

**SOCIO-ECONOMIC FACTORS INFLUENCING SMALLHOLDER PUMPKIN
PRODUCTION, CONSUMPTION AND MARKETING IN EASTERN AND
CENTRAL KENYA REGIONS**

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DECLARATION

I declare that this thesis is my original work and has not been presented for the award of a degree in any other University or any other award.

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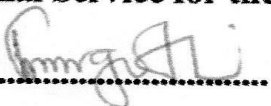
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DEDICATION

I wish to dedicate this thesis to my mother, Leah Wanjiru Kagiri; my wife, Gladys; our children Maureen Wanjiru, Sylvia Wangari and Joshua Nderitu for their moral support, sacrifices and understanding.

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LIST OF ABBREVIATIONS AND ACRONYMS

CIMMYT	-	International Maize and Wheat Improvement Centre
CIAT	-	International Centre for Tropical Agriculture
FAO	-	Food and Agriculture Organization of the United Nations
HCDA	-	Horticultural Crops Development Authority
ICRAF	-	International Centre for Research in Agroforestry
IFPRI	-	International Food Policy Research Institute
IPGRI	-	International Plant Genetic Resources Institute
JICA	-	Japan International Cooperation Agency
MOA	-	Ministry of Agriculture
MOARD	-	Ministry of Agriculture and Rural Development
NEMA	-	National Environment Management Authority
ROK	-	Republic of Kenya
SD	-	Standard Deviation
SPSS	-	Statistical Package for Social Scientists
UK	-	United Kingdom
UN	-	United Nations
USAID	-	United States Agency for International Development
USDA	-	United States Department of Agriculture

ABSTRACT

Pumpkin is an indigenous vegetable with huge potential to provide nutrition, food security and income to households in Kenya but its production remains low. The crop has been given little attention in research and has not been promoted as a viable enterprise. Literature indicates that socio-economic factors and farming constraints in pumpkin production, consumption and marketing by smallholder farmers in Eastern and Central Kenya have not been studied nor documented. This research was carried out to assess these factors and constraints in order to inform the development of appropriate policy interventions for improved pumpkin production, consumption and marketing. The study was carried out in eight major pumpkin growing Sub-Counties in the semi-arid areas of Eastern Kenya and medium altitude areas of Central Kenya. The objectives of the study were to (a) assess the influence of demographic and socio-economic factors on pumpkin production; (b) analyze uses of pumpkin products and socio-cultural practices in pumpkin consumption by smallholder farmers; (c) determine farm households, traders and market characteristics influencing pumpkin marketing; and (d) identify and analyze the major constraints in smallholder pumpkin production and marketing in Eastern and Central Kenya regions. A household survey of 260 pumpkin growing households and a market survey of 172 primary traders were conducted using structured questionnaires. The collected data were analyzed using descriptive statistics, multiple regression and Tobit model analysis with the aid of SPSS and Stata computer software. The research showed that pumpkin productivity by smallholder farmers in Eastern and Central Kenya regions was below the national average of 20 tons per hectare. Age and education level of household head, household size, on-farm income, farm area under pumpkins and engagement in off farm activities were statistically significant and positively influenced smallholder pumpkin production in Eastern and Central Kenya. Pumpkin fruits and leaves were mainly used as food while seeds were mainly used for planting by majority of the households. Household size and distance to market were statistically significant with negative influence on the marketed pumpkin proportion among farm households in Eastern and Central Kenya. Membership in farmers group was significant in Eastern Kenya while market price and gender of household head were significant in Central Kenya. These factors positively influenced the proportion of marketed pumpkin among the farm households. Market price, membership in marketing associations, selling frequency and distance to market were statistically significant and positively influenced market participation by pumpkin traders in Eastern and Central Kenya. The major constraints in pumpkin production were pests, diseases and insufficient rainfall while the main marketing constraints were poor market prices, exploitation by brokers, post-harvest losses, inadequate market information, low consumer awareness and low demand. The proposed policy interventions include farmers' education and strategies to promote pumpkin production, strategies to enhance access to physical markets and market information, organizing farmers into marketing groups, improvement of market infrastructure and organizing pumpkin traders into marketing associations or groups.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Smallholder agriculture is a key source of food, livelihoods and employment for many rural households in Kenya. However, agricultural production in Kenya has declined in recent years recording a low performance of 2.9 percent in 2013 (Republic of Kenya [ROK], 2014). Kenya's smallholder farmers play an important role in agricultural production accounting for 75 percent of total output and 70 percent of the marketed produce (ROK, 2010). The production of the major food crops has been generally low due to depressed rainfall and unpredictable rainfall patterns (Ministry of Agriculture, 2013). Declining food production, high population growth and limited arable land are major concerns in improving agricultural productivity in Kenya (MOA, 2009). Food insecurity has increased in most parts of the country particularly in arid and semi-arid lands (ASALs) where about 3.2 million people suffer from chronic food insecurity and poor nutrition (RoK, 2011). Strategies and interventions are required to improve agricultural productivity, food security and nutrition to meet food needs of the increasing population (ROK, 2010). Introduction and use of improved agricultural technologies is one way of enhancing agricultural productivity in the country (Olwande *et al.*, 2009).

Indigenous vegetables such as pumpkins have potential to provide nutrition, food security and cash income to households but they need to be developed, promoted and marketed (Mojeremane *et al.*, 2011). Traditional vegetables and food crops have multiple

uses and high adaptability to marginal climatic conditions (Will, 2008). However, abandonment of these crops by most farmers has led to loss of traditional knowledge, genetic diversity erosion and increased crops susceptibility to pests and diseases (NEMA, 2004). Lack of promotion, documentation and research has contributed to loss of knowledge on traditional food crops (Raschke *et al.*, 2007). There is increased realization for the need to create awareness and improve use of traditional crops (Padulosi *et al.*, 2006). In 2013, Kenya produced 176,736 metric tons of indigenous vegetables from 85,550 hectares valued at Kshs. 3.6 billion which was 2 percent share of the revenue generated by the horticulture industry (HCDA, 2013). Promotion and increased production of these crops such as pumpkins would increase their value, widen their availability and improve livelihoods of rural communities.

Pumpkin (*Cucurbita maxima*) which originated from North America belongs to the family Cucurbitacea which also includes gourds, melons, squash, courgettes and cucumber. The crop is rich in nutrients, adapts well to local conditions and grows in a wide range of agro-ecological zones (MOARD & JICA, 2000). It is low in calories and a rich source of vitamin A, vitamin C, potassium and proteins (Tammy, 2008). Pumpkin fruits and leaves are used as vegetables and the seeds are consumed roasted as a snack food. Pumpkin seeds are rich in protein, carbohydrates and oil containing unsaturated fatty acids (Karanja *et al.*, 2013). Pumpkins have been used as medicine for various human diseases in Central and North America. The seeds are widely used as an antihelmintic and in the treatment of tapeworms and other parasites especially in children

and expectant women. The fruit pulp is applied to burns, scalds, inflammation, abscesses and boils. It is also used in the treatment of migraine and neuralgia (Plants for Future, 2010).

Pumpkin has emerged as an important indigenous vegetable in Kenya for food security, income and livelihoods of smallholder farmers. Increase in pumpkin production was recorded in the country in the last five years according to Horticultural Crops Development Authority (HCDA) reports as shown in Table 1.1. Pumpkin is widely adapted to various agro-ecological zones in Kenya and has huge potential for food production but this has not been adequately appreciated nor fully exploited. Like other traditional crops, pumpkins remain underutilized in national development. Pumpkin production in the country remains low with smallholder farmers producing less than the potential of 20 tons per hectare (HCDA, 2013).

Table 1.1: Pumpkins production in Kenya, 2009 - 2013

Year	Production area (ha)	Quantity ('000'kg)	Yield (kg/ha)	Value (Kshs)
2009	888	18,973	21,365.99	482,453,000
2010	979	20,769	21,214.50	529,519,000
2011	1,046	20,588	19,682.60	532,452,500
2012	1,298	24,702	19,030.82	783,943,650
2013	1,342	28,150	20,976.15	874,966,284

Source: HCDA (2013) and HCDA (2010)

Research carried out in the Lake Victoria Basin established that pumpkin acreage and yields was limited due to several factors (Ondigi *et al.*, 2008). Low pumpkin production was attributed to pests, diseases, seeds unavailability, inappropriate husbandry practices and lack of awareness on the crop's nutritive value. As found by Shava *et al.* (2009), majority of people regard traditional vegetables as 'a poor man's crop' and this general notion has also contributed to low pumpkin production. Indigenous pumpkins are in high demand in markets in Kenya particularly in major urban and peri-urban areas (Ngugi *et al.*, 2007). There is need to enhance pumpkin production to meet the increasing demand.

Pumpkins like other indigenous vegetables have the potential to provide nutrition, food security and cash income to households in Kenya. More awareness creation on pumpkin's medicinal and nutritional values could increase its demand and transform it to a viable enterprise to address food insecurity, ill health and poverty in Kenya (Ondigi *et al.*, 2008). However, information on practices and knowledge required for improving pumpkin production has not been well documented as revealed in a study by Ondigi *et al.* (2008). There is need therefore to assess and document socio-economic factors and farming constraints in pumpkin production, consumption and marketing in the country. This would enable formulation of policy interventions for development and promotion of pumpkin value chain for improved food security, incomes and livelihoods of smallholder farmers in Kenya. The motivation behind this study was to contribute to increasing

attention by policy makers, researchers and farmers to the importance and potential of pumpkin production, consumption and marketing.

1.2 Problem statement

The food security situation in Kenya is worsening due to declining agricultural productivity particularly in medium altitude and semi-arid areas which are more prone to drought. According to the current National Food Security and Nutrition Policy, low agricultural productivity is attributed to low and erratic rainfall, changes in rainfall patterns, low use of improved technologies, pests and diseases among other factors. Increasing production of traditional crops such as pumpkins which are adapted to a wide range of agro-ecological zones could be one of way of addressing variability and rapidly changing climatic conditions particularly in medium altitude and semi-arid areas of Kenya. Pumpkin is a resilient traditional crop adapted to diverse climatic conditions and rich in various nutrients. Its production could contribute to improved household food security and livelihoods. However, the crop has not been given much attention in research nor promoted as a viable enterprise particularly in Eastern and Central Kenya regions. Smallholder farmers in these regions have mainly relied on indigenous knowledge in pumpkin farming.

Most research studies in Kenya have concentrated on production and utilization of African leafy vegetables but little attention has been given to production, consumption and marketing of pumpkins (Abukutsa-Onyango, 2007; Kimiywe *et al.*, 2007; Ondigi *et*

al., 2008 and Ekesa *et al.*, 2009). Socio-economic factors and farming constraints in pumpkin production, consumption and marketing by smallholder farmers in Central and Eastern Kenya have not been studied nor documented. This necessitated the assessment of these factors and constraints in order to inform the development of appropriate policy interventions for improved pumpkin production, consumption and marketing. The purpose of the study was to assess and document socio-economic factors and constraints in pumpkin production, consumption and marketing in Eastern and Central Kenya regions.

1.3 Objectives

1.3.1 General objective

The overall objective was to assess socio-economic factors and farming constraints relating to smallholder pumpkin production, consumption and marketing in Kitui, Machakos, Kirinyaga and Muranga Counties in Eastern and Central Kenya regions.

1.3.2 Specific objectives

The specific objectives of the research included the following.

- i) To assess the influence of demographic and socio-economic factors on pumpkin production by smallholder farmers in Eastern and Central Kenya regions.
- ii) To analyze uses of pumpkin products and socio-cultural practices in pumpkin consumption by smallholder farmers in Eastern and Central Kenya regions.

- iii) To determine farm households, traders and market characteristics influencing pumpkin marketing in Eastern and Central Kenya regions.
- iv) To identify and analyze the major constraints in smallholder pumpkin production and marketing in Eastern and Central Kenya regions.

1.4 Hypotheses

- i) Demographic and socio-economic characteristics such as age, gender, education level, household size, farm size and income do not significantly influence smallholder pumpkin production in Eastern and Central Kenya regions.
- ii) Farm households, traders and market characteristics such as demographic factors, distance to market, prices and market information do not significantly influence pumpkin marketing in Eastern and Central Kenya regions.

1.5 Research questions

- i) What are the uses of pumpkin products and socio-cultural practices in pumpkin consumption by smallholder farmers?
- ii) What are the major constraints in pumpkin production and marketing?

1.6 Significance of the study

Pumpkin production has gained some commercial importance in Kenya but its potential remains unexploited particularly in Central and Eastern Kenya. This study aimed at establishing the socio-economic factors and farming constraints relating to

smallholder pumpkin production, consumption and marketing in Eastern and Central Kenya. The study has generated information on the possible research and policy interventions for enhancing pumpkin production, utilization and marketing. It also recommends interventions and strategies for implementation by agricultural extension service providers in educating and creating awareness to smallholder farmers on pumpkin production, consumption and marketing aspects. The recommended interventions once implemented would go a long way in enhancing the capacity of smallholder farmers in pumpkin farming to improve their food security, incomes and livelihoods. In addition the information generated in this study feed into the design of the necessary policy interventions for improved pumpkin production, consumption and marketing in the country. The findings of this study also contribute to the body of knowledge on pumpkin production, consumption and marketing and suggest areas for further research in developing the pumpkin value chain.

1.7 Theoretical Framework

Smallholder farmers produce agricultural commodities mainly for two purposes; consumption and marketing. Farm households entirely consume, entirely market or consume and market the output of a particular commodity. Farm households that entirely consume their produce are not market-oriented and their main objective is to meet their food needs. In this study, household decisions on pumpkin production and marketing were premised on the utility maximization theory. According to the utility maximization theory, producers maximized utility subject to constraints in production resources. It was

assumed that farm households were rational in using production resources and choosing the market that maximized their utility.

The main objective of selling an agricultural commodity by farm households or traders is to maximize profit. In this study it was assumed that farm households and pumpkin traders' decisions to participate in the pumpkin market were influenced by perceived utility or net benefit from selling the commodity. Pumpkin marketing was also influenced by socio economic factors of farm households and market characteristics. It was also assumed that pumpkin producing households and traders interacted with perfect competitive markets in determining the output sold, price and demand for pumpkins.

According to the utility maximization theory, if there are two or more alternative choices, then a rational producer or seller chooses the alternative that yields maximum utility or benefit. If the two alternative choices are shown by j and k , then the corresponding utilities can be represented by U_j and U_k respectively. If a household or trader decided to use option j , the perceived utility or benefit from option j would be greater than the utility or benefit from option k as depicted in equation 1 (Greene, 2003).

$$U_{ij}(\beta_j X_i + e_j) > U_{ik}(\beta_k X_i + e_k), k \neq j \forall i \dots\dots\dots (1)$$

The probability that a household or trader choose option j instead of k can be defined as:

$$P(Y = 1|X) = P(U_{ij} > U_{ik}) \dots\dots\dots (2)$$

Where X_i represents the vector of the independent variables that were assumed to affect the choices, β_j is a vector of unknown parameters, e_i and e_j are the error terms, which are assumed to be independent and identically distributed.

