AN ASSESSMENT OF THE DEMAND FOR MEAT IN RURAL AND PERI-URBAN AREAS OF CENTRAL KENYA

MONI ALFRED NGULA

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DECLARATION

This thesis is my original work and has not been presented for the award of a degree in any other University.

Signature:..... Date:....

Moni Alfred Ngula

A56/60403/2011

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

Signature:....

Date:....

Dr. Jonathan M. Nzuma

Signature:....

Date:....

Dr. K. Munei

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DEDICATION

I dedicate this work to my father, mother and siblings for their encouragement and support during the thesis write up.

LIST OF ACRONYMS AND ABBREVIATIONS

AERC:	African Economic Research Consortium
AIDS:	Almost Ideal Demand System
ASALS:	Arid and Semi-Arid Lands
ASDS:	Agricultural Sector Development Strategy
CMAAE:	Collaborative Masters in Agricultural and Applied Economics
EPZA:	Export Processing Zones Authority
FAO:	Food and Agricultural Organization of the United Nations
GDP:	Gross Domestic Product
KEVEVAPI:	Kenya Veterinary Vaccines Production Institute
Kshs:	Kenya shillings
MT:	Metric Tonnes
NLP:	National Livestock Policy
USDA:	United States Department of Agriculture

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ABSTRACT

This study examines the consumption patterns of four meat types in rural and peri-urban Central Kenya. The study used cross-sectional data gathered from a household consumption survey of 447 households conducted between June and August 2012 in three towns of central Kenya namely Mwea, Njabini and Ol-kalou. The Almost Ideal Demand System (AIDS) model was employed to estimate the demand elasticities. All estimated own-price elasticities were negative to satisfy the law of demand. The cross-price Hicksian effects for the meats indicated that beef and chicken, beef and pork, shoats and chicken, as well as chicken and pork are gross-substitutes to one another. The expenditure elasticities were all positive implying that all the four meats are normal goods in the country. The expenditure elasticities characterized three of the meats (beef, shoats and pork) as luxury commodities in the country where as only chicken turned out to be a necessity. Moreover, socio-economic factors such as age of the household head, his/her education level, gender, household size and off-farm income were found to be important factors in explaining perceived variations in the consumption patterns of meat in the country. Moreover, the estimated demand system fulfilled all the demand regularity conditions. It could therefore be recommended that any mechanism that enhances the incomes of the rural Kenyan households, and reduces meat prices would be desirable since it will boost their relative purchasing power hence increased meat consumptions.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND INFORMATION

Livestock plays important roles among many Kenyan households in contributing towards household food and nutritional security. Animals provide a key source of proteins from meat, milk and eggs for human diets. The livestock sector also serves as a source of households' income, employment and foreign exchange earnings (Agricultural Sector Development Strategy, 2010). Most Kenyan communities traditionally kept livestock for subsistence, prestige, as a form of insurance against drought, provision of draught power, manure for crop production and as a means of transportation. The animals also served other social needs like paying the bridal price and traditional ceremonies (National Livestock Policy, 2008).

It is estimated that the livestock sector contributes over 12 percent of the country's gross domestic product (GDP) and 40 percent to the agricultural GDP and employs 50 percent of agricultural labour force (Kenya Veterinary Vaccines Production Institute, 2011). About 10 million Kenyans living in the Arid and Semi-Arid Lands (ASALs) also derive their livelihood largely from livestock rearing (FAO, 2005; KEVEVAPI, 2011). The key livestock species in the country are beef, dairy, sheep, goats, camel, poultry, pigs, fish and other emerging livestock (ASDS, 2010).

The main meat types consumed in the country are beef, pork, chicken, fish, mutton and chevron (goat meat). On average, the country produces 320,000 metric tonnes (MT) annually of beef meat worth Kshs 62.1 billion of which 70 percent is consumed locally while the rest is exported to Middle East and the European Union markets (NLP, 2008; ASDS, 2010). The annual mutton and chevron production is estimated at 84,000 MT worth Kshs 14 billion.

The sheep and goat industry contributes about 30 percent of the total red meat consumed in the country (NLP, 2008; ASDS, 2010).

On the other hand, the country's annual poultry meat production is about 20,000 MT worth Kshs 3.5 billion while the annual pork production is about 12,000 MT worth Kshs 1.2 billion (ASDS, 2010). These meats can be classified into two groups i.e. red meat which comprises beef, mutton, chevron and pork; and white meat comprising chicken and fish (USDA, 2009; EPZA, 2005). Red meat accounts for over 80 percent of all the meat consumed locally while white meat accounts for about 19 percent of the meat consumed locally (EPZA, 2005).

The contribution of meat exports to GDP is about one percent (USAID, 2012). Approximately 99 percent of the total meat production in the country is consumed in the domestic market where as only about one percent of the country's meat production is exported mainly to Tanzania, the United Arab Emirates and the EU markets by the Kenya Meat Commission (KMC) abattoir which is the only export-licensed facility for use by private meat exporters in the country (USAID, 2012). In 2010, several large new markets were opened or expanded like Qatar, Oman, Kuwait, Somalia and Egypt (USAID, 2012).

This study was carried out in Central Kenya because there was a need to capture a sizeable amount of consumptions of all the meat types whereby pork consumption is not common in many parts of the country. For example, in places like North Eastern and Coast provinces, there are only a few cases of pork consumption because a majority of the people there are Muslims who do not consume pork at all as per their religion. Therefore, Central Kenya being the major producer of pork in the country; it was presumed to have the highest amount of pork being consumed than in any other region in the country hence its choice in this study. According to 2009 census report, Central Kenya has a population of 1, 125, 905 cattle, 1, 195, 446 shoats, 5, 529, 623 chicken and 91, 977 pigs. The production patterns of these livestock are intensive to semi-intensive and are mainly market oriented (Valk, 2008). Over 80 percent of beef in Central Kenya comes from female culls from the small-scale dairy production system and sold to private butcheries (Staal *et al.*, 2001). Goats and sheep production in Central Kenya are done by small-holders with marketing and distribution of meat done by private entities (Valk, 2008).

In Central Kenya, chicken production has a significant economic importance to many farmers. According to Kanyi (2011), a high demand for chicken meat in the country's major urban areas has greatly fuelled the industry to thrive in Central Kenya. In the year 2011, chicken farmers in Central Kenya earned KES 4.1 billion (US\$47.3 million) from chicken meat sales (Kanyi, 2011).

Central Kenya is the dominant producer of pigs in the country which are mainly kept for commercial purposes (Gichuhi, 2012). Farmers' choice is the main buyer and processor of pigs in the country although there are other pork butcheries throughout the country. In terms of economic importance of pork in Central Kenya, farmers earns between Kshs 12,000-18,000 (150\$-225\$) from Farmers choice and other pork butcheries for one pig depending on its size and weight (Gichuhi, 2012).

All the four meat types are therefore of great economic importance to a majority of people in that region by uplifting their livelihoods through income generated from the meat proceeds. Apart from knowing the economic importance of the various meats in Central Kenya, it is also important to have a clear understanding of the demand structure and consumption patterns of the meats in that area hence the importance of this study.

