and the absence of irrigation infrastructure confines their cultivation to the rainy season. This cyclic approach to AIV production was particularly common in regions characterized by distinct wet and dry seasons, influencing year-round AIV supply (Krause *et al.*, 2019).

These studies collectively underscore the importance of farm size in determining the scale and profitability of AIV production. However, one is yet to understand how farm size in particular influence s on the commercial production of AIVs in the areas such as Bobasi Sub-county, Kenya, where the land resources and farming conditions may be different from other places. This study seeks to address the existing gap by analyzing the effects of farm size on the commercial production of AIVs in Bobasi, which is likely to add new knowledge to the effects of land resources on agricultural commercialization. Also, assist in the identification of measures that can be taken to assist smallholders to effectively utilize their limited land resources.

2.6 Influence of Farmers' age on production of African Indigenous Vegetables

Farmers age is among the factors that determine farming practices in agriculture and the production of AIVs. Various studies conducted in various countries demonstrated how age influences farming practices, the use of inputs and consequently, agricultural productivity.

Research conducted in the European Union (EU) by Barnes *et al.*(2019) showed that younger farmers are more likely to access and use information about farming technologies compared to older farmers. Younger farmers tend to utilize modern information channels such as social media, radio, and online platforms, which helps them increase their production acreage and adopt new agricultural practices. On the other hand, older farmers often rely on traditional farmer-to-farmer communication and are less exposed to these newer forms of information dissemination.

In China, age of the farmers was found to have either a positive or a negative influence on uptake of agriculture related farming practices in production of Litchi (Lychee) a traditional vegetable to Southern China. For instance, older farmers had high uptake of knowledge and skills related to production of litchi since they had been participating in the production while youths had been found to negatively influence the uptake of agronomic practices like grafting litchi since they perceive them to be crops for old and poor people. At the same time,

youths felt growing exotic vegetables they were more competent and exposed in agriculture than growing traditional vegetables (Li *et al*., 2019).

In Indonesia, the age of smallholder vegetable farmers was found to have an influence to uptake of various practices on vegetables. The young farmers were risk takers than old farmers. Therefore, the young farmers who attend extension meetings were found to be few as they took risk of getting agricultural information from other sources. Old farmers attended extension meetings frequently leading to production of high quality vegetables since old farmers mostly learn practically than youths (Maspaitella *et al.,* 2018).

In South Africa, a study by Mulaudzi *et al.*(2019a) on technical efficiency of African Indigenous Vegetable Production in Vhembe District of Limpopo Province revealed that age had a great significance on production and consumption of AIVs. For instance, the number of youths participating in AIVs production were only 17.7%. Age was directly proportional to experience thus old people had more skills in agronomic practices of AIVs than youths. In Kenya a study by Mshenga *et al.*(2016) revealed that age had a significant influence on adoption of agricultural skills. For instance, age measured the experience of the farmer whereby old farmers tend to had acquired hands on skills and considered uptake of AIVs. Young farmers adopted agricultural practices by taking risks since they applied education level in decision-making.

These studies collectively underscore the significant influence of age on the production of AIVs. However, there still remains a gap in understanding how age of farmers specifically influences the commercial production of AIVs in areas such as Bobasi where both traditional and modern practices are employed. This research aims to address this gap by exploring the role of farmers age in the commercial production of AIVs in Bobasi and therefore contributing new insights to the existing knowledge on how age affects commercialization and production of AIVs in the process.

2.7 Influence of Income level on production of African Indigenous Vegetables

The income level of farmers is a key factor that affects the production and marketing of African Indigenous Vegetables (AIVs). Farmers' ability to participate in commercial farming and adopt new agricultural practices is often closely linked to their income levels. This influences their capacity to invest in farming inputs and access better markets. In Indonesia, smallholder farmers growing vegetables had greatly increased due to availability of ready markets. Farmers who participate in commercial vegetable production prefer selling the

produce to supermarkets and urban areas due to high income as opposed to selling in rural areas where the demand for vegetables was low (Maspaitella *et al.,* 2018).

South Africa was among the countries whose farmers were active in AIVs production andconsumption. For instance, AIV species such as nightshade, Chinese cabbage, and pumpkin leaves were more prevalent in the Vhembe district of Limpopo province. In the last five years, the production of AIVs has doubled due to huge returns acquired by smallholder farmers in rural regions. For instance, 76.3% of farmers in Limpopo province engage in AIVs production in order to sell and generate income (Mulaudzi *et al.,* 2019a).

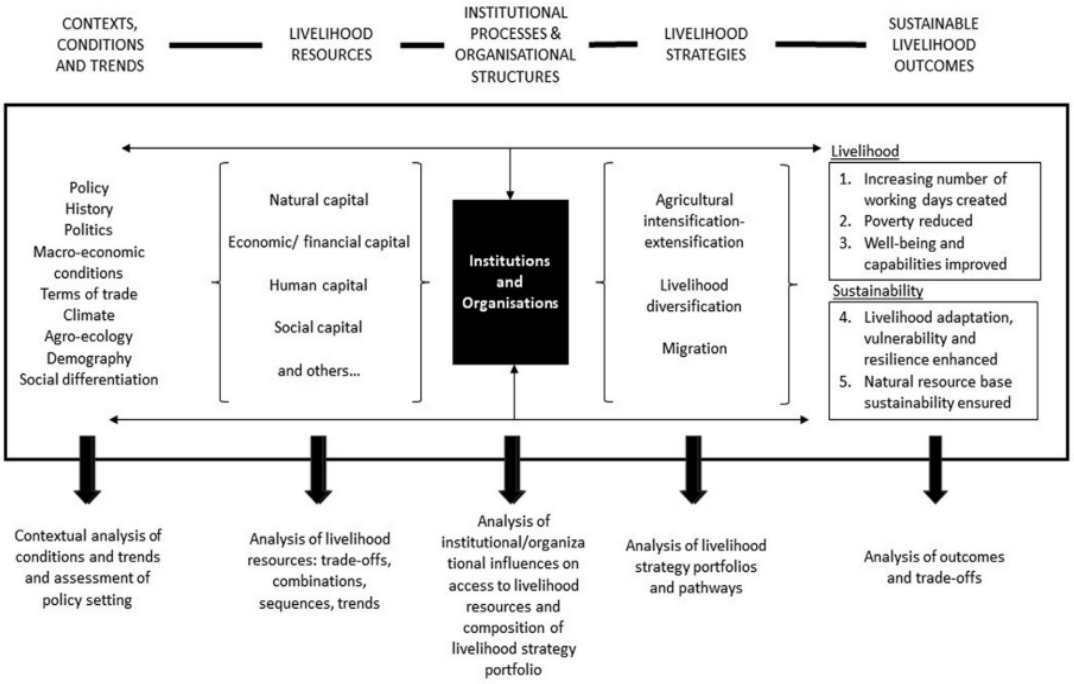
In western Kenya, both men and women were active producers of AIVs for commercial purposes despite both men and women having similar interest in marketing, women tend to earn low income from AIVs seeds. Despite AIVs being considered as women's crop, Men were found to be more aware of the market trends in seed entrepreneur than women were (Pincus *et al.,* 2018). Farmers take decision on uptake of agricultural inventions based on prospects of a ready market and associated better income. A study by Bokelmann *et al.*(2022a) indicated that in Kenya, there was a positive increase in commercialization of AIVs which was attributed by a positive income obtained after marketing the vegetables.

The studies emphasized the significant role of income level in determining the extent to which farmers can engage in the commercial production of AIVs. However, there is still a gap in understanding how income levels specifically influence the commercialization of AIVs in areas like Bobasi where economic conditions and market access may differ from other regions. This study seeks to address this gap by examining the influence of income levels on the commercial production of AIVs in Bobasi. The goal is to provide new insights into the role of income in agricultural commercialization and to identify strategies that can enhance income generation for smallholder farmers in this region.

2.8 Theoretical Framework

This study is based on the Sustainable Livelihoods Framework (SLF), which is a conceptual tool initially developed by Robert Chambers and Gordon Conway (Chambers & Conway, 1992).The SLF provides a comprehensive approach to analyzing the factors that influence livelihoods, particularly in rural settings. It does so by examining how various forms of capital (human, social, natural, physical, and financial) interact within specific socio-economic and environmental contexts. The SLF posits that individuals and communities draw upon these five types of capital to construct their livelihoods, which are further shaped by the external environment, including institutions, policies, and processes that govern access to

resources and opportunities. The framework also accounts for the vulnerability context, which includes external shocks, trends, and seasonal variations that can influence livelihoods. Recent updates to the SLF, as discussed by De Haan and Zoomers,(2005), have incorporated structural and relational elements, acknowledging that livelihoods are increasingly affected by global processes such as climate change and market connections. This evolution highlights the significance of recognizing how local livelihoods are interconnected with and influenced by larger systems. The Sustainable Livelihoods Framework (SLF) emphasizes that people's livelihoods are influenced by various factors such as financial, social, human, and natural resources, as well as broader economic and environmental conditions. The interactions between these factors can either expand or limit livelihood options, especially when facing challenges like market changes or environmental impacts. Human Capital encompasses the skills, knowledge, health, and labor capacity used by individuals to pursue livelihood strategies. Social Capital refers to social networks, relationships of trust, and norms that facilitate cooperation and collective action. Natural Capital pertains to natural resources available to individuals, such as land, water, and biodiversity. Physical Capital includes infrastructure, tools, and equipment that support livelihood activities. Financial Capital refers to financial resources, including savings, credit, and income from various sources.



Source: Sustainable rural livelihood: a framework for analysis (Scoones,1998)

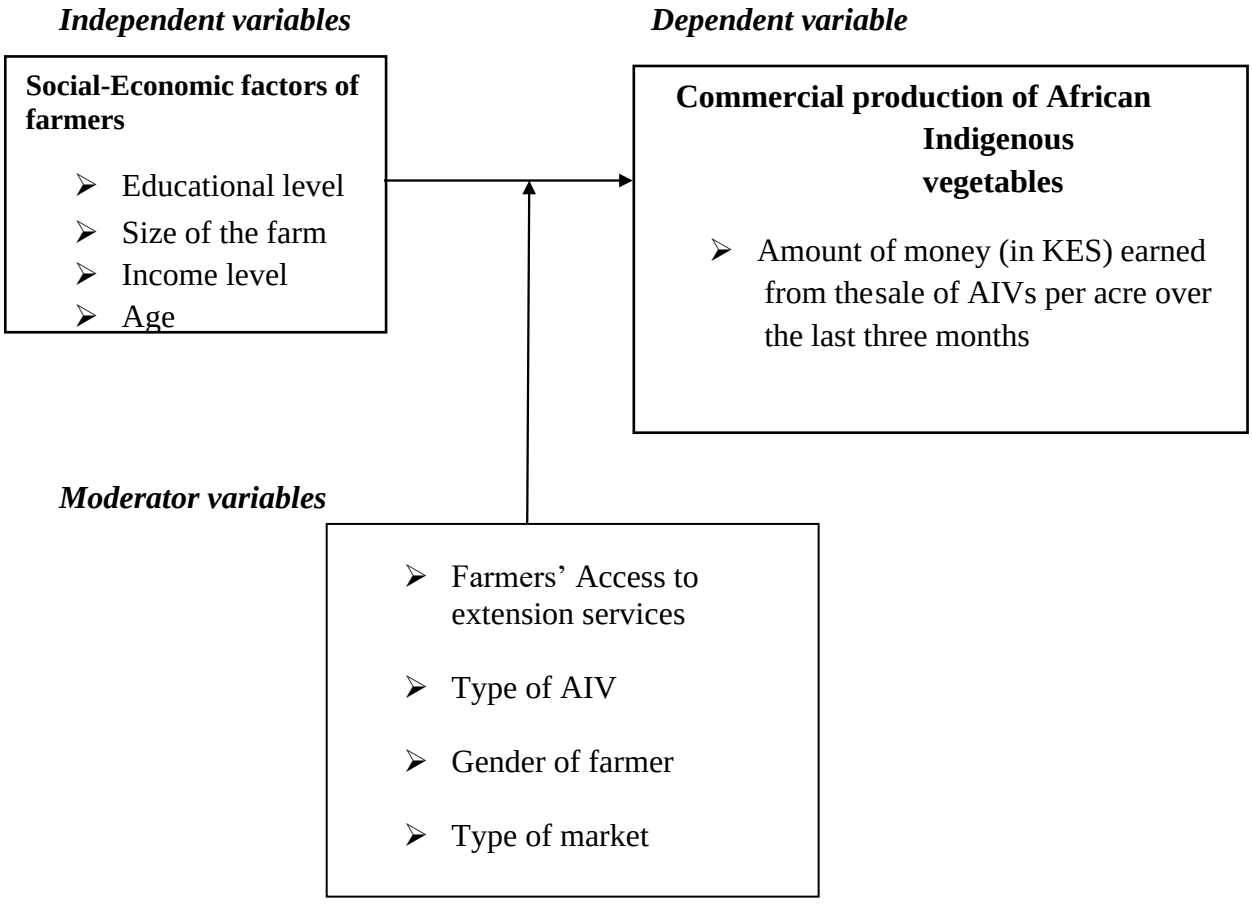
In this study, human capital refers to the education level and agricultural knowledge of

smallholder farmers in Bobasi, which are crucial for effectively producing and commercializing African Indigenous Vegetables (AIVs). Social capital includes the influence of community norms, the role of farmer groups, and the support provided by agricultural extension services, which are essential for adopting commercial farming practices. The size and quality of farmland, access to water resources for irrigation, and the overall environmental conditions in Bobasi are critical components of natural capital that influence AIV production. Access to farming tools, irrigation systems, and transportation infrastructure are considered key aspects of physical capital that affect the scale and efficiency of AIV production. Additionally, the income levels of farmers, their ability to invest in agricultural inputs, and their access to financial services are pivotal in determining their capacity to engage in commercial AIV production.

2.9 Conceptual framework

Figure 3 shows the conceptual framework. The independent variables were the socio-economic factors namely; education level, the size of farm, age and income level of smallholder commercial AIVs farmers.

Figure 2: *Conceptual framework showing the variables of the study and their interaction*



The dependent variable of the study was commercial production of African Indigenous Vegetables, which was measured in terms of amount of money earned from the sale of AIVs per acre over the last three months. The moderating variables influenced the effects of independent and dependent variables. For this study, the moderating variables were gender, farmers access to agricultural extension services, type of market and type of AIV. The moderating variables were taken care of by incorporating them into the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology that was used to achieve the objectives of the study. The method chosen by the researcher should help them answer their research questions to completion (Opoku *et al.*, 2016). It presents the research design, location of the study, population of the study, sampling procedures, sample size, instrumentation, data collection, and data analysis.

3.2 Research Design

The study used a descriptive survey research design. The design enables the researcher to answer the *when, why, and how* and not "*What"* questions in relation to the study objectives (Dulock, 1993). The design was appropriate for this study because the population was spread across the sub-county. The researcher used survey research design to collect data on smallholder African Indigenous vegetables (AIV) and to enable the description of the situation as it appears. Therefore, through use of the survey, the researcher gathered information on the influence of selected socio-economic factors on Commercial AIVs production in Bobasi Sub-County. In addition, descriptive survey is particularly advantageous when the goal is to describe the status of a phenomenon in detail, rather than simply examining relationships or correlations. In this study, the descriptive survey allowed the researcher to capture and present a detailed picture of the socio-economic factors affecting AIV production, providing valuable insights into the current situation as it stands. The '*Why*' enabled researcher to be able to examine and explain in detail the socio-economic factors influencing AIV production, thus giving a clear understanding of how education level, age, income and farm size affect the commercial production of these crops. The '*When'* enabled the researcher to be able to record the socio economic factors at a certain time hence giving a certain point of view of the factors that may have an influence on commercial AIV production in the sub-county. The '*How*' enabled collection of both qualitative and quantitative data on the socio-economic status of the farmers and their association with AIV production as well as the current trends in the production.