1.8 Conceptual framework

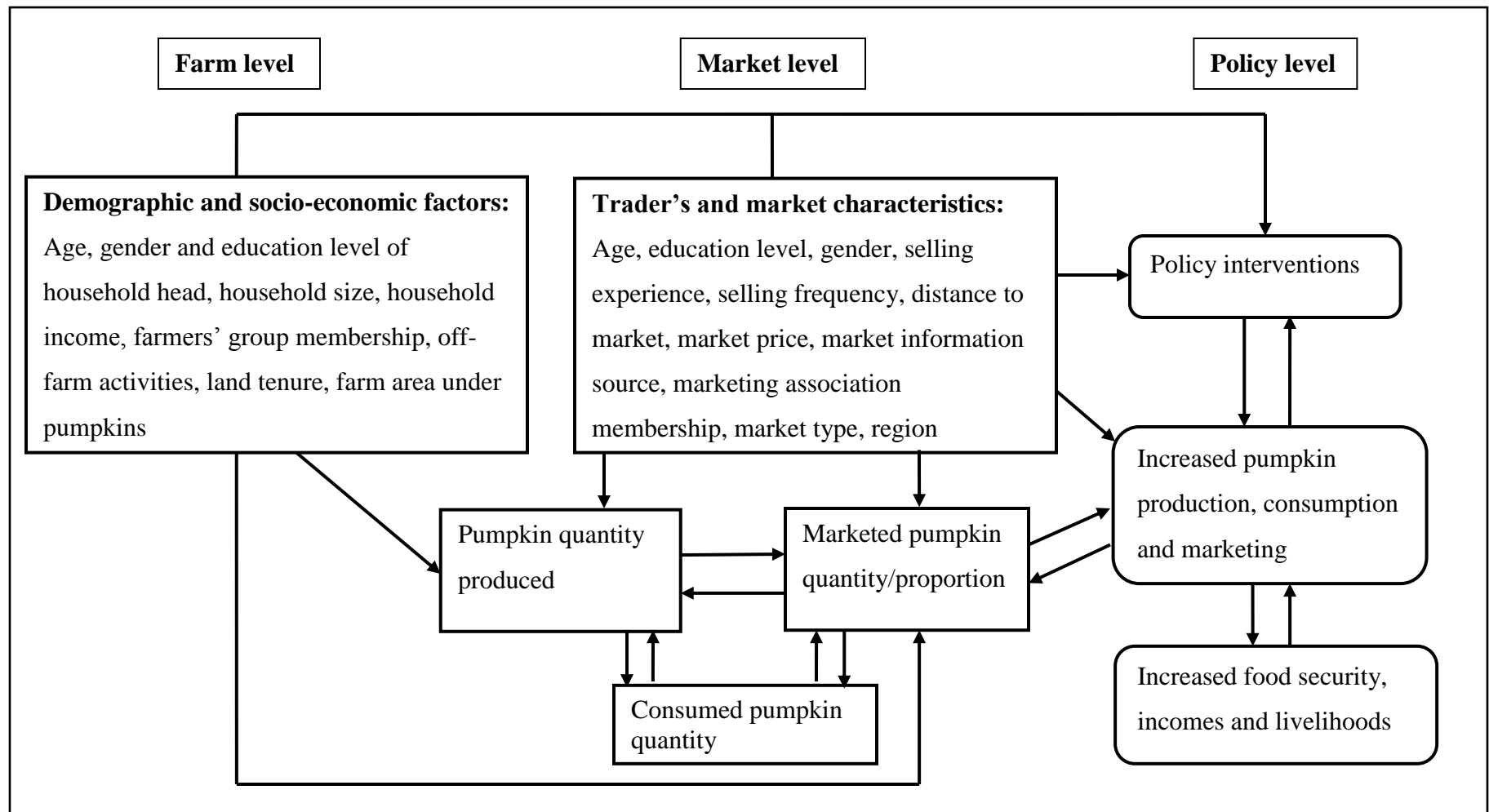
The purpose of the study was to establish the socio-economic factors influencing pumpkin production, consumption and marketing in Eastern and Central Kenya regions. Farm households are central in decision making in agricultural production with the main objective being to meet their subsistence needs and incomes. Socio-economic factors influence allocation of household resources in agricultural production activities undertaken by farmers. The outcome of the decision making process of the farm household is reflected in their production pattern, farm productivity, incomes and livelihoods (Pender, 2002).

Demographic and socio-economic factors such as age and gender of household head, household size and farm size were anticipated to influence smallholder pumpkin production. The age of household head is an indicator of farming experience while household's income determined ability to pay for labour and purchase of agricultural inputs. Gender is a determinant of access to production resources such as land and capital while education level is an indicator of access to knowledge and information. Kidoido *et al.* (2002) established that farming experience and membership in farmer groups were key factors in crop production by smallholder farmers. Family size was closely related to

labour availability and productivity at household level (Oladele, 2011). Other determinants of food production at household level included land and land tenure system.

In this research it was proposed that pumpkin marketing was influenced by farm households, traders and market characteristics such as distance to market, market price, market information, marketing association, market type, trader's age, education, gender, experience and selling frequency. It was anticipated that farmers' marketing decisions were influenced by household size, gender, income, access to information, market distance, produce prices and region. In this study it was hypothesized that market participation by traders was influenced by factors such as gender, trading experience, prices, distance to the market and membership in marketing associations. The marketed pumpkin quantity or proportion was also influenced by the quantity of pumpkins consumed at household level.

The results of this study were expected to provide recommendations on policy interventions for increased smallholder pumpkin production, consumption and marketing. Ultimately, improved food security, incomes and livelihoods of farming households were anticipated (Figure 1.1)



Direction of influence →

Figure 1.1: Conceptual framework

Source: Author's schematic presentation

1.9 Scope of the study

This study involved collection of primary data on pumpkin production, consumption and marketing from smallholder farmers and primary traders in selected Sub-counties in Central and Eastern Kenya regions. A farm household survey and a market survey were carried out in the major pumpkin growing Sub-counties in the medium altitude areas of Central Kenya and semi-arid areas of Eastern Kenya. In Central Kenya, the study was carried out in Kirinyaga Central, Kirinyaga South, Thika East and Gatanga Sub-counties. In Eastern Kenya, the research was carried out in Machakos Central, Kangundo, Kitui Central and Nzambani Sub-counties. Primary data was collected from 260 sampled households in the farm household survey. The data collected included demographic and socio-economic characteristics of farming households, pumpkin uses, socio-cultural issues in pumpkin consumption and constraints in production and marketing.

In the market survey, 172 primary traders were sampled in urban and rural markets. The markets in major towns and urban centres covered in the study included Kitui, Machakos, Kangundo, Thika, Kerugoya, Kutus and Kagio. The major markets in rural areas included Kirwara and Kaguku in Gatanga Sub-county, Chuluni in Nzambani Sub-county, Mutituni in Machakos Central Sub-county, Mitaboni and Kakuyuni in Kangundo Sub-county. Data collected on pumpkin marketing included traders and market characteristics, marketed quantities, market prices, trading frequency, market information sources and marketing constraints.

1.10 Operational definition of key terms

Agricultural productivity – This is the ratio of output to inputs used in the production of an agricultural commodity. It is generally considered to be the result of efficient use of the factors of production such as land, capital and labour. In this study it is the output per unit area of land put under pumpkins by the farming households.

Household - Refers to a person or group of persons who reside in the same compound or homestead, have a common cooking arrangement and are answerable to the same head (KNBS compendium).

Household consumption – Refers to foods used by households for the satisfaction of their needs and wants which are either produced or purchased.

Indigenous or traditional crop - A crop grown due to its importance for subsistence, maintained by socio-cultural preferences and use practices of local communities as in Padulosi *et al.* (2002).

Marketing – Is a set of activities, institutions, processes and services involved in moving a product or commodity from the point of production to the point of consumption. It involves delivering and exchanging products that have value for consumers, customers and society in general (American Marketing Association).

Primary traders – Are those who buy agricultural commodities directly from producers. They aggregate the produce and later sell to consumers or traders in distant markets.

Value addition – A change in the physical state or form of agricultural commodity or product through processing to enhance its value and offer it to an expanded customer base for enhanced producers income or revenue (USDA).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Literature that is important to the objectives of this study is reviewed in this chapter. This includes literature review on major issues related to pumpkin production and consumption including food consumption and socio-cultural practices. The review of literature also includes farm households, traders and market characteristics related to market participation. It also covers major constraints in vegetables production and marketing. Research gaps are also identified in this chapter.

2.2 Production of traditional crops and pumpkins

Food policies in Sub-Saharan Africa give recognition to the importance of traditional food crops in food security. Indigenous foods are superior in health qualities, nutritional values and dietary diversity compared to exotic foods such as wheat and rice but their consumption has greatly reduced (Raschke *et al.*, 2007). A study in Nigeria found that older people are the majority of producers of indigenous vegetables because they recognize them for their health properties and ability to prevent diseases (Oladele, 2010). Young people on the other hand prefer consuming “modern foods” and do not identify with indigenous and traditional foods (Matenge *et al.*, 2012). A study on wild food plants in Zimbabwe established that women have more knowledge on leafy vegetables than do men (Shava, 2005). A study in South Africa found that pumpkin was

one of the most preferred vegetables but people's knowledge on leafy vegetables was the domain of women (Vorster & Rensburg, 2005).

Kenya's policy has been promotion of food self sufficiency and diversification in the production of agricultural commodities (RoK, 2004). The focus in Kenya has been on production of a few food commodities such as maize, wheat and rice resulting to neglect of traditional food crops and subsequently food insecurity in the country. Kenya has experienced variability in climatic patterns in recent years with recurrent drought leading to food insecurity in some parts of the country. Pumpkins are mainly grown as a subsistence crop in a wide range of agro-ecological zones and are well adapted to the local conditions in Kenya (MOARD & JICA, 2000). A study in Western Kenya found that the majority of farmers grew pumpkins mainly for domestic consumption and only the surplus was used for commercial purposes (Ondigi *et al.*, 2008). The study further established that pumpkins were an important source of food and income for households but were mainly grown by low income farmers.

2.3 Indigenous vegetables and pumpkin consumption

Rural communities in many African farming systems rely on indigenous plants for food and cash income from one cropping season to another (Mojeremane *et al.*, 2011). However, traditional vegetables which rural communities mainly use as food and medicine are rarely sold in markets (Maroyi, 2011). Studies in South Africa showed that traditional vegetables were a major source of food due to their ability to grow in marginal

areas (Vorster & Rensburg, 2005). Traditional dishes provide cheap and quality nutrition to poor families both in urban and rural areas (Rodlack, 2011). Indigenous vegetables are important sources of food and are recognized by communities in Western Kenya for their nutritional and therapeutic properties (Abukutsa-Onyango, 2007).

Pumpkin fruits, leaves and flowers are used as vegetables while seeds are roasted to give oil or eaten as a snack. Most households in Uganda mainly use pumpkin leaves as vegetables while seeds are used as a sauce and snack (Musinguzi *et al.*, 2006). In a study in Zimbabwe, Maroyi (2011) found that pumpkin was one of the most preferred traditional leafy vegetable. Ndoro *et al.* (2007) established that in Zimbabwe, pumpkin leaves were consumed three to four times per week during the rainy season. In the Lake Victoria basin, Ondigi *et al.*, (2008) found that pumpkins were used as relaxatives, antifatulents, anti-diarrhea, de-wormers and in the treatment of heartburns and ulcers.

2.4 Socio-cultural practices in traditional vegetables and pumpkin consumption

Traditional foods consumption was generally low mainly due to the negative perception given to these foods (Eyzaguirre *et al.*, 2006). In Zimbabwe, traditional vegetables were collectively referred to as “poor man’s food” because they are regarded as inferior and marginalized by the majority of people (Shava *et al.*, 2009). Negative beliefs act as barriers but health, nutrition, tradition and culture are main drivers for indigenous and traditional foods consumption by rural communities (Matenge, *et al.*, 2012). Indigenous and traditional foods were consumed for cultural, traditional and

heritage reasons as found by Guerrero *et al.* (2009). In South Africa, studies found that men preferred eating meat and left indigenous and traditional foods for consumption by women and children (Vorster & Rensburg, 2005). In the Lake Victoria basin, cooked pumpkin fruits were mainly consumed by women and children while men considered them as food for children (Ondigi *et al.*, 2008).

2.5 Socio-economic factors related to food production

Farming households have differences in their demographic and socio-economic characteristics such as education level, age of household head, farm size and household size. Socio-economic factors determine the success and development of an enterprise (Guzman & Santos, 2001). On the other hand, food security is influenced by household structure, income, savings behavior, socio-cultural orientation and nutrition awareness (Nyangweso *et al.*, 2007). Risk and uncertainty largely influence farmers' actions in the use of productive resources. Agricultural productivity can therefore be improved by assuring farmers of improved income and livelihood opportunities.

Smallholder farmers' production systems are highly diversified with strong interactions among crops, livestock and off-farm activities (IFPRI, 2005). Half of Kenya's farming households in rural areas are involved in off-farm income generating activities and about 36 percent have at least one salary earner living away from the farm (RoK, 2004). Farm produce sales and off-farm activities are major sources of income for smallholder farmers in Western Kenya (Waithaka *et al.*, 2006). However, access to and

control over financial, physical, social and human resources for agricultural production depends on factors such as age, position and gender of rural household members' (Mikalitsa, 2010). Women in rural areas of Kenya are more constrained by limited access to productive resources such as land, capital and income. The land tenure system in Kenya is mainly individual ownership with or without title deeds. Land is an essential resource for many people in rural areas and the land tenure system influences crop production (Clover, 2003).

Social capital contributes to income generation for households belonging to farmer organizations or associations (Katungi *et al.*, 2010). A study in Western Kenya established that social capital affects performance and increases the level of commercialization of rural producer organizations (Wambugu *et al.*, 2010). Members of producer groups have better access to technical advice on crop management which helps them increase their yields (Komarek, 2010).

2.6 Factors related to market participation by farm households and traders

Marketing of agricultural produce and products in Kenya is critical to increasing agricultural productivity and commercialization of enterprises (RoK, 2010). Poorly developed marketing and markets are a common characteristic of traditional foods in Sub-Saharan Africa (Eyzaguirre *et al.*, 2006). However, knowledge on food choices and nutrient qualities of traditional crops provides an opportunity for their increased marketability (Raschke *et al.*, 2007). A study in Central Kenya showed that small-scale

farmers fetched low prices for their produce due to low bargaining power (Matere *et al.*, 2010). Smallholder farmers face enormous constraints in physically accessing markets and also lack market information (Magingxa & Kamara, 2003). Farmers involved in traditional food crops generally depend on informal markets due to weak or lack of linkages with formal markets (Eyzaguirre *et al.*, 2006). With a large share of the market, smallholder farmers can significantly increase their incomes (IFPRI, 2005). This implies the need for interventions to enable smallholder farmers penetrate markets and improve their marketing efficiency.

Most rural farmers in Kenya sell their produce mainly at farm gate and in rural open-air markets. Their decisions on the amount of output to sell are mainly influenced by marketing information, produce prices and nearness to the market (Omiti *et al.*, 2009). A study on market participation by vegetable farmers in Kenya showed that access to formal marketing information is positively associated with higher output prices (Otieno *et al.*, 2009). Studies have shown that output market participation by farmers is influenced by market information, prices and traded produce quantities (Enete & Igbokwe, 2009, Berhanu & Moti, 2010, Komarek, 2010).

Improved infrastructure and producer marketing organizations are vital for smallholder farmers to access and compete in markets (IFPRI, 2005). The state of infrastructure influences farmers and traders engagement in agribusiness. It has been shown that marketing association membership is a channel of relevant information and

increases returns to crop production and marketing (Boughton *et al*, 2007). The social structure of farmer groups is positively associated with improved marketing performance and enhances their ability to take advantage of market opportunities (Barham & Chitemi, 2009).

A research study on marketing traditional vegetables in Nigeria showed that vegetable marketers are generally in the active productive age group (Thompson & Agbugba, 2013). In Mozambique, a study on market participation by rural households found that older people are less likely to sell in markets (Boughton *et al*, 2007). Other studies have shown that high produce prices encourage market participation and motivate farmers to increase the traded volumes of vegetables (Otieno *et al.*, 2009, Komarek, 2010). Research has also shown that nearness to the market influences the amount of output sold and increases participation by households due to cost advantage (Omiti *et al.*, 2009, Berhanu & Moti, 2010). Decrease in the distance to the market lowers transaction costs and households closer to markets generate larger sale volumes (Komarek, 2010). A study by Otieno *et al.* (2009) showed that long distance to the nearest market reduces vegetable volumes marketed in rural areas.

Previous research found that large household size is negatively correlated with volume of market sales (Rios *et al*, 2008). Domestic consumption requirement for food rises as household size increases and lowers household market participation (Berhanu & Moti, 2010). The percentage of vegetables sold by rural farmers reduces with increase in

household size (Otieno *et al.*, 2009). A study by Vorster & Rensburg (2005) showed that households with many members tend to be more reliant on traditional vegetables. Research in Nigeria showed that the larger the family size, the more the available labour force and productivity (Oladele, 2011). A research study in Western Uganda showed that high crop yields are positively related with market participation and the surpluses sold by farmers (Komarek, 2010). Households with higher productivity tend to participate in agricultural markets and the volumes of indigenous vegetables produced contribute to their incomes (Rios *et al.*, 2008, Oladele, 2011). As the amount of vegetables produced by rural farmers rises, the percentage sold increases but lower sales show that more of the output is consumed (Otieno *et al.*, 2009).

2.7 Traditional crops production and marketing constraints

The production of traditional food crops in Kenya is generally low while demand is increasing due to urban consumers' awareness of the crops nutritional and medicinal values. Indigenous crops are produced on small scale and dispersed areas with generally low production. This is attributed to lack of agronomic information, limited research, lack of high yielding cultivars and undeveloped seed systems (Eyzaguirre *et al.*, 2006). Pumpkin production is limited but the crop has the potential to improve food security, nutritional status and livelihoods of rural households (Ondigi *et al.*, 2008). A study by Doss *et al.* (2003) established that lack of information, high inputs cost, lack of credit, low product prices and lack of farm inputs are major constraints in food crops production in Eastern Africa. A research study in Central Uganda showed that growing of local

vegetables is limited by poor soil fertility and low soil moisture (Ssekabembe *et al.*, 2003).

Indigenous and traditional foods have been diminishing in production and consumption because of socio-economic changes and preference for modern foods (Matenge, *et al.*, 2012). A study in Western Kenya by Abukutsa-Onyango (2007) found that production of indigenous vegetables is constrained by poor seed quality, pests, diseases, drought and lack of agronomic and utilization packages. In South Africa, poor weather conditions, low soil fertility and lack of seed systems restricted the availability and consumption of traditional leafy vegetables (Vorster *et al.*, 2008). However, a study in Botswana by Mojeremane *et al.* (2011) showed that indigenous food plants are adapted to low rainfall, poor soils, have few insect and disease problems than arable crops.