Delgado *et al.*, (1999) argues that the demand for animal products in the country is expected to double by the year 2020 due to the current surge in human population and urbanization. Teklu (1996) pointed out that the growth of urban centers and urban population in the past decades has been tremendous and marked by a significant shift in food consumption patterns. In Kenya, the urban population grew at the rate of 6 percent per annum from independence in 1964 until 1980 (Kimuyu, 1993), surpassing economic growth, and by 2007 it accounted for over 22 percent of the total population (FAOSTAT, 2009). Between 2005 and 2010, the annual urban population growth rate in Kenya was estimated at four percent (UN, 2010).

Due to increases in population and urbanization, there is a possibility of meat deficit in the country in future unless appropriate measures are put in place. This deficit will further have a negative impact on the country's economy because it will lose foreign exchange earnings from meat exports to the global meat markets which accounts for over 12 percent of the country's gross domestic product (KEVEVAPI, 2011) and thus become importers of meat instead of being net meat exporters.

In devising appropriate measures however, policy makers need reliable empirical estimates of meat demand in the country from which to base their investment priorities so as to overcome any future meat deficits. In the Kenyan meat industry however, these demand estimates and information regarding the meat consumption patterns from which policy makers base their investment priorities are not well known. This is because of dearth of meat consumption studies in the country articulating these aspects. This has further translated into inadequate information to policy makers for appropriate policy formulation decisions. It has also contributed to the relegation of consumer issues and concerns in different parts of the country in the livestock policy arena (Juma *et al.*, 2008).

This study therefore will be of great importance to policy makers in the country by providing them with information on the meat consumption patterns, the magnitude and direction of response of meat to changes in prices, incomes and other household demographic characteristics in the country so as to make informed investment decisions in the livestock sector. These investment decisions will be geared towards matching production to consumption needs so as to avoid any future meat deficits which may compromise both consumer welfare issues and foreign exchange earnings from meat exports.

1.2 PROBLEM STATEMENT

In the recent past, the global meat demand has been growing due to increases in urbanization and population growth. As a result, both domestic and foreign meat demands are not likely to be met. In order to ensure satisfaction of all meat consumers, there is need for clear information and understanding of the meat consumption patterns and demand estimates in the country which will help policy makers to gain insights into appropriate policies to be formulated in the livestock sector. The information will also help policy makers in making informed future demand projections rather than relying on subjective projections.

However, these demand estimates and information on the meat consumption patterns in the country are not well understood. This in turn has resulted to unplanned meat production schedules thus huge losses during times of plenty and scarcity during times of high demand. These losses and scarcity are detrimental to the various stakeholders involved in the livestock sector particularly the meat producers, marketers and consumers.

The research problem addressed in this study is that of lack of reliable information on the consumption patterns of meat in the country. In addition, the magnitude and direction of response of meat to changes in prices, incomes and other household demographic characteristics are also not well known. Therefore, a need to undertake empirical studies in the country that addresses this problem is vital for the development of the livestock sector. This study will be of great interest to policy makers by providing them with reliable meat demand estimates and information from which they can base their policy formulation decisions for purposes of meeting meat producers', marketers' and consumer needs.

1.3 PURPOSE AND OBJECTIVES OF THE STUDY

The purpose of this study is to evaluate the consumption patterns of meat in rural and periurban areas of Central Kenya.

The specific objectives of this study are;

- I. To characterize the consumption patterns of four meat types among consumers with different demographic characteristics in rural and periurban areas of Kenya.
- II. To assess the responsiveness of Central Kenya meat consumers to price changes.

1.4 HYPOTHESES

The hypotheses tested were;

- I. That the consumption patterns of all meats are not the same for all households in Central Kenya.
- II. That the Central Kenya meat consumers are not responsive to price changes.

1.5 JUSTIFICATION OF THE STUDY

The livestock sector aids in the growth and development of the country's economy. For example, the sector contributes over 12 percent of the country's gross domestic product (GDP) and 40 percent to the agricultural GDP and employs 50 percent of agricultural labour force (KEVEVAPI, 2011).

In the year 1999, the country also exported some meat and meat products generating Kshs 30.3 million while in the year 2002, the country earned Kshs 77.4 million from meat exports. In 1999, the country also exported some bacon and other pork products which earned the country Kshs 27.6 million while in 2002, the pork exports earned the country Kshs 90.6 million (EPZA, 2005).

The study focused on demand because according to Delgado *et al* (1999), demand creates markets for animal products and encourages commercialization and development of the livestock sector. Meyer (2011) also points out that the estimates obtained in demand analysis are of great importance in policy formulation and projections. Hassan and Johnson (1976) also acknowledges that accurate estimates of demand parameters are important inputs for the development of national price, trade, storage, production and other policy formulations. The study area was chosen because it is the dominant producer of pork in the country unlike in other parts of the country where pork is hardly consumed.

Information from this analysis will be of interest to policy makers, meat producers, marketers and consumers by providing them with reliable policy variables that might help improve production, marketing and consumption of meat in the country.

CHAPTER TWO: LITERATURE REVIEW

2.1 THEORETICAL REVIEW

In analysing demand, the earliest empirical demand studies are characterized by extensive use of single equation specifications. The centre of these analyses has been the measurement of elasticities. However, the requirement that demand systems satisfy properties such as addingup was ignored by these single-equation models and perhaps unimportant because these early studies considered only a fraction of the total budget (Deaton and Muellbauer, 1980a). Moreover, the single equation models do not capture substitution effects across goods (Shaikh and Larson, 2003). These models are appropriate in studies focusing on individual commodities at a time but not numerous commodities at a go.

Due to the inefficiencies of the single equation models to analyse various commodities at a time, economists have shifted their consumer demand analyses to the more recent systems of demand equation models. These demand systems have the capability of categorizing goods as either gross substitutes or gross complements. The basic demand restrictions of adding up, homogeneity and symmetry are also easily imposed and tested in the case of demand system approaches. They include;

The Linear Expenditure System (LES) which was developed by Stone (1954) and is the only linear demand system in expenditure relative to price (Meyer, 2011). The linearity and the little number of independent parameters (commodities) make its application easy but also imposes some limiting constraints. For example, all goods are Hicksian substitutes, and cross-price derivatives are proportional to expenditure derivatives, and expenditure elasticities are always positive (no inferior goods). In addition, the Engel-flexibility is limited because of constant marginal budget shares.

The LES is most appropriate when a few number of commodities are considered and when one is not interested in differentiating between complements and substitutes among the commodities because all goods are treated as Hicksian substitutes. Moreover, LES can be used if the study is not intended to categorize commodities as either normal or inferior goods because all commodities are treated as normal goods.

There is also the Quadratic Expenditure System (QES) which is a generalization of the LES and was first introduced by Howe *et al.*, (1979). In its specification, the addition of the squared expenditure terms makes it more Engel-flexible compared to the LES. However the Engel-flexibility is still limited because of the linearity of marginal expenditure (Howe *et al.*, 1979). It is also difficult to estimate compared to the LES. It is appropriate to use the QES especially when dealing with three commodities because the additional squared expenditure terms makes it a three commodity demand system.