3.3 Location of the Study

The study was conducted in Bobasi Sub-County of Kisii County, Kenya. The Sub-county borders Nyaribari chache to the North, Bomachoge to the East and Nyaribari Masaba to the West. It comprises of nine wards namely; Bobasi Chache, Sameta, Bobasi Boitangare,

Masige East, Basi Central, Nyacheki, Basi Bogetaorio, Masige West. It covered a total area of 2418 km^2 with a total population of 197429 persons and population density of 790 people per square kilometer (Bobasi Sub-County, 2021). Bobasi was located 17.9 km southeast of Kisii town.It lies between longitude 34º 49'59" East and Latitude 0º 46'59" South. Apart from AIVs farming,other crops grown in Bobasi Sub county include maize, avocado, bananas and tea (Kisii County Government, 2018). Additionally, livestock rearing characterize it. The livestock kept include poultry, cattle, goats and sheep (Kisii County Government CIDP, 2020). Bobasi Sub- County falls under agro-ecological zone three of Kenya and it receives average annual rainfall that ranges between 1650 and 1980 mm per year. It was located in an area with an altitude of between 1690 to 1970 m above sea level, which was suitable for agricultural activities (Bobasi Sub-County, 2021).

3.4 Target Population

The study targeted smallholder AIV farmers from Bobasi Sub-county. There were 6,341 smallholder AIV farmers in the two wards according to (Bobasi Sub-County, 2021). Out of the target population, the number of commercial smallholder AIVs farmers was 2,363. Therefore, the accessible population for the study was 2,363 Commercial AIV farmers who were drawn from the two wards. The wards were purposively selected because Basi Bogetaorio had the highest number and Masige West had the least number of Commercial AIV farmers. The 2,363 smallholder Commercial AIV farmers were distributed in the two wards; as indicated in Table 1

Table 1: *Distribution of target population per ward*

Ward name	Number of smallholder Commercial AIV farmers
Basi Bogetaorio	1750
Masige West	613
Total	2363

3.5 Sampling Procedure and Sample Size

Bobasi Sub-County was chosen purposively as the study location because it was among the leading producers of African Indigenous Vegetables in Kisii County, which was among the top producers of AIVs in Kenya (Agriculture Food Authority, 2022). The study was conducted in two wards; Basi Bogetaorio and Masige West as indicated in Appendix B. Purposive sampling was used to select two wards; Basi Bogetaorio and Masige West on the basis of having

the highest and the lowestnumber of smallholder commercial AIV farmers respectively. This was because the wards had large farm size (Bobasi Sub-County, 2021). Proportionate random sampling technique was used to select smallholder Commercial AIV farmer respondents from the two wards in Bobasi Sub- County. The sampling frame consisted of a list of smallholder commercial AIV farmers who were obtained from the Ward Agricultural Extension Officers Simple random sampling technique was used to obtain participants from each ward to avoid bias and give all farmers equal chances of participating in the study. Additionally, the researcher included key informants from the two wards and they were purposively selected, a total of two extension officers who had direct contact with AIV farmers were interviewed one from each ward. In addition, the research included focus group discussions, which were held independently and whose participants were among questionnaire respondents. The respondents were purposefully selected, and the criteria for selecting the respondents was their level of resourcefulness, their status as group leaders, and their track record as successful farmers. A total of twenty respondents were selected, with ten chosen from each ward.

The sample size was determined using a formula by Nassiuma (2001) which was used to calculate the sample size needed for a proportionate sampling design. The formula was as follows:

Where:

n = the required sample size,

$$n = \frac{NC^2}{c^2 + (N-1)e^2}$$

N = the population within the study area,

C= Coefficient of Variation,

e = Standard error.

$$n = \frac{2363(0.25)^2}{(0.25)^2 + (2363-1)\,(0.02)^2} = 153.8044$$

=154 Commercial AIV farmers

The formula takes into account the proportion of the population with the characteristics and desired level of precision to determine the sample size needed for the study. The sample size was determined using the coefficient of variation of 25%, a standard error of 2% as this

helped the researcher obtain a large sample size thus reducing attrition.

The accessible population in the study area was 2,363 Commercial AIVs farmers in Masige West and Basi Bogetaorio wards. This meets Nassiuma's (2001) assertion that in most surveys a coefficient of variation occurs within the range of 21%≤C≤30 % and that standard error occurs in the range of 2%≤e≤5%. Therefore, the stated coefficient of variation and standard error was preferred for this study. The upper limit for the coefficient of variation and standard error was selected to ensure low variability in the sample and minimize the degree of error.

The study used 95% confidence (5% sampling error) to obtain a sample size of 154 Commercial AIV farmers. The sample size for each ward was obtained using proportionate random sampling from the population in the study area. Table 2 summarizes the distribution of the sample sizes.

Table 2: *Distribution of respondents Per Ward*

Wards	Population (commercial AIV farmers)	Proportion (%)	Sample size
Basi Bogetaorio	1750	74	114
Masige West	613	26	40
Total	2363	100	154

3.6 Instrumentation

This study used a researcher-constructed semi-structured questionnaire to collect data from the respondent farmers in Masige West and Basi Bogetaorio wards of Bobasi Sub-County. A semi-structured questionnaire was used because it was an efficient and cost-effective way to gather detailed large amount of data from a large number of respondents in a relatively short amount of time, while providing standardization which allowed easy comparison of responses across different farmers and regions (Hove & Anda, 2005). The questionnaire items were developed based on the study objectives. Section A of the instrument collected data on general information of the respondents. Section B collected information on socio-economic factors namely; educational level, size of farm, income and age. In addition, the study captured production information in section C and the amount of money earned from sale of AIVs per acre over the last three months. The researcher also used a developed Focus group discussion guide and key informant interviews. Extension officers from two participating wards, Basi

Bogetaorio and Masige West, served as key informants. The FGDs provided an in-depth understanding, and gathered critical confidential information that might not have been obtained from other sources. Data collected through the FGD guide and key informant interview guide were used for triangulation

3.6.1 Validity

In research, validity has two major aspects in which it manifests and these were content and face validity (Dawson *et al.,* 2018). Face validation of the instrument was done to ensure all instruments that is; farmers' questionnaire, Focus Group Discussions (FGD) guide, and key informant interview guide appeared to measure what they were intended to measure. Content validity was confirmed by ensuring all items across these instruments were in line with the research objectives by making sure that all the respondents understand very well the items of the questionnaire, guides with purpose to avoid misinterpretation. Comments from specialists in agricultural extension from the Department of Agricultural Education and Extension at Egerton University and an expert in horticulture from the Department of Agricultural Science at Kisii University were used to improve validity of the instrument.

3.6.2 Reliability

Reliability measures the degree to which a research instrument produces consistent results over repeated trials (Hopkins, 2000). Pilot testing enabled the researcher to gauge its reliability. The instruments were pilot-tested in Nyakoe Ward of Kitutu Chache South Sub-County which had similar agricultural conditions and smallholder AIV farmers of similar characteristics to those in Bobasi Sub-County. In a pilot study, a researcher had the freedom to use a sample ranging from 10-30 (Johanson & Brooks, 2010). The study used 30 randomly selected smallholders Commercial AIV farmers in Nyakoe ward, Kitutu Chache South Sub-County. The reliability of the instrument was assessed using Cronbach's alpha coefficient, resulting in a reliability coefficient of 0.745. For the Focus Group Discussions (FGD) and key informant interviews, reliability was ensured through consistency in the facilitation of discussions, the use of a standardized guide, and repeated engagement with different groups to ensure similar patterns and insights emerged across different sessions. Thematic analysis was employed to analyze data from the FGD and key informant interviews, with triangulation providing a mechanism to compare and validate the consistency of responses obtained across various data collection methods.

3.7 Data Collection Procedure

A letter of clearance was first obtained from Board of Post Graduate Studies at Egerton University, which was a prerequisite for seeking ethical approval from the Egerton University Research Ethics committee. The researcher proceeded and obtained a research permit from National Commission for Science, Technology, and Innovation (NACOSTI). The researcher used the research permit to seek permission for community entry into Bobasi Sub-County and access to the study population for data collection. The researcher made a visit to the Kisii County Agriculture office, to notify the extension office on the intended research in the Bobasi Sub-county. The researcher obtained a list of commercial smallholder AIV farmers from the agricultural extension officers in Bobasi Sub-County, which was used as a sampling frame, to sample respondents for the study. Through the help of the ward agricultural extension officers, the researcher met the AIV farmers in individual households for data collection. A questionnaire was administered to the sampled farmers during data collection. The questionnaire was researcher-administered for respondents who were not proficient in the English language. It was self-administered for respondents who were proficient in the English language. In the event that some farmers did not understand English and Kiswahili the local language was used as a medium of communication.

3.8 Data Analysis

The data collected was coded and entered into the Statistical Packages for Social Sciences (SPSS Version25). Descriptive statistics was used to measure mean and standard Deviation. Table3 depicts the data analysis summary.

Table 3*: Summary of Data Analysis*

Research Questions	Independent variables	Dependent variables	Statistical analysis
i. How does education level influence commercial production of African Indigenous vegetables among smallholder farmers in Bobasi Sub-County	Education level	Amount of money earned from sale of AIVs per acre over the last three months	Percentage, Frequency Thematic analysis
ii. How does age influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?	Age of smallholder farmer	Amount of money earned from sale of AIVs per acre over last three months	Percentage, Frequency Thematic analysis
iii. How does income level influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?	Income of smallholder farmer	Amount of money earned from sale of AIVs per acre over the last three months	Percentage, Frequency Thematic analysis
iv. How does size of farm influence commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County?	Size of farm of smallholder AIV farmer	Amount of money earned from sale of AIVs per acre over the last three months	Percentage, Frequency Thematic analysis

3.9 Ethical Considerations

Ethics must be considered for any research (Mligo, 2016). Furthermore, ethics are rules that have been placed and accepted by society to be used as a guidance on behaviors of society (Saunders *et al*., 2012). Before the commencement of data collection Ethical clearance was sought from Egerton University Ethics committee. Research permit was obtained from the National Council for science, Technology and Innovation (NACOSTI) and permission sought from County administrators in Kisii county. The instructions were read and the researcher only proceeded with the interview after the respondents had agreed, respondents were assured of anonymity, as mentioned in the introduction part of the questionnaire, FGD and interview guide.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study that sought to determine the influence of selected socio-economic factors on commercial production of African Indigenous Vegetables among smallholder farmers. The data analyzed is presented in form of charts, bar graphs, percentage, frequency and table. The AIV personal characteristics, socio-economic characteristics, information on production of AIVs, access to extension services, type of AIVs and AIV income and market information are the aspects analyzed. The study achieved a response rate of 100% of the target sample size as all respondents took part in the study and returned fully filled questionnaire.

4.2 Characteristics of African Indigenous Vegetables Farmer Respondents

This section presents the respondents' occupation, gender, farm size, land tenure, and main agricultural enterprise.

4.2.1 Occupation of African Indigenous Vegetables Smallholder Farmers

Respondents were asked to indicate their occupation and their responses were as indicated in Figure 4.

Figure 3

Occupation of African Indigenous Vegetables Farmers

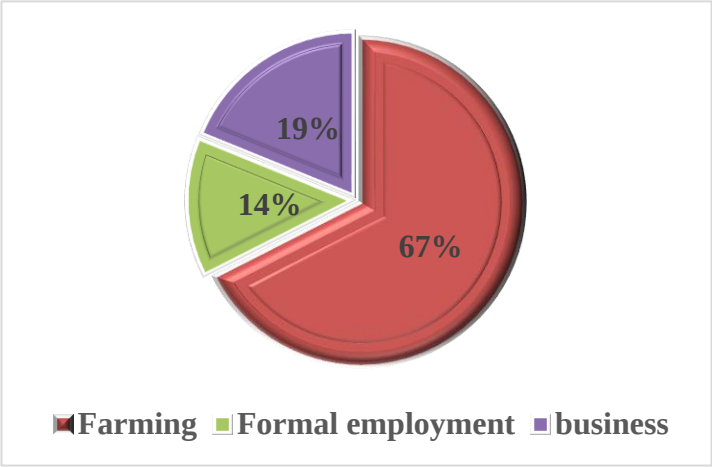


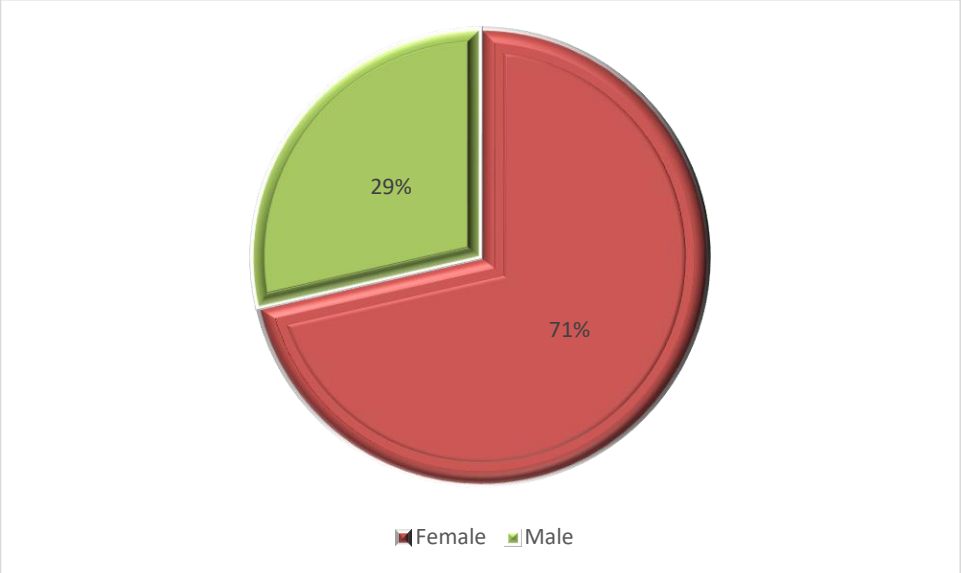
Figure 4 indicates that the majority of surveyed respondents (67%) identified farming as their main occupation among African Indigenous Vegetables (AIV) farmers. The prevalence of

farming as the leading occupation (67%) among respondents underscores the significance of agriculture as a primary pursuit within this group. Furthermore, a notable portion of respondents were involved in formal employment (14%) and business activities (19%), emphasizing a diversified engagement beyond farming within the AIV farming community. In numerous regions, particularly rural areas, agriculture stands as a time-honored tradition, woven intricately into familial legacies and cultural heritage, often passed down through successive generations. Consequently, a predominant number of respondents might have opted for farming due to deeply ingrained ties to their land, inheritance practices, and a reverence for their cultural lineage. Moreover, individuals engaged in business ventures or formal employment may have sought supplementary means of augmenting their income derived from cultivating African Indigenous Vegetables (AIVs). A study conducted in Nigeria by Agu-Igwe *et al.* (2020) indicated that diversification into business or formal employment by rural communities was driven by the desire to bolster financial stability increase food supply and achieve food security. In addition, this result aligns with a study conducted in Zimbabwe by Ndlovu and Mjimba (2021) that indicated individuals in rural communities predominantly choose farming as a primary income source due to entrenched cultural ties, familial traditions, and the accessibility of land.

4.2.2 Gender of AIV Respondents

Figure 5 results shows that women made up 71% of the respondents, compared to men at 29%, among the farmers polled, which indicated that female farmers were more by 42%.