Production of indigenous vegetables in Western Kenya is constrained by poor marketing channels and infrastructure (Abukutsa-Onyango, 2007). Inadequate road network, storage facilities and physical trading space; unsuitable policies, lack of credit, lack of product differentiation and value addition constrained the marketing of indigenous vegetables in Nairobi and its environs (Irungu, 2007). A study in South Africa established that smallholder farmers face enormous constraints in physically accessing markets and lack market information (Magingxa & Kamara, 2003).

2.8 Empirical models on factors influencing production and marketing

This section reviews empirical models applied to studies to determine factors influencing crop production and marketing. In this study multiple regression analysis was used to determine the socio-economic factors influencing smallholder pumpkin production and pumpkin marketing by traders. Multiple regression analysis is useful in determining the effect of independent variables on the dependent variable while allowing explicit control for many other unobserved factors (Wooldridge, 2002). Regression analysis enables measuring of the change in the dependent variable caused by a unit change in each of the independent variables while holding the others constant. It is useful in predicting linear relationships between the dependent variable and a set of dependent variables where the dependent variable is continuous and takes a numerical value. In this study regression analysis was used to calculate the coefficient for each independent variable to estimate the effect of each predictor on the dependent variable while holding the other independent variables constant. The statistical significance of each independent variable was also established.

Tobit model enables estimation of the linear relationship between dependent and independent variables when there is censoring in the dependent variable. Censoring is either on the left or right of some threshold value. Left censoring in the dependent variable takes place when observations take a value at or above the threshold. On the other hand, right censoring in the dependent variable occurs when cases take values falling at or below the threshold. In this research, Tobit model analysis was used to

determine the factors influencing pumpkin marketing by smallholder farmers. The model was used to estimate the expected value of the dependent variable, Y_i as a function of a set of independent variables (X_i) weighted by the probability that $Y_i > 0$ (Tobin, 1958).

2.8.1 Empirical studies on socio-economic factors influencing crop production

In a study of factors influencing adoption of protected tomato farming practices, Shadiadeh *et al* (2012) used multiple regression analysis to examine socio-economic characteristics of the farmers. The study established that family size, farming experience and level of education influenced adoption of protected tomato farming practices. Similarly, Singha *et al* (2012) used multiple regression analysis to determine the socio-economic factors influencing technology adoption of different land based enterprises by farmers. Land size, education level and annual income were found to influence adoption of technologies and practices by vegetable and rice farmers. Xaba and Masuku (2013) also used multiple regression analysis in a study in Swaziland to determine factors affecting the productivity and profitability of vegetables production. The study found that productivity of vegetable farmers was significantly and positively related to selling price and gender. Agwu *et al* (2012) used multiple regression analysis in a study in Nigeria to estimate the socio-economic determinants of commercialization among smallholder farmers. The study established that household size, income, farming experience, farm size, distance to market and membership in associations significantly influenced commercialization among the smallholder farmers.

Odiaka *et al.* (2009) while using multiple regression analysis in a study of diversity and production methods of fluted pumpkin by vegetable farmers in Nigeria found that plot size had positive relationship with pumpkin yields. Adebisi-Adelani and Oyesola (2013) used linear regression analysis to investigate socio-economic factors influencing adaptation strategies of horticultural farmers in Nigeria. Income and age were found to be significant. Sani *et al.* (2014) also used multiple regression analysis to determine socio-economic factors influencing farmers' adoption of dual purpose cowpea production technologies. Education level, household size, farming experience and social participation were found to be significant. In a study in Nigeria, Nwaiwu *et al.* (2012) used multiple regression analysis to assess socio-economic determinants of the productivity of garden egg producers. Age of the farmer and farm size were major determinants of garden egg productivity. Ayoola *et al.* (2011) used regression to investigate the socio-economic factors influencing rice production among farmers in Nigeria. Land, farmers' experience and age were found to influence rice productivity. Wambugu *et al.* (2010) using regression model in a study in Western Kenya found that social capital had a positive effect on the performance of rural producer organizations.

2.8.2 Empirical studies on factors influencing marketing

Baba *et al.* (2010) used multiple regression analysis to examine the existing marketing arrangements of vegetables. The study established that area under improved varieties; net price and education level were significant and positive determinants of marketed surplus. Similarly, Adenuga *et al.* (2013) used multiple regression analysis to

determine marketable surplus in vegetable production in Nigeria. The study revealed that most vegetable producers and marketers were women. Education level of household head, farming experience and household size were significant determinants of marketable vegetable surplus. Onubuogu and Onyeneke (2012) used multiple regression analysis in a study to determine the factors affecting level of market orientation of root and tuber crop production. They found that age, education, household size, membership in cooperative societies, income and farm size were positively related to market orientation of root and tuber crops. Maponya *et al.* (2014) used regression analysis in a study on vegetable and fruit markets in South Africa. The study found that age, education level, farming experience, land size and gender were positively associated with market participation.

Cunningham *et al.* (2009) using regression models to estimate the effects of gender differences in marketing styles established that women sold lower volumes of produce while men had higher number of transactions and sold their produce more frequently than women. In a study of soybean market participation by smallholder farmers in Zimbabwe, Zamasiya *et al.* (2014) found that gender of household head had a negative effect while distance to the market had a positive influence on market participation by smallholder farmers. Similarly, Reyes *et al.* (2012) in a study of market participation and sale of potatoes by smallholder farmers in Angola established that gender of household head and quantity produced significantly influenced market participation of farm households. Lekunze (2014) used regression analysis to examine the socio-economic characteristics of producers, marketers and consumers of pumpkin

leaves. The study revealed that majority of producers; marketers and consumers were female while age, household-size and gender of the marketers negatively affected the marketing of pumpkin leaves.

Otieno *et al.* (2009) used truncated regression estimation in a study of market participation by vegetable farmers in rural and peri-urban areas in Kenya. The study established that distance to market, price, amount of output produced, gender and education of household head, household size, access to market information and non-farm income significantly influenced the percentage of marketed vegetable output by farmers. Enete and Igbokwe (2009) used tobit regression analysis in a study of cassava market participation decisions. The study established that market participation was influenced by product price, availability of information on prices and age of the household head. Tufa *et al.* (2014) used truncated regression to explore factors determining smallholder farmers' market participation decisions in horticultural crops. In the study it was found that market participation was influenced by gender, cultivated land and distance to market. Gani and Adeoti (2011) used tobit model to analyze market participation among farmers in Nigeria. The study revealed that market participation was determined by market information, distance, output size, cooperative membership, family size and education.

2.9 Research Gaps

It was clear from the reviewed literature that studies on pumpkins were very few compared to other crops. The studies carried out on pumpkins in Kenya (Ondigi *et al.*,

2008 and Karanja *et al.*, 2013) have concentrated mainly on pumpkin species and varieties, cultural, gender, historical and environmental aspects, storage methods, utilization and levels of micronutrients of pumpkins grown by smallholder farmers. Most studies in Kenya have mainly revolved around production and utilization of indigenous African leafy vegetables (Abukutsa-Onyango, 2007; Kimiywe *et al.*, 2007 and Ekesa *et al.*, 2009).

Pumpkin production, consumption and marketing have not been comprehensively covered by previous studies in the country. It was therefore necessary to carry out a comprehensive study to assess and document the socio-economic factors and farming constraints affecting smallholder pumpkin production, consumption and marketing in Central and Eastern Kenya regions. This would inform the development of appropriate research and policy interventions to improve pumpkin production, consumption and marketing particularly in the two regions and the country in general. This research was therefore carried out to assess and document socio-economic factors influencing pumpkin production and marketing, uses of pumpkin products, socio-cultural practices in pumpkin consumption as well as constraints in pumpkin production and marketing in Eastern and Central Kenya regions.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Introduction

This chapter covers the location and key aspects of the research methodology for this study. It also highlights the study location, research design, population and sample, sampling and data collection procedures and research instruments. It also gives model specification and data analysis methods used in the study. The chapter also highlights the dependent and independent variables used in the study to determine factors influencing pumpkin production, consumption and marketing. Validation tests for the variables used in the study are also included in this chapter.

3.2 Location of the study

Pumpkins grow from lowlands up to an altitude of 2500 metres above sea level. They are drought-tolerant and require relatively little rainfall to grow. Pumpkins are adapted to mean temperatures of 18°C to 27°C. The study was carried out in the main pumpkin growing Sub-Counties in the semi-arid and medium altitude areas of Eastern and Central Kenya regions respectively. The areas are suitable for pumpkin growing due to favorable climatic conditions. The average annual rainfall in Eastern Kenya region is 700 to 1250 mm while the mean temperature is 18 to 22°C (MOA, 2007a). The average annual rainfall in Central Kenya region ranges from 800 to 1800 mm while the mean temperature is 16 to 21°C (MOA, 2007b).

The study areas represented two diverse agro-climatic zones, namely; semi-arid and medium altitude areas. The farming households in Eastern and Central Kenya regions have diverse socio-economic characteristics and production systems. The households being in a rural set up are involved in farming as their main economic activity and would immensely benefit from interventions geared towards improving agricultural production. The study areas have several major markets which made them ideal for a market survey. People in urban areas have high awareness and demand for nutritional foods. The proximity of the study areas to Nairobi gave them a comparative advantage in pumpkin production and marketing over other pumpkin growing regions.

In Eastern Kenya region, the study was carried out in the major pumpkin producing Sub-Counties of Kitui Central and Nzambani in Kitui County; Machakos Central and Kangundo in Machakos County. Kitui Central Sub-County is located at 01.17°S and 38.01°E, Nzambani Sub-County at 01.5°S and 38.00°E, Machakos Central Sub-County at 01.30°S and 37.15°E while Kangundo Sub-County is located at -01.30°S and 37.35°E. The Sub-Counties in Eastern Kenya receive bimodal rainfall in two distinct rainy seasons, long rains in March to May and short rains in October to December (MOA, 2007a).

In Central Kenya region, the study was carried out in the Sub-Counties of Kirinyaga Central and Kirinyaga South in Kirinyaga County; Thika East and Gatanga in Muranga County. Kirinyaga Central is located at -0.30°S and 37.15°E, Kirinyaga South at -00.75°S

and 37.5°E, Thika East at -00.93°S and 37.35°E while Gatanga is situated at 00.45°S and 37.09°E. The Sub-Counties in Central Kenya receive bimodal rainfall in two rainy seasons, long rains in March to May and short rains in October to December (MOA, 2007b). The study area is shown in Figure 3.1 and key parameters are summarized in Table 3.1.

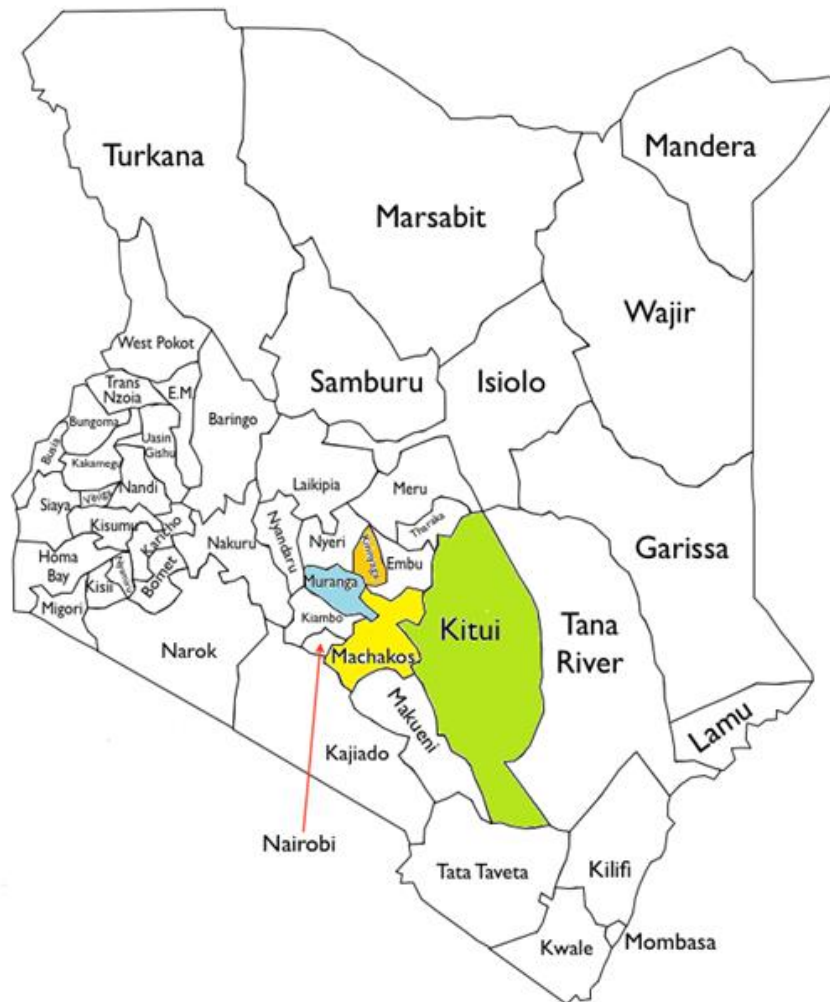


Figure 3.1: Map of Kenya showing the study area

Table 3.1: Description of the study area

County	Kitui		Machakos		Kirinyaga		Muranga	
Sub-county	Kitui Central	Nzambani	Kangundo	Machakos	Kirinyaga Central	Kirinyaga South	Thika East	Gatanga
Area (km²)	1028.3	846.5	754.7	925.3	496.4	542.6	413.0	312.4
Population	193,200	34,357	219,103	199,211	113,355	190,512	77,073	113,094
Density (persons per km²)	188	41	290	215	228	351	187	362
Number of households	38,377	19,460	50,822	48,979	37,197	55,841	20,441	30,211
Altitude (m asl)	960-1550	760-1280	1340-2130	790-1950	1400-1820	1090-1400	1360-1580	1340-2190
Annual Rainfall (mm)	400-800	450-750	600-1500	1280-1830	700-2150	600-1250	600-1250	1200-2500
Temperature (°C)	18.6-21.0	19.0-24.0	16.0-20.9	17.9-22.0	14.5-20.6	20.1-22.0	18.4-20.7	12.7-22.4

Source: KNBS, 2013; MOA, 2007a and MOA, 2007b

3.3 Research design

A farm household survey and market survey were carried out in the main pumpkin producing areas in Eastern and Central Kenya regions. A survey design gives insight into an existing situation through data collection and analysis without having to study the whole population. A survey enables use of quantitative and qualitative methods to collect data and investigate certain characteristics of a pre-determined sample of a population. It also enables generalization of the observations on a sample to the whole population of a study. Farm household survey was conducted to collect primary data on demographic and socio-economic characteristics, pumpkin uses, socio-cultural issues in pumpkin consumption and constraints in pumpkin production and marketing. A market survey was conducted in urban and rural markets to collect data on pumpkin marketing including marketing constraints, traders' and market characteristics..

3.4 Population and sample

The target population in the household survey was pumpkin growing households. The sampling frame comprised of 1220 and 1375 households in Eastern and Central Kenya regions respectively from lists provided by the Ministry of Agriculture extension officers. The sample size in the study was determined using the following formula according to Kothari (2004).

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2(N - 1) + z^2 \cdot p \cdot q} \dots\dots\dots (3)$$

Where; n = desired sample size, z = value of standard deviation at 95% confidence level (in this case 1.96), e = desired level of precision ($\pm 5\%$), p = sample proportion in target population, $q = 1 - p$ and N = size of population.

$$n_1 = \frac{1.96^2 * 0.1 * 0.9 * 1220}{0.0025 * 1219 + 1.96^2 * 0.1 * 0.9} = 124$$

$$n_2 = \frac{1.96^2 * 0.11 * 0.89 * 1375}{0.0025 * 1374 + 1.96^2 * 0.11 * 0.89} = 136$$

Where; n_1 = sample size in Eastern Kenya and n_2 = sample size in Central Kenya.

This gave a total sample of 260 households for the study comprising of 124 and 136 households in Eastern and Central Kenya regions respectively.

In the market survey the sampling frame comprised of pumpkin traders in primary markets in rural and urban areas. A total of 38 market outlets with at least three pumpkin sellers were sampled in the study. The sample size was determined from data obtained from the main rural and urban market outlets in the study area by the Ministry of Agriculture field extension officers. The number of traders was determined using the following formula according to Cochran (1977):

$$n = \frac{Z^2 pq}{e^2} \dots\dots\dots (4)$$

Where; n = sample size, z = value of standard deviation at 95% confidence level (1.96 in this case), e = desired level of precision (0.05), p = proportion of pumpkin traders in major markets in study area, $q = 1 - p$.

$$n = \frac{1.96^2 * 0.128 * 0.872}{0.05^2} = 172$$

This gave a sample size of 172 pumpkin traders, 84 in Eastern and 88 in Central Kenya as shown in Table 3.2.