The AIDS model developed by Deaton and Muellbauer (1980) is another demand system and can be derived from a second order approximation of any cost function, implying that it has a flexible functional form. It has enough independent parameters such that all the elasticities can be identified. The Engel-flexibility is limited to linearity in logarithms. The AIDS model can be seen as the most recent major breakthrough in demand system analyses. Alston & Chalfant (1993) indicated that, in the comparatively short time since the AIDS model was introduced, it has been widely adopted by agricultural economists to the point that it now appears to be the most popular of all demand systems. In the year following this statement, Buse (1994) supported their statement by saying that the model of Deaton and Muellbauer had become the model of choice for many applied demand analysts. According to Deaton and Muellbauer (1980), the popularity of the AIDS can be ascribed to several reasons which makes it to be the model of choice of this study. These attributes among others include; the model is rooted in a well-structured analytical framework; it allows certain types of aggregation; it's easy to estimate and it permits empirical testing of the standard restrictions of the classical theory of demand (Deaton and Muellbauer, 1980). The model yield elasticities that are consistent with consumer theory and which are more flexible than those obtained from other commonly used demand systems (Anderson and Blundell, 1983).

In addition, the basic demand restrictions i.e. adding up, homogeneity and symmetry of the AIDS model can be expressed with simple parametric restrictions (Alston and Chalfant, 1993). The model has budget-share semi-log functional form that provides a theoretically consistent and flexible representation of consumer preferences. It is derived from a cost function and thus corresponds to a well defined preference structure which is convenient for welfare analysis (Chalfant, 1987).

The PIGLOG (Price-Independent Generalized Logarithmic) class of preferences have the property of consistent aggregation from micro to the market level and allows for nonlinear Engel curves. The functional form of the preferences is flexible in that it can be thought of as a local second order approximation to an unknown preference structure (Deaton and Muellbauer, 1980). Moreover, the model perfectly aggregate across consumers without invoking parallel linear Engel curves and is said to have a functional form which is consistent with well known household budget data (Deaton and Muellbauer 1980; Alston and Chalfant (1993); and Eales and Unnevehr (1994).

The Quadratic Almost Ideal Demand System (QUAIDS) is an extension of the AIDS and was first proposed by Banks *et al.*, (1997). It is consistent with consumer theory but needs an addition of a quadratic term to overcome the limitation of the flexibility in expenditure. Like the QES, it has the limitation of the Engel-flexibility due to the linearity of marginal expenditure. The model is said to be difficult to estimate due to the inclusion of the quadratic term. Due to the limitation of Engel-flexibility brought about by the linearity of marginal expenditure, and difficulties in its estimation process, the model is rarely used in demand analysis.

The Translog model as proposed by Christensen *et al.*, (1975) is derived by applying Roy's identity to a function that approximates the unknown indirect utility function by a quadratic form in the logarithms of the price to expenditure ratios. Its Engel-flexibility is limited to linearity in logarithms. The model has been criticized for mistakenly classifying goods as complements when they are actually substitutes, and it loses its flexibility when semi definiteness (curvature) is imposed (Diewert and Wales, 1987). The model is appropriate if the study is not intended to classify goods as either substitutes or complements for it treats all goods as complements. For this study, the model cannot be used because the study intended to classify the meat types as complements or substitutes.

The Rotterdam model developed by Barten, (1964) has been widely used in demand analysis, especially in the field of agricultural economics. However, the Rotterdam model has some limitations in that it imposes constant price and expenditure elasticities and it typically does not satisfy the theoretical restrictions when applied to data (Deaton and Muellbauer, 1980a).

The marginal expenditure shares and Slutsky terms are thus assumed constant. These constant budget shares pose a limitation in its applicability in demand analysis for it implies that price and income elasticities do not change as prices and income changes.

From the above review of different demand analysis approaches, many economists have shifted from the single approaches to demand system approaches due to the need of analysing numerous commodities at a time. The pros and cons of the numerous demand system approaches have been highlighted in the above discussion. In the discussion, the AIDS model was found to be the most commonly used approach for analysing demand in the field of agricultural economics. This is because it has numerous desirable properties like its flexible functional form, ease of estimation and interpretation of results, its ability to allow empirical testing of the standard restrictions of demand, among others hence its choice in this study.

2.2 EMPIRICAL REVIEW

Demand studies for various commodities have attracted the attention of a number of economists worldwide. Some of these studies among others include; Heien and pompelli (1988) in US, Abdulai *et al.*, (1999) in India, Karagiannis *et al.*, (2000) in Greece, Menezes *et al.*, (2002) in Bangladesh, Lazaridis (2003) in Greece, Taljaard *et al.*, (2004) in South Africa, Jabarin (2005) in Jordan, Juma *et al.*, (2010) and Musyoka *et al.*, (2010) in Kenya, Hannan *et al.*, (2010) in Bangladesh, Alboghdady (2010) in Egypt, Huq and Arshad (2010) in Bangladesh, and Bett *et al.*, (2012) in Kenya. What follows next is a review of these studies.

Heien and pompelli (1988) estimated the economic and demographic effects on the demand for steak, roast, and ground beef using USDA spring 1977 Household Food Consumption Survey (HFCS) data from 3,196 households across the nation. The authors employed a LA/AIDS model and the results indicated that the demand for steak and ground beef was inelastic but elastic for roast beef. The cross-price effects were significant, and all goods are substitutes. The impact of certain demographic effects, such as household size, region, tenancy, and ethnic origin, was quite significant. However, employment status, shopper, and occupation, were not significant.

The authors concluded that the results would serve to indicate several important factors which the beef industry can use as a basis for meeting the changing demand for beef in the market place. The study by Heien and pompelli (1988) only focused on beef demand unlike the current study which focused on various meat types.

However, it is similar to the current study in that it was based on cross-sectional data and also included demographic factors in the analysis.

Abdulai *et al.*, (1999) analysed household food demand in India using a household survey data collected in rural and urban areas of India. The authors employed the LA/IDS model and the results indicated that for commodity groups (milk and milk products; cereals and pulses; edible oils; meat, fish, and eggs; vegetables and fruits; other foods) demand was elastic only for milk and milk products in both rural and urban areas of India. In addition, all commodity groups were quite responsive to expenditure changes, with milk and milk products and meat, fish, and eggs showing the largest responses. Also food demand was quite responsive to price changes. Thus, as prices of the commodities increased, expenditure allocated to them was expected to decline.

The demographic variables like region, household size, and education which were significant were therefore termed important in explaining observed differences in food consumption patterns. Also, if food supply could be increased to maintain food prices constant, increases in consumer incomes may result in considerable improvements in food consumption. Policies aimed at increasing food supply without a simultaneous increase in incomes of nutrient-deficient consumer groups may entail large nutritional waste and are therefore ineffective. The study by Abdulai *et al.*, (1999 is similar to the current study in that it used cross-sectional data, included demographic variables and was aimed at classifying the various food commodities using elasticity estimates. However, it is different from the current study in that it aggregated all the food items.

Karagiannis *et al.*, (2000) estimated the demand for meat in Greece using data for 1953-1993 and employed an error corrected almost ideal demand system. The study found that beef and chicken may be considered as luxuries while mutton-lamb and pork as necessities. In the short-run, beef was found to have price-elastic demand, pork an almost unitary elasticity, whereas mutton-lamb, chicken and sausages had inelastic demands.