Figure 4: *Gender of AIV farmers*



Many factors contribute to women's significant presence in farming communities, such as their active participation in agricultural labor, cultural expectations, and their frequent role as primary caregivers responsible for household nourishment. In addition, although it varies by area, females' control and access to land play a major part in their prominence in agricultural output. These results are consistent with a study by Jabeen *et al.* (2020) in Pakistan on women's traditional activities on household food security indicated that women play a vital role in agriculture. The study indicated women's roles in farming go beyond simple participation; they also include their vital contributions to household economies, food security, and the general sustainability of rural communities. Similar to the findings of the study, a study by Lelea *et al.* (2022) in Southwest Ethiopia highlighted that women in agriculture frequently handle a variety of tasks, from crop cultivation to post-harvest management, and that they are essential to the well-being of their families and the resilience of their communities. Female farmers often face challenges such as limited access to resources, credit, and training compared to their male counterparts, which can affect their productivity. However, when provided with equal support and resources, female farmers have shown strong performance in AIV production due to their high levels of dedication and innovative approaches

4.2.3 Respondent's Size of Farm in Acres

As indicated by Figure 6, 38% of the farmers questioned had 2 acres of land making majority of farmers. Subsequently, 29% were 3-acre farms, and 26.0% were 1-acre and below. Four-acre farms made up the least percentage of responders (7%). The distribution presented here highlights the fact that African Indigenous Vegetables (AIV) farmers often own modest to medium-sized landholdings

Figure 5

Respondent's Size of Farm in Acres

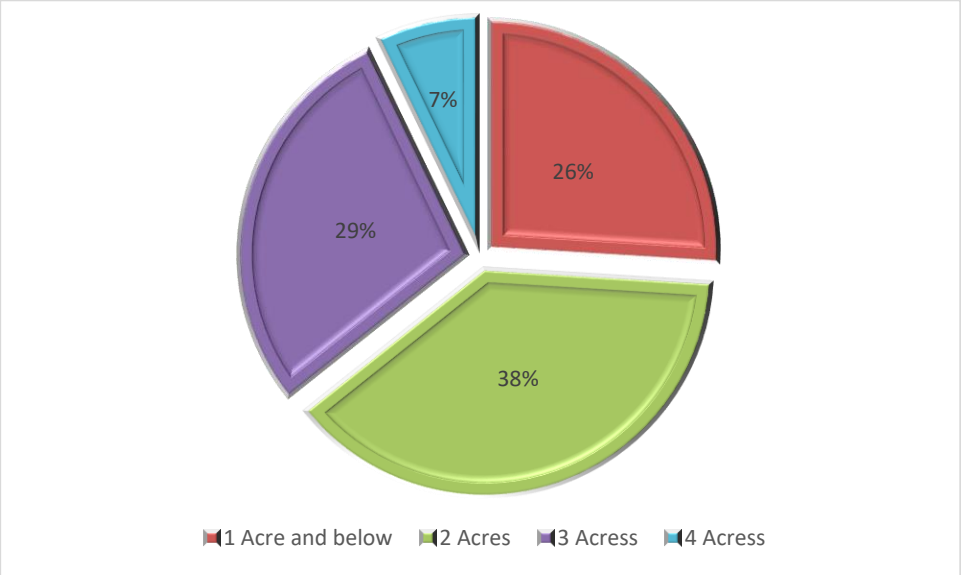


Figure 6 results shows that most smallholder farmers (64%) continue to work on land of not more than 2 acres. The results of this study are in agreement with a study conducted by Geng *et al.* (2023) in China on the share of land among smallholder farmers in rural areas which confirmed the tendency of dispersed land ownership and the dominance of small-scale farming in smallholder agricultural communities. The study's findings about the prevalence of 2 and 1 acre farms are consistent with the conditions that smallholder farmers encounter, where they are frequently restricted by the scarcity of available land due to population increase and confront difficulties in optimizing productivity in these limited areas. Furthermore, the research conducted by Giller *et al.* (2021) highlighted the resourcefulness and tenacity of smallholder farmers, emphasizing their capacity to maximize productivity in spite of land limits. In a similar vein, the study's findings that 1 to 3-acre farms are more common demonstrate the flexibility and resourcefulness of AIV farmers in making effective use of their limited land.

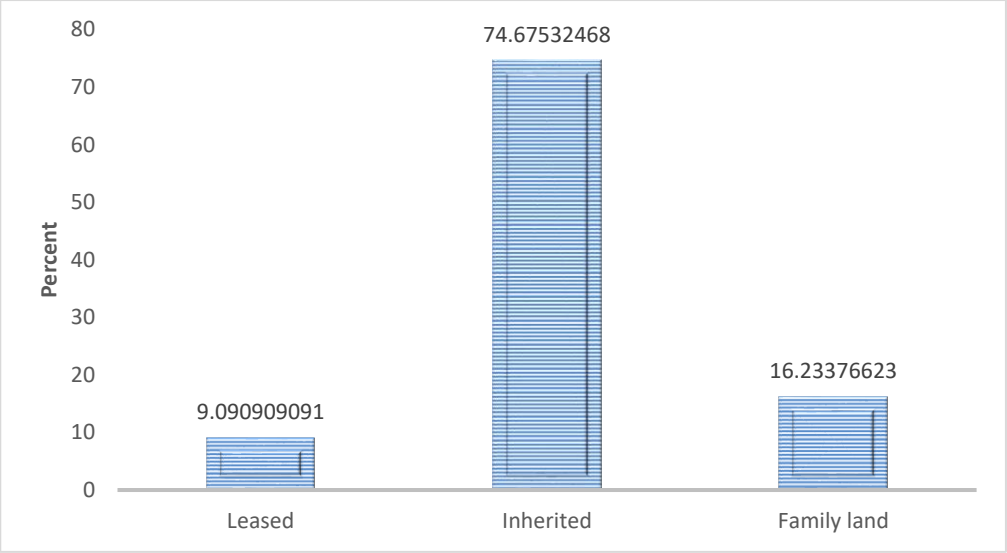
4.2.4 Land tenure system of AIV Farmers

Figure 7 shows that 75% of smallholder AIV farmers inherited their land. This heavy reliance on land passed down through the generations indicates a significant continuation of farming within families. Given how common inherited land is among AIV farmers, it seems

likely that land is passed down through the generations.

Figure 6

Land tenure system of AIV Farmers



This trend of inheritance indicates how agricultural knowledge and methods are being passed down through families from one generation to the next. The maintenance of indigenous agricultural knowledge and sustainable farming practices are facilitated by the continuity of land ownership and cultivation techniques, which also cultivates a sense of attachment and awareness of the intricacies of the land. Furthermore, the high percentage of inherited land can point to future issues with younger generations' access to and ownership of land. According to Chigbu *et al.* (2019) land inheritance is a deeply ingrained practice that is essential to the agricultural continuity of families across many African regions. The importance of land inheritance practice was emphasized by Sharma *et al.* (2020) 's study, which focused on how it maintains traditional farming practices, advances agricultural knowledge, and instills a strong feeling of land stewardship in future generations.

4.2.5 Main Agricultural Enterprises Besides African Indigenous Vegetables

The analysis in Table 4 indicates crop production prevailed significantly, encompassing 83.1% of respondents, highlighting a pronounced focus on cultivating crops. This dominance in crop-centric activities indicates a strong inclination towards agricultural practices related to plant cultivation like bananas, maize, and tea. Conversely, animal-related enterprises represented the least, accounting for 16.9%. The lower participation in animal husbandry might suggest several factors such as higher investment needs, space requirements, or potentially

lower market demand compared to crop-based ventures. The prevalence of crop production could stem from its diverse product utilization, shorter production cycles, or perceived lower complexity in management, making it a more attractive and accessible choice for a larger portion of surveyed farmers.

Table 4

Main Agricultural Enterprises

Main Agricultural Enterprises	Frequency	Valid Percent
Maize	28	18.2
sugar cane	26	16.9
Tea	19	12.3
Dairy	12	7.8
Poultry	14	9.1
Coffee	11	7.1
Bananas	40	26.0
Beans	4	2.6
Total	154	100.0

Giller *et al.* (2021)'s research highlighted a prevalent focus on crop cultivation among farming communities, resonating with the dominance of crop production observed here. Adesina *et al.* (2020) emphasized factors like market demand, ease of cultivation, and economic viability, mirroring the probable reasons behind the prominence of crop-centric enterprises in this dataset. Similarly, Tuyttens *et al.* (2022) likely identified challenges or lesser interest in animal-related activities, aligning with the lower representation of animal production in both studies.

4.3 Socio-Economic Characteristics of AIV Farmer Respondents

This section delineates crucial socio-economic traits among AIV farmers, pivotal in understanding their context, influence, and implications for their agricultural practices and livelihoods.

4.3.1 Age of Respondents

The study sought to determine the age distribution of AIV farmers and the results were as indicated by Table 5

Table 5

Age of Respondents

Age range in years	Frequency	Valid Percent
<25	0	0
25-34	13	8.4
35-44	23	14.9
45-54	69	44.8
55-64	38	24.7
>65	11	7.1
Total	154	100.0

The distribution of age among AIV farmers revealed a significant representation of older individuals within the farming community. The majority, comprising 44.8% of respondents, fell within the age bracket of 45-54 years. Additionally, a substantial percentage, 24.7%, encompassed farmers aged 55-64 years, displaying a prevalence of middle-aged individuals in this occupation. Following this, 14.9% of respondents were in the age group of 35-44 years, while a smaller proportion, 8.4%, fell within the age range of 25-34 years. Only 7.1% of farmers were above 65 years old. This distribution underscores a higher representation of middle-aged and older individuals within the AIV farming community, with a comparatively smaller presence of younger farmers. Older farmers dominate African Indigenous Vegetables (AIV) production due to inherited traditions, access to resources, and perceived stability. In addition, older individuals often dominate due to accumulated indigenous skills and inherited knowledge passed down through generations. Their experience and familiarity with traditional farming methods contribute to their prominence in AIV production. Younger individuals might view farming as labor-intensive, lacking support or incentives.

The findings of this study agree with Mulaudzi *et al.* (2019)'s study that highlighted a comparable trend, displaying a prevalence of middle-aged and older individuals engaged in agricultural practices, aligning with the dominance of these age groups within AIV farming. Perceptions of farming as labor-intensive with inadequate support systems or incentives leading to a decrease in farming (Sauda & Devotha, 2023). Age significantly influences AIV productivity, primarily through accumulated experience that improves farming practices. However, experience alone isn't the only factor. Productivity also depends on access to

resources, adoption of technology, and market knowledge. Older farmers may leverage their experience, but younger farmers' openness to innovation also plays a vital role.

4.3.2 Years of Production of African Indigenous Vegetables by Smallholder Farmers

The findings in Table 6 on the duration of African Indigenous Vegetables (AIV) production among farmers depict a varied tenure within this agricultural sector. A significant proportion, 57.1%, has been cultivating AIVs commercially for 6-10 years, representing the largest group within the surveyed population. Furthermore, 22.1% have engaged in AIV production for 1-5 years, displaying a notable presence of relatively newer entrants into this field. A smaller but notable portion, constituting 14.3%, has a more extensive experience, spanning 16-20 years in commercial AIV production. Interestingly, only a minimal percentage, 6.5%, falls within the 11-15 years' bracket. This distribution illustrates a diverse experience level among AIV farmers, with a substantial majority having engaged in commercial AIV production for a moderate duration of 6-10 years.

Table 6

Smallholder Years of AIV production

Years in AIV production	Frequency	Valid Percent
1-5	34	22.1
6-10	88	57.1
11-15	10	6.5
16-20	22	14.3
Total	154	100.0

The majority of farmers, comprising 57.1%, possessed 6-10 years of experience in commercial African Indigenous Vegetables (AIV) production, reflecting a pivotal phase. This duration likely signifies a maturation period where farmers gained substantial expertise, honed techniques, and established sustainable practices. In contrast, a smaller yet significant group (20.8%) had 10-20 years of experience, indicating a more seasoned cohort with deep-rooted knowledge and potentially early adopters of AIV cultivation. This minority might have pioneered AIV production, fostering its growth and serving as mentors to newer entrants. The distribution show cases a pivotal stage of learning and growth among the majority, while a seasoned segment likely played a foundational role in advancing AIV farming practices (Ntawuruhunga *et al.,* 2020).

4.3.3 Education Level of African Indigenous Vegetables Farmers

The findings reveal that the educational attainment among AIV farmers is predominantly limited, with 86.4% having not progressed beyond the secondary level as shown in Table 7. A considerable majority holds educational qualifications at the primary and secondary school levels. A minor proportion has attained higher levels of education, with 6.5% possessing certificates and 7.1% holding diplomas. This distribution signifies a concentration of educational achievement at foundational levels, highlighting limited academic advancement within this farming community. The implications of this educational landscape suggest potential challenges in accessing advanced agricultural knowledge, technology, or modern farming practices requiring higher educational backgrounds.

Table 7

Education Level of African Indigenous Vegetables Farmers

Education Level	Frequency	Valid Percent
Primary school	72	46.8
Secondary school	61	39.6
Certificate	10	6.5
Diploma	11	7.1
Total	154	100.0

The results are consistent with the study conducted by Moahid and Maharjan (2020) in Afghanistan, which presents a similar situation in which most rural farmers do not possess higher educational qualifications thus influencing their farming activities negatively. This resemblance highlights a common pattern in agrarian communities, pointing to limited academic advancement beyond secondary education. Similar to this research, Ullah *et al.* (2020)'s study in Pakistan highlights how farmers lack higher education, which limit their access to contemporary agricultural innovations and technologies. This common trend draws attention to the pervasive problem of low educational attainment among farming people, highlighting the necessity of focused educational programs designed to improve agricultural knowledge and practices in these communities through extension activities.

4.3.4 The AIV farmers' Source of Income

Findings on the AIV farmers' source of income are summarized in Table 18. The results indicate that about 85.1% of respondents in the African Indigenous Vegetables (AIV) farming community primarily get their income from farming activities. The significant majority highlights the crucial role of agriculture as the primary economic activity in this farming community. Only a small portion, amounting to 14.9%, obtains their main source of income from other commercial activities.

Table 8:

The AIV farmers Source of Income

The AIV farmers Source of Income	Frequency	Valid Percent
Farming	131	85.1
Business	23	14.9
Total	154	100.0

The prevalence of farming as the main source of income highlights the importance of agricultural activities in supporting the livelihoods of AIV farmers. The dependence on agriculture as the primary source of income is consistent with the prevailing agricultural environment in rural areas, highlighting the crucial importance of traditional farming methods in economic subsistence. The involvement of a minority in non-agricultural enterprises suggests that a tiny percentage of farmers are expanding their sources of income.

The findings presented in Table 9 highlighted other significant sources of income that smallholder African Indigenous Vegetable (AIV) farmers rely on, in addition to AIV production. These income streams are ranked in order of importance based on the results obtained from this study .

Table 9

Other significant sources of income that you have in order of importance

Other significant sources of income in order of importance	Frequency	Valid Percent
Rotating savings club (Merry go round)	89	57.8
Farm produce	50	32.5
Loans from farmers saccos	15	9.7
Total	154	100.0

Table 9 indicates 57.8% of respondents named rotating savings clubs more especially, the Merry-Go-Round as their most common additional source of income. This research highlights the widespread adoption of community-based financial systems for mutual aid and savings, demonstrating the farming community's reliance on group efforts to maintain financial stability. According to 32.5% of interviewees, agricultural produce thereafter became another important source of income. This result indicates that farmers receive a significant amount of their income from agricultural products other than AIVs. Additionally, 9.7% of farmers reported borrowing money from their SACCOs (farmers' savings and credit cooperative organizations), demonstrating the utilization of official financial institutions to get funding and credit in the agricultural sector. This pattern of varied sources of income is consistent with earlier research that highlighted the diversity of smallholder farmers' revenue streams (Snashall & Poulos, 2023). Similar findings in revenue diversification within farming communities have been noted by research conducted by Fowowe (2020), who reported that the presence of financial schemes driven by the community and the reliance on a variety of agricultural outputs for income production.

4.3.5 Average income Earned from Other non AIV projects per Month

The findings Table 10 depicted a varied distribution of income earned from these non-AIV projects, providing insights into the financial landscape of these farmers.

Table 10

Average income Earned from Other non-AIV projects per Month

Income in KES	Frequency	Valid Percent
less 4000	25	16.2
4001-8000	93	60.4
8001-12000	36	23.4
Total	154	100.0

The majority of respondents, accounting for 60.4%, reported earning an income ranging from 4001 to 8000 Kenyan Shillings per month from these non-AIV ventures. This range signifies a moderate but relatively consistent source of additional income derived from projects like Merry-Go-Round, SACCOs, or other savings initiatives. Following this, 23.4% of respondents earned between 8001 and 12000 Kenyan Shillings per month, indicating a subset of farmers who garnered slightly higher income from these alternative projects. Additionally, 16.2% reported earning less than 4000 Kenyan Shillings per month from these non-AIV initiatives. This segment represents those earning lower supplemental incomes, which could imply limitations or lesser involvement in these income-generating projects. The distribution of income from non-AIV projects portrays a spectrum of earnings, with the majority falling within a mid-range income bracket. This aligns with the financial landscape of smallholder farmers, indicating a moderate but reasonably stable income generated from activities such as Merry-Go-Round, SACCOs, or savings initiatives. This pattern underscores the diversified nature of income sources among farmers, emphasizing the significance of not only agricultural endeavors but also community-based financial systems and other supplementary projects in contributing to their overall income. These findings correspond to previous studies highlighting the significance of diversified income streams among smallholder farmers, emphasizing the role of collective financial schemes in bolstering their financial stability and livelihoods.