Table 3.2: Number of sampled pumpkin traders in the study areas

Region	County	Sub-County	Number of markets	Sampled traders
Central	Kirinyaga	Kirinyaga Central	6	32
		Kirinyaga South	4	16
	Muranga	Thika East	4	20
		Gatanga	4	20
Eastern	Kitui	Kitui Central	4	20
		Nzambani	6	24
	Machakos	Machakos Central	6	20
		Kangundo	4	20
Total			38	172

3.5 Sampling and data collection procedures

Administrative locations with substantial area under pumpkin production were identified and purposively selected for the study with the assistance of the Ministry of Agriculture extension officers. The sampling unit was individual pumpkin growing households. Systematic random sampling was used to sample the pumpkin growing households for the study from the sampling frame of 1220 and 1375 in Eastern and Central Kenya respectively. The households were assigned numbers using lists provided by the Ministry of Agriculture field extension staff. The pumpkin growing households were divided by the sample size of 124 and 136 in Eastern and Central Kenya

respectively to get a sampling interval of 10. Sampling units in each of the two study areas were selected at an interval of 10. The starting point of sampling the households was determined by randomly picking wrapped papers numbered from 001 to 010 from a container. Thereafter every tenth household was picked to get the total sample of 260 households in the study. Data collected at household level included demographic and socio-economic characteristics, uses and socio-cultural issues in pumpkin consumption as well as constraints in pumpkin production and marketing.

In the market survey, purposive sampling method was used to select primary traders in major towns, urban and rural market centres for the study. In Eastern Kenya region, the markets included Muluu, Kalundu and Chuluni in Kitui County; Machakos Municipal Market, Mutituni, Kaloleni, Kivaani and Kakuyuni in Machakos County. In Central Kenya region, the markets included Gatunyu, Kirwara, Kaguku and Ngoliba in Muranga County; Kerugoya, Kutus, Kagio and Ngurubani in Kirinyaga County. Pumpkin traders were interviewed in the markets to collect data on demographic characteristics, marketed quantities, market prices and frequency of trading in pumpkins. Data were also collected on market information sources and pumpkin marketing constraints. in major towns, urban market centres and major rural markets.

3.6 Research instruments

Primary and secondary data were used in the study. Primary data on demographic and socio-economic characteristics of farm households, pumpkin production and

marketing constraints were collected using a structured questionnaire (appendix 1). Data on pumpkin traders' characteristics, market characteristics and marketing constraints were collected using a structured questionnaire (appendix 2). The questionnaires were pre-tested in one site each in Kirinyaga, Muranga, Machakos and Kitui Counties. This was done to ascertain clear understanding of questions and correct responses by the respondents. The enumerators who assisted in data collection were trained on administering the questionnaires and creating good rapport with the respondents. Secondary information on the study area was obtained from the Ministry of Agriculture.

3.7 Model specification and data analysis

Descriptive data analysis (means, standard deviations, frequencies and percentages) and inferential statistics aided by SPSS (version 17) and Stata computer software were used to analyze the collected data. Descriptive statistics were run as the first step at the beginning of data analysis to derive means, standard deviations, frequencies and percentages of the independent variables. This helped to show the main patterns in the collected data. Descriptive analysis allowed calculation and presentation of the main results in form of statistics summarized in tables and charts.

Inferential statistics were derived using multiple regression analysis and Tobit model where the dependent variables were hypothesized to depend on a number of independent variables. Regression coefficients were estimated to determine the influence of each independent variable on the dependent variables which included quantity of

pumpkin produced by farming households, marketed pumpkin proportion by households and quantities of pumpkins sold annually by traders.

For objective (i), multiple regression analysis was used to determine the socio-economic factors influencing pumpkin production. The dependent variable (pumpkin quantity produced measured in kilograms) was regressed on the independent variables described in Table 3.3. The following model was used:

$$Y_i = \beta_0 + \beta_1EDHH + \beta_2AGHH + \beta_3GHH + \beta_4HHS + \beta_5OFACT + \beta_6HHIN + \beta_7MFGP + \beta_8PFA + \beta_9LT + u_i \dots\dots\dots (5)$$

Where; Y_i = dependent variable (PQP), β_0 = intercept term, β_i = parameters to be estimated, X_i = vector of independent variables assumed to influence household pumpkin production and u_i = disturbance term which is independently and normally distributed with a mean of zero and a constant variance.

Table 3.3: Description of pumpkin production related variables and expected signs

Variable	Description	Units of measure	Expected sign
PQP	Pumpkin quantity produced (Y)	Kilogram	
EDHH	Education of household head	Number of years	+
AGHH	Age of household head	Years	+/-
GHH	Gender of household head	1=male, 0=female	+/-
HHS	Household size	Number of people	+/-
OFACT	Engagement in off-farm activities	1=engaged, 0=otherwise	+/-
HHIN	Household income per annum	Kenya shillings	+
MFGP	Membership in farmers group	1= member, 0=otherwise	+/-
PFA	Farm area under pumpkins	Hectares	+
LT	Land tenure	1= with title deed, 0=otherwise	+/-

For objective (ii), descriptive statistics were used to analyze the data collected on pumpkin uses and socio-cultural practices in pumpkin consumption. The collected data were analyzed to show how the various pumpkin products were used and households' socio-cultural perceptions on pumpkin consumption.

For objective (iii), the farm household characteristics that influence pumpkin marketing were determined using Tobit model analysis. The dependent variable was marketed pumpkin proportion while the independent variables were as shown in Table 3.4. The dependent variable ranged from 0 to 1 in a continuous manner as a result making Tobit model the preferred tool for analysis rather than Logit and Probit models which are appropriate for discrete and binary choice dependent variables. Tobit model was used to estimate the expected value of the dependent variable, Y_i as a function of a set of independent variables (X_i) weighted by the probability that $Y_i > 0$ (Tobin, 1958).

$$Y_i = X_i\beta + u_i \dots \dots \dots (6)$$

$$Y_i = Y^* \text{ if } Y^* > 0; Y_i = 0 \text{ if } Y^* \leq 0$$

Where; Y_i is the dependent variable, Y^* is the latent dependent variable which is not observed, X_i is a vector of independent variables and u_i is the error term.

The model used to determine the factors influencing the marketed pumpkin proportion by farm households was presented as follows:

$$\begin{aligned} \text{MPP} = & \beta_0 + \beta_1\text{AGHH} + \beta_2\text{GHH} + \beta_3\text{HHS} + \beta_4\text{DMKT} + \beta_5\text{MINFO} + \beta_6\text{MFGP} + \beta_7\text{MKTP} \\ & + \beta_8\text{REG} + u_i \dots \dots \dots (7) \end{aligned}$$

Where; $MPP = Y^*$ if $Y^* > 0$; $MPP = 0$ if $Y^* \leq 0$, MPP is the marketed pumpkin proportion, β is a vector of unknown coefficients, u_i is error term and Y^* is the latent dependent variable which is not observed.

In order to determine the traders and market characteristics that influence pumpkin marketing multiple regression analysis was used. The dependent variable (quantities of pumpkins sold annually) was regressed on the independent variables described in Table 3.4. The model used was presented as follows.

$$QPS = \beta_0 + \beta_1AGTR + \beta_2GNTR + \beta_3EDTR + \beta_4EXP + \beta_5DMKT + \beta_6MKTP + \beta_7MINFO + \beta_8MMASS + \beta_9SFRQ + \beta_{10}MTYP + u_i \dots\dots\dots (8)$$

Where; QPS = quantities of pumpkins sold annually (dependent variable), β_0 = intercept term, β_i = parameters to be estimated and u_i = disturbance term.

In the fourth objective, descriptive statistics presented in tabular form were used to analyze the major pumpkin production and marketing constraints.

Table 3.4: Description of pumpkin marketing related variables and expected signs

Dependent variable (Y)	Independent variables (X_i)	Description	Units of measure	Expected sign
Marketed pumpkin proportion (MPP)	AGHH	Age of household head	Years	+/-
	GHH	Gender of household head	Male=1, female =0	+/-
	HHS	Household size	Number of people	+/-
	DMKT	Distance to market	Kilometer (km)	-
	MINFO	Source of market information	Access=1, No access=0	+/-
	MFGP	Membership in farmers group	Member=1, otherwise=0	+/-
	MKTP	Market price	Kenya shilling (Kshs)	+
	REG	Region	Eastern=1, Central=0	+/-
Quantities of pumpkins sold annually (QPS)	AGTR	Age of trader	Years	+/-
	GNTR	Gender of trader	Female=1, male=0	+/-
	EDTR	Education of trader	Years of schooling	+/-
	EXP	Selling experience	Years	+
	DMKT	Distance to market	Kilometer (km)	+/-
	MKTP	Market price	Kenya shillings (Kshs)	+
	MINFO	Market information source	Access=1, No access=0	+/-
	MMASS	Membership in marketing association	Member=1, otherwise=0	+
	SFRQ	Selling frequency	Number of times	+
MTYP	Type of market	Urban=1; rural=0	+/-	

3.8 Validation tests

3.8.1 Heteroscedasticity test

In a linear regression model, it is assumed that the disturbance term has a normal distribution with a mean of zero and a constant variance. Heteroscedasticity occurs when the error term is not independently and identically distributed (Russel and Mackinnon, 1999). This happens when the variance in the error term is different for all combinations of outcomes of the independent variables (Woolridge, 2002). The variance of the disturbance term should not be dependent on the independent variables neither change with any of these variables. The variables used in the regression models were tested for heteroskedasticity using Breusch-Pagan/Cook-Weisberg test. The test assumes that the variance of the disturbance term is a linear function of one or more independent variables in a regression equation. The null hypothesis in the Breusch-Pagan/Cook-Weisberg test is that the variance of the disturbance term is constant while the alternative hypothesis is that the error term variance varies with the set of independent variables (Greene, 1993). The test follows a Chi-square distribution and the test statistic value is compared to the critical statistic value at 1%, 5% and 10% significance levels.

3.8.2 Multicollinearity test

The analysis also ensured that highly correlated independent variables were not used simultaneously; a condition of multicollinearity. This is a situation where it is difficult to identify the separate effect of independent variables on the dependent variable because strong relationship exists among them (Gujarati, 2003). Thus, multicollinearity is

a situation where independent variables are highly correlated. Variance Inflation Factor (VIF) was used to test for multicollinearity among the independent variables in the regression models used to analyze the data collected in this study. As a rule of thumb, if VIF is greater than 10 it indicates high multicollinearity among the independent variables (Gujarati, 2003).

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

The results of this research are presented in this chapter. Descriptive and inferential statistics were used in analyzing the data collected in this study. Results of descriptive analysis are given for sampled households characteristics, pumpkin uses and socio-cultural practices in pumpkin consumption. Descriptive analysis on pumpkin traders and market characteristics are also presented in this chapter. Multiple regression analysis results for the socio-economic factors influencing pumpkin production by farming households are presented in this chapter. In addition, Tobit model analysis results for the factors influencing pumpkin marketing by farming households are given in this chapter. Further, multiple regression analysis of traders and market characteristics that influence pumpkin marketing are also presented in this chapter. Finally, major constraints in pumpkin production and marketing are presented.

4.2 Demographic and socio-economic characteristics of farm households

4.2.1 Household characteristics

The study findings presented in Table 4.1 show that among the sampled farmers, the household head had attained post-primary education level averaging 10 years of schooling. This varied from 9 to 10 years of schooling in Central and Eastern Kenya regions respectively. The overall average age of household head was 55 years.

Table 4.1: Descriptive results of the sampled households in Eastern and Central Kenya

Variable	Eastern Kenya (N=124)		Central Kenya (N=136)		Overall (N=260)	
	Mean	SD	Mean	SD	Mean	SD
Pumpkin quantity produced (kg)	1,384	1,352.44	657.50	980.27	1,003.98	1,225.44
Education (years in school)	10.43	3.54	9.27	4.27	9.83	3.98
Household head age (years)	56.53	12.85	53.18	13.26	54.78	13.15
Household size (number)	6	2.39	4	1.90	5	2.23
Household income (Kshs/pa)	47,194.60	14,994.29	47,382.40	6,366.23	47,292.80	113,091.62
Farm size (hectares)	1.59	4.59	0.79	4.67	1.17	5.44
Farm area under pumpkins (hectares)	0.14	1.01	0.07	2.44	0.11	1.21
Marketed quantity (kg)	37.30	36.53	43.95	41.18	40.78	39.08
Distance to market (km)	2.84	2.42	3.91	2.76	3.40	2.65
Market price (Kshs.)	16.60	16.30	12.50	9.87	11.20	13.63
Productivity (kg ha^{-1})	9,767.10		9,553.10		9,680.31	

This was lower at 53 years in Central Kenya compared to 57 years in Eastern Kenya. The results implied that majority of pumpkin producers were generally old people, in both cases the typical age being greater than 50 years. Age indicates farming experience and older farmers are considered to use production resources more wisely. Overall, the household size was 5 persons with an average of 4 and 6 persons in Central and Eastern Kenya regions respectively. The sampled households had a mean income of Kenya shillings 47,292.80 per annum while the average farm size was 1.17 hectares. The households in Central Kenya had smaller farm sizes of 0.79 hectares while those in Eastern Kenya had relatively larger farms of 1.59 hectares. The average farm area under pumpkin production was 0.11 hectares which varied from 0.07 hectares in Central Kenya to 0.14 hectares in Eastern Kenya.

Overall, pumpkin productivity by the sampled farmers in Eastern and Central Kenya was 9,680.31 kg ha^{-1} . Pumpkin productivity by farmers in Eastern Kenya was higher at 9,767.10 kg ha^{-1} compared to 9,553.10 kg ha^{-1} in Central Kenya. This implied that pumpkin productivity in the two study areas was below the potential of 20,000 kg ha^{-1} . The sampled households kept 96% of the harvested pumpkins for consumption while only 4% was marketed. Households in Central Kenya marketed slightly more pumpkins quantities (44 kg) than did those in Eastern Kenya (37 kg). The average market price was Kshs. 11.20 per kilogram but this was higher in Eastern Kenya (Kshs. 16.60) compared to Central Kenya (Kshs. 12.50). The overall average distance travelled by the sampled farmers to the nearest market was 3.4 km but this was longer in Central Kenya (3.9 km)

compared to Eastern Kenya (2.8 km). Majority (82%) of the sampled households were female while male were 18%. Among these households, 17% were engaged in off-farm activities while 79% had membership in farmers groups. On land tenure system, slightly over half of the sampled households (57%) had title deeds for their land while 43% did not. Most of the farmers (78%) did not have access to market information sources such as radio, television, newspapers and mobile phone services (Table 4.2).

Table 4.2: Percentage distribution of sampled household characteristics

Variable	Category	Eastern % (N=124)	Central % (N=136)	Overall % (N=260)
Gender	Male	11	24	18
	Female	89	76	82
Engagement in off farm activities	Engaged	27	15	17
	Not engaged	73	85	83
Membership in farmers groups	Member	73	85	79
	Not member	27	15	21
Land tenure	With title deed	56	57	57
	Without title deed	44	43	43
Market information source	Access	24	18	22
	No access	76	82	78

Tests of mean differences showed that pumpkin quantity produced, household size, farm area under pumpkins and farm size were statistically significant at 1% significance level. Education was significant at 5% significance level while marketed quantity and distance to market were significant at 10% significance level (appendix 3).

4.2.2 Demographic and socio-economic factors influencing pumpkin production

Multiple regression analysis was used to determine the demographic and socio-economic factors that influenced pumpkin production in Eastern and Central Kenya. The results are presented in Table 4.3. The independent variables collectively predicted 90% of the effect of demographic and socio-economic factors on pumpkin production among smallholder farmers in Eastern Kenya region. Age of household head was significant at 10% ($p \leq 0.1$) while membership in farmers group was significant at 5% ($p \leq 0.05$) significance level. Household on-farm income and farm area under pumpkins were significant at 1% ($p \leq 0.01$) significance level. The results of this study implied that age of household head, membership in farmers group, farm area under pumpkins and household on-farm income had significant and positive effect on the quantity of pumpkin produced by smallholder farmers in Eastern Kenya.

In Central Kenya, the independent variables collectively predicted 76% of the effect of demographic and socio-economic factors on pumpkin production among smallholder farmers. Farm area under pumpkins was significant at 1% ($p \leq 0.01$) while engagement in off farm activities was significant at 10% ($p \leq 0.1$) significance level. Farm area under pumpkins had positive while engagement in off farm activities had negative effect on pumpkin production among smallholder farmers in Central Kenya. The results implied that the quantity of pumpkin produced increased with increase in the farm area under pumpkins but reduced with engagement of the households in off-farm activities.

Table 4.3: Multiple regression results of factors influencing pumpkin production

Variable	Eastern Kenya			Central Kenya		
	Coefficients	Std. Error	p-value	Coefficients	Std. Error	p-value
Age of household head	13.3765*	7.9209	0.094	5.9285	3.8799	0.129
Gender of household head	-190.4393	294.2556	0.519	-93.8560	109.7135	0.394
Household size	53.8619	41.5168	0.197	-23.4891	24.2625	0.335
Education level of household head	19.6887	27.5653	0.477	4.5880	11.9304	0.701
Engagement in off-farm activities	-38.0284	223.2737	0.865	-237.2201*	127.8407	0.066
Membership in farmers group	545.0775**	225.6738	0.017	206.0579	127.7937	0.109
Land tenure	96.1745	189.1588	0.612	-14.7385	99.9556	0.883
Household on-farm income	0.0022***	0.0006	0.001	0.0004	0.0007	0.571
Farm area under pumpkins	2392.9410***	258.6366	0.000	29.7899***	1.5837	0.000
Constant	-1098.2750	614.8479	0.077	-201.4385	297.3131	0.499
R-squared (R ²)	0.901			0.759		

***, ** and * represents significance at 1, 5 and 10% levels respectively.

The overall results of multiple regression analysis of factors influencing pumpkin production in Eastern and Central Kenya are presented in Table 4.4.