In the long-run, beef, and pork were found to have demand elasticity greater than one, whereas mutton-lamb, chicken, and sausages still had inelastic demands. All meat items were found to be substitutes to each other except chicken and mutton-lamb, and pork and chicken. The study by Karagiannis *et al.*, (2000) is similar to the current study in that it focused on meat demand and also computed the elasticity estimates but is different from the current study in that it used time series data.

Menezes *et al.*, (2002) estimated a quadratic expansion of the Almost Ideal Demand System (QUAIDS) on Bangladesh food consumption micro-data collected on 1995/96. The authors ran a system of equations for 39 food items and found negative price elasticities for cassava meal and milk powder, while figures for beans and sugar were close to zero. The authors then recommended for more investments to be devoted to both cassava and milk for they are necessity commodities in order to increase their production to match consumption needs. The study by Menezes *et al.*, (2002) used a different approach (QUAIDS) in the analysis process unlike the current study which uses AIDS and involved so many food commodities but with the same objective as the current study and use of cross-sectional data.

Lazaridis (2003) carried a household meat demand analysis in Greece using micro-data for 1987/88 and 1993/94 Family Budget Surveys (FBS). The author employed the LA/AIDS model to investigate the economics and demographic effects on the demand for four meat types (beef, lamb, pork and poultry). The results from both time periods indicated that beef and lamb had expenditure elasticities that approach unity. Pork had an expenditure elasticity that is clearly less than one while poultry had expenditure elasticity above unity. These findings suggested that as households' expenditure on meat increases, consumers would tend to spend proportionately less on pork and more on poultry. The shares of beef and lamb remain more or less the same.

The uncompensated own-price elasticities were all negative and less than 1 in both time periods. The elasticities of beef and poultry were more elastic ranging between -0.6 and-0.7 in both time periods while lamb and pork were less price-elastic in both time periods ranging from -0.1 to -0.3. The results indicated that a uniform decrease in prices would change the share of each item in the family basket in favour of beef and poultry. The compensated own-price elasticities are much smaller in magnitude making the role of prices less important.

The uncompensated cross-price elasticities showed more complementary relationships than was expected. However, these were gross elasticities and included the income effect for a given level of meat expenditure. The compensated cross price elasticities showed that only lamb and pork can be considered as complements. This study by Lazaridis (2003) is different from the current study in that it considered two time periods unlike one time period in the current study. However, it is similar to the current study study in that it focused on meat, used micro-data and included demographic variables in its analysis. Taljaard *et al.*, (2004) estimated the demand for four meat types in South Africa using time series data from 1970-2000. They employed the LA/AIDS model in order to know the demand relations among four meats for policy concerns. The calculated expenditure estimates showed that beef and mutton were classified as luxury products whilst pork was close to be considered a luxury product. On the other hand, chicken turned out to be the only product to be classified as a necessity in the budget share group.

The compensated and uncompensated own and cross price elasticity estimates were significantly lower (more inelastic) compared to previous estimates for meat in South Africa. They concluded that this was so because the estimates were for different time periods and the estimation technique used but compared well to estimates of other countries which used similar techniques in the same time periods. The study by Taljaard *et al.*, (2004) differs from the current study in that it used time series data and did not include demographic factors in the analysis but is similar to the current study in that both studies intends to know the demand relations among the meat types.

Jabarin (2005) estimated meat demand in Jordan using cross-sectional data collected by the Department of Statistics in Jordan as part of the household expenditure survey. The author employed the AIDS model and the results revealed that the demand for mutton and poultry is elastic while the demand for beef and fish is inelastic. The cross-price elasticities indicated that poultry and beef were substitutes to mutton. The expenditure elasticities confirmed that beef and mutton were luxury goods while poultry and fish were necessity goods.

The author recommended that researchers and model builders could use the estimated elasticities in that paper in model building or in short-term demand projections rather than using subjective estimates in other neighbouring countries. The estimated elasticities could also be used in the context of food security which is given high priority by the government of Jordan in terms of access, availability and stability. The study by Jabarin (2005) is similar to the current study in that it used cross-sectional data to estimate meat demand. However, it differs from the current study in that it did not include socio-economic factors in its analysis.

Juma *et al.*, (2010) studied the consumption and willingness to pay for indigenous small ruminants' meat in Marsabit district and used the single-bounded logit model. Results showed that 55 percent of households prefer and consume small ruminant meat to beef while the current price of the product, household income, household size and the consumer's perception of meat qualities were factors found to influence willingness to pay. The study by Juma *et al.*, (2010) though was about consumption; it included willingness to pay aspect and only focused on small ruminants using the single-bounded logit approach unlike the current study.

Musyoka *et al.*, (2010) assessed the structure and properties of urban household food demand in Nairobi, Kenya and its implications for urban food security. The authors employed the Almost Ideal Demand System (LA/AIDS using data obtained through a household survey in Nairobi in 2003 for a total of 40 food items which were aggregated into eleven food categories namely; sifted flour, posho, dairy and dairy products, vegetables, fruits, beef and beef products, maize, poultry, sugar, wheat and wheat products and rice. Musyoka *et al.*, (2010) found that all food categories were more responsive to their own prices than to cross prices and were price elastic except for posho. The expenditure elasticities revealed a normal behaviour for all the food categories and a shift from hard cereals (maize and maize products) to soft cereals (wheat and rice) and other foods. Thus, with an increase in income, there would be increased consumption of vegetables, dairy and beef related products. Household characteristics such as engagement in income generating activities, household size and level of household income showed some bias towards consumption of some food items. Dairy and dairy products and wheat and wheat products were identified as subsidy carriers which would improve the nutrition of the urban poor.

The authors recommended that food policy formulation aimed at improving food security of the urban households should focus on; increasing their income generating activities, food policy programs targeting several commodities as subsidy carriers for enhanced food access for the poor urban households, and integrating rural food production areas with urban markets which might augment the supply of farm output thus bringing the prices down. The study by Musyoka *et al.*, (2010) is different from this study in that if focused on a number of commodities which were aggregated together. However, it is similar to the current study in that it was based on demand analysis and included demographic factors for information provision to food policy formulators.

Hannan *et al.*, (2010) analyzed the household demand for dairy products in Bangladesh using micro-level cross section Household Income and Expenditure Survey (HIES-2000) data of 7440 households. The authors employed the LA/AIDS model and found that the budget shares were generally more responsive to per capita total expenditure than to prices.

Family size and occupation of the household head had a significant impact on household demand behaviour for dairy products.

The authors concluded by saying that food industry analysts can use this information in planning marketing program strategies and assessment of agricultural price intervention policies. The study by Hannan *et al.*, (2010) is different from the current study in that it only focused on dairy products and not meat but is similar to this study in that it included demographic variables in its demand analysis. More so, it is of help to the current study in information provision to policy makers for policy formulations on the selected meat types to realign production with consumption.

Alboghdady (2010) studied the demand for meat in Egypt using data for the period 1990-2005 and employed the LA/AIDS model. The author found that the Marshallian own-price elasticity was the highest for fish, followed by chicken, beef and duck. On the other hand, the cross-price elasticity of beef showed a complementary relationship with the other meat types, except for fish, which is substitutive. Chicken and fish showed a substitutive relationship with all meats except rabbit. Mutton and rabbit showed a versatile relationship with the other meat types. The highest substitutive relationship was between mutton and beef.