4.3.6 Frequency of AIV farmers' Income

The results in Table 11 on the consistency of revenue among farmers cultivating African Indigenous Vegetables (AIV) demonstrates a wide range of patterns. About 50.0% of the participants indicated that they consistently and regularly earned cash from their agricultural pursuits. This indicates that a substantial number of farmers are experiencing a state of financial stability and dependability in their income. In contrast, 33.8% reported that

their income exhibited occasional regularity, suggesting fluctuations or variability in wages. In addition, 16.2% of respondents indicated that they have inconsistent incomes, indicating the presence of a smaller group of farmers that have inconsistency in their earnings from AIV production.

Table 11

Frequency of AIV farmers' Income

Frequency of income source	Frequency	Valid Percent
Not regular	25	16.2
Sometimes regular	52	33.8
Regular	77	50.0
Total	154	100.0

The existence of different income patterns highlights the complex financial situations that AIV farmers encounter. While a significant number of individual's experience stable incomes, a substantial group faces occasional variations or inconsistencies in their revenue sources. Disparities in income regularity may arise due to factors such as market volatility, seasonal changes, or difficulties in accessing stable markets. The current findings align with Muflikh *et al.* (2021)'s study in Indonesia, affirming the volatility of income within agricultural activities. Similar to this research, Parab and Reddy (2020)'s findings in India emphasized the variable nature of earnings in farming, citing market fluctuations, price variability, and demand dynamics as key contributors to income volatility. The 50.0% consistency in income echoes findings where some farmers experience stability, while 33.8% facing occasional irregularity and 16.2% encountering inconsistency resonate with the uncertainties highlighted by Tripathi *et al.* (2022). This consistency underscores the broader trend of income unpredictability within agricultural sectors, emphasizing the susceptibility of farmers to market shifts and demand variations, influencing their income regularity.

4.3.7 Size of Land in Acres for AIVs production

The data in Table 12 depicts the allocation of farm sizes specifically designated for the commercial cultivation of African Indigenous Vegetables (AIVs) among the participants. 57.1% of farmers cultivate AIV within the range of 1.1 to 1.5 acres. Subsequently, 27.9% of farmers oversee farms that span from 2.1 to 2.5 acres only for AIV production. In addition, 7.8% of individuals engage in the cultivation of AIVs on farms ranging from 0.5 to 1.0 acres,

while a lesser proportion, 7.1%, manage farms that are larger than 2.5 acres.

Table 12

Size of Land in Acres for AIVs production

Size of farm	Frequency	Valid Percent
0.6-0.9 Acres	12	7.8
1-1.4 Acres	88	57.1
1.5-2.0 Acres	54	35.1
Total	154	100.0

The results indicate that a large number of AIV farmers have relatively small farm holdings, with a major percentage managing land between 1.0 to 2.0 acres. This distribution indicates that a significant proportion of farmers are involved in the production of agricultural industrialized vegetables (AIV) within a small land area. This suggests that they may be practicing intensive cultivation methods or facing constraints in terms of available land for AIV cultivation. Given the scarcity of land, the majority of farmers employ intensive agricultural methods to maximize their profits. Working in limited places necessitates the use of tactics such as intense cultivation to maximize the yield per unit area. This approach seeks to optimize yields from a restricted land area, focusing on effective resource allocation and intensified agricultural methods to improve productivity and profitability within the limited farming space.

These findings align with a study conducted by Zerssa *et al.* (2021), affirming the prevailing challenge of limited land access among smallholder farmers. Dzvene *et al.* (2022) 's research highlighted that inadequate land prompts farmers to adopt strategies such as intercropping and mixed farming to optimize yield within confined spaces. Similarly, the data here illustrates a prevalent scenario among African Indigenous Vegetables (AIV) farmers, with a substantial proportion managing relatively small land sizes for cultivation. This resemblance underscores the broader trend wherein land scarcity compels farmers to employ diversified farming practices to maximize productivity. Intercropping and mixed farming, emphasized in Taskin *et al.* (2021)'s study, serve as strategic approaches utilized by farmers facing land limitations, aligning with the potential adoption of intensive cultivation methods observed among AIV farmers.

4.3.8 Size of the farm Allocated for Various AIV Crops

In relation to the size of land allocated for each AIV, the results were as indicated in Table 13. Where 1= (Less than 0.5Acres), 2= (0.6-0.9 Acres), 3= (1-1.4 Acres), 4=(1.5-1.9 Acres) and 5=(More than 2.0 Acres).

Table 13

Size of the farm Allocated for Various AIV Crops

Type of AIV	Percentages				
	1	2	3	4	5
Spider plant	7.2	25.5	23.5	40.5	3.8
Black nightshade	9.7	(20.1	46.1	18.2	5.8
Cow peas	5.2	31.2	54.2	9.4	0
Amaranth	93.8	6.3	0	0	0

The distribution of land sizes allocated to various types of African Indigenous Vegetables (AIVs) is illustrated by the percentages of Spider plant, Black nightshade, Cowpeas, and Amaranth across distinct categories. The cultivation proportions for different African Indigenous Vegetables (AIVs) vary significantly across land size divisions. Spider plant is distributed among different land sizes as follows: 7.2% for less than 0.5 acres, 25.5% for 0.6-0.9 acres, 23.5% for 1-1.4 acres, 40.5% for 1.5-1.9 acres, and 3.8% for more than 2.0 acres. Black nightshade showcases percentages of 9.7%, 20.1%, 46.1%, 18.2%, and 5.8% across land sizes from less than 0.5 acres to more than 2.0 acres, respectively.

Cowpeas are distributed as 5.2%, 31.2%, 54.2%, and 9.4% in land sizes from less than 0.5 acres to 1.9 acres. For Amaranth, the percentages reported are 6.3% for less than 0.5 acres, 93.8% for 0.6-0.9 acres, and no data for larger land sizes. These diverse distributions illustrate farmers' strategic decisions, considering different land sizes when cultivating specific AIVs. These choices likely account for soil suitability, market demand, cultural significance, and agronomic practices concerning each vegetable type across distinct land size categories.

The substantial proportion of 40.5% of farmers dedicating land sizes between 1.5 to 1.9 acres for cultivating Spider plant could be influenced by several plausible factors. Spider plant

is known for its adaptability to various soil types and climatic conditions, allowing for its successful cultivation in moderately-sized plots. However, its sprawling growth habit and relatively high yield potential per acre could be a primary reason for farmers allotting larger areas for its cultivation. Spider plant, due to its growth characteristics, might require more space to flourish, especially considering its branching and leafy nature.

In Relation to FGD the AIV farmers indicated the Spider plants' vegetable's expansive growth necessitate sufficient room to prevent overcrowding, ensuring adequate sunlight exposure and airflow for healthy development and optimal yields. Additionally, the key informant cited popularity and demand for Spider plant in local markets prompted farmers to allocate more extensive land sizes to meet these market needs, aiming to capitalize on its market value and profitability. Moreover, Spider plant's longer harvest duration or extended cropping cycle might encourage farmers to allocate larger plots to streamline harvesting and maximize overall yield efficiency.

This result aligns with the findings of a research conducted in Nigeria by Chataika *et al.* (2020), highlighting farmers' inclination towards cultivating Spider plant due to its economic advantages. According to Alulu *et al.* (2021) 's study emphasized that farmers favor Spider plant cultivation owing to its high market price and consistent demand. The profitability associated with Spider plant, stemming from its popularity in local markets or cuisines, encourages farmers to allocate larger land areas to meet the demand and capitalize on its economic viability. The observed trend in land allocation for Spider plant cultivation corroborates with the notion that farmers strategically dedicate larger plots to crops like Spider plant that offer better economic returns and steady market demand, substantiating the alignment of this study's results with existing literature.

The substantial proportion, 66.1%, of farmers dedicating land sizes ranging from 0.6 to 1.4 acres for cultivating Black nightshade might be influenced by several reasons. Black nightshade, known for its adaptability and relatively compact growth, might not require as much space as Spider plant for its cultivation. Its compact growth habit and potentially higher yield per acre could have influenced farmers to allocate smaller land sizes for its cultivation compared to Spider plant.

From the FGD the market demand and local preferences for Black nightshade might be conducive to smaller-scale production. This vegetable is often used in various local cuisines or traditional dishes, with consistent but perhaps not as high demand or market value as Spider plant. Hence, farmers may choose to cultivate Black nightshade in smaller areas to cater to local demand without overproducing, ensuring efficient utilization of land resources.

Moreover, Black nightshade could have a shorter growth duration or harvesting cycle compared to Spider plant, allowing farmers to rotate crops more frequently or utilize smaller plots for this vegetable. For instance, some farmers cited that the black night shade mostly dried up after first harvesting something that reduced the acreage.

A study by Ntawuruhunga *et al.* (2020) highlighted that crops like Black nightshade, despite their economic viability and local culinary importance, are often cultivated in smaller land areas compared to certain high-yield or economically lucrative crops. This implies that vegetables like Black nightshade, while valuable in local cuisines, may not always command the same market value or demand as other high-value crops, hence, farmers tend to allocate smaller plots for their cultivation. Moreover, study by Sangija *et al.* (2021) suggests that the compact growth habit and adaptable nature of Black nightshade allow for successful cultivation in smaller land areas, influencing farmers to optimize their land utilization.

The distribution of land sizes for Cowpeas cultivation showcases varied percentages across different categories. A notable proportion of 54.2% of farmers dedicate land sizes ranging from 1 to 1.4 acres for Cowpeas cultivation, followed by 31.2% in the category of 0.6 to 0.9 acres. This distribution might be influenced by several factors specific to Cowpeas cultivation. Cowpeas are recognized for their adaptability to diverse soil and climatic conditions, making them suitable for cultivation in varying land sizes. Their moderate growth habit and potentially moderate yield per acre could be a contributing factor to farmers allocating moderate-sized plots for Cowpeas cultivation.

Furthermore, Cowpeas are commonly used as a subsistence crop and possess nutritional value, making them an essential dietary component in many regions. This consistent demand for Cowpeas for household consumption could influence farmers to allocate moderate-sized plots, ensuring a continuous supply for personal consumption and local markets. Additionally, Cowpeas are known for their nitrogen-fixing abilities, contributing to soil fertility (Kebede, 2021). This characteristic might encourage farmers to include Cowpeas crop rotation practices within limited landholdings, hence the allocation of varied land sizes.

The data indicates a stark pattern for Amaranth cultivation, with a significant majority of farmers (93.8%) allocating land sizes less than 0.5 acres for its cultivation. Several factors could contribute to this concentrated allocation of smaller land sizes for Amaranth cultivation. Amaranth, known for its leafy greens and high nutritional value, often thrives in compact spaces and does not require extensive land for cultivation. Its efficient use of space and adaptable growth characteristics might encourage farmers to cultivate it in smaller plots compared to other crops with more expansive growth habits. According to study by Bhatta *et*

al. (2021) Amaranth typically has a rapid growth cycle, allowing for quicker turnovers and repeated planting cycles within a smaller land area. Its fast maturity and continuous harvesting potential could enable farmers to optimize yields within limited space, prompting them to allocate smaller plots for its cultivation. Additionally, a study by Akinola (2021) amaranth is a common vegetable in local diets and is often cultivated for household consumption or local markets rather than large-scale commercial purposes. Its regular demand for household nutrition rather than significant commercial value might influence farmers to allocate smaller land sizes for its cultivation, catering to personal or local community needs rather than extensive market requirements. Furthermore, smaller land allocation for Amaranth could also be influenced by farmers' strategies to diversify crops within their limited landholdings, ensuring a variety of produce for household consumption or local markets.

4.4 Production of African Indigenous Vegetables

In order to determine the income obtained from the commercial production of AIVs its important to establish the general information on AIV production, number of seasons, technique of processing and frequency of harvesting. This section captured information on the methods of AIV production, number of seasons in a year AIVs are cultivated, number of times harvested in a week, and methods of AIV processing.

4.4.1 Methods of AIVs production

The data from Table 18 illustrates that a substantial majority of African Indigenous Vegetable (AIV) farmers, comprising 92.2%, rely on rainfed agriculture for AIV production. This dominance of rainfed farming practices among the surveyed farmers aligns with a prevalent trend seen in agricultural studies, especially in regions with suitable climatic conditions.

Table 14

Methods of AIVs production

Methods of Irrigation	Frequency	Valid Percent
Irrigation	12	7.8
Rainfed	142	92.2
Total	154	100.0

The reliance on rainfed agriculture can be attributed to various factors. Firstly, rainfed farming requires less infrastructure investment compared to other methods like irrigation cultivation. For many smallholder farmers, especially in areas where rainfall is reliable, rainfed agriculture is a cost-effective method, as it relies on natural precipitation for crop growth. Moreover, the choice of rainfed agriculture might stem from the adaptability of AIVs to local environmental conditions. Many AIV species are hardy and well-suited to diverse climates, making them suitable for rainfed cultivation in regions where rainfall is relatively consistent and evenly distributed. The lesser adoption of irrigation (7.8%) could be due to fact that irrigation might pose challenges in terms of water availability, infrastructure, and associated costs, making it less feasible for many smallholder farmers.

The dominance of rainfed agriculture among AIV farmers in this study aligns with research by Dendir and Simane (2021) that emphasizes the significance of rainfall in agricultural practices, particularly among smallholder farmers. This reliance on rainfed agriculture underscores the importance of considering local environmental conditions and available resources in determining the most viable farming methods (Asfaw *et al.,* 2019). It also highlights the need for sustainable farming practices that adapt to and optimize the use of natural resources while ensuring consistent crop yields.

4.4.2 The Number of Seasons in a Year that the AIVs are Produced

The data in Table 15 presented reveals that the majority of AIV farmers (92.2%) produce African Indigenous Vegetables (AIVs) for three seasons within a given year. This high percentage indicates a prevalent practice among the surveyed farmers, highlighting that a significant proportion of them engage in multiple seasonal production cycles.

Table 15

The Number of Seasons in a Year that the AIVs are Produced

Number of harvesting seasons per year	Frequency	Valid Percent	Cumulative Percent
2.00	12	7.8	7.8
3.00	142	92.2	100.0
Total	154	100.0	

The cultivation of AIVs across three seasons within a year could be attributed to various factors. First, AIVs often have different growth patterns and are adaptable to various climatic

conditions. This characteristic allows farmers to stagger planting and harvesting periods across different seasons, ensuring a consistent supply to meet market demands throughout the year. Moreover, the diversity in seasons might offer distinct advantages for growing specific types of AIVs. Some vegetables might thrive better in specific weather conditions, allowing farmers to optimize their production by capitalizing on the different seasonal variations. The agreement among the majority of farmers in engaging with three seasonal cycles aligns with a study by Flores *et al.* (2019) emphasizes the trend observed in small-scale farming practices where farmers strategically utilize multiple growing seasons to maximize yields, ensure a consistent supply, and potentially cater to varying market demands.

4.4.3 Frequency of AIV harvesting

The data on the frequency of harvesting different African Indigenous Vegetables (AIVs) presents the harvesting occurrences per week for each vegetable type as indicated in Table 16. For Spider plant, a significant majority of farmers harvested it once a week (96.1%), while only a small portion harvested it twice a week (3.9%). In the case of Black nightshade, 78.6% of farmers harvested it once a week and 21.4% harvested it twice weekly. Similarly, for Amaranth, 85.1% of farmers harvested it once a week, while 14.9% harvested it twice weekly. The harvesting frequency for Cowpeas was different, with 64.3% of farmers harvesting them once a week and a higher percentage, 35.7%, harvesting them twice a week.