Table 4.4: Overall results of multiple regression analysis of factors influencing pumpkin production in Eastern and Central Kenya

Variable	Coefficient	Std. Error	t	p>t
Age of household head	16.9289***	6.2585	2.70	0.007
Gender of household head	-247.6374	204.64	-1.21	0.227
Household size	94.0816***	34.9403	2.69	0.008
Education level of household head	44.4631**	20.4997	2.17	0.031
Engagement in off-farm activities	473.3097***	188.3241	2.51	0.013
Membership in farmers group	53.8621	189.646	0.28	0.777
Land tenure	165.2471	156.5946	1.06	0.292
Household on-farm income	0.0012*	0.0007	1.79	0.075
Area under pumpkin	-102.891	223.9499	-0.46	0.646
Constant	-891.1294	488.5508	-1.82	0.069
R-squared (R ²)	0.850			

***, ** and * represents significance at 1, 5 and 10% levels respectively

Age of household head, household size and engagement in off farm activities were significant at 1% ($p \leq 0.01$) significance level. Education level of household head was significant at 5% ($p \leq 0.05$) while household on-farm income was significant at 10% ($p \leq 0.1$) significance level. These factors had positive influence on pumpkin production among smallholder farmers in Eastern and Central Kenya. The value of R-squared indicated that the explanatory variables collectively predicted 85% of the effect of socio-

economic factors on pumpkin production among smallholder farmers in Eastern and Central Kenya regions.

The results implied that pumpkin quantity produced by the households increased with increase in the age and education level of the household head. Older farmers' main objective in crop production is to meet household food security since food is one of the most important basic requirements in a family. Older farmers tend to associate more with crops known for their nutritional and health benefits unlike younger farmers whose main interest in an enterprise is income and profitability. Education enhances taking up of new ideas and modern techniques in agricultural production. The more a farmer is educated the higher the level of reception and understanding of information as well as access and adoption of modern technologies.

The results also implied that increase in household size and on-farm income had positive effect on pumpkin production. Household size as a proxy for labour indicates the importance of family labour in smallholder agricultural production. This means the larger the family size, the higher the probability of labour force availability and consequently the higher the productivity. Income plays a significant role in the purchase and access to farm inputs which are key production factors. Further, the results implied that engagement of households in off farm activities had positive influence on pumpkin production. Off farm activities are a source of additional income which enables farmers to invest in agricultural activities resulting in increased production.

4.3 Pumpkin consumption in Eastern and Central Kenya

4.3.1 Uses of pumpkin products

Table 4.5 gives results of the uses of pumpkin products in Eastern and Central Kenya. Pumpkin fruits and leaves were mainly used as food by 33% and 29% of the sampled households in this study. Less than 1% of the households used fruits and leaves for medicinal purposes, as herbs or spices and animal feeds. The households used seeds mainly for planting (31%) with a few using them as medicine (3%) and food (2%).

Table 4.5: Percentage distribution of pumpkin product uses in Eastern and Central Kenya

Pumpkin product	Use	Eastern % (N=124)	Central % (N=136)	Overall % (N=260)
Fruits	Food	37.0	28.0	33.0
	Herb/spice	0.7	0.1	0.4
	Feed to animals	0.0	0.6	0.2
	Medicine	0.9	0.6	0.8
Leaves	Food	25.0	34.0	29.0
	Medicine	1.5	0.1	0.8
Seeds	Planting	29.0	33.0	31.0
	Food	2.4	1.0	1.6
	Medicine	3.3	2.5	2.9

Utilization of pumpkin fruits for food was higher in Eastern Kenya (37%) and that of leaves was higher in Central Kenya (28%). Less than 1% of households in Central Kenya used fruits to feed animals. More households in Eastern Kenya used seeds as food

(2.4%) and medicine (3.3%) compared to those in Central Kenya (Table 4.5). The results of this research showed that pumpkin products especially fruits and leaves were mainly used as food by majority of the households in Eastern and Central Kenya to meet their nutritional needs.

4.3.2 Socio-cultural issues in pumpkin consumption

The descriptive results of the socio-cultural issues in pumpkin consumption by households in Eastern and Central Kenya regions are presented in Table 4.6.

Table 4.6: Socio-cultural issues in pumpkin consumption by smallholder farmers

Socio-Cultural Perception	Eastern % (N=124)	Central % (N=136)	Overall % (N=260)
Considered as food for the poor	28	25	27
Food for children	12	11	12
Foodstuff for rural dwellers	10	8	9
Most people do not like pumpkins	5	12	8
Pumpkins control roundworms	9	5	7
Most farmers are not aware of nutritional values	7	7	7
Pumpkins are medicinal	9	4	6
Major shift from traditional to modern foods	6	6	6
Negative connotations towards pumpkins	2	8	5
Personal taste	4	7	5
Most people are detached from pumpkins	5	5	5
Embarrassing to serve pumpkin meal to visitors	3	2	3

The results showed that majority of the sampled households in Eastern and Central Kenya regarded pumpkins as food for the poor (27%), children (12%) and rural dwellers (9%). More households in Eastern Kenya regarded pumpkins as food for the poor (28%), children (12%) and rural dwellers (10%) compared to those in Central Kenya. Other socio-cultural perceptions on pumpkin consumption by the households included dislike by most people (8%), control roundworms (7%), farmers were not aware of the nutritional values (7%), pumpkins are medicinal (6%) and shift from traditional to modern foods (6%). More households in Central Kenya (12%) compared to those in Eastern Kenya (5%) indicated that pumpkins were disliked by most people. A higher number of households in Eastern Kenya (9%) considered pumpkins to control roundworms and medicinal as compared to 5% and 4% respectively in Central Kenya. Other perceptions by the sampled households were negative connotations towards the crop (5%), personal taste (5%), detachment of most people from pumpkins (5%) and embarrassing to serve pumpkin meal to visitors (3%).

4.4 Households characteristics influencing pumpkin marketing

The factors that influenced farm households' participation in pumpkin marketing in Eastern and Central Kenya were determined using Tobit model analysis. The results are presented in Table 4.7.

Table 4.7: Tobit model results of factors influencing households' market participation

Variable	Eastern Kenya				Central Kenya			
	Coefficient	Std. Error	t	p>t	Coefficient	Std. Error	t	p>t
Age of household head	-0.0016	0.0023	-0.71	0.478	0.0002	0.0024	0.08	0.94
Gender of household head	0.0880	0.0907	0.97	0.334	0.1575*	0.0814	1.94	0.057
Household size	0.0071	0.0127	0.56	0.577	0.0174	0.0174	0.99	0.323
Membership in farmers group	0.1674**	0.0706	2.37	0.02	0.0321	0.0992	0.32	0.747
Distance to market	-0.0104	0.0144	-0.72	0.473	0.0012	0.0125	0.09	0.927
Market price	-0.0012	0.0021	-0.55	0.58	0.0056***	0.0022	2.56	0.013
Source of market information	-0.0053	0.0649	-0.08	0.936	-0.0451	0.1018	-0.44	0.659
Constant	0.1840	0.1973	0.93	0.353	-0.1423	0.19833	-0.72	0.475
	LR Chi ² (7)=10.07 Prob>chi ² =0.0981				LR Chi ² (7)=12.31 Prob>chi ² =0.0907			
	31 left-censored observations				2 left-censored observations			
	81 uncensored observations				79 uncensored observations			
	0 right-censored observations				0 right-censored observations			

***, ** and * represents significance at 1, 5 and 10% levels respectively.

In Eastern Kenya, the Tobit model results showed that there were 31 left-censored and 81 uncensored observations at the lower limit (marketed pumpkin proportion ≥ 0). The Prob $> \chi^2$ value of 0.0981 indicated that the fitted model was significant at 10% significance level ($p \leq 0.1$). Membership in farmers group was significant at 5% ($p \leq 0.05$). This had a positive effect on the proportion of marketed pumpkin among the farm households in Eastern Kenya. The results implied that membership in farmers' group had significant and positive influence on marketed pumpkin proportion and market participation by farm households.

In Central Kenya, 2 observations were left-censored while 79 were uncensored. The Prob $> \chi^2$ value of 0.0907 indicated that the fitted model was significant at 10% significance level ($p \leq 0.1$). Market price and gender of household head were significant at 1% ($p \leq 0.01$) and 10% ($p \leq 0.1$) significance level respectively. These factors had positive effect on marketed pumpkin proportion among farm households in Central Kenya. The results implied that increase in market prices and gender of the household head influenced the proportion of marketed pumpkins and market participation by farm households.

The overall results of Tobit model analysis on the factors that influenced farm households' participation in pumpkin marketing in Eastern and Central Kenya are presented in Table 4.8. The p-value indicated that the model fit was significant at 1% significance level ($p \leq 0.01$).

Table 4.8: Overall results of Tobit model of factors influencing households' market participation in Eastern and Central Kenya

Marketed proportion	Coefficient	Std. Error	t	p>t
Age of household head	0.1929	0.1683	1.15	0.259
Gender of household head	0.1126	0.1154	0.98	0.336
Household size	-0.1259*	0.0706	-1.78	0.083
Membership in farmers group	0.0358	0.0880	0.41	0.687
Distance to market	-0.0791*	0.0439	-1.8	0.08
Market price	0.0377	0.0675	0.56	0.58
Source of market information	-0.0334	0.0906	-0.37	0.714
Region	-0.5099	1.0534	-0.48	0.629
Constant	-0.6186	0.7182	-0.86	0.395
LR Chi ² (8)=19.24	Prob>chi ² =0.0136	Pseudo R ² =0.0116		
Observations summary: 33 left-censored, 160 uncensored, 0 right-censored observations				

* represents significance at 10% level

The results showed that 33 and 160 observations were left-censored and uncensored respectively at the lower limit (marketed pumpkin proportion \geq 0). Household size and distance to market were significant at 10% significance level ($p\leq 0.10$). The factors had negative effect on the marketed pumpkin proportion among farm households in Eastern and Central Kenya. This implied that as the household size increases the proportion of pumpkins marketed by the farm households reduced. This also implied that an increase in the distance to the market reduced the proportion of pumpkins marketed by farm households. The results implied that household size and distance to the market had

significant but negative influence on farm households' participation in pumpkin marketing in Eastern and Central Kenya.

4.5 Factors influencing pumpkin market participation by traders

4.5.1 Pumpkin traders and market characteristics

The descriptive results of pumpkin traders and market characteristics are given in Table 4.9. The results showed that the sampled traders experience in selling pumpkins was an average of 7 years. This was higher in Eastern Kenya with a mean of 8 years compared to 6 years in Central Kenya. Traders in the study areas had similar education level of post-primary education with a mean of 9 years of schooling. Overall, pumpkin quantities sold by traders was an average of 104 kg but this was higher in Eastern Kenya (113 kg) compared to Central Kenya (96 kg).

Table 4.9: Descriptive analysis of pumpkin traders and market characteristics

Variable	Eastern Kenya (N=84)		Central Kenya (N=88)		Overall (N=172)	
	Mean	SD	Mean	SD	Mean	SD
Sold pumpkin quantity (kg)	112.63	176.20	96.34	215.86	104.27	197.10
Selling experience (years)	8.24	7.21	6.32	8.35	7.25	7.86
Education (years in school)	9.27	3.75	9.31	3.57	9.28	3.64
Market price (Kshs.)	34.40	14.58	23.50	16.64	28.70	13.22
Distance to market (km)	3.32	4.50	4.55	5.04	5.43	4.90

The traders sold pumpkins at an average price of Kshs. 28.70 per kg. Pumpkin prices were higher in Eastern Kenya at Kshs. 34.40 per kg compared to Kshs. 23.50 per kg in Central Kenya. The mean distance to the market travelled by pumpkin traders was 5.4 kilometers. Pumpkin traders in Central Kenya travelled longer distances of 4.6 km compared to 3.3 km in Eastern Kenya. This implied that traders in Central Kenya incurred higher transaction costs in marketing pumpkins than did those in Eastern Kenya. Majority of the sampled traders were aged between 25 to 35 years (41%) and 36 to 45 years (39%) while majority were women (82%) and men were 18% as shown in Table 4.10.

Table 4.10: Percentage distribution of pumpkin traders and market characteristics

Variable	Category	Eastern Kenya (N=84)	Central Kenya (N=88)	Overall (N=172)
Age of trader (years)	25-35	43	40	41
	36-45	44	36	39
	46-55	12	23	17
Gender of trader	Male	15	18	18
	Female	85	82	82
Marketing association membership	Member	13	5	9
	Not member	87	95	91
Market information access	Access	57	51	54
	Do not access	43	49	46
Selling frequency	Daily	43	33	38
	Once a week	20	32	25
	Twice a week	24	30	27
Type of market	Urban	80	65	73
	Rural	20	35	27

Overall only 9% of the traders were members of marketing associations in their areas. Membership in marketing associations was higher in Eastern Kenya (13%) compared to Central Kenya (5%). Most of the traders (73%) sold pumpkins in urban markets and 27% in rural markets. The traders mainly sold pumpkins daily (38%), once a week (25%) and twice a week (27%). The traders who sold pumpkins on daily basis ranged from 33% in Central Kenya to 43% in Eastern Kenya. Traders who sold pumpkins once a week varied from 20% to 32% while those who sold twice a week ranged from 24% to 30% in Eastern and Central Kenya respectively. Most of the traders (54%) had access to market information sources while 46% did not.

4.5.2 Traders and market factors influencing pumpkin marketing

Multiple regression analysis was used to determine traders and market factors that influenced pumpkin marketing in Eastern and Central Kenya. The results are presented in Table 4.11. In Eastern Kenya, age of trader, selling experience and selling frequency were significant at 10% ($p \leq 0.1$) significance level while membership in marketing association was significant at 1% ($p \leq 0.01$) significance level. All the significant factors had positive influence on pumpkin marketing in Eastern Kenya.

Table 4.11: Multiple regression results of traders and market factors influencing pumpkin marketing

Variable	Eastern Kenya				Central Kenya			
	Coefficient	Std. Error	t	Sig.	Coefficient	Std. Error	t	Sig.
(Constant)	-158.233	131.206	-1.206	0.235	-80.808	86.533	-0.934	0.358
Age of trader	61.179*	34.243	1.787	0.081	16.220	15.816	1.026	0.314
Gender of trader	23.429	63.848	0.367	0.716	-25.121	34.040	-0.738	0.466
Education level of trader	3.999	6.691	0.598	0.553	3.893	3.653	1.066	0.295
Selling experience	5.223*	3.024	1.727	0.092	0.615	1.450	0.424	0.675
Market price	2.428	1.616	1.503	0.140	2.643**	1.269	2.083	0.046
Selling frequency	14.862*	8.847	1.680	0.101	2.530	6.310	0.401	0.691
Distance to market	8.044	5.608	1.434	0.159	5.146**	2.362	2.179	0.038
Membership in marketing association	169.352***	59.293	2.856	0.007	50.068	45.195	1.108	0.277
Market information source	1.755	52.600	0.033	0.974	16.204	32.247	0.502	0.619
Type of market	-73.724	51.901	-1.420	0.163	-27.192	26.198	-1.038	0.308

***, ** and * represent significance at 1%, 5% and 10% levels respectively.

The results implied that increase in trader's age and selling experience significantly and positively influenced the pumpkins quantities sold annually in Eastern Kenya. Age is an indicator of experience in making transaction decisions and market participation. The influence of selling frequency of the traders on the pumpkins quantities sold annually could be due to the regular contacts made with consumers and other traders. It could also be attributed to the networks the traders have established through long periods of market participation. On the other hand, membership in marketing associations influenced the pumpkin quantities sold annually. This could be attributed to sharing of marketing information and established networks through the associations.

In Central Kenya, market price and distance to market were significant at 5% significance level ($p \leq 0.05$). The factors had positive influence on pumpkin marketing in Central Kenya as shown in Table 4.11. The results implied that an increase in market price had positive effect on the pumpkin quantities sold by traders. The output price is normally an incentive to sellers to supply more to the market. Increase in distance to the market had also positive effect on the pumpkin quantities sold by traders. Distance to market is negatively related to marketed quantities for most agricultural commodities due to the transaction costs involved. However traders are likely to travel long distances in search of better market channels particularly in urban areas where demand for pumpkins was likely to be higher due to consumers' awareness and preferences for nutritious foods (Ngugi *et al.*, 2007).

The overall multiple regression analysis results on traders and market factors that influenced pumpkin marketing in Eastern and Central Kenya are presented in Table 4.12.