Compensated own-price elasticity estimates showed similar trends but smaller values than uncompensated ones, which is theoretically consistent. The calculated expenditure elasticities are positive except for mutton, which implies that meat of different types can be considered normal goods. The expenditure elasticities for chicken and fish show they are luxury goods. On the other hand, beef, duck and rabbit are necessary goods. The author concluded that increase in consumer incomes would increase consumption of the luxuries while production of the necessities to be increased. The study by Alboghdady (2010) is different from the current study in that it used time series data but is similar to the current study in knowing the relationships among the various meat types.

Huq and Arshad (2010) estimated demand elasticities for different food items in Bangladesh using secondary data extracted from the Household Expenditure Survey (HES) for the periods 2005/06, 1995/96, 1991/92, 1988/89 and 1983/84 in order to identify the magnitude of food demand for projection and planning purposes. Huq and Arshad (2010) employed the AIDS model with the corrected stone price index.

The authors found that the compensated and uncompensated own price elasticity of all food items (cereals, pulses, vegetables, fish, meat fruit and milk) were price inelastic except for edible oil and spices. The estimates of cross-price elasticity on the other hand showed that the substitution effects of price change were not quite strong. More so, there were no systematic differences in the absolute magnitudes of the expenditure elasticities and own price elasticities.

The authors therefore concluded that income and price policies were more effective in influencing the consumption patterns than those based solely on individual basis without taking into consideration other factors. The study by Huq and Arshad (2010) is different from the current study in that it used time-series data and analysed demand for different food items using the corrected stone index of the AIDS model.

The current study only focuses on meat using the AIDS model but also with the same aim of computing the demand elasticity estimates for meat in the country to know the magnitude and direction of meat to price changes used for projection and planning purposes.

Bett *et al.*, (2012) estimated the demand for meat in rural and urban areas of Kenya with a focus on the indigenous chicken using a cross sectional data collected in Western and Riftvalley regions. The authors employed the LA/AIDS model in their estimation process and found that the socio-demographic factors such as household location, the proportion of household members and the family size are important factors in explaining perceived variations in the consumption of meat products. Indigenous chicken meat, beef and mutton were identified as necessities where as exotic chicken, goat meat and other meats were identified as luxuries. Indigenous chicken meat and beef were identified as substitutes while indigenous chicken, goat and exotic chicken meats were complements.

The authors recommended that due to the high expenditure elasticities, considering a policy option that would enhance consumer income is desirable, since it will result in high consumption thereby providing more incentives for production of meat products. The authors also recommended that the information generated from their study would be more beneficial to the interest groups in the livestock sector as a whole in the formulation of effective policies in line with food security and poverty alleviation.

The study by Bett *et al.*, (2012) is similar to the current study in that it estimated the demand for Kenyan meats with the inclusion of socio-economic factors for information provision to policy formulations in the livestock sector. However, it is different from the current study in that it employed a different approach in estimation process; that is the LA/AIDS model.

The current study employs the AIDS model. There is also geographical differences of the study areas where by, the study by Bett *et al.*, (2012) was done in Western and Rift-valley regions where as the current study was based in Central region. More so, there is a difference in time periods of data collection which is a distinct feature of the two studies.

The study by Bett *et al.*, (2012) is also different from the current study in that it laid more emphasis on indigenous chicken unlike the current study which treats all the meat types equally with no emphasis on either of them. The study by Bett *et al.*, (2012) also disaggregated the chickens, mutton and goat meats, and also captured the aggregated other types (OT) of meat which included pork which is not the case to the current study.

From the above empirical review, the QUAIDS approach used by Menezes *et al.*, (2002) was initially said to have limitation of Engel-flexibility due to the linearity of marginal expenditures. On the other hand, the single-bounded Logit model employed by Juma *et al.*, (2010) cannot be employed in this study because it cannot capture substitution effects across the various meat types. In addition, with the use of the single-bounded Logit model, it is difficult to impose and test the basic demand restrictions; that is, homogeneity and symmetry.

A majority of the studies reviewed above have used the AIDS model developed by Deaton and Muellbauer (1980). The reason being that it has desirable properties which are well grounded and conforms to the consumer theory as discussed *a priori* in the theoretical review. These properties make the AIDS model to be adopted as the model of choice in this study. The choice is also supported by the fact that the other approaches used by some authors in the above review have been shown to have some weaknesses.

CHAPTER THREE: METHODOLOGY

3.1 THEORETICAL FRAMEWORK

The aim of any rational consumer is to make consumption decision based on maximizing utility from consuming certain goods and services while keeping the costs as minimal as possible. According to Barten (1977), consumers maximize utility subject to a budget constraint which is the limiting factor for consumers when making purchases. This maximization problem according to Barten (1977) can be specified as;

$$Max \ U = U(q_1, q_2, ..., q_n) \quad s.t \ m = \sum p_i q_i$$
(1)

where;

U is the utility function of the quantities of goods consumed by households; M is the total income; p is the price of goods bought; and q is the quantities of goods bought.

Solving the above maximization problem by setting up the Lagrangian multiplier gives a set of demand equations that express the quantity demanded for each good as a function of the price and total income given by;

$$q_i^* = f_i(m, p_i)$$

The above demand function based on utility maximization is referred to as Marshallian or uncompensated demand function which gives the optimal solution to the consumer's utility maximization problem subject to the budget constraint. The Hicksian/compensated demand functions tell us what consumption bundle achieves a target utility while maximizing total expenditure. In the recent past, numerous demand system models for computation of both compensated and uncompensated elasticities exist as earlier discussed. These demand systems and their functional forms are as follows;

The Linear Expenditure System (LES) which according to Stone (1954) is estimated with the formula given by;

$$p_{i}q_{i} = p_{i}a_{i} + b_{i}(m - \sum_{j=1}^{n} p_{j}a_{j})$$
(2)

where p_i , q_i and *m* are price, quantity and expenditure of the commodities respectively.

The underlying utility function makes the following assumption necessary; $q_i > a_i$. The model satisfies the homogeneity and symmetry properties automatically. However, for adding-up, it is necessary to implement these restrictions;

$$\sum_{i=1}^{n} b_i = 1, and \quad b_i > 0$$

The Quadratic Expenditure System (QES) according to Howe *et al.*, (1979) in budget share is given by;

$$w_{i} = \frac{p_{i}b_{i}}{m} + a_{i}\left(1 - \frac{\sum_{j=1}^{n}p_{j}b_{j}}{m}\right) + \left(\frac{p_{i}c_{i} - a_{i}\sum_{j=1}^{n}p_{j}c_{j}}{m}\right) \prod_{j=1}^{n} p_{j}^{-2a_{j}}(m - \sum_{j=1}^{n}p_{j}b_{j})^{2}$$
(3)

where *wi* is the budget share of the i^{th} commodity, ai,b_i and c_i are the commodities where as the other variables are as described above.