Table 16

Frequency of AIV harvesting

Name of AIV	Percentages (%)
Spider plant	Once 96.1
	Twice 3.9
Black nightshade	Once 78.6
	Twice 21.4
Amaranth	Once 85.1
	Twice 14.9
Cowpeas	Once 64.3
	Twice 35.7

These variations in harvesting frequencies suggest that different AIVs have distinct growth patterns, maturation rates, or market demands. Factors like the plant's growth cycle,

perishability, and market needs likely influence farmers' decisions on how often they harvest each type of vegetable. For instance, vegetables with shorter maturation times or those more susceptible to spoiling might be harvested more frequently to maintain freshness and meet market demands. Conversely, vegetables with longer shelf lives or slower growth rates might be harvested less frequently. The findings align with agricultural practices that consider each vegetable's unique growth characteristics and market requirements (Flores *et al.,* 2019). Frequency reflects farmers' adaptive strategies in managing harvest frequencies based on crop-specific traits and market dynamics to optimize yield and meet consumer needs efficiently. However, individual farming practices, climatic conditions, or regional market variations might also contribute to these differences in harvesting frequencies (Vogel *et al.,* 2019).

4.4.4 Methods of Processing Harvested Vegetables

The study sought to determine the methods used by farmers in AIV processing. The results were recorded as indicated by Table 17.

Table 17

Methods of Processing Harvested Vegetables

Processing method	Black Nightshade	Spider plant	Amaranth	Cowpeas
Charcoal cooling	0	0	0	0
Fermentation	0	0	0	0
Blanching	0	0	0	0
Solar drying	20.8	18.2	0	9.1
Packaging	0	0	0	0
None	79.2	81.8	100	90.9
Total (%)	100	100	100	100

The findings from the survey on African Indigenous Vegetable (AIV) processing methods underscored a prevalent trend among smallholder farmers, indicating minimal processing activities. Across Black Nightshade, Spider plant, Amaranth, and Cowpeas, the majority opted not to engage in any form of processing, ranging from 79.2% to 100%. This suggests a significant reliance on fresh produce without subsequent processing steps for these vegetables among the surveyed farmers. However, a small proportion of farmers, around 9.1%

to 20.8%, utilized solar drying as a processing method, primarily observed between those cultivating Spider plant and Black Nightshade. Remarkably, these farmers were part of farming groups that received solar equipment, specifically designated for vegetable production. This correlation suggests that certain collective farming initiatives or support programs equipped farmers with solar technology, potentially to aid in preserving harvested AIVs through solar drying. Solar drying stands as a feasible means of preserving vegetables, ensuring longer shelf life, and mitigating post-harvest losses. The prevalent lack of processing, particularly among the majority who did not engage in any form of processing, might reflect a variety of factors. These could include limited access to processing facilities, insufficient knowledge on diverse processing techniques, or a preference for immediate consumption or sale of fresh produce. Additionally, the absence of specific processing methods such as fermentation, blanching, or charcoal cooling indicates potential gaps in knowledge or infrastructure for more advanced processing techniques among these farmers. The prominence of solar drying among those equipped with solar technology within farming groups implies the beneficial influence of such interventions in enhancing post-harvest practices. It not only extends the shelf life of AIVs but also allows farmers to better manage their produce and potentially access markets beyond immediate localities.

This result aligns with existing literature emphasizing the importance of post-harvest processing methods in agricultural produce (Rajapaksha *et al.,* 2021). However, the prevalent lack of processing activities observed among the majority of farmers highlights an area for potential intervention and support. Educational programs or initiatives aimed at imparting knowledge about diverse processing techniques could significantly benefit these smallholder farmers, potentially enhancing their produce value, reducing wastage, and widening market opportunities.

4.5 Influence of Education Level on Commercial Production of African Indigenous Vegetables

This section presents the responses by AIV farmers in relation to the influence of education level in vegetable production and the results tabulated in Table 15. A five point Likert scale was used to rate the responses Where 1=strongly disagree, 2=disagree, 3=not sure, 4=agree and 5=strongly agree

Table 18

Influence of Education Level on Commercial Production of African Indigenous Vegetables

Education level Characteristics	1	2	3	4	5
		Percentage			
Education level influence your decision to participate in commercial AIV production	22.7	0	20.8	49.4	7.1
Education level influence your ability to analyze market demand trends	0	21.4	0	71.4	7.1
Education level influence your capability in carrying out various field management practices	6.5	13.6	0	72.7	7.1
Education level influences method of harvesting AIVs	7.1	29.9	0	55.2	7.8
Education level influences your ability in analyzing and control of soil born pests and diseases affecting AIVs	0	26.6	0	58.4	14.9

In relation to the responses in Table 15 farmers' decisions to engage in commercial African Indigenous Vegetable (AIV) production, the results indicate a varied perspective among respondents. Around 49.4% of farmers agreed that education significantly influenced their decision-making, suggesting that education plays a pivotal role in their choice to participate in commercial AIV production. However, there were contrasts in opinions, with 22.7% strongly disagreeing or expressing reservations about education's influence, and 7.1% strongly agreeing.

This disparity in responses might stem from differing perceptions among farmers regarding the relevance of formal education in agricultural pursuits. Those who agreed might attribute their knowledge from education to better decision-making, possibly due to enhanced understanding of market dynamics, modern farming techniques, or business acumen acquired through education. Conversely, those who disagreed could be influenced by practical experiences or traditional farming knowledge, considering education less influential in their decision-making process. Additionally, the percentages of those uncertain or not providing a response (20.8%) indicate a group of respondents who might not clearly attribute their decision solely to education, possibly influenced by a mix of factors beyond formal education, such as family traditions or resource availability. The results are in tandem with findings from

Nambafu *et al.* (2023) 's study in Bungoma Kenya, aligning with the notion that education significantly shapes farmers' decisions in engaging with commercial African Indigenous Vegetable (AIV) production. Shakhawat Hossain *et al.* (2019)'s study highlighted a correlation between education and farmers' choices in agricultural pursuits, emphasizing the pivotal role of education in influencing their decisions to participate in commercial ventures. The disparity in responses underlines varying perceptions among farmers concerning the relevance of formal education, echoing Kumar *et al.* (2020)'s observations in Nepal about the multifaceted influences on farmers' decisions in agricultural activities.

In relation to the influence of education levels on the ability to analyze market demand trends among African Indigenous Vegetable (AIV) farmers, the results demonstrate a significant alignment between education and this analytical skill. A considerable majority, comprising 71.4%, agreed that their education significantly influenced their capability to analyze market demand trends. This high agreement percentage reflects a consensus among farmers regarding the positive influence of education on their ability to understand and interpret market trends related to AIVs. Additionally, 21.4% disagreed or were uncertain, potentially indicating differing perceptions or experiences among some respondents. The strong agreement proportion underscores the vital role of education in enhancing farmers' analytical abilities concerning market demand, showcasing how educational attainment might contribute to informed decision-making in responding to market dynamics within the AIV sector.

According to a study conducted by Anwarudin *et al.* (2019) higher education levels positively influence farmers' understanding of market dynamics, including demand trends, pricing mechanisms, and consumer preferences. In addition, Javaid *et al.* (2022) cited improved analytical skills with higher education, enabling farmers to make informed decisions regarding crop production, marketing strategies, and responding to market fluctuations. Therefore, the alignment observed in this study, where a significant majority agreed on the influence of education on market analysis, is in line with broader findings in agricultural research emphasizing the pivotal role of education in enhancing farmers' abilities to comprehend and respond to market demands effectively.

The data illustrates that among African Indigenous Vegetable (AIV) farmers, 72.7% agreed that their education significantly influenced their capability in carrying out various field management practices. This strong agreement indicates the perceived of education on enhancing skills related to tasks like soil preparation, irrigation management, pest control, and crop maintenance. However, a notable proportion 13.6% who disagreed and 6.5% who strongly disagreed expressed skepticism regarding the influence of education on field management

practices. This combined 20.1% disagreed with the assertion, indicating a subset of farmers who did not perceive education as a significant contributor to their proficiency in executing field-related tasks. This disparity in perspectives might stem from varying experiences, with some farmers potentially prioritizing practical knowledge or traditional approaches over formal education in agriculture. The majority's agreement highlights the perceived positive correlation between education and proficiency in field management practices, yet the contrasting viewpoints emphasize the diverse perceptions regarding the actual influence of education on practical agricultural skills among AIV farmers.

The results align with findings by Elahi *et al.* (2020), underscoring the diverse perceptions among AIV farmers regarding the influence of education on practical field management practices. Tadesse *et al.* (2021)'s study in Ethiopia highlighted similar disparities in viewpoints, emphasizing that while a substantial majority of farmers acknowledge the positive influence of education on field-related skills, a significant subset holds differing opinions. This variation may stem from regional differences, individual experiences, or contrasting beliefs regarding the role of formal education in practical agricultural tasks. Shimali *et al.* (2021)'s study echoes the idea that while education might significantly enhance field management skills for many farmers, there remains a subset whose experiences or perspectives challenge the perceived correlation between education and proficiency in executing agricultural practices, reflecting the nuanced nature of educational influence within the farming community.

The responses regarding the influence of education levels on harvesting methods for African Indigenous Vegetables (AIVs) demonstrate diverse viewpoints among the surveyed farmers. A majority of 55.2% agreed that education influenced their harvesting techniques, suggesting a perceived influence of educational attainment and the choice or implementation of harvesting methods. This alignment might indicate that formal education offers insights or knowledge influencing the selection and execution of AIV harvesting practices. Conversely, 37% expressed disagreement or uncertainty about education influencing harvesting methods. This dissenting perspective highlights a subset of respondents who might perceive harvesting techniques as less influenced by formal education. This group could rely more on traditional or experiential knowledge rather than formal education when deciding on harvesting methodologies.

The findings regarding the influence of education on various agricultural practices among African Indigenous Vegetable (AIV) farmers resonate with previous studies. Research by Alant and Bakare (2021) highlighted the significant correlation between education levels

and agricultural proficiency among smallholder farmers. Their study emphasized how higher education often contributes to better field management practices, including harvesting methods and pest control, aligning with the results observed here. Moreover, Lu *et al.* (2019) noted a similar pattern, affirming that education enhances farmers' analytical skills in understanding market demands, a trend mirrored in the substantial agreement seen in this study regarding education's role in analyzing market demand trends among AIV farmers. These congruent findings underline the persistent influence of education on agricultural capabilities, emphasizing its pivotal role in shaping diverse aspects of farming practices among smallholder farmers.

The data suggests a noteworthy influence of education on the analysis and control of soil-borne pests and diseases affecting African Indigenous Vegetables (AIVs) among farmers. A substantial 58.4% of respondents agreed that their education had a significant influence on their capability to analyze and manage these issues. This majority agreement implies that education plays a pivotal role in enhancing farmers' understanding and ability to combat soil-borne pests and diseases affecting AIVs. Conversely, 26.6% disagreed or were unsure about this influence, potentially indicating varied experiences or perspectives among respondents. The strong agreement percentage supports the notion that education equips farmers with the knowledge and skills necessary for effective diagnosis, prevention, and management of soil-borne issues in AIV production. This alignment with education's influence on pest and disease control echoes findings from previous studies. Research conducted by Ngoya *et al.* (2023) emphasized the positive correlation between education levels and farmers' ability to mitigate soil-borne challenges in crop production. These consistent outcomes underscore the critical role of education in empowering farmers to address and manage soil-related issues in AIV cultivation. In addition, the key informants and FGD participants indicated that education had a positive effect on crop production. One key informant reiterated that:

"Higher-educated farmers are often better able to implement modern farming techniques, understand market dynamics, and obtain information and resources to increase their yields. Low level of education influence*s negatively since most farmers cannot understand good modern agronomic practices,".*

4.6 Influence of age on commercial production of African indigenous vegetables

The second objective sought to determine influence of age on commercial production of African indigenous vegetables among smallholder farmers in Bobasi Sub-County.

Respondents were given scale with reference to for their understanding; (Where 1=strongly disagree, 2=disagree, 3=not sure, 4=agree and 5=strongly agree)

Table 19

The age Parameters of smallholder AIV farmers

Age parameters	1	2	3	4	5
		Percentages			
Increase in the period (months/years) of AIV production has a positive effect on yield	0	0	0	44.2	55.8
To a greater extent the age of the farmer positively influences commercial production of AIVs	7.8	15.6	12.3	27.3	37
The period in AIV production to a greater extent helps a farmer to predict the weather patterns in their area	8.4	34.4	15.6	3.9	37.7
To a greater extent older farmers are more involved in AIVs production as compared to younger farmers	7.1	12.3	13	44.2	23.4
Older farmers are willing to cooperate in farming for collective marketing as opposed to young farmers	10.4	20.8	0	53.9	14.9

Table 19 data indicates a noteworthy division in the perceptions regarding the influence of increased production time on the yield of African indigenous vegetables (AIVs). A combined total of 100% agreement (44.2% and 55.8%) infers that all respondents, to some degree, acknowledged a positive correlation between extended production periods and enhanced yield in AIV cultivation. The agreement among respondents might stem from various factors. Increased production duration can allow farmers to observe and adapt to specific crop requirements, understand optimal growth conditions, implement better pest and disease management strategies, and refine cultivation techniques over time. Additionally, prolonged production periods may offer opportunities for farmers to fine-tune their knowledge of soil

fertility, crop rotation, and water management, all of which contribute significantly to improved yields.

According to a study by Etten *et al.* (2019) a longer tenure in AIV cultivation enable farmers to select superior seed varieties, adopt more efficient harvesting and post-harvesting practices, and gain insights into market demands and fluctuations. Similar findings were cited by a study by Chepkoech *et al.* (2020) indicated that accumulated experience lead to increased proficiency in managing challenges specific to AIV cultivation, thereby positively affecting overall yield. However, it is crucial to consider that despite this collective agreement, individual experiences and local contexts may lead to varied interpretations. Factors such as environmental conditions, varying farm sizes, access to resources, and agronomic practices can influence the actual influence of extended production periods on yield, prompting differing opinions among farmers as depicted in Europe by a study by Le-Gouis *et al.* (2020).

In the assessment of the influence of age on commercial production of African indigenous vegetables (AIVs) around 27.3% of respondents strongly agreed and 37% agreed that the age of the farmer positively influences commercial AIV production. Conversely, 7.8% disagreed, and 15.6% were uncertain, indicating a lack of consensus among respondents regarding this proposition. The results demonstrating that 64.3% agreed with the assertion that the age of the farmer positively influences commercial production of African indigenous vegetables (AIVs) while 23.4% disagreed suggest a divided perception among respondents regarding the influence of age on AIV cultivation. Those who agreed likely perceive age as a contributing factor to successful AIV production due to accrued experience. The results of FGD cited that with age comes a prolonged exposure to farming practices, environmental conditions, and indigenous knowledge, allowing older farmers to harness this wisdom for enhanced productivity. In addition, key informant indicated that extensive experience provide farmers with an intuitive understanding of local ecosystems, crop cycles, and traditional farming methods, which could significantly benefit AIV cultivation. The results align with a study conducted in Northern Pakistan by Aldosari *et al.* (2019), highlighting the multifaceted relationship between age and agricultural production, particularly in AIV cultivation. A study by Abay *et al.* (2019)'s study similarly suggested that age influences farming practices but does not solely determine success. It acknowledged the significance of experience garnered over time, indicating the potential benefits of accumulated knowledge and traditional practices held by older farmers.

Conversely, those who disagreed may argue that factors such as adaptability, access to resources, education, and technological advancements play crucial roles in contemporary

agricultural practices. This results agree with the findings by Anwarudin *et al.* (2019) younger farmers, although lacking extensive experience, may bring innovative ideas, modern techniques, and adaptability to the field, contributing to the enhancement of AIV cultivation. They might challenge the traditional belief that experience solely equates to success, advocating for a more holistic approach that value both experience and innovation.

In relation to the assertion about the duration of African Indigenous Vegetables (AIV) production aiding in predicting local weather patterns, the results indicated that a total of 58.4% of respondents disagreed or were uncertain about this statement. This comprised 34.4% who disagreed and 15.6% who were not sure. On the other hand, a total of 41.6% agreed with this assertion, which included 3.9% who agreed and 37.7% who strongly agreed. This split in opinions might stem from varying experiences and perspectives regarding the influence of AIV production on weather prediction. Farmers with extended AIV production experience might trust their observations, linking farming cycles to weather patterns. Conversely, others may perceive weather forecasting as a complex domain beyond the scope of agricultural practices, hence expressing uncertainty or disagreement. Moreover, the regional variability in weather patterns within Bobasi Sub-County could also contribute to these disparities. Areas exhibiting more predictable weather might have farmers more inclined to agree due to clearer correlations, while those experiencing inconsistent patterns may express skepticism. The findings presented in this study align with the observations made by Raza *et al.* (2019), who highlighted the influence of climate change on unpredictable weather patterns affecting crop cultivation. Climate variability often results in erratic weather conditions, influencing farmers' perceptions of weather prediction reliability. These erratic patterns could contribute to the divergent opinions seen in this study regarding the relationship between African Indigenous Vegetables (AIV) production and weather forecasting.