Table 4.12: Overall multiple regression results of traders and market factors influencing pumpkin marketing

Variable	Coefficient	Std. Error	t	Sig.
Constant	-108.850	82.633	-1.317	0.191
Age of trader	29.463	19.101	1.542	0.127
Gender of trader	22.112	36.607	0.604	0.547
Education level of trader	1.827	4.029	0.453	0.651
Selling experience	-2.257	1.726	-1.308	0.195
Market price	3.098***	1.063	2.913	0.005
Selling frequency	10.328**	5.250	1.967	0.0538
Distance to market	5.554*	3.064	1.813	0.074
Membership in marketing association	122.799***	40.849	3.006	0.004
Market information	25.804	31.189	0.827	0.410
Type of market	-46.208	31.010	-1.490	0.146
R-squared (R ²)	0.630			

***, ** and * represent 1, 5 and 10% significance levels respectively.

The results showed that the independent variables collectively predicted 63% of the effect of traders and market characteristics on pumpkin marketing in Eastern and Central Kenya. Market price and membership in marketing association were significant at 1% ($p \leq 0.01$) significance level. Selling frequency and distance to market were significant at

5% ($p \leq 0.05$) and 10% ($p \leq 0.1$) significance levels respectively. All the significant factors had positive influence on pumpkin marketing in Eastern and Central Kenya.

The results implied that increase in market prices had significant and positive effect on quantities of pumpkins sold by traders. High output price is an incentive for traders to supply more to the market. The results also implied that membership in marketing associations had significant and positive effect on pumpkin quantities sold by traders. This could be attributed to access to market information and networking among traders. Selling frequency by traders significantly and positively influenced the pumpkin quantities they sold in the market. This was due to the mutual links and relationships established with consumers and other traders. Increase in the distance to the market had significant and positive effect on pumpkin quantities sold by traders. This could be due to the traders reaching new markets and linkages established with existing outlets particularly in urban areas.

4.6 Smallholder pumpkin production and marketing constraints

4.6.1 Pumpkin production constraints

This research established that pumpkin productivity in Eastern and Central Kenya was generally low at an average of $9,680.31 \text{ kg ha}^{-1}$ compared to the potential of $20,000 \text{ kg ha}^{-1}$. The sampled households attributed the low productivity to several constraints as presented in Table 4.13.

Table 4.13: Percentage distribution of pumpkin production constraints

Constraint	Eastern % (N=124)	Central % (N=136)	Overall % (N=260)
Pests and diseases	16	46	30
Insufficient rainfall	22	4	13
Farmers preference for maize and beans	9	8	9
Pumpkin not a major crop	6	8	7
Negative connotations towards pumpkins	7	4	6
Pumpkins take a lot of space	7	3	5
Inadequate land	6	2	5
Damage by moles	6	3	5
Pumpkin was a traditional food crop	4	4	4
Poor yields	4	5	4
Flower abortion	2	6	4
Traditional beliefs	4	2	3
Modern civilization	4	1	2
Inadequate utilization knowledge	2	2	2
Seed unavailability	1	2	1

Majority (30%) of the households identified pests and diseases as the main constraints in pumpkin production. This was indicated by 46% of households in Central Kenya compared to 16% in Eastern Kenya. Insufficient rainfall was reported as a major constraint by 13% of the households but more so in Eastern Kenya (22%) compared to 4% in Central Kenya. Other constraints were farmers' preference for maize and beans (9%), pumpkin not a major crop (7%) and negative connotations (6%). Pumpkins take a lot of space; inadequate land and damage by moles were indicated as constraints by 5%

of the sampled households. Other constraints identified by less than 5% of the sampled households were pumpkin was a traditional food crop, poor yields, flower abortion, traditional beliefs, modern civilization, inadequate utilization knowledge and seed unavailability.

4.6.2 Pumpkin marketing constraints

Results of descriptive analysis of pumpkin marketing constraints in Eastern and Central Kenya are presented in Table 4.15.

Table 4.14: Percentage distribution of pumpkin marketing constraints

Constraint	Eastern % (N=124)	Central % (N=136)	Overall % (N=260)
Poor market prices	20	18	19
Exploitation by brokers	18	10	14
Post harvest losses	9	16	12
Inadequate market information	11	6	9
Low consumer awareness	8	8	8
Low demand	8	7	8
High transport costs	6	8	7
Over ripening of fruits	4	10	7
Few organized markets	6	4	5
Unavailability of pumpkins	4	4	5
Poor storage facilities	2	5	3
High market charges	3	3	3

Majority of the sampled households in the research indicated that the main constraints in pumpkin marketing were poor market prices (19%), exploitation by brokers (14%), post-harvest losses (12%), inadequate market information (9%), low consumer awareness (8%), low demand (8%), over ripening of fruits (7%) and high transport costs (7%). Other marketing constraints reported by less than 6% of the sampled households included few organized markets, unavailability of pumpkins, poor storage facilities and high market charges. In Eastern Kenya, the main constraints included poor market prices (20%); exploitation by brokers (18%), inadequate market information (11%), post harvest losses (9%), low consumer awareness (8%) and low demand (8%). The main constraints in Central Kenya were poor market prices (18%), post-harvest losses (16%), exploitation by brokers' (10%), over ripening of fruits (10%), low consumer awareness (8%) and high transport costs (8%).

4.7 Validation tests

4.7.1 Heteroscedasticity test

Breusch-Pagan/Cook-Weisberg test was used to test for heteroscedasticity in the independent variables used in the regression and Tobit models. None of these variables were found to have heteroscedasticity as shown by the chi-square values and p-values in appendix 4, 5 and 6. The Chi-square and p-values for the heteroscedasticity tests of the three models used in this study were not significant at $p \leq 0.10$, $p \leq 0.05$ or $p \leq 0.01$. This indicated that the data were homoscedastic and hence absence of heteroscedasticity.

4.7.2 Multicollinearity test

Variance Inflation Factor (VIF) was used to test for multicollinearity in the independent variables in the regression models used in this study. As rule of thumb, VIF greater than 10 indicates the presence of high multicollinearity in the independent variables. The results of the test indicated that the highest VIF was 3.89 in the household pumpkin production regression model, 1.17 in the Tobit model for household marketing and 1.70 in the pumpkin traders marketing regression model (appendix 4, 5 and 6). These values were below the maximum value of 10 that is used to indicate multicollinearity. The results implied that multicollinearity was not a problem among the independent variables used in the three models and therefore the variables were not correlated.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

The results of this research are discussed in this chapter. The discussion includes demographic and socio-economic factors that influence pumpkin production, pumpkin products uses and socio-cultural issues in pumpkin consumption. Results on farm household, traders and market characteristics that influence pumpkin marketing are also discussed. The chapter also includes discussion on constraints in pumpkin production and marketing in Eastern and Central Kenya.

5.2 Demographic and socio-economic factors influencing pumpkin production

The results of this study showed that pumpkin farming households differed in their demographic and socio-economic characteristics. As expected in this study, age of the household head, household size, engagement in off farm activities, education level of household head and household on-farm income had significant and positive influence on pumpkin production. These results were consistent with findings by Nandi *et al.* (2011) in a study on economic analysis of cassava production in Nigeria which showed that gender, education, capital, farm size, labour, age, experience, income and family size were positively related to cassava output. Age of the household head had significant and positive influence on pumpkin production as expected in this study. This implied that older farmers were more likely to be involved in pumpkin production.

Among the sampled households, 82% were female, 18% male and the average age of household head was 55 years. The results indicated that pumpkin production was mainly the domain of older and women farmers. The findings were consistent with those of Oladele (2010) in a study on contribution of indigenous vegetables and fruits to poverty alleviation in Nigeria where it was established that majority of producers of indigenous vegetables and fruits were older people. The results were also consistent with a study by Vorster *et al.* (2008) that showed that traditional leafy vegetable production was the domain of older and women farmers due to the important role of the vegetables in food security of rural households. In decision making, the age structure has direct influence on agricultural practices and activities necessary for improved livelihoods. Age is also an indicator of farming experience where older persons are more experienced in farming and tend to diversify their production activities to spread risk.

As the study results indicated, older farmers were more involved in pumpkin production since they had more knowledge on uses and benefits of traditional foods. Similarly, Matenge *et al.* (2012) established that older people recognized indigenous and traditional foods for their health properties and ability to prevent diseases while young people preferred consumption of “modern foods”. This was also consistent with other studies by Shava (2005) and Vorster & Rensburg (2005) that found that women had more knowledge of leafy vegetables than men. As found out by Mikalitsa (2010) in a study in Western Kenya, gender and age determined rural household members’ access to and control over resources for agricultural production. Old people and women farmers were

considered to be among the poor and vulnerable in communities and hence pumpkin production offers them a substantial opportunity to meet their food and nutrition security.

Household size had significant and positive influence on pumpkin production as expected in this study. This meant that as household size increased the more the households were involved in pumpkin production. This was consistent with a study by Vorster & Rensburg (2005) which found that households with many members tended to be more reliant on traditional vegetables. Farmers depend on the family as an immediate source of the labour. The larger the family the more the available labour force and consequently more productivity is expected to meet their food needs. In a study of market participation decisions of cassava producing households, Enete & Igbokwe (2009) established that the larger the household size the higher were the domestic consumption needs. Similarly, Oni *et al* (2010) established that most smallholder farmers in South Africa farmed for commercial reasons but a larger proportion of their farm product was consumed at the household level. Family size is an important factor in determining the level of production and productivity of smallholder farmers. As found by Sani *et al.* (2014) and Shadiadeh *et al.* (2012), household size was one of the factors that influenced adoption of technologies and practices in crop production.

This study found that households' engagement in off farm activities had significant and positive influence on pumpkin production. This implied that households engaged in off farm activities were more likely to be involved in pumpkin production.

However, in Central Kenya engagement in off farm activities had significant but negative influence on pumpkin production. This implied that households engaged in off-farm activities in Central Kenya were less likely to be involved in pumpkin production. These findings indicated that engagement in off-farm activities would likely limit time available to engage in on-farm activities. In addition, engagement in off-farm activities sometimes contributed to rural urban migration which limited access to farm land thereby limiting farming activities. Both findings were as expected in this research. The findings agreed with a study by IFPRI (2005) that showed that there was high diversification and strong interactions among agricultural activities and off-farm activities in smallholder farmers' production systems. Non-farm activities enable households to obtain additional income, empower themselves financially and diversify their agricultural production. In a study on analysis of occupational diversification among rural women in Nigeria, Ajani & Igbokwe (2012) established that diversification of occupations assured households of food security, additional incomes, poverty reduction and enabled them cope with seasonality of farming activities.

The results of this study showed that education level of household head had significant and positive influence on pumpkin production. This implied that as the education level of the household head increased the more the households were likely to be involved in pumpkin production. On average the household heads had attained post-primary education level of 9 years of schooling. Education level is an indicator of access to knowledge and information as well as ability to synthesize it to usable form whereby

the household head can be in a position to explore and adopt cost minimization methods while ensuring food security in a household economy. The educational level of household head is very important for it enhances taking up of new ideas and modern techniques in agricultural production. As ascertained by Singha *et al.* (2012), education level was among the factors that influenced adoption of agricultural technologies and practices under a diversified farming system. Similarly, Fashola *et al.* (2007) established that education level increased the probability of technology adoption by farmers. High level of education enhances the understanding and improves the participation level of farmers in agricultural activities. Education comes in handy for farmers and consumers to understand the nutritional values of pumpkins as well as distinguish between socio-cultural beliefs and benefits of the crop.

As expected in this study, household on-farm income had significant and positive influence on pumpkin production. The results implied that as on-farm income increased the more the households were likely to be involved in pumpkin production. As established by Oladele (2010), indigenous vegetables were a major source of income and nourishment to farmers. Household income determines the availability of working capital to invest in the adoption of technologies and production activities. As found by Nobeji *et al.* (2015) in a study of socio-economic determinants of inputs use, education level and farm income influenced smallholder farmers' use of agricultural inputs. Similarly, Adebisi-Adelani & Oyesola (2013) found that income was a major socio-economic factor influencing the adaptation strategies of horticultural farmers. Farm income orientates

farmers towards commercialization and expansion of an enterprise due to increased volume of traded output as established by Agwu & Ibeabuchi (2011). Increased farm income has the potential of enhancing commercialization of pumpkin production by smallholder farmers in the study area of this research.

In Eastern Kenya, membership in farmers group had positive and significant influence on pumpkin production. This implied that farm households in Eastern Kenya with membership in farmers group were more likely to be involved in pumpkin production. The findings agreed with a study by Katungi *et al.* (2010) which established that social networks played an important role in agricultural production. As found out by Hellin *et al.* (2007), farmer organizations were critical in improving access to agricultural inputs and output markets in the vegetable sector. Group membership as shown by Narrod *et al.* (2009) enhanced farmers' ability to access inputs cheaply and to bargain for better prices. Similarly, Komarek (2010) showed that members of producer groups had better access to technical advice on crop management which helped them increase their yields.

Associational memberships had a positive effect on the decision and extent to adopt sustainable agricultural practices by farmers by providing information and knowledge as established by Munasib & Jordan (2011). This was corroborated by findings by Okuthe *et al.* (2013) which showed that farmers belonging to farmers' groups had higher adoption of technologies than those who were not members. Similarly, Sani *et*

al. (2014) in a study of dual purpose cowpea established that social participation was among the major socio-economic factors that influenced adoption of production technologies. Organized farmer groups have the potential to enhance networking, information sharing, exchange of new ideas and increased access to production and marketing information among pumpkin producers in the study areas.

Farm area under pumpkins had positive and significant influence on pumpkin production in both Eastern and Central Kenya. The results of this study implied that as farm area under pumpkins increased, households in the two study areas were more likely to be involved in pumpkin production. This was consistent with findings by Odiaka *et al.* (2009) which established that plot size had positive relationship with pumpkin yields and the larger the plot size the higher the generated yields. Pumpkins were planted in very small portions of land particularly in Central Kenya where land sizes were generally small and hence pumpkins were grown in same plots with a mixture of other crops. This compared well with a study in the Lake Victoria Basin by Ondigi *et al.* (2008) which established that majority of farmers produced pumpkins on small portions of land and inter-cropped with other crops. Similarly, Guere *et al.* (2006) showed that indigenous crops were produced in dispersed areas on small scale. Land is a key production factor but average landholdings in Kenya have declined due to rapid population growth. Increase in the cultivated land of a crop leads to higher productivity as a result of economies of scale. As Xaba & Masuku (2013a) established, farmers' profitability was influenced by land area under vegetable production. Expanding the land under pumpkin

production in the study area would increase the volume of marketable produce and incomes to the smallholder farmers. This would result in improved nutrition, health and livelihoods of the pumpkin farmers.

5.3 Pumpkin consumption in Eastern and Central Kenya

5.3.1 Uses of pumpkin products

The research results showed that pumpkin fruits and leaves were mainly used as food while seeds were used for planting by majority of the sampled households in Eastern and Central Kenya. The findings were consistent with studies by Oladele (2011) and Ondigi *et al.* (2008) which found that pumpkins were eaten by farmers for their nourishment with fruits, leaves and flowers used as vegetables. Similarly, a study by Musinguzi *et al.* (2006) found that most households mainly used pumpkin leaves as vegetables and pumpkin seeds as a sauce and snack. A study by Maroyi (2011) on the role of traditional vegetables in household food security in Zimbabwe showed that traditional vegetables were used as food and medicine while pumpkin was one of the most preferred traditional leafy vegetables. Similarly a study by Ndoro *et al.* (2007) showed that pumpkin leaves were consumed as food three to four times per week.

The results of this research indicated that pumpkins like other indigenous vegetables had the potential to provide nutrition, food security and cash income to households. This agreed with a study by Mojeremane *et al.* (2011) which found that many rural communities in many African farming systems relied on indigenous plants as

sources of food and cash income. As established by Vorster & Rensburg (2005), traditional vegetables were a source of food due to their ability to grow in marginal areas where low inputs and rainfed conditions were common. The findings of this study implied that pumpkins which are rich in proteins, vitamins and minerals could play an important role in the diet and food security of the households in Eastern and Central Kenya. Opportunities exist in the study areas for promoting increased pumpkin production and consumption by creating more awareness on the nutritional and medicinal values of the crop.

5.3.2 Socio-cultural practices in pumpkin consumption

Food security is a primary objective for households as food is one of the most important basic requirements in a family. The results of this study indicated that pumpkins were not given due importance in food production and consumption in Eastern and Central Kenya. Majority of the sampled households regarded pumpkins as food for the poor, children, rural dwellers and women. The findings were consistent with a study in the Lake Victoria Basin by Ondigi *et al.* (2008) which established that cooked pumpkins were consumed by women and children while men considered it as food for children. The findings also concurred with a study in South Africa by Vorster & Rensburg (2005) that found that men insisted on eating meat, leaving indigenous and traditional foods for women and children.

This study found that the sampled households had various socio-cultural perceptions related to production, nutritional and medicinal values of pumpkins. The findings of this study agreed with research carried out by Eyzaguirre *et al.* (2006) which established that consumption of traditional foods was generally low due to the negative perception given to them. Similarly, Shava *et al.* (2009) found that traditional vegetables were regarded as inferior and marginalized by the majority of people. A study conducted by Guerrero *et al.* (2009) showed that indigenous and traditional foods were consumed for cultural, traditional and heritage reasons. Likewise, Matenge, *et al.* (2012) established that negative beliefs were barriers but health, nutrition, tradition and culture were the main drivers for the consumption of indigenous and traditional foods by rural communities. Eating habits of rural households have changed over the years and therefore educating them on health and nutritional benefits of pumpkins could change their negative perceptions of the crop.