The homogeneity and symmetry properties of consumer demand are also automatically satisfied but for adding-up, it is necessary to impose the restriction given by;

$$\sum_{i=1}^{n} a_i = 1$$

The Almost Ideal Demand System (AIDS) model in budget share form according to Deaton and Muellbauer (1980) is given by:

$$w_i = \alpha_i + \sum_{j=1}^n r_{ij} \ln p_j + \beta_i \ln \left(\frac{x}{p}\right) + \varepsilon_i \tag{4}$$

where;

 w_i is the budget share associated with the i^{th} good; p_i and q_i is the price and quantity of good i; α_i is the intercept constant coefficient in the i^{th} budget share; γ_{ij} is the slope coefficient associated with the j^{th} good in the i^{th} share equation; p_j is the price of the j^{th} good, and X is the total expenditure.

The functional form of the AIDS model is flexible and consistent with well known household budget data (Deaton and Muellbauer 1980)

The Quadratic Almost Ideal Demand System (QUAIDS) according to Banks *et al.*, (1997) in budget share is given by;

$$w_{i} = \alpha_{i} + \sum_{j=1}^{n} \gamma_{ij} \ln p_{j} + \beta_{i} \ln \left[\frac{m}{a(\boldsymbol{p})}\right] + \frac{\lambda_{i}}{b(\boldsymbol{p})} \left\{ \ln \left[\frac{m}{a(\boldsymbol{p})}\right] \right\}^{2} + \varepsilon_{i}$$
(5)

where p is a vector of prices, a(p) is a function that is homogenous of degree one in prices, b(p) is a function that is homogeneous of degree zero in prices, and m is the total expenditure. The Translog model according to Christensen et al., (1975) in budget share is given by;

$$w_i = \frac{a_i + \sum_j b_{ij} \log\left(\frac{p_j}{m}\right)}{1 + \sum_k \sum_j b_{kj} \log\left(\frac{p_j}{m}\right)} \tag{6}$$

For adding-up, homogeneity and symmetry, it is necessary to impose the following restrictions in the estimation process;

$$\sum_i a_i = 1$$
 $\sum_i \sum_j b_{ij} = 0$ $b_{ij} = b_{ji}$

There is also the Rotterdam model which according to Barten (1964), its estimable absolute price version for n goods is written in the form;

$$\overline{w}_{it} \Delta \log q_{it} = a_i + \sum_{j=1}^n \gamma_{ij} \Delta \log p_{jt} + \beta_i \left(\Delta \log x_t - \sum_j \overline{w}_{jt-1} \Delta \log p_{jt} \right) + \varepsilon_{it}$$
(7)

where; \overline{w}_{it} is the average budget share weight between consecutive time periods *t* and *t*-1 for good *i*; Δ is the across-periods first difference operator; q_{it} denotes the quantity demanded on good *i* at time *t*; p_{jt} is the nominal price of good *j* at time *t*; x_t is the total expenditure on the *n* goods at time *t*; a_i , γ_{ij} and β_i are the parameters to be estimated, and ε_{it} is a zero mean normally distributed constant error term.

The adding-up, homogeneity and symmetry restrictions of demand theory are imposed as;

$$\sum_{j} \beta_{i} = 1, \quad \sum_{j} \gamma_{ij} = 0; \qquad \sum_{j} \gamma_{ij} = 0; \qquad \gamma_{ij} = \gamma_{ji}$$
The pros and cons of each of the above demand systems have been earlier highlighted in the theoretical review. Some of the fore mentioned limitations of the other approaches and the numerous desirable properties of the AIDS model in demand system analysis makes it the model of choice in this study. For example, in LES, all goods are Hicksian substitutes and cross-price derivatives are proportional to expenditure derivatives, and expenditure elasticities are always positive (no inferior goods). In QES, Engel-flexibility is limited because of the linearity of marginal expenditure. QUAIDS like QES has the limitation of Engel-flexibility due to the linearity of marginal expenditure and is said to be difficult to estimate due to the inclusion of the quadratic term.

The Translog model has been criticized for mistakenly classifying goods as complements when they are actually substitutes; while the Rotterdam model has limitations of imposing constant price and expenditure elasticities. Due to this, it does not satisfy the theoretical restrictions when applied to data hence the marginal expenditure shares and Slutsky terms are thus assumed constant. The AIDS model was found to be the most commonly used approach for analysing demand in the field of agricultural economics. This is because it has numerous desirable properties like its flexible functional form, ease of estimation and interpretation of results, its ability to allow empirical testing of the standard restrictions of demand, among others hence its choice in this study. In theory, consumers maximize utility but in practical terms, economists model them as though they minimize costs following a two-step budgeting procedure. The estimation of the AIDS model follows a two-step budgeting procedure which presumes that consumers allocate their total expenditures in two stages (Deaton and Muellbauer, 1980). In the first stage, total expenditure is allocated over broad groups of food and non-food items such as food, shelter, clothing and entertainment. However, allocation of expenditure on individual groups is determined by consumers' total income and group price indexes (Heien and Pompelli, 1989). In the second stage, the group expenditures are then allocated over individual commodities within each group depending on the prices of individual commodities and the expenditure allocated to that group in the first stage (Deaton and Muellbauer, 1980; Jung, 2000).

Deaton and Muellbauer, (1999) adds that in the first stage, allocation must be possible, given knowledge of total expenditure and appropriately defined group prices, while in the second stage, individual expenditures must be functions of group expenditure and prices within that group only. The AIDS model is compatible with the step-wise budgeting procedure as it perfectly aggregates across goods. The resulting demand equations of the AIDS model generate nonlinear Engel curves which allow precise aggregation across consumers unlike other models (Moschini, 1998). A necessary and sufficient condition for the second stage of the two-stage budgeting procedure is weak separability of the utility function over broad groups of goods (Jung, 2000). In the case of separability, Phlips, (1974) stated that, for a function to be separable, the marginal rate of substitution between any two variables belonging to the same group must be independent of the value of any variable in any other group.

Deaton and Muellbauer, (1980) adds that the prerequisite in the application of the two-step budgeting procedure of the AIDS model is weak separability among expenditures in the household. When food demand systems are empirically modelled, economists assume a priori weak separability of consumer preferences. This helps to overcome the problems caused by the numerous commodities that households consume, thus limiting the number of equations in the demand system that would otherwise pose estimation problems. Therefore, assuming weak separability, the demand system is modelled at the second stage of a two-step budgeting procedure based on consumer cost minimization problem.

3.2 EMPIRICAL MODEL

The derivation of the AIDS model which is used in this study starts from the Price-Independent Generalized Logarithmic (PIGLOG) class of preferences represented through the cost or expenditure function which defines the minimum expenditure necessary to obtain a certain level of utility at given prices. This permits exact aggregation across consumers as a representation of market demands as if they were decision outcomes by a rational representative consumer (Deaton and Muellbauer, 1980).

The AIDS model according to Deaton and Muellbauer, (1980) in budget shares of n-good system is given by;

$$w_i = \alpha_i + \sum_{j=1}^n r_{ij} \ln p_j + \beta_i \ln \left(\frac{x}{p}\right) + \varepsilon_i \tag{8}$$

Where;

 w_i is the budget share associated with i^{th} good given by; $w_i = \frac{p_i q_i}{X}$

 p_i and q_i is the price and quantity of good *i*.