In relation to the statement about the involvement of older farmers compared to younger ones in African Indigenous Vegetables (AIV) production, the results exhibited a notable split in opinions. A considerable 67.6% agreed with the statement, while 19.4% disagreed. The agreement might stem from various factors. Older farmers often have accumulated experience and inherited knowledge in AIV production, displaying a deeper understanding of indigenous agricultural practices. This contention is in tandem with a study conducted in Moshi by Kazungu and Nyagango (2022) Tanzania that cited old farmers possess more significant land holdings or access to resources conducive to AIV cultivation, increasing their involvement in this agricultural domain. Cultural factors also play a role, as traditional practices and values linked to AIV farming could be more prevalent among older generations Ntawuruhunga *et al.*

(2020b). On the contrary, the disagreement, a smaller percentage, could arise from diverse perspectives. Younger farmers might not have fully immersed themselves in AIV production due to various reasons such as diversification of interests, opportunities in other sectors, or limited exposure to traditional farming practices. Additionally, some younger farmers might opt for alternative, more modern agricultural ventures that differ from AIV cultivation.

The disagreement could also reflect evolving trends where certain younger farmers might be actively engaged in AIV production, challenging the conventional belief that older farmers are predominantly involved. This pattern of responses aligns with previous research indicating generational disparities in agricultural involvement. Young farmers have preference for more individualistic or modern approaches to marketing, potentially influenced by changing market dynamics, technological advancements, or varying ideologies regarding business strategies as reported by a study conducted in Italy by Milone and Ventura (2019).

4.7 Influence of income level on Commercial production of African Indigenous vegetables

The third objective aimed to determine whether the income generated from the sale of African Indigenous Vegetables (AIVs) is adequate and how it influences their commercialization. Higher income levels from AIV sales can incentivize farmers to shift towards cultivating AIVs, as these vegetables often command premium prices in the market. This transition is likely to enhance farmers' financial stability and encourage more investment in AIV production, thereby promoting commercialization. Ultimately, increased income from AIVs can lead to greater adoption of these crops, improving livelihoods and contributing to sustainable agricultural practices. The income disparities among different African Indigenous Vegetables (AIVs) harvested by smallholder farmers highlight varying earning potentials influenced as indicated by Table 20. Spider plant, for instance, showed a predominant percentage (40.3%) earning between 25,001 to 30,000 Kenyan Shillings (KES). This substantial income, especially for some Spider plant farmers who earned above 30,000 KES, might be attributed to several factors. These high earnings could potentially be linked to certain farmers having larger land areas dedicated to Spider plant cultivation. Larger land allocations might lead to increased production and consequently higher earnings due to economies of scale or higher yield per unit area. Table 21 provides additional support to this information. It shows that majority of the respondents accounting to 37% of AIV farmers earning over 20,001 KES per month were more commercially engaged compared to the 31.2% earning below 15,000 KES. Additionally, 31.8% of farmers earned incomes ranging between 15,001 and 20,000 KES

per month, further highlighting the income disparities.

Table 14

Average Income Earned By Smallholder AIV Farmers from the Sale per Season

	Average Income (KES)									
Type of AIV	1000-5000	5001-10000	10001-15000	15001-20000	20001-25000	25001-30000	30001-35000	Above 35000	Total (%)	n
Spider plant	10.4	7.8	11	6.5	9.7	40.3	9.1	5.2	100	154
Black nightshade	14.3	22.1	58.4	5.2	0	0	0	0	100	154
Cow peas	8.4	27.3	50	14.3	0	0	0	0	100	154
Amaranth	69.5	30.5	0	0	0	0	0	0	100	154

Conversely, Black nightshade had the largest proportion (58.4%) of farmers earning between 10,001 to 15,000 KES. This income distribution possibly reflects this vegetable's market demand or pricing dynamics within that specific earnings range. Cowpeas also displayed a significant percentage (50%) earning between 10,001 to 15,000 KES, indicating a certain level of market value or potentially favorable yields within this range. However, Amaranth showed a strikingly different pattern with the majority (69.5%) of farmers earning between 1,000 to 5,000 KES, signifying lower returns compared to the other AIVs. This income disparity might be due to lower market demand, lower yield, or possibly less favorable pricing compared to other AIVs, affecting the income potential for Amaranth farmers. These observations reinforce the influence of various factors like market dynamics, crop-specific demand, yield, and possibly different land allocations on the earnings of smallholder AIV farmers. The higher incomes observed in Spider plant and the disparities across different AIVs' income distributions underline the significant role of land allocation and crop-specific characteristics in determining farmers' earnings. These findings align with existing literature, suggesting that income from agricultural produce can significantly differ based on crop-specific factors, market dynamics, and land allocation (Paus *et al.,* 2023). The need for

smallholder farmers to consider various factors including land size, market trends, and crop-specific characteristics to maximize their income is reiterated through these income disparities among different AIVs.

4.7.1 Average Income Earned by Smallholder AIV Farmers from the Sale per Month

The data from Table 21 displays a varied spectrum of monthly income earned by smallholder African Indigenous Vegetable (AIV) farmers from their sales. It reveals a diverse distribution of income among these farmers, shedding light on their financial gains from AIV sales.

Table 15

Average Income Earned By Smallholder AIV Farmers from the Sale per Month

Average income per month in KES	Frequency	Percentage
less 5000	10	6.5
5001-10000	16	10.4
10001-15000	22	14.3
15001-20000	49	31.8
20001-25000	33	21.4
above 25000	24	15.6
Total	154	100.0

The majority of respondents, accounting for 37% of AIV farmers, reported earning incomes exceeding 20,001 Kenyan shillings per month. This proportion signifies a significant segment of farmers who achieved relatively higher incomes from their AIV sales.

Most farmers are now focusing on AIV farming compared to exotic vegetables due to the higher income potential associated with these crops. For example, the spider plant (Cleome gynandra) and black nightshade (Solanum nigrum) yield more income when harvested and sold fresh, providing farmers with a lucrative market opportunity. The increased demand for AIVs, coupled with their nutritional benefits, has made them a preferred choice for many farmers," a key informant added.

Additionally, 31.8% of farmers earned incomes ranging between 15001 and 20000 Kenyan shillings per month. Another notable proportion, comprising 31.2% of respondents, earned less than 15000 Kenyan shillings per month from their AIV sales. This group represents

those with comparatively lower income levels from their AIV farming endeavors. The distribution of income among smallholder AIV farmers illustrates a noteworthy prevalence of farmers earning higher incomes, with nearly two-thirds of respondents falling within the income brackets of above 15001 Kenyan shillings per month. This indicates a substantial proportion of farmers achieving moderate to higher income levels from their AIV sales. These findings highlight the potential for AIV farming to yield favorable financial returns for a considerable number of farmers, especially those earning incomes surpassing the 20001 Kenyan shilling mark. However, it is essential to acknowledge the percentage of farmers earning lower incomes, emphasizing the need for support and strategies to enhance income-generating opportunities for all farmers within this sector. The demand for AIVs in urban and suburban areas may cause some farmers to earn more income as opposed to the farmers selling their AIVs in local markets or to resellers. The findings of this study are in tandem with findings by Kangile *et al.* (2020)'s study in Tanzania that highlights the disparity in income among farmers, influenced by multiple factors such as farm size, access to resources, market dynamics, and crop choice. Similar trends of varying income levels among farmers engaged in specific crop production, as observed in this study, correspond to general agricultural income distribution patterns reported in various agricultural contexts. In addition, study by Amare *et al.* (2019) point out the significance of market access, productivity, and value addition in determining farmers' earnings. In this context, the variation in income levels among AIV farmers might be attributed to factors like market connections, production efficiency, post-harvest management, and access to higher-value markets.

4.8 Influence of Size of Farm on Commercial Production of African Indigenous Vegetables

The fourth objective of the study sought to determine whether the size of the farm influenced the commercial production of AIVs among the farmers in Bobasi Sub-County. The responses were recorded as shown in table 16. A five point Likert scale was used Where 1=strongly disagree, 2=disagree, 3=not sure, 4=agree and 5=strongly agree

Table 22

Farm Size characteristics on Commercial Production of African Indigenous Vegetables

Farm size characteristics	1	2	3	4	5
			Percentage		
The size of the farm allocated to my AIVs always remains constant regardless of the weather seasons	6.5	37.7	20.8	13.3	22.1
The size of the farm under AIV production is influenced by market demand	0	22.1	7.8	70.1	0
The size of the farm influences your decision to participate in commercial AIV production	0	7.1	7.8	77.9	7.1
The size of the farm allocated to my AIVs is influenced by income level	7.8	20.8	0	64.3	7.1
The size of the farm under AIVs production is influenced by the number of years have been in commercial AIVs production	7.8	35.1	0	57.1	0

In reference to Table 22, the data illustrates a divided perspective among farmers regarding the consistency of farm size allocated to African Indigenous Vegetables (AIVs) despite changing weather seasons. The majority of farmers, constituting 44.2%, disagreed with the notion that farm sizes remain constant regardless of whether variations. This group emphasizes the influence of weather on farm allocations, suggesting a tendency to adjust farm sizes in response to climatic fluctuations. Additionally, a notable 20.8% expressed uncertainty, indicating varied or ambiguous opinions among respondents concerning the influence of weather on farm size. On the contrary, a combined 35.4% (13.3% +22.1%) who strongly agreed suggested a belief in the constancy of farm sizes despite changing weather patterns. The varying responses might be influenced by multifaceted factors. Farmers often adjust farm sizes not only due to weather changes but also in response to market demands, economic considerations, or personal preferences. Some might believe that altering farm sizes optimizes production, while others may prioritize stability in their agricultural practices. The findings partially align with prior studies that emphasize the adaptability of farmers in adjusting farm

sizes based on weather conditions as cited by a study conducted by Shahzad and Abdulai (2020). However, the division of opinions within this study highlights the complexity of decision-making processes among farmers. It indicates while a substantial portion believes in adjusting farm sizes according to weather variations, there remains a significant group that adheres to consistent allocations of farm size regardless of weather changes with an aim of increasing crop profit.

The data reveals interesting insights regarding the influence of market demand on the size of farms dedicated to African Indigenous Vegetables (AIVs) among farmers. Notably, a substantial 70.1% of respondents strongly agreed that the size of their farms under AIV production is indeed influenced by market demand. This resounding agreement signifies a collective acknowledgment among the majority of farmers regarding the pivotal role of market dynamics in determining the farm sizes dedicated to AIVs. The agreement could stem from a fundamental understanding among farmers that aligning farm sizes with market demand enhances profitability. Farmers likely adjust the acreage allocated to AIVs based on market signals, aiming to optimize production to meet consumer needs and capitalize on market opportunities. Moreover, in a competitive market scenario, where demand fluctuates, farmers might be inclined to scale their productions accordingly to avoid surpluses or shortages. On the contrary, a small proportion of respondents, constituting 7.8%, disagreed with the influence of market demand on farm size dedicated to AIV production. This dissenting group may have various reasons for their stance. Some farmers might prioritize self-sufficiency or traditional practices over adapting to market fluctuations. Additionally, logistical constraints or limited access to market information could deter some farmers from tailoring their farm sizes based on market dynamics.

These findings resonate with a study conducted in Northern China by Sheng *et al.* (2019) highlighting the interplay between market demand and farm size adjustments. Studies often emphasize the significance of market orientation in guiding farmers' production decisions, underscoring the importance of aligning agricultural practices with consumer preferences and market trends. In reference to Table 13, the majority of farmers, constituting 85%, acknowledged that the size of the farm significantly influences their decision to partake in commercial African Indigenous Vegetable (AIV) production. This resounding agreement underscores the prevalent belief among farmers that farm size plays a pivotal role in shaping their engagement in commercial agricultural activities. The substantial agreement might be attributed to various factors. For instance, larger farm sizes are often associated with increased productivity and profitability due to economies of scale, encouraging farmers to opt for larger-

scale AIV production for enhanced economic returns. Moreover, sizable farm operations might offer more opportunities for diversification, allowing farmers to cater to diverse market demands and fluctuations. However, a small proportion, accounting for 15% (7.8% disagreed and 7.1% were uncertain), expressed dissent or uncertainty regarding the influence of farm size on their decision-making in commercial AIV production. These farmers may prioritize other aspects such as specialized production, unique market niches, or innovative cultivation techniques over the sheer size of the farm when considering engaging in commercial AIV cultivation.

This alignment with previous studies resonates with existing literature emphasizing the significant role of farm size in shaping farmers' decisions related to commercial agricultural activities as reported by Saint-Cyr *et al.* (2019)'s study in Britain. The prevailing agreement reaffirms the widely recognized notion that farm size remains a critical factor influencing farmers' choices in entering and sustaining commercial AIV production endeavors. The key informant supported the farmers' observations;

"*Farm size some farmers could be grateful that there is land available for growing vegetables commercially, particularly if they have access to enough suitable acreage that allows them to expand their farming operations. Small land size is an impediment to commercial production eg.no room for expansion."* Key informant.

In examining Table 16 the data signifies that 71.4% of farmers acknowledged that their income level influences the size of the farm allocated to African Indigenous Vegetables (AIVs). This substantial agreement underscores the perceived influence of financial considerations on farm size allocation. The predominant alignment suggests that a significant portion of farmers' factor in their income when determining the acreage dedicated to AIV cultivation. This concordance between income level and farm size allocation can be attributed to various reasons. Limited financial resources might restrict farmers from expanding their farm sizes, compelling them to work within constrained acreage. Conversely, higher income might allow for more substantial investments in AIV production, enabling farmers to expand their operations. Additionally, farmers with higher income might be more willing to take risks associated with larger-scale production, influencing their decision to allocate more land to AIVs. However, 28.6% of respondents either disagreed (7.8%) or were uncertain (20.8%) regarding the influence of income on farm size allocation for AIVs. These dissenting opinions or uncertainties might stem from various factors. Some farmers might prioritize factors other than income, such as land availability, soil suitability, or technological advancements, when deciding on farm sizes. Additionally, certain farmers might have diversified income sources or

access to support programs, minimizing the direct influence of income on their farm size decisions.

This results agree with a study by Ren *et al.* (2019) that underscores the multifaceted influence of income on farm size allocation. Understanding this connection between income and farm size allocation is crucial for policymakers and agricultural support organizations. Tailoring interventions and programs that focus on enhancing income opportunities could potentially empower farmers to expand their AIV cultivation, leading to improved agricultural productivity and livelihoods. Moreover, providing financial literacy and access to credit might further assist farmers in making informed decisions regarding farm size allocation for AIV production (Ngenoh *et al.,* 2019c).

In addition, Table 22 indicates that 64.9% of respondents agreed that the size of the farm under African Indigenous Vegetables (AIVs) production is influenced by the number of years they have been engaged in commercial AIVs production. This substantial agreement suggests that experience plays a crucial role in determining the farm size dedicated to AIV cultivation. The alignment between farm size and years of experience can be attributed to several factors. Farmers with more experience might have gained better insights into market demands, optimal crop management practices, and suitable land allocation for AIV cultivation. Consequently, they might be inclined to adjust farm sizes based on this accumulated knowledge, expanding or contracting based on their learning from previous years. However, 42.9% of respondents either disagreed (7.8%) or were uncertain (35.1%) about the influence of the number of years in AIV production on farm size allocation. These dissenting opinions or uncertainties might be attributed to varying contexts or perspectives. Some farmers may not perceive a direct correlation between their years of experience and the optimal farm size for AIVs. Factors such as fluctuating market demands or changes in production techniques could contribute to these differences in opinion.

This result is of this study is congruent with prior studies that underscore the significance of experience in determining farm size in agricultural production as cited by (Sheng *et al.,* 2019). Experienced farmers make more informed decisions regarding farm sizes based on past successes and challenges in vegetables production as reported by a study conducted in Sri Lanka by Mahindarathne and Min (2019). Understanding this connection could assist agricultural extension services in offering targeted guidance and support to newer farmers, facilitating knowledge transfer and aiding them in making informed decisions about farm size allocation for AIV cultivation.