The results of this study showed that pumpkins were regarded as a minor and inferior crop compared to maize and beans. Farmers' main objective is to meet their household food needs and therefore tend to give priority to staple crops in their cropping systems. Ekesa *et al.* (2009) established that accessibility at local markets and production in farms greatly influenced the consumption of indigenous foods at household level. This implies that improved production and efficient marketing systems could encourage more farmers to grow and consume pumpkins. Therefore promoting pumpkin as a viable

enterprise for household food security and income generation could change farmers' negative attitudes towards the crop.

5.4 Households, traders and market characteristics in pumpkin marketing

5.4.1 Farm household characteristics in pumpkin marketing

The results of this research showed that pumpkin production by the sampled smallholder farmers in Eastern and Central Kenya was below average. Only 4% of the sampled households sold the produced pumpkins while the majority (96%) consumed their produce. The results of this study established that market participation by the pumpkin producing households in Eastern and Central Kenya was influenced by various factors. The proportion of pumpkins marketed by farm households was influenced by household size, distance to market, farmers group membership, market price and gender of household head.

This study established that household size had significant but negative influence on pumpkin marketing. This implied that an increase in household size reduced the marketed pumpkin proportion. The findings were consistent with previous research by Rios *et al.* (2008) that found that household size was negatively correlated with the volume of market sales. Food consumption increases as households become larger thus reducing sales of agricultural commodities. Berhanu and Moti (2010) established that as household size increased domestic consumption requirements for food rose and lowered household market participation. The findings of this research were also consistent with

Otieno *et al.* (2009) who found that household size contributed to reduction in the percentage of vegetables sold by rural farmers.

The findings of this study showed that distance to market had significant but negative influence on marketed pumpkin proportion among farm households in the study area. This was as expected and it implied that the longer the distance to the market the less the marketed pumpkin proportion. This was consistent with findings by Omiti *et al.* (2009) that established that output amount sold was influenced by nearness to the market. Similarly, studies by Osebeyo & Aye (2014) and Sebatta *et al.* (2014) established that market distance was among factors that influenced market participation by farm households. Smallholder farmers further away from the market outlet have lower market participation and sell smaller amounts of their output due to the high transaction costs involved as Reyes *et al.* (2012) revealed. As Komarek (2010) established decrease in the distance to the market lowered transaction costs and generated larger sale volumes. Well organized market channels would help farmers in the study area to commercialize pumpkin production and marketing. Organizing themselves into niche groups for pumpkin marketing the farmers could aggregate their produce and sell collectively to specific market outlets at negotiated prices. This would reduce their transaction costs and increase their incomes.

In this research study, membership in farmers groups was found to have positive and significant influence on pumpkin marketing in Eastern Kenya. This was consistent

with the study by Barham and Chitemi (2009) which showed that social structure of farmer groups was positively associated with improved marketing performance due to ability to take advantage of market opportunities. As established by Poulton *et al.* (2008) and Okello and Swinton (2007), farmers' organizations helped members to aggregate their produce volume, find a buyer, negotiate for the quantity to sell and bargain for fair prices. Similarly, Shiferaw (2008) showed that farmers' organizations enhanced sharing of information and collective decision-making among members. Studies by Hellin *et al.* (2007) and Darr (2005) showed that collective action facilitated easier access to commodity markets, technical skills and market information. This in turn facilitated increased production, commercialization and participation in commodity value chains by members of farmers' groups. This suggests that farmers in the study area could organize themselves into groups to enhance their market participation in pumpkin trade and bargain for better prices.

The results of this study showed that market price had significant and positive influence on marketed pumpkin proportion among farm households in Central Kenya. This implied that high market prices increased the proportion of pumpkins marketed by farm households. This was consistent with a study by Enete & Igbokwe (2009) which established that market price positively influenced market participation by farm households. Similarly, Otieno *et al.* (2009) found that unit price increased the percentage of vegetable sold by farmers in both rural and peri-urban areas. Market price generally influenced traded output of agricultural commodities and small-scale farmers generally

fetches low prices for their produce due to low bargaining power as Matere *et al.* (2010) revealed. Narrod *et al.* (2009) established that provision of timely market information to farmers enabled them deliver the right quantity and quality desired by a particular market outlet. Market price of agricultural commodities is closely related with production output and traded volumes. Xaba & Masuku (2013a) showed that selling price influenced vegetable farmers' productivity. On the other hand, high crop yields affected market participation and marketable surpluses sold by farmers as established by Komarek (2010). Provision of market information by extension service providers particularly on market prices would trigger increased production and traded volume of pumpkins leading to increased incomes to the smallholder farmers in the study area.

This research found that gender of household head positively influenced marketed pumpkin proportion among farm households in Central Kenya. This was as expected and implied that household head gender influenced the proportion of marketed pumpkins. The findings were consistent with those of Otieno *et al.* (2009) which found a significant increase in the percentage of vegetables sold by male household head. Cunningham *et al.* (2008) also established that male household heads tended to sell more output than female household heads. Male-headed households had more access to resources such as land and hence produced more output for the market. As found by Musah *et al.* (2014) gender was one of the socio-economic factors that determined intensity of market participation by smallholder farmers. Pumpkin marketing in the study area was dominated by women despite the fact that traditionally men have more control over production resources. This

could be attributed to men's attitude towards the crop which they considered as food for women and children. There are immense opportunities in the study area to commercialize pumpkin as a viable enterprise and hence empower women to enhance household food security and incomes.

5.4.2 Trader and market characteristics in pumpkin marketing

The results of this study showed that market price had significant and positive influence on pumpkin marketing by traders. This implied that an increase in market prices raised the quantities of pumpkins sold by traders. The research findings agreed with a previous study by Omiti *et al.* (2009) which established that farmers decisions on the amount of output to sell was significantly influenced by produce prices among other factors. Similarly, Sebatta *et al.* (2014) in a study of decision and level of participation in the potato market in Uganda established that market price influenced farmers' decision to participate in the market. High market prices serve as an incentive to sellers to supply more output to the market. High pumpkin prices could therefore trigger increased production and enhance commercialization of the crop.

This study as expected found that membership in marketing association had significant and positive influence on pumpkin marketing by traders. The results implied that membership in marketing associations would increase the pumpkin quantities sold by traders. Membership in marketing associations or groups enhances access to market information and networking by sellers which gives them an advantage of selling larger

quantities of agricultural produce. This agreed with a study by IFPRI (2005) which showed that producer marketing organizations were necessary for smallholder farmers to access and compete in markets. Similarly, Boughton *et al.* (2007) showed that membership in a marketing association was a channel of relevant information for increased returns to crop production and marketing. A study by Xaba & Masuku (2013b) established that membership in farmer organization determined the choice of market channels. Similarly, Mukiyama *et al.* (2014) found that group membership influenced farmers' choices of marketing channels. Fischer & Qaim (2012) found that marketing through a group yielded a higher price than selling individually. Group membership increased household income for farmers who marketed collectively due to advantages of output price and efficient information flows.

This research study as expected found that selling frequency had positive influence on pumpkin marketing by traders. The results implied that high selling frequency increased the pumpkin quantities sold by traders. This was consistent with a study by Page (2012) that showed that sales increased with more frequent markets which were necessary to accommodate the sale of high perishable products. Tadesse and Bahiigwa (2015) in a study in Ethiopia on marketing decisions found that perishable and bulky products such as vegetables were sold more frequently than storable commodities. The study also established that transaction cost determined the frequency of marketing of the products. Where transaction cost was low, products were sold at any time but where it was high marketers transacted less frequently. Frequent marketing of agricultural

commodities enables sellers to establish mutual links and relationships with consumers and other traders. Women were majority of traders in pumpkin marketing and hence markets in close proximity to the produce source would enable them to participate more frequently in the pumpkin trade, enhance their sales and incomes.

The findings of this study showed that distance to market had significant and positive influence on pumpkin marketing by traders. This implied that increase in the distance to the market increased pumpkin quantities sold by traders. This was consistent with Zamasiya *et al.* (2014) in a research study of soya bean in Zimbabwe that found that distance to market positively influenced smallholder farmers' market participation. However, the findings were contrary to other studies by Barrett (2007), Rios *et al.* (2008) and Omiti *et al.* (2009) that showed that farmers' orientation towards commercialization of an enterprise was less with increased distance to the market. Studies by Otieno *et al.* (2009) and Berhanu and Moti (2010) showed that distance reduced marketed vegetable volumes and participation in output markets. Traders in the study area possibly travelled longer distances due to linkages established with existing outlets and to reach new and better established markets especially in urban areas. This could also be due to higher prices fetched at the distant markets compared to low farm gate prices offered to farm households. The transactions costs involved in far away markets could be covered by higher pumpkin volumes traded and the price differentials at farm gate and urban markets. Policy interventions are therefore necessary to improve the infrastructure of markets nearer to farmers and make them more efficient.

Age of trader had positive influence on pumpkin marketing in Eastern Kenya. The results implied that an increase in trader's age increased the pumpkin quantities sold. Similarly, Iyiade (2013) in an economic analysis of indigenous and exotic vegetables in Nigeria revealed that marketers of indigenous vegetable were older people with long experience. Young people were not involved since they lacked access to capital for setting up business. Age is an indicator of experience in making transaction decisions and market participation. As Thompson *et al.* (2013) found key players in vegetable marketing were in their active productive age group which ensured sustainability. Similarly, Awobajo *et al* (2010) in a study of major food markets of nutritional and medicinal vegetables in Nigeria found that most of the market women were in the economically active and productive age group.

Selling experience had positive influence on pumpkin marketing among traders in Eastern Kenya. This implied that higher experience of traders increased pumpkin quantities sold. The findings were consistent with those of Sigei *et al.* (2013) in the study of determinants of market participation among small-scale pineapple farmers in Kericho, Kenya that found that marketing experience influenced the extent of market participation. Studies by Adenuga *et al.* (2013) and Emam (2011) on marketing efficiency established that well experienced traders participated in vegetable marketing. Marketing experience influenced the margin of net returns in marketing of produce as established by Onyemauwa (2010). Experience led to perfection in activities and manifested in increased knowledge of techniques involved in any enterprise as found by Agwu and

Ibeabuchi (2011). This was attributed to the contacts and networks experienced traders established through long periods of market participation. Pumpkin production and marketing was a major occupation particularly for women in the study area. Therefore promotion and commercialization of pumpkin would empower more women economically as producers and marketers.

5.5 Smallholder pumpkin production and marketing constraints

5.5.1 Pumpkin production constraints

The research findings showed that pests, diseases and insufficient rainfall were cited as the main constraints in pumpkin production in Eastern and Central Kenya. The findings concurred with a previous study by Abukutsa-Onyango (2007) which showed that production of indigenous vegetables was constrained by poor seed quality, pests and diseases, drought, lack of agronomic and utilization packages. Similarly, Ssekabembe *et al.* (2003) found that growing of local vegetables was limited by poor soil fertility and low soil moisture. This was corroborated by a study by Vorster *et al.* (2008) which found that poor weather conditions, low soil fertility and lack of seed systems restricted the availability of traditional leafy vegetables. Likewise, Eyzaguirre *et al.* (2006) attributed low production of traditional food crops to lack of agronomic information, lack of high yielding cultivars and undeveloped seed systems. As found by Odiaka *et al.* (2009) constraints in fluted pumpkin production were scarcity of quality seeds, lack of technical advice and weed infestation. Matenge, *et al.* (2012) revealed that production and

consumption of indigenous and traditional foods was diminishing due to socio-economic changes and preference for modern foods.

5.5.2 Pumpkin marketing constraints

The main constraints in pumpkin marketing were poor market prices, exploitation by brokers, post-harvest losses, inadequate market information, low consumer awareness, low demand and high transport costs. The findings agreed with those of Fakayode *et al.* (2012) that established that the main risks in fruit and vegetable marketing were produce perishability, low produce price, exploitation by middlemen and poor product handling. Likewise, Matsane and Oyekale (2014) found that the major constraints in vegetables marketing were lack of storage facilities, lack of market information, poorly developed village markets, poor producer prices, high produce perishability, inadequate access roads and high transportation costs. Aju *et al.* (2013) also established that the most important constraints in indigenous leafy vegetables marketing were storage problems, extortion by market agencies, declining availability of vegetables, low prices and low demands. A study by Kumburu *et al.* (2013) established that lack of knowledge, poor working environment, poor storage facilities and lack of capital were challenges in vegetable selling. These findings indicated that access to information and market related infrastructure played an important role in decision making and marketing of agricultural commodities. Policy interventions are therefore necessary to enhance access to physical markets and market information by smallholder farmers to improve pumpkin marketing and trade.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions based on the findings of this study and also gives recommendations for policy interventions. The recommendations are aimed at enhancing smallholder pumpkin production, consumption and marketing particularly in Eastern and Central Kenya regions. These could also be implemented in other pumpkin growing areas in the country. Further research is recommended on pumpkin value chain analysis.

6.2 Conclusion

Pumpkin remains a crop with unexploited potential in Eastern and Central Kenya regions despite its nutritional and medicinal values. Pumpkin production remains the domain of older farmers and women in the two study areas. Older persons are more experienced in farming and tend to diversify their production activities but they may not play a significant role in pumpkin commercialization. Women on the other hand played a significant role in the production and marketing of the crop. The pumpkin farming households comprised an average of 5 people which indicated there were increased food needs in the family. The households produced slightly more than a ton of pumpkins in very small portions of land and depended on production and marketing information from informal sources. Farm sizes were relatively small and slightly over half of the

households had title deeds for their land meaning land ownership was not a major problem.

It was established that age and education level of household head, household size, household on-farm income, engagement in off farm activities and farm area under pumpkins were statistically significant and had positive influence on pumpkin production among the smallholder farmers in Eastern and Central Kenya regions. However, membership in farmers group was significant only in Eastern Kenya region while engagement in off farm activities had negative influence on pumpkin production in Central Kenya region. The findings of this research were as expected and show that demographic and socio-economic factors have an influence on pumpkin production in Eastern and Central Kenya.

Pumpkin products particularly fruits and leaves were mainly used as food by majority of the households with limited uses for their medicinal values. Seeds were mainly used for planting with limited uses as medicine and food. However, pumpkins were not given importance in food production and consumption in Eastern and Central Kenya due to socio-cultural perceptions and negative attitudes towards the crop. Majority of the households regarded pumpkins as food for the poor or uncivilized, children, rural dwellers and women. Very few farmers related pumpkins to their medicinal values such as control of roundworms and treatment of snake bites. Pumpkins were not a priority for

majority of farmers in Eastern and Central Kenya as compared to other food crops such as maize and beans.

Smallholder farmers in Eastern and Central Kenya sold only 4% of the pumpkins produced from the small land portions allocated to pumpkin production and kept 96% for consumption by household members. This indicated that pumpkins were grown to meet household food needs and not for commercial purposes. This research established that household size and distance to market had significant but negative influence on pumpkin marketing by the farming households in Eastern and Central Kenya. In Central Kenya, market price and gender of household head had significant and positive influence on pumpkin marketing by the farming households. In Eastern Kenya, membership in farmers group was significant with positive influence on pumpkin marketing by the farming households. This was as expected and is evident that farm household characteristics have an influence on pumpkin marketing in Eastern and Central Kenya.

Traders involved in pumpkin marketing had attained post-primary education level and an average of 7 years experience in selling pumpkins. The traders sold small amounts of pumpkins mainly in urban markets that were on average 5.4 km from the sources of pumpkins. Pumpkins were mainly sold on daily basis, once or twice a week. Majority of the traders were women aged between 25 and 45 years. Very few of the traders had membership in marketing associations in their areas. They depended on both formal and informal sources for market information. The research established that market price,

membership in marketing association, selling frequency and distance to market had significant and positive influence on pumpkin marketing by traders in Eastern and Central Kenya. In Eastern Kenya, age of trader and selling experience had significant and positive influence on pumpkin marketing by traders. This supports the proposition that traders and market factors influenced pumpkin marketing in Eastern and Central Kenya.

Pumpkin production in Eastern and Central Kenya was generally low due to several constraints with pests, diseases and insufficient rainfall as the main ones. Other constraints included farmers' bias on maize and beans; pumpkin was not a major crop and takes a lot of space, negative attitude, lack of adequate land and damage by moles. A few of the households considered pumpkin as a traditional food crop, poor yields, flower abortion, traditional beliefs, modern civilization, inadequate knowledge on utilization and seed unavailability as production constraints. The main constraints in pumpkin marketing were poor market prices, exploitation by brokers, post-harvest losses, inadequate market information, low consumer awareness, low demand and high transport costs. Few of the traders also identified lack of organized markets, unavailability of pumpkins, poor storage facilities, high market charges, social cultural beliefs and seasonality of the crop as marketing constraints.

6.3 Recommendations

The findings of this research provide vital information for policy interventions to enhance pumpkin production, consumption and marketing in the study area and Kenya in general. The findings have also contributed to the limited body of knowledge on pumpkin production, consumption and marketing. Based on the findings of study the following recommendations are made.