 α_i is the intercept constant coefficient in the *i*th budget share equation which represents the estimated budget share of commodity when all logarithmic prices and real expenditures are zero and is interpreted as the subsistence consumption of commodity *i*.

 γ_{ij} is the slope coefficient associated with the j^{th} good in the i^{th} share equation

 p_j is the price of the j^{th} good

X is the total expenditure on the system of goods given by; $X = \sum_{i=1}^{n} p_i q_i$

P is the aggregate price index in the non linear AIDS model defined by;

$$\ln P = \alpha_0 + \sum_{i=1}^n \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \gamma_{ij} \ln p_i \ln p_j$$
(9)

The price index P makes demand estimation in empirical work difficulties. To overcome the difficulties, Deaton and Muellbauer (1980) therefore suggested the use of stone price index given by;

$$\ln p^* = \sum_{i=1}^{n} \overline{w}_i \ln p_i \tag{10}$$

Where

 \overline{w}_i represents the mean budget share of the i^{th} meat type.

Moschini (1995) pointed out that the use of the stone index has been shown to be inappropriate as it may make the estimated parameters inconsistent. He attributes this problem to the fact that the stone price index does not satisfy what Diewert (1987) calls the commensurability property in the sense that it is not invariant to changes in units of price measurement.

Several authors, including Green and Alston (1991); Pashardes (1993); Alston *et al*, (1994); Buse (1994); Hahn (1994); Asche and Wessels (1997), have discussed the relationship between estimating the AIDS model and the LA/AIDS model. In several of these studies, Monte Carlo studies showed that the results obtained from the AIDS and the LA/AIDS models compared reasonably well (Asche & Wessels, 1997). Alston *et al* (1994) for example said that demand analysts should consequently have a certain degree of confidence when estimating the elasticity estimates using the AIDS or LA/AIDS models. This study therefore uses the AIDS model for computing the elasticity estimates due to its desirable properties in demand analysis. According to Heien and pompelli (1988), the influence of demographic factors on meat demand is incorporated into the model by modifying the intercept in equation (8) through the translation method. Heien and Wessells (1990) points out that the translation method preserves the linearity of the model and is modified by;

$$\alpha_i = \rho_i + \sum_{j=1}^n \rho_{ij} d_j \tag{11}$$

where;

 d_j is the j^{th} demographic variable.

After substituting equation (11) into (8), the final equation is then given by;

$$w_i = \rho_i + \sum_{j=1}^n \rho_{ij} d_j + \sum_{j=1}^n r_{ij} \ln p_j + \beta_i \{ \ln X - \sum_{i=1}^n \overline{w}_i \ln p_i \} + \varepsilon_i$$
(12)

Since the study used cross-section data, some households were found not to have consumed some meat types during the survey period. This implies zero budget shares for those commodities. The decision to buy or not to buy a particular meat type can be represented by a binary indicator variable which is a function of the latent variables (Lee, 1978). To solve the problem of zero consumption, this required the use of the inverse Mill's ratios that avoids the violation of zero correlation between the model independent variables and the error term in the system of demand equations (Heien and Wessells, 1990).

The estimation procedure involves two steps. First, a probit regression is computed that determines the probability that a given household consumed the meat type in question. The assumptions underlying this model (and its proofs) are that the error terms from the model are approximately normal with zero means and constant variance over all observations (Lee, 1978).

Many choice models like probit falls under the normal distribution which is the most widely known and used of all distributions. Because the normal distribution approximates many natural phenomena so well, it has developed into a standard of reference for many probability problems (Krishnamoorthy and Kalimuthu, 2006). Under normal distribution, the mean of many random variables independently drawn from the same distribution is distributed approximately normally, irrespective of the form of the original distribution.

A random variable X with a normal distribution is said to be approximately normal with mean μ and variance σ^2 if it has the notation; X~ N(μ , σ^2) (Krishnamoorthy and Kalimuthu, 2006). On the other hand, a sequence or collection of random variables is said to be independent and identically distributed (iid) if each random variable has the same probability distribution as the others and are all mutually independent (Krishnamoorthy and Kalimuthu, 2006). However, in practical applications of statistical modelling, the assumption that observations be iid may or may not be realistic hence the extensive basis of probability problems on normal distribution.

The probit regression is then used to compute the inverse Mill's ratios for each household. The inverse Mill's ratios are then used as variables that incorporate the censoring latent variables in the second stage estimation of the demand relations (Heien and Wessells, 1990). In the first stage, Heien and Wessells (1990) points out that the decision to consume is modelled as a dichotomous choice problem given by;

 $Y_{ih} = f(P_{1h}, \dots, P_{nh}, X_h, d_{1h}, \dots, d_{jh}),$

where Y_{ih} is 1 if the h^{th} household consumes the i^{th} meat type, (i.e. if $w_{ih} > 0$) and 0 if the household does not consume the item in question. The other variables are as defined previously.

For the i^{th} meat type for the h^{th} household which consumes it, the inverse Mill's ratio is computed as;

$$R_{ih} = \frac{\emptyset(\boldsymbol{P}_h, \boldsymbol{d}_h, \boldsymbol{X}_h)}{\Phi(\boldsymbol{P}_h, \boldsymbol{d}_h, \boldsymbol{X}_h)}$$

where \mathbf{P}_h is a vector of prices for the h^{th} household, \mathbf{d}_h is a vector of demographic variables for the h^{th} household, and $\mathbf{0}$ and $\mathbf{\Phi}$ are the density and cumulative probability functions, respectively. For those households who did not consume the meat type in question, their inverse mills ratios were computed by;

$$R_{ih} = \frac{\emptyset(\boldsymbol{P}_h, \boldsymbol{d}_h, X_h)}{(1 - \Phi(\boldsymbol{P}_h, \boldsymbol{d}_h, X_h))}$$

The inverse Mills ratio for each meat type is then used as an instrumental variable in the second-stage regression. With the inclusion of this ratio, the model to be estimated is given by;

$$w_i = \rho_i + \sum_{j=1}^n \rho_{ij} d_j + \sum_{j=1}^n r_{ij} \ln p_j + \beta_i \{ \ln X - \sum_{i=1}^n \overline{w}_i \ln p_i \} + \omega_i R_{ih} + \varepsilon_i$$
(13)

 $\rho_i, \rho_{ij}, r_{ij}, \beta_i$ and ω_i are parameters to be estimated; R_{ih} is the included inverse Mill's ratio. The other variables are as defined previously. The basic demand restrictions homogeneity and symmetry according to Deaton and Muellbauer (1980) are directly imposed on the system as implied by consumer theory. The demand restrictions according to Deaton and Muellbauer (1980) are thus expressed in terms of the model's coefficients as follows;

Adding up is satisfied when;

$$\sum_{i=1}^{n} p_i = 1; \ \sum_{i=1}^{n} p_{ij} = 1; \ \sum_{i=1}^{n} \beta_i = 0; \ \sum_{i=1}^{n} \gamma_{ij} = 0$$

Homogeneity is satisfied *iff* for all *i*;

$$\sum_{j=1}^{n} \gamma_{ij} = 0$$

Symmetry is satisfied if

$$\gamma_{ij} = \gamma_{ji}$$

Only the adding-up property is affected by this model modification by replacing $\sum_{i=1}^{n} \alpha_i = 1$ with $\sum_{i=1}^{n} p_i = 1$; and $\sum_{i=1}^{n} p_{ij} = 0$.