4.9 Access to Extension Services by Smallholder AIV Farmers

The source of extension services and the type of information AIV farmers sought are the main results presented under this subheading. This was considered helpful in understanding the most preferred extension service provider.

4.9.1 Providers of Extension Services

The findings in Table 23 from the survey on access to extension services among smallholder African Indigenous Vegetable (AIV) farmers revealed several notable patterns. The majority of farmers, comprising 47.4%, primarily relied on fellow farmers as their primary source of extension services. This reliance on knowledge sharing among peers suggests a robust system of farmer-to-farmer information exchange within the agricultural community. Moreover, a considerable proportion of farmers, 22.7%, accessed private extension service providers, while a slightly lower percentage, 22.1%, engaged with public extension service providers. A smaller subset, 7.8%, indicated utilizing both public and private extension services. This diversity in accessing extension services reflects a multifaceted approach to knowledge acquisition and indicates the existence of various channels for agricultural guidance and support within the community.

Table 16

Providers of Extension Services

Extension Providers	Frequency	Valid Percent
Public extension service provider	34	22.1
Private extension services providers	35	22.7
Fellow farmers	73	47.4
Both Public and Private Extension providers	12	7.8
Total	154	100.0

The prevalent reliance on fellow farmers might signify the trust and credibility farmers place on the practical knowledge and experiences shared by their peers. This informal method of learning often provides localized, context-specific advice, fostering a sense of camaraderie and community among farmers. Conversely, the engagement with private and public extension services, albeit lower in percentage, signifies the value placed on professional guidance and technical expertise offered by these service providers. These findings align with existing literature emphasizing the importance of diverse sources of agricultural extension services for smallholder farmers (Kassem *et al.,* 2021). Farmer-to-farmer knowledge transfer has been recognized as a crucial and effective means of disseminating information, particularly in areas where formal extension services might face limitations in accessibility or resources (Sah *et al.,* 2021). However, while the reliance on fellow farmers is valuable, it is essential to recognize potential gaps in information or technical support that might arise from over-reliance on informal channels. Strengthening collaborations between public and private extension service providers and promoting synergies between formal and informal knowledge-sharing mechanisms could enhance the overall support available to smallholder AIV farmers. The predominant reliance on fellow farmers for agricultural knowledge among smallholder African Indigenous Vegetable (AIV) farmers underscores potential limitations in formal extension services. This reliance is often an indicator of the constrained accessibility or adequacy of extension services, a finding supported by research conducted by Norton and Alwang (2020). Limited access to professional extension services could lead farmers to depend more heavily on peer-based information sharing, suggesting a gap in the availability or effectiveness of formal support systems. The study highlights the significance of farmer-to-farmer knowledge exchange while signaling the need for enhanced and accessible formal extension services to complement and strengthen the agricultural support framework for smallholder AIV farmers.

4.9.2 Services Sought by Smallholder Farmers

The study on services sought by smallholder African Indigenous Vegetable (AIV) farmers revealed essential insights into their preferences for extension services and results were as indicated in Table 24. Nearly half of the respondents, accounting for 49.4%, sought guidance on routine field practices like land preparation, seed selection, planting, weeding, and pest control. This robust emphasis on fundamental farming practices underscores the critical need for foundational agricultural knowledge and effective management among these farmers.

Table 17

Services Sought by Smallholder Farmers

Services sought	Percentages	Valid Percent
Routine filed practices (land preparation, seed selection, plating, weeding, pests and disease control)	76	49.4
Value Chain addition	13	8.4
Marketing	53	34.4
Modern technologies	12	7.8
Total	154	100.0

A smaller yet noteworthy subset, constituting 34.4% of respondents, expressed interest in obtaining guidance on marketing strategies. This signifies a significant interest in understanding market dynamics and optimizing sales, highlighting the farmers' focus on improving their commercial prospects within the AIV sector. Around 8.4% sought information on value chain addition, indicating a modest but distinct interest in enhancing the value of their produce. This could entail exploring methods to improve product quality, processing, or differentiation to increase the overall value of their agricultural output. Moreover, 7.8% sought information on modern agricultural skills, reflecting a moderate interest in adopting contemporary farming methods or tools for increased efficiency and productivity. The patterns observed in the services sought align with past studies emphasizing the importance of fundamental agricultural guidance (Cole & Fernando, 2021). However, the emerging interest in marketing and value chain addition may indicate a growing recognition among farmers regarding the significance of market-oriented approaches and value addition strategies,

suggesting a possible shift from historical trends that primarily focused on agricultural practices (Dung *et al.*, 2020).

4.10 Income and Marketing Information

This subheading presents results on the marketing of AIVs and the challenges encountered.

4.10.1 Places where Smallholders Sold the Vegetables

The findings regarding the selling venues for African Indigenous Vegetables (AIVs) among smallholder farmers indicate that the local market is the primary avenue for sales, accounting for 65.6% of responses. This suggests a significant reliance on local markets as the chief distribution channel for their produce. About 27.9% of farmers reported selling their AIVs in urban markets, highlighting a substantial portion of produce reaching more extensive and potentially more lucrative markets. This diversification into urban areas signifies a strategic effort to access broader consumer bases and potentially higher prices for their produce. A smaller fraction, 6.5%, mentioned selling through intermediaries, indicating a reliance on intermediaries for marketing and distribution. While this might offer convenience in selling, it could also imply reduced direct control over pricing and market access. The predominant reliance on local markets highlights the importance of regional trade and community consumption. However, the considerable portion selling in urban markets indicates efforts to tap into larger markets, suggesting an entrepreneurial approach to marketing strategies. These findings align with previous studies indicating that smallholder farmers predominantly rely on local markets due to convenience and familiarity (Labeyrie *et al.*, 2023). However, the involvement in urban markets displays adaptability and an inclination toward expanding their market reach beyond immediate communities, aiming for increased profitability and access to a more extensive customer base.

4.10.2 Challenges Faced by Smallholder Farmers in Marketing AIVs

The data illustrates the challenges faced by smallholder farmers in marketing African Indigenous Vegetables (AIVs). The majority of farmers, accounting for 42.9%, highlighted unreliable markets as a significant challenge in selling their produce.

Table 18

Challenges Faced By Smallholder Farmers in Marketing AIVs

Challenges Faced	Frequency	Valid Percent
Unreliable markets	66	42.9
Fluctuating prices	67	43.5
High cost of inputs	21	13.6
Total	154	100.0

The results imply that farmers encounter difficulties in finding consistent and dependable avenues to sell their AIVs, influencing their ability to plan and manage their agricultural businesses effectively. Moreover, 43.5% of respondents expressed concerns about fluctuating prices, indicating that the inconsistent pricing of AIVs poses a challenge. Such volatility can affect the profitability of farmers, as unpredictable price shifts may result in financial instability and uncertain revenue generation from their produce. Additionally, a smaller percentage of farmers, constituting 13.6%, identified the high cost of inputs as a challenge in marketing their AIVs. This issue suggests that the expenses associated with inputs like seeds, fertilizers, and other farming essentials might be a barrier for some farmers, influencing their ability to cultivate and market their AIVs at a competitive cost. These challenges align with common issues faced by smallholder farmers in agricultural marketing. The uncertainties in market reliability and pricing can lead to financial risks and affect the overall sustainability of their farming ventures. The high cost of inputs further compounds these challenges, making it challenging some farmers to engage in profitable AIV production and marketing.

The challenges faced by smallholder farmers in marketing African Indigenous Vegetables (AIVs) align with several studies in agricultural economics. For instance, a study conducted by Hoang (2021) in Vietnam highlighted similar concerns regarding unreliable markets and their influence on smallholder farmers' income stability. Additionally, research by Chèze *et al.* (2020) indicated that fluctuating prices significantly affect the profitability of farmers, reflecting the sentiments echoed in this survey's results. Furthermore, another study conducted by Pingali *et al.* (2019) identified high input costs as a hindrance to farmers' ability to compete effectively in the market, correlating with the concerns expressed by respondents in this study. Similarly, findings from Buitenhuis *et al.* (2020)'s research emphasized the

detrimental effects of unstable prices on farmers' economic sustainability, resonating with the challenges highlighted in this survey.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary, conclusions, and recommendations of the study, and suggestions for future research.

5.2 Summary of Study

The study examined the influence of several key socio-economic variables on the commercial production of African Indigenous Vegetables (AIV) among smallholder farmers in Bobasi Sub-County, Kenya. These variables included education level, age, income level, and farm size. Using a descriptive survey research design, data was collected through survey questionnaires, focus group discussions, and interviews to provide a comprehensive understanding of how these factors influence AIV production in the study area.

The first objective sought to determine influence of education level on commercial production of African Indigenous vegetablesamong smallholder farmers. The findings from the surveyed African Indigenous Vegetable (AIV) farmers underscore a strong influence of education and various facets of commercial production. Almost half of the respondents, approximately 49.4%, perceive education as a significant factor influencing their decisions to partake in commercial AIV production. Yet, contrasting viewpoints, with 22.7% strongly disagreeing, reflect a spectrum of perspectives. Notably, 20.8% expressing uncertainty suggests a mix of factors shaping farmers' choices, extending beyond formal education. Regarding market analysis, a substantial 71.4% believe education plays a pivotal role in comprehending market trends. This alignment emphasizes education's importance in navigating market dynamics. However, approximately 21.4% held contrary opinions or uncertainties. In the realm of field management practices, a significant 72.7% acknowledged education's role in enhancing their proficiency. Conversely, 20.1% disagreed, indicating a subset valuing practical wisdom over formal education. Opinions on the influence of education on harvesting methods varied among respondents. While 55.2% acknowledged a potential link, a notable percentage expressed disagreement or uncertainty, favoring traditional or experiential knowledge over formal education. Regarding soil-borne pest and disease control, a substantial 58.4% recognized education's influence on managing these issues in AIV cultivation. This acknowledgment underscores education's role in equipping farmers with essential skills, although around 26.6% disagreed or were uncertain about this influence.

The study's second objective delved into the age of farmers concerning their influence on African Indigenous Vegetable (AIV) production. Firstly, in considering extended production periods and yield, there was unanimous agreement (44.2% and 55.8%) among respondents on the positive correlation between prolonged AIV production periods and increased yield. This agreement might stem from accumulated knowledge, refined techniques, and adaptation to crop requirements over time. Regarding the influence of age on AIV production, findings revealed a split perception: while 64.3% acknowledged age's positive influence, leveraging accrued experience for productivity, 23.4% disagreed. Older farmers' extensive exposure and intuitive understanding of local ecosystems were seen as positive contributors. However, dissenting opinions highlighted the importance of adaptability, innovation, and modern agricultural practices among younger farmers. A notable divergence surfaced concerning AIV production's influence on weather prediction, with 58.4% expressing disagreement or uncertainty. Varied experiences and the complexity of weather forecasting contributed to this divergence among respondents. Additionally, there was significant agreement (67.6%) indicating that older farmers are more involved in AIV production due to their accumulated knowledge and resource access. Conversely, 19.4% disagreed, reflecting younger farmers' diversification of interests, limited exposure, or preference for modern agricultural approaches.

The third objective sought to determine the income disparities among smallholder farmers cultivating different African Indigenous Vegetables (AIVs). The findings indicated that among non-AIV projects, the majority (60.4%) of respondents reported earning between 4001 to 8000 Kenyan Shillings per month. This income range represented a moderate yet consistent additional income source derived from initiatives like Merry-Go-Round, SACCOs, or other savings schemes. Regarding the income earned specifically from AIVs, a notable proportion (68.8%, comprised of 37% and 31.8% segments) earned above 15000 Kenyan Shillings. This suggests that the income derived from AIVs significantly contributed to the commercialization of these vegetables among the farmers. The substantial percentage of farmers earning above 15000 Kenyan Shillings from AIV sales underscores the significance of AIVs as a source of income. This finding indicates that AIVs played a substantial role in bolstering the overall income of these farmers, influencing the commercialization and profitability of AIV production. This aligns with the notion that the income level derived from AIVs was influential in encouraging their commercial production among smallholder farmers.

The study's fourth objective shed light on the diverse perspectives of farmers in Bobasi Sub-County regarding farm size and its influence on African Indigenous Vegetable (AIV)

production: Farm Size's Adaptation to Weather: A division emerged with 44.2% disagreeing on constant farm sizes for AIVs during weather changes, while 35.4% believed in consistent allocations. This suggests other considerations beyond weather, like market demands or individual preferences, influenced farm size decisions. A substantial 70.1% recognized market demand's strong sway on farm sizes for AIVs. Farmers adjust their allocations according to market needs to enhance production and seize market opportunities. However, 7.8% disagreed, potentially emphasizing traditional practices or facing limitations in accessing market information. An emphatic 85% acknowledged that farm size significantly influences their choice to engage in commercial AIV production. Larger farms promise increased profitability and diversification, although 15% expressed dissent or uncertainty, possibly valuing specialized production or innovative techniques over mere size. A significant agreement of 71.4% indicated that income levels influence farm size allocation for AIVs. Limited resources could impede expansion, while higher incomes facilitate larger-scale operations. However, 28.6% disagreed or were uncertain, possibly due to varying priorities or diverse income sources beyond direct influence. Approximately 64.9% recognized a link between farm size in AIV production and years of engagement. Experienced farmers tend to adjust farm sizes based on market insights and optimal practices. However, 42.9% either disagreed or were uncertain, indicating differing perceptions about this relationship between experience and optimizing farm size for AIV production.

5.3 Conclusions

The main conclusions of this study are as follows;

i. Education level of smallholder AIV farmers has a positive influence on commercial production farming practices with varying perceptions among farmers across market understanding, field management, and expertise among smallholder farmers in Bobasi Sub-County.

ii. Age of the farmer positively influences the commercial production of AIV, as older farmers tend to have more experience. However, divergence exists due to innovation differences and varied weather prediction perspectives among smallholder farmers in Bobasi Sub-County.

iii. Income level of the farmer positively influences the commercial production of African Indigenous Vegetables (AIVs). Higher income enables farmers to invest more in inputs, improve production practices, and access better markets, enhancing their capacity to

commercialize AIV production. This underscores the importance of financial capacity in driving commercial production among smallholder farmers in Bobasi Sub-County.

iv. Size of the farm of the farmer has a positive influence on commercial production of AIVs among smallholder farmers as reflected in farmers' perceptions in Bobasi Sub-County. This influence is driven by factors such as market demand, income levels, and farming experience among smallholder farmers.

5.4 Recommendations

Based on the findings, the study recommends**;**

i. Private and public stakeholders should collaborate to provide workshops and training aimed at improving farmers' knowledge.

ii. Extension agents ought to set up sessions for younger and older farmers to share knowledge and participate in mentoring programs.

iii. In order to create value-adding projects, market links, and financial services accessibility, national and county government should collaborate.

iv. Policymakers should design programs that will increase market demand, effectively manage resources, and allow them to make well-informed decision about the size of farms.

5.5 Suggestions for Further Research

The following are the suggestions for further research:

i. Investigate innovative methods for climate-resilient agriculture and examine the socio-economic influence of varying farm sizes on AIV production.

ii. Conducting longitudinal studies to track evolving market dynamics and their influence on AIV cultivation.

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APPENDICES

Appendix A: Abstract of published paper

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DOES THE FARM SIZE INFLUENCE THE COMMERCIAL PRODUCTION OF INDIGENOUS AFRICAN VEGETABLES? A STUDY ON SMALLHOLDER FARMERS IN BOBASI SUB-COUNTY, KISII COUNTY, KENYA

[a]Hyvonne W. Kemunto*, [a]Agnes O. Nkurumwa, [b]Lydiah M. Kitonga

[a] Department of Agricultural Education and Extension, Egerton University, Kenya.