The Ministry of Agriculture, Livestock and Fisheries at County level should undertake education of farmers to equip them with knowledge and skills to enhance pumpkin production and promote the crop as a viable enterprise. Education would be an important factor in enhancing farmers' understanding of the medicinal and nutritional benefits of pumpkins for increased production. Educating farmers would also change their eating habits and negative perceptions on pumpkins.

Policy makers in National and County governments should develop strategies and provide resources for promotion of pumpkin production by smallholder farmers. Expansion of pumpkin production would increase the volume of marketable produce and on-farm incomes to farm households to improve their nutrition, health and livelihoods. This would in turn enable them engage in off-farm activities to expand their income base and increase investments in pumpkin production. Increased pumpkin production would play an important role in the food and nutrition security of farm households.

Policy makers at National and County levels should develop and implement strategies to enhance access to physical markets and market information by smallholder farmers in order to improve pumpkin marketing. Women played a key role in pumpkin marketing and hence markets in close proximity to produce sources would enable them participate more frequently in pumpkin trade to enhance their sales and incomes. Well organized market channels would trigger increased volume of traded pumpkins leading to increased production and incomes to smallholder farmers.

Extension staff of the Ministry of Agriculture, Livestock and Fisheries at National and County levels should provide market information especially on market prices to smallholder farmers to improve pumpkin marketing. An effective market information system would enhance the pumpkin output marketed by smallholder farmers leading to increased household incomes. Extension staff should also organize the farmers into groups for ease of marketing their pumpkins. This would help farmers to aggregate and collectively sell their produce in specific market outlets. Well organized marketing groups would easily access market information and bargain for better produce prices for increased incomes.

Policy makers at national and county levels should facilitate improvement of market infrastructure in the pumpkin growing areas to make them more efficient. This would improve marketing channels, commercialize pumpkin production and improve trade. Extension and development agents at county level should organize pumpkin traders

into marketing associations or groups for increased networking, access and exchange of marketing information.

There is need for further research on value chain analysis including roles of key actors and constraints at various levels of the pumpkin value chain. This would go a long way in providing further information and knowledge for developing the pumpkin value chain. Pumpkin value chain analysis and development would help in commercializing and promoting the crop as a viable enterprise. This would also contribute further to the limited body of knowledge on pumpkin production, consumption and marketing.

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APPENDICES

Appendix 1: Questionnaire for household survey

The purpose is to collect household information on pumpkin production, consumption and marketing. The information provided will be used to make recommendations on research and policy interventions. It will be treated as confidential.

1. Site Description

Household No.	
Date	
Enumerator	
District	
Division	
Location	
Sub-Location	
Village	
Distance to the nearest market (Km)	

2. Household Description

Name of household head _____

Name of respondent _____

Relationship to household head (code) _____

0=Head, 1=Spouse, 2=Parent, 3=Child, 4=Grandchild, 5=Nephew/Niece,
6=Son/Daughter-in-law, 7=Wife, 8= Other (specify)

Type of household (code) _____

1=Male headed, 2=Female headed, 3=Child headed/male, 4= Child headed/female

3. Characteristics of household members

A “household” includes all members of a common decision making unit (usually within one residence) that are sharing income and other resources.

No	Name	Sex 1=M 2=F	Age in years	Relation to head (code)	Marital status (code)	Highest grade completed (code)
1.						
2.						
3.						
4.						
5.						
6.						

Relation to head	Marital status	Highest grade completed
0=Head 1=Spouse 2=Parent 3=Child 4=Grand child 5=Nephew/Niece 6=Son/Daughter-in-law 7=Wife 8=Other (specify)	1=Single, 2=Married 3=Widowed, 4=Separated 5=Divorced, 6=Other (specify)	0= No formal schooling and illiterate 1=No formal schooling but literate 2= Primary 3=Secondary, 4= College 5=University, 6= Still in school 7=Other (specify)

4. Engagement in off-farm activities

- a) Were you engaged in off-farm activities in the last 12 months? 1=Yes { } 2=No { }
- b) Off-farm activities were you engaged in? ____ 1= Self-employment, 2= Employment
- c) How frequent are you at home? 1=Permanently at home, 2=Frequently at home (every three months), 3=Mostly away (more than six months)

5. Membership in farmers' groups

- a) Are you a member of a group currently? 1=Yes { } 2=No { }

Name of Group	Primary activity (code)	Number of members in the group		Monthly membership fee (KES)	Major benefit received from this group (code)	Month and year you became a member
		M	F			
Primary activity of this group				Major benefit received from this group		
1=Production of agricultural produce, 2=Marketing of agricultural produce, 3=Group access to inputs and extension services, 4=Mobilizing saving and credit for group members, 5=Mutual support/Social services, 6=Other (specify)				1=Easier access to inputs, 2=Easier access to markets of products, 3=Easier access to extension services, 4=Easier access to credit, 5=Easier access to transport, 6=better input and output prices, 7=other (specify)		

b) If not, did you resign from a group? 1=Yes { } 2=No { }

c) Which month and year did you stop being a member? _____

d) Reason for resigning from the group _____ 1=No benefits, 2=Time consuming, 3=Group dissolved, 4=Failed to raise subscription fee, 5=Internal conflicts 6= Other (specify)

6. Land assets

Parcel ID	Parcel description /name	Size of parcel	Unit of land (code)	Tenure system (code)
1				
2				
Unit of Land		Tenure System		
1= acre, 2= ha, 3=sqm, 4= other (specify)		1= Title deed, 2= Owned but not titled, 3= Public land, 4= Rented-in/ share cropped, 5=Other (specify)		

- a) If parcel is owned, who owns? _____ 1= HH Head, 2= Spouse, 3= Head's parents, 4= Other (specify)
- b) If parcel is rented, how much do you pay per year? Kshs. _____

7. Enterprises in the farm

What would you rank as the top 5 crop enterprises in your farm according to?

- (i) Income generation and (ii) family food availability

Cash Crops	Acreage	Approx. Annual income	Food Crops	Acreage
1.			1.	
2.			2.	
3.			3.	
4.			4.	
5.			5.	

8. Crop production profile

- a) How long have you grown pumpkins? _____
- b) What is the acreage under pumpkins currently? _____
- c) What acreage was under pumpkins last season? _____
- d) Do you rent land for pumpkins growing? Yes _____ No _____
- i) If Yes, what area? (Acres) _____
- ii) What is the rental value KES? _____
- e) Do you intend to expand your pumpkin production? Yes _____ No _____
- i) If No, why? _____
- ii) If Yes by how much (Acres) _____

iii) Why _____

f) Have you had any training on pumpkin production? Yes ____ No ____

g) If Yes, from whom?

h) What aspects were you trained on? _____

9. Germplasm diversity and use

Pumpkins varieties/ types grown (give description)	Sources of seeds/ planting material (code)	Yield per variety (code)	Uses of various varieties (code)		
			Fruit	Leaves	Seeds
Colour e.g. green, yellow, Shape e.g. round, oval, etc. Ridged/not ridged Others (specify)	1=Own 2=Another farmer 3=Market 4=Others (specify)	1=High, 2=Medium 3= Low, 4=Very low	1=Food, 2=Medicine 3=Herb/spice 4=Processed products 5=Others(specify)		

10. Harvest and sale of pumpkins

a) Pumpkin products harvests

i) What product did you harvest? _____ 1= fruit, 2=leaves

ii) In your opinion what was the yield? _____ 1=average, 2=above average,
3=below average

iii) If the yield was below average, what was the reason? 1=rain shortage, 2=heavy
rain, 3=flood, 4=insect pests, 5=crop diseases, 6=other (specify)

iv) What amount of the total harvest was consumed? _____

v) What amount was sold? _____

vi) What was the selling price? _____

b) Largest pumpkin sales made

i) What was the unit price (Kshs)

ii) When did you sell? Month _____ Year _____

iii) To whom did you sell? _____ 1=trader, 2=retail shop 3=individual consumer
4=supermarket 5=institution (e.g. school), 6=other (specify)

iv) Where did you sell? _____ 1=farm gate, 2=nearby trading centre, 3=local
market, 4=other (specify)

11. Gender Issues

a) Activity profile

Who does the following activities?

Activities	Cost per activity	Percentage labour contribution					
		Male		Female		Children	
		Own	Hired	Own	Hired	Own	Hired
Land preparation							
Planting							
Manure application							
Fertilizer application							
Watering							
Weeding							
Harvesting							
Marketing							

b) Access and control profile

Who makes the following decisions on pumpkin?

Type of Decision	%Contribution to decision by household member category					
	Men		Women		Children	
	Access	Control	Access	Control	Access	Control
Crop for consumption						
Crop for sale						
Money/income from crop sales						

14. Sources of pumpkin production and marketing information

What are your current sources of information on pumpkin production and marketing?

- a) Production information _____
- b) Market information _____

1= Radio, 2=TV programmes, 3= Exhibition 4=Open days, 5= NGOs convening, 6=Govt. extension services, 7= Research Institutes, 8= News paper article/advertisement, 9=Cooperative/Group/Association, 10=Other farmers 11=Others (specify)

15. Social-cultural issues

List any social-cultural issues related to pumpkin production, consumption and marketing in the area.

1. _____
2. _____
3. _____
4. _____

16. Main constraints

Rank the main constraints in pumpkin production and marketing

Production	Marketing
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.

Appendix 2: Market survey questionnaire

The purpose of this survey is to collect information on status and constraints in pumpkin marketing. The information provided will be treated confidential and will be used research purposes and to recommend the necessary research and policy interventions.

1. Bio Data

Questionnaire Number

Date of interview

Name of enumerator

District

Location

Name of market

Name of respondent

Respondent's area of residence

Age of respondent (in years) []=Under 25, []=25-35, []=36-45, []=46-55

[]=above 55

Sex of respondent [] [1=Male, 2=Female]

Marital status of respondent []

[1=Single, 2=Married, 3= Widowed, 4=Separated, 5=Divorced, 6=Other (specify)]

Educational level of respondent []

[0=No formal schooling and illiterate, 1=No formal schooling but literate, 2=Primary,

3=Secondary, 4=College, 5=University, 6=Other (specify)]

2. (a) Do you normally trade on pumpkins? [] =Yes [] = No (tick)

(b) Do you grow pumpkins in your farm? [_____] =Yes [_____] = No (tick)

(c) If you sell when did you first start selling pumpkins? [_____] (Year)

(d) How often do you sell pumpkins in this market? [_____]

1=Daily 2=Twice a week 3=Once a week 4=Other (specify)

3. Where do you normally buy pumpkins (quantity/price/distance and frequency)?

Buy from	Quantity (kg)	Unit Price (Kshs/kg)	Distance travelled (Km)	Frequency
3.1 Farm				
3.2 Rural open-air markets				
3.3 Urban open-air markets				
3.4 Brokers				
3.5 Green grocers				
3.6 Others (specify)				
Frequency: 1=Daily 2=Weekly 3=Monthly 4=Yearly 5=Other (specify)				

4. To whom do you sell pumpkins (quantity/price/distance and frequency)?

Sell to	Quantity (kg)	Unit Price (Kshs/kg)	Distance travelled (Km)	Frequency
4.1 Local open-air markets				
4.2 Individual consumers				
4.3 Institution (e.g. school)				
4.4 Processor				
4.5 Brokers				
4.6 Green grocers				
4.7 Others (specify)				
Frequency: 1=Daily 2=Weekly 3=Monthly 4=Yearly 5=Other(specify)				

5. Rank in order of importance the qualities most preferred by buyers and state why?

Quality	Reason
1	
2	
3	

6. What mode of transport do you use in your trading business?

Mode of transport	Tick
7.1 On foot	
7.2 Bicycle	
7.3 Oxen/donkey drawn carts	
7.4 Public transport	
7.5 Private/Company car/truck	
7.6 Others (specify)	

7. How can you rate your pumpkin marketing infrastructure?

Type of infrastructure	Good	Average	Poor	Why
8.1 Storage structures				
8.2 Roads				
8.3 Market place				
8.4 Others (specify)				

8. Which are your market information sources? [_____] 1=Radio. 2=TV, 3=Newspapers, 4=Telephone, 5=Mobile Phone Service, 6=Others (specify)

9. Do you normally do any pumpkin quality improvements? [___] =Yes [___] =No (tick)

10. How? 1=Cleaning, 2=Grading, 3=Ripening, 4=Packaging, 5=Others (specify)

11. Which one of these marketing associations do you have in your area?

Association	Tick
11.1 Pumpkin growers and marketing association	
11.2 Pumpkin traders group/network	
11.3 Others (specify)	

12. Do you belong to any of the associations [____] = Yes [____] = No

13. If Yes, what benefits do you get?

.....

14. If No, why not?

.....

15. What are the major taxation/legislative matters (cess and by-laws) do you normally experience in pumpkin marketing?

.....

16. How do you finance your business?

Source of finance	Tick
16.1 Own resources	
16.2 Formal bank loan	
16.3 SACCO	
16.4 Farmer group/organization	
16.5 Merry-go-round	
16.6 Other (specify)	

17. (a) Do you ever have difficulties selling your pumpkins? [____] = Yes [____] = No

(b) If yes, explain

.....

(a) In the last 12 months, have you searched for new pumpkin buyers? [____] = Yes

[____] = No

(b) If yes, why? [____] [____] [____]

[1= Find a better price, 2= Find a single buyer of larger quantity, 3= Want more buyers

4= Find a more reliable buyer, 5= Buyers stopped buying, 6= Others (specify)]

18. Which are the preferred varieties in the market and why?

Variety	Reasons
1.	
2.	
3.	
4.	

19. What do you see as some of pumpkin marketing constraints? What should be done to overcome them?

Constraints	Likely solutions
1.	
2.	
3.	
4.	
5.	
6.	

Appendix 3: Mean differences of the sampled households characteristics

Variable	Mean		Mean difference	t	p> t
	Eastern	Central			
Pumpkin quantity produced (kg)	1384	657.5	726.5	-4.13	0.0000***
Education (years in school)	10.43	9.27	1.16	-2.18	0.0304**
Household head age (years)	56.53	53.18	3.35	0.67	0.5059
Household size (number)	6.00	4.00	2.00	-2.90	0.0041***
Household income (Kshs/pa)	47194.6	47382.4	-187.8	-1.13	0.2605
Farm size (hectares)	3.92	1.96	1.96	-3.53	0.0005***
Farm area under pumpkins (Ha)	0.35	0.17	0.18	-3.17	0.0015***
Marketed quantity (kg)	37.30	43.95	-6.65	-1.87	0.0629*
Distance to market (km)	2.84	3.91	-1.07	1.95	0.0528*
Market price (Kshs.)	16.60	12.50	4.10	0.32	0.7526
Productivity (kg ha^{-1})	9767.1	9553.1	214	-1.00	0.3203

***, ** and * represents significance at 1, 5 and 10% levels respectively.

Appendix 4: Validation test of household production variables in regression model

a) Breusch-Pagan/Cook-Weisberg Test for Heteroskedasticity

Ho: Constant variance

Variables: Household head age, gender, household size, education level, engagement in off-farm activities, farmers group membership, household income, pumpkin farm area and land tenure.

$$\text{Chi}^2(9) = 13.74$$

$$\text{Prob}>\text{Chi}^2 = 0.1854$$

b) Multicollinearity Test

Variable	VIF	1/VIF
Income	3.89	0.772006
Pumpkin farm area	3.79	0.772503
Household head age	1.27	0.785464
Household size	1.24	0.804010
Education level	1.17	0.852305
Gender	1.17	0.857890
Farmer group membership	1.16	0.862566
Land tenure	1.15	0.872279
Engagement in off-farm activities	1.13	0.885232
Mean VIF	1.77	0.829362

Appendix 5: Validation test of household marketing variables in Tobit model

a) Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: Household head age, gender, household size, distance to market, information source, farmer group membership and market price.

$$\text{Chi}^2 (7) = 10.56$$

$$\text{Prob}>\text{Chi}^2 = 0.2278$$

b) Multicollinearity test

Variable	VIF	1/VIF
Household size	1.17	0.857908
Household head age	1.16	0.864121
Farmer group membership	1.12	0.889584
Distance to market	1.09	0.915897
Information source	1.08	0.924206
Market price	1.06	0.943193
Gender	1.06	0.943291
Mean VIF	1.11	0.905457

Appendix 6: Validation test of traders and market variables in regression model

a) Breusch-Pagan/Cook-Weisberg Test for Heteroskedasticity

Ho: Constant variance

Variables: age, gender, education level, selling experience, selling frequency, market distance, market price, membership in marketing association, marketing information, market type

$$\text{Chi}^2(10) = 1.07$$

$$\text{Prob}>\text{Chi}^2 = 0.21$$

b) Multicollinearity Test

Variable	VIF	1/VIF
Market type	1.70	0.587898
Education level	1.51	0.664006
Membership in marketing association	1.42	0.704236
Age	1.36	0.736515
Marketing information	1.28	0.778823
Market price	1.25	0.799779
Selling frequency	1.21	0.827453
Selling experience	1.17	0.854747
Gender	1.17	0.856012
Market distance	1.07	0.938201
Mean VIF	1.31	0.774767