With the simplification in equation (13), the model can then be estimated using iterative Zellner's (1962) seemingly unrelated regressions (SUR) model. Since the budget shares sum to unity in the system, one of the share equations (pork) was dropped to avoid the singularity problem. The reason for dropping the pork share equation is that it has the smallest budget share. However, whichever share equation is dropped, it does not affect the results. This is because the parameters associated with the dropped share equation are recovered through the parameter restrictions implied by adding up, homogeneity and symmetry.

After running the SUR model, elasticities can then be calculated. According to Chalfant (1987) formula of evaluating elasticities, the Marshallian price and income elasticities of good i with respect to good j are computed as;

$$\sum_{ij}^{M} = \frac{\gamma_{ij-\beta_i (w_j - \beta_j \ln (\frac{X}{P^*}) - \delta_{ij})}}{w_i}$$
(14)

where,

δ is the Kronecker delta and δij = 1 if i = j; and δij = 0 if $i \neq j$). *P** is the corrected stone index.

The income elasticities are given by;

$$\eta_i = \frac{\beta_i}{w_i} + 1 \tag{15}$$

Chalfant (1987) points that the Hicksian elasticities for good i with respect to good j can be derived from the Marshallian price elasticities by transforming it using the Slutsky equation as follows:

$$\varepsilon_{ij}^{H} = \varepsilon_{ij}^{M} + w_{j} \eta_{i} \tag{16}$$

where;

 ε_{ij}^{M} is the Marshallian elasticity of good *i* with respect to good *j*;

 ε_{ij}^{H} is the Hicksian elasticity of good *i* with respect to good *j*;

 w_j is the budget share on good *j*;

 η_i is the income elasticity of good *i*.

Alston *et al.*, (1994), simplified the computation of the Marshallian (uncompensated) and Hicksian (compensated) elasticities which this study uses and is given by;

- $\varepsilon_{ii} = -1 + \frac{\gamma_{ii}}{w_i} \beta_i \qquad \text{Marshallian own-price elasticities}$ $\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} \beta_i \left(\frac{w_j}{w_i}\right), i \neq j \qquad \text{Marshallian cross-price elasticities}$ $\ell_{ii} = -1 + \frac{\gamma_{ii}}{w_i} + w_i \qquad \text{Hicksian own-price elasticities}$
- $\ell_{ij} = \frac{\gamma_{ij}}{w_i} + w_j$, $i \neq j$ Hicksian cross-price elasticities

Heien and pompelli (1988) points out that the demographic variables, through their influences on the budget shares (the $w_{i's}$) affect the magnitude, but not the sign of these elasticities. For instance, the classification of goods as to luxuries or necessities is not affected by demographic variables. However, they do affect whether or not demand is elastic.

3.2.1 MODEL SPECIFICATION

The empirical model of this study is specified as;

$$\begin{split} \mathbf{w}_{i} &= \alpha_{i} + \gamma_{1}\ell nbeefprice + \gamma_{2}\ell nshoatsprice + \gamma_{3}\ell nchickenprice + \gamma_{4}\ell nporkprice + \\ \gamma_{5}\ell nmaizeprice + \gamma_{6}\ell nexpenditure + \gamma_{7}\ell noff farmincome + \gamma_{8}ageofhead + \\ \gamma_{9}genderof head + \gamma_{10}educationofhead + \gamma_{11}householdsize + \varepsilon_{i} \end{split}$$

where; w_i is the budget share of the $i^i h$ commodity, γ_{is} are the parameters to be estimated, and the other variables are commodity prices and demographic factors.

In the specification of the AIDS model, the budget share is the dependent variable while the commodity prices, expenditures and the demographic factors are the explanatory variables. A thorough discussion of the included variables is given below.

3.2.2 DESCRIPTION OF THE MODEL VARIABLES

Table 1 presents the variables included in the model, their description, how they are measured and their expected sign.

Table 3.1: Name and description of variables							
Variable	Description	Measurement	Expect				
			ed sign				
Wi	Budget share of the i^{th}						
	meat type						
Beef price	Price of beef	Average beef price (Kshs)/kg	-				
Pork price	Price of pork	Average pork price (Kshs)/kg	-				
Chicken price	Price of chicken	Average chicken price (Kshs)/kg	-				
Goat/Mutton price	Price of goat/mutton	Average shoats price(Kshs)/kg	-				
Maize price	Price of maize	Average maize price (Kshs)/kg	-				
Expenditure on meats	Amount spent on meats	Average expenditure (Kshs)	+				
Off-farm income	If head works off-farm	1=works off-farm; 0=otherwise	+				
age	Age of h/h head	Number of years	-				
education	Highest education level	Number of years of schooling	+				
gender	Gender of h/h head	Dummy; 1=male; 0=otherwise	±				
H/H size	Size of the h/h members	No. of h/h members	+				

Source: Author's Conceptualization

The budget share (w_i) is the dependent variable for the four meats and is the proportion of total expenditure allocated to each meat type by each household during the survey period. It is computed by multiplying the price of each meat type by its associated quantity and dividing the product by the total expenditure on all meats. The prices of the various meat types and maize were also included as they are determinants of demand. They indicate whether different commodities are substitutes or complements by computing price elasticities. Maize price was included in the model because maize is the key staple food in Central Kenya.

Expenditure by different households on the meats was included as a proxy of income. As household income increases, they are thought to increase their consumption quantities of the meats hence a positive sign expected. This is the same as with household head engaging in off-farm income generating activities. This is because a person who is employed is expected to have more disposable income which he/she can allocate to the consumption of high valued foods like meat. In line with economic theory, as income increases, expenditure on food also increases but not proportionally.

The household head is the main decision maker in the household in terms of money allocation to different tasks and makes decisions on consumption within the household. Gender of the household head is hypothesized to influence food demand in different ways depending on the level of income difference between male and female household heads. Several studies like those cited by Teklu (1996) have found that women headed households are likely to have a higher propensity for food expenditure than male headed households.

Education level of the household head is also hypothesized to have an influence on meat demand. People who are more educated are presumed to be consumers of high calibre foods like meat, fruits and vegetables. On a similar note, as household size expands, more and more food items are consumed due to differences in food tastes and preferences.

The age of the household head though not a determinant of demand is hypothesized to influence food demand negatively. As people ages, their demand for tough and coarse foods declines while that of soft foods like milk, rice and vegetables increases.

3.3. DATA NEEDS AND SOURCES

The data used in the study is derived from a cross-sectional survey of 451 households carried out in three towns of Central Kenya which were selected based on size namely; Njabini (small town), Ol-kalou (medium town) and Mwea (large town) between June and August 2012. Moreover, the towns were selected in such a way that they were a distance far away from each other to allow for substantial price variations in the quantities of meat consumed. Prior to the actual study, pretesting of the questionnaire was done at Engineer town in Central Kenya.

A three-stage sampling procedure was used to select the respondents. In the first stage, all the estates surrounding the three towns were identified with the help of the local authorities' maps. These estates were then taken as the primary sampling units. In the second stage, all the households living in those estates were identified and recorded. With a target of around 150 household in each town, the respondents