[b] Department of Agricultural Sciences, Kisii University, Kenya,

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ABSTRACT

The production of African Indigenous Vegetables (AIVs) is of significant importance for smallholder farmers in Bobasi Sub-county, Kisii County, Kenya, contributing to food security, nutrition, and income improvement. However, its predominant focus remains on subsistence farming. This study investigates the influence of farm size on the commercial production of AIVs among smallholder farmers in the region. Employing a descriptive survey research design, the study targeted 6,341 smallholder commercial AIV farmers from two wards in Bobasi Sub-County, with an accessible population of 2,363 commercial AIV farmers. Through proportionate random sampling, 154 commercial AIV farmers were selected from two purposively selected wards. Data collection utilized a semi-structured questionnaire, key informant interviews, and focus group discussions. The research instruments were validated by experts from Egerton University and Kisii University, and their reliability was confirmed through a pilot study in Kitutu Chache South Sub-County, Nyakoe Ward, yielding a reliability coefficient of 0.745. Descriptive statistics were employed for data analysis using SPSS version 25. The AIVs under study were Spider plant (Chinsaga), Black nightshade (Rinagu), Cowpeas (Egesare), and Amaranth (Emboga). Moreover, income level influences farm size for AIV production, with 85% agreeing that farm size significantly impacts their decision to engage in commercial AIV production. Based on these findings, the study recommends targeted interventions to support smallholder farmers in optimizing land use for AIV production, including access to appropriate technologies, training in efficient farming practices, and improving market access. These measures aim to enhance productivity and economic outcomes while promoting sustainable agriculture in the region.

Corresponding Author: Hyvonne W. Kemunto

Email: winnieyvonne95@gmail.com

Appendix B: Questionnaire for Smallholder African Indigenous Vegetable Farmers

Introduction

Ser. No. …… Ward ……

Dear Farmer,

My name is Hyvonne Winnie Kemunto, a student pursuing a Master's degree in Agricultural Extension at Egerton University. I am carrying out a research on *Influence of selected socio-economic factors on commercial production of African indigenous vegetables among smallholder farmers in Bobasi sub county, Kenya*, as part of the course work. I am kindly requesting you to participate in the research by filling this questionnaire. May I assure you that any information provided will be kept with utmost confidentiality and used solely for the purpose of research.

Thank you

Hyvonne Winnie Kemunto

Instructions

i. Do not write your name on the questionnaire.

ii. Indicate the selected responses by placing a tick (√) in the appropriate box or provide the answer to a question in the given space

SECTION 1

Part A: Personal characteristics

Instructions: Tick and or fill where appropriate

1. What is your main Occupation? Farming [ ] Formal employment [ ] Business [ ] Other (specify) …….
2. State your gender Female ( ) Male ( ) Other (specify)
3. What is the size of your farm in acres?..... ……
4. Land tenure system of the land you have access to Leased ( ) Communal ( ) Inherited ( ) Family land ( ) Others (specify) …….
5. List the main agricultural enterprises that you normally have on your farm besides African indigenous vegetables……
   ……
   ……

Part B: Socio-Economic characteristics

7. Indicate your age in years. 15-24 [ ] 25-34 [ ] 35-44 [ ] 45-54 [ ] 55-64 [ ] >65[ ]

8. How long in years have you been in commercial AIVs production?.....

9. What is the highest level of formal education you have attained? (Tick one)

No formal education ( ) Primary school ( ) Secondary school ( ) Certificate ( ) Diploma ( ) Degree ( ) Post-graduate ( ) Others (Specify) ……..

10. What is your single main source of income?

Farming [ ] Business [ ] Employment [ ] Remittances [ ] Other (specify)……

11. Specify any other significant sources of income that you have, in order of importance?

……

……

……

……

…….....

12. How regular is your income? Not regular ( ) Sometimes regular ( ) Regular ( )

13. Give an estimate of your average income per month in Kenya shillings ……..

14. Give an estimate of the size in acres of your farm under commercial AIVs production.

< 0.5 [ ] 0.5 – 1.0 [ ] 1. 0-1.5 [ ] 1.5-2.0 [ ] >2.0 [ ]

15. What is the size of the farm allocated to the AIVS you grow?

	Name of AIV	Acreage of land
1.	Spider plant (*Chinsaga*)	
2.	Black nightshade (*Rinagu*)	
3.	Amaranth (*Emboga*)	
4.	Other (specify)	
	Total	

16. Use the scale provided to score the statements below, with reference to your understanding;
Where 1=strongly disagree, 2=disagree, 3=not sure, 4=agree and 5=strongly agree

Statements	1	2	3	4	5
Age					
i. Increase in the period (months/years) of AIV production has a positive effect on yield					
ii. To a greater extent the age of the farmer positively influences commercial production of AIVs					
iii. The period in AIV production to a greater extent helps a farmer to predict the weather patterns in their area					
Education level					
i. Education level influence your decision to participate in commercial AIV production					
ii. Education level influence your ability to analyze market demand trends					
iii. Education level influence your capability in carrying out various field management practices					
Farm size					
i. The size of the farm allocated to my AIVs always remains constant regardless of the weather seasons					
ii. The size of the land under AIV production is influenced by market demand					
iii. The size of the farm influences your decision to participate in commercial AIV production					

PART C: Information on Production of African Indigenous Vegetables

a. What type/s of AIVs do you grow? (Select all those which you grow)

i. Spiderplant (*chinsaga)* [ ]

ii. Amaranth (Emboga) [ ]

iii. Black nightshade (*rinagu*) [ ]

iv. Other (*specify*) …….

b. State the number of seasons in a given year that the AIVs are produced ……

c. What method/s of AIVs production do you practice?

Irrigation (open field) ( ) Rainfed ( ) Greenhouse ( ) Other (specify) ……..

d. For each AIV grown, what is the frequency of harvesting, how much do you harvest in Kgs per harvest and what is the average income you earn

from the sale per season?

Name of AIV	**Frequency of harvest per week**	**Average income earned per season (KES)**
Spider plant (*Chinsaga*)	Once [ ] twice [ ]	
Black nightshade (*Rinagu*)	Once [ ] twice [ ]	
Amaranth (*Emboga*)	Once [ ] twice [ ]	
Other (specify)	Once [ ] twice [ ]	

e. How do you process the harvested vegetables before selling them? (*tick all that apply)*

Processing method				
	Black Nightshade	**Spider plant**	**Amaranth**	**Other**
Charcoal cooling				
Fermentation				
Blanching				
Solar drying				
Packaging				
None				
Other (specify) ……..				

Part D: Access to Extension Services

1.Indicate the organizations that provide you with extension services on commercial AIV production (Tick all that apply)

i. Government/Public extension service provider [ ]

ii.	Private extension services providers	[ ]
iii.	Fellow farmers	[ ]
iv.	Agro-chemical dealers	[ ]
v.	Agricultural Universities	[ ]
vi.	Research institutions	[ ]
vii.	Non-Governmental Organisations	[ ]
viii.	Marketing agencies	[ ]
ix.	Credit providers	[ ]
x.	Others specify …….	

2. Indicate the types of information/services provided by your Extension Service providers (Tick all that apply)

i.	Soil testing	[ ]
ii.	Land preparation	[ ]
iii.	Inputs	[ ]
iv.	Seed selection	[ ]
v.	Planting	[ ]
vi.	Weeding	[ ]
vii.	Pests and diseases control	[ ]
viii.	Harvesting	[ ]
ix.	Preservation/storage	[ ]
x.	Value chain addition	[ ]
xi.	Marketing	[ ]
xii.	Modern technologies	[ ]
xiii.	Others specify ……..	

Part E: Income and Marketing information

1. Where do you sell your AIVs? (*tick more than once if applicable)*
   a) Local market ( )
   b) Urban market ( )
   c) Middlemen ( )
   d) Directly to cities ( )
   e) Resellers ( )
   f) Other specify…….

2. What challenges do you face in marketing your AIVs? (*tick all that apply))*
   a) Unreliable markets ( )
   b) Fluctuating prices ( )
   c) High cost of inputs ( )
   d) High perishability of AIVs ( )
   e) Exploitation by brokers ( )
   f) Other specify…….

3. Give an estimate of the average income you get from sale of AIVs per season in Kenya Shillings ……

Thank you for participating in the study

Appendix C: Interview Schedule for Key Informants
Name of respondent…….

Respondent location……

Part A: Production of African Indigenous Vegetables (AIVs)

1. What is your view on commercial production of AIVs/land allocation?.....
2. Which production methods are used by commercial AIV farmers ……

……
…...

3. Types of AIVs grown by the smallholder farmers and number of seasons
   i. Major AIVs grown in the area (give number according to the most grown 1 for mostly grown…and 3 for least grown)
      a) Spider plant (Chinsaga) ( )
      b) Black nightshade (Rinagu) ( )
      c) Amaranth (Emboga) ( )
      Other (specify) ……
   ii. Number of Seasons in a year AIVs are grown……..
4. What is the estimated quantity of AIVs in Kgs do farmers harvest per season from an acre of land?…….

Part B: Extension Services Provision

1. Who provides the commercial farmers with extension services and in which areas?
   i. Extensions services providers ……..……..
   ii. Types of Extension Services provided to commercial AIVs farmers ……..……

Part C: Processing, marketing and Income from AIVs

1. Are there any AIV processing methods used by farmers after harvesting before selling? ……
2. What is your view on marketing challenges faced by farmers for AIVs in terms of accessibility, demand, and prices?.....

Part D: Socio-economic Factors and Commercial Production of AIVs

1. What is your view on the influence of the following socio-economic characteristics of farmers on their engagement in commercial AIV Production:

i. Level of education ……...

ii. Age ……

iii. Gender……

iv. Level of income ……...

2.What is your general comment on commercial AIVs production……

Thank you for participating in the study

Appendix D: Checklist for Smallholder Commercial AIV Farmers' Focus Group discussion

Name of respondent…….

Respondent location……

Part A: Engagement in Production of African Indigenous Vegetables (AIVs)

i. What is your view on production and land allocation for commercial AIVs production?.....
ii. Which type of AIVs do you grow?.....
iii. What is the number of seasons in a year are AIVs produced?.....
iv. Which methods of production do you practice?.....

Part B: Extension Services Provision

i. Who provides extension services to commercial AIV farmers……?
ii. Which type of extension services are provided?.....

Part C: Processing, marketing and Income from AIVs

i. Do you process AIVs before selling them ?……..
ii. What is the estimated amount of AIVs harvested by farmers per season?.....
iii. What is the status of AIVs market in terms of (demand, accessibility, prices) ……?
iv. What is the average estimated income made from the sale of AIVs per season?.....

Part D: Socio-economic Factors and Commercial Production of AIVs

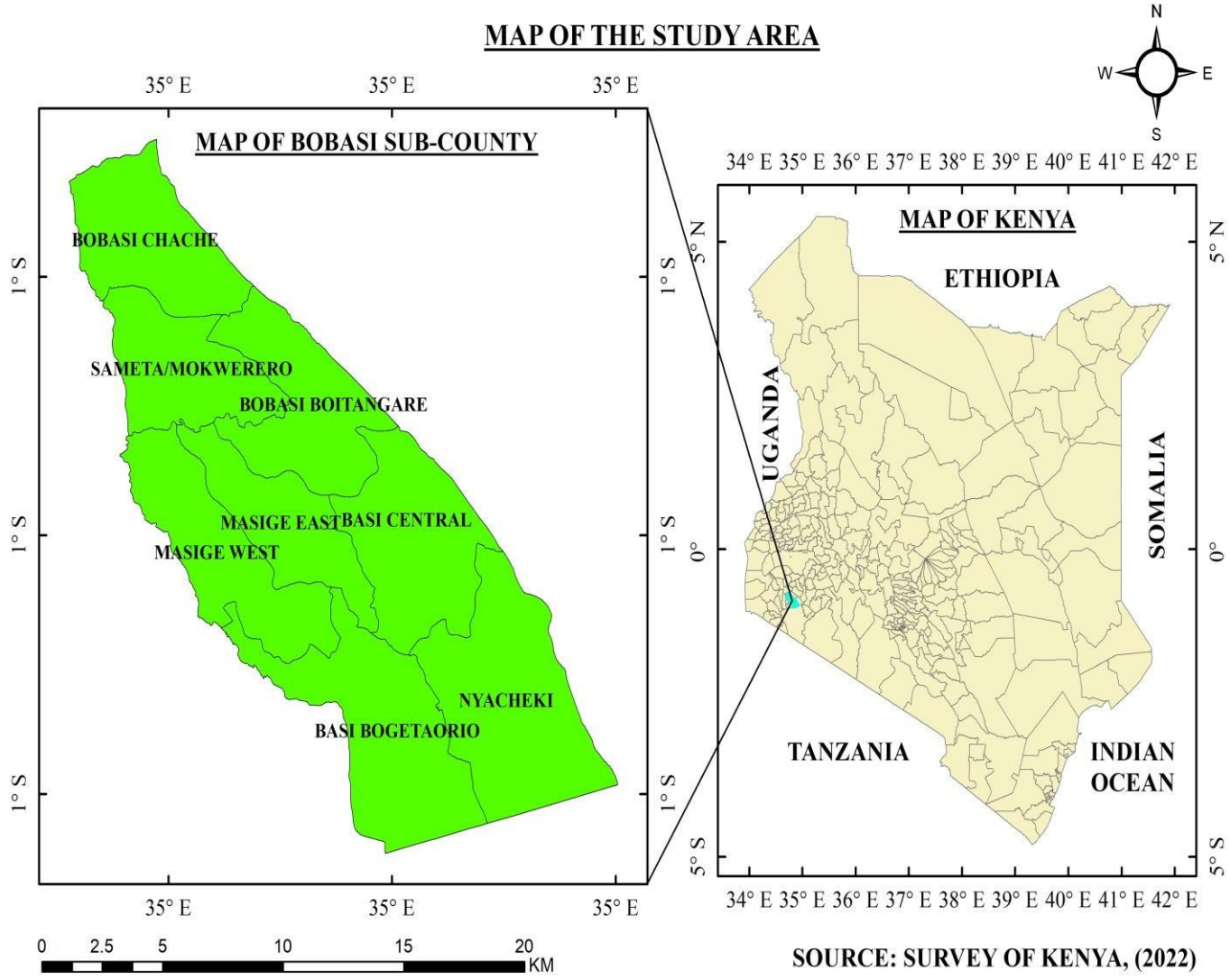
1. What is your view on the influence of the following socio-economic characteristics of farmers on their engagement in commercial AIVs production:

i. Level of education ……...
ii. Age ……..
iii. Gender……..
iv. Level of income ……...

2. In your own opinion, what are the prospects/potential/possibilities for the future of commercial AIVs production …….……

Thank you for participating in the study

Appendix E: Map of study area



Appendix F: Egerton Ethics clearance

EGERTON UNIVERSITY
TEL: (051) 2217808
FAX: 051-2217942

UNIVERSITY
P. O. BOX 536
EGERTON

EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW COMMITTEE

EU/RE/DIR/009
Approval No. EUISERC/APP/312/2024 ***29th February 2024***

Hyvonne Winnie Kemunto,
P.O Box 536-20115,
Egerton
Telephone: +254(0)714106586
Email: winnieyvonne95@gmail.com

Dear Winnie,

RE: ETHICAL APPROVAL: INFLUENCE OF SELECTED SOCIO-ECONOMIC FACTORS ON COMMERCIAL PRODUCTION OF AFRICAN INDIGENOUS VEGETABLES AMONG SMALLHOLDER FARMERS IN BOBASI SUB-COUNTY, KENYA

This is to inform you that the ***Egerton University Institutional Scientific and Ethics Review Committee*** has reviewed and approved your above research proposal. Your application approval number is ***EUISERC/APP/312/2024.*** The approval period is ***29th February 2024 – 1st March, 2025***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***Egerton University Institutional Scientific and Ethics Review Committee.***
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***Egerton University Institutional Scientific and Ethics Review Committee*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to ***Egerton University Institutional Scientific and Ethics Review Committee*** within 72 hours.
v. Clearance for Material Transfer of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***Egerton University Institutional Scientific and Ethics Review Committee.***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely.

EGERTON UNIVERSITY RESEARCH ETHICS Date. 24/02/2024

Prof. Raphael M. Ngure
CHAIRMAN, EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW CTTEE
RMN/BK/

Appendix G: Research Permit (NACOSTI)

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **201098**

Date of Issue: **24/January/2024**

RESEARCH LICENSE

This is to Certify that Miss.. Hyvonne Winnie Kemunto of Egerton University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kisii on the topic: Influence of selected socio-economic Factors on Commercial Production of African Indigenous Vegetables among smallholder farmers in Bobasi Sub-county, Kenya for the period ending : 24/January/2025.

License No: **NACOSTI/P/24/32501**

201098

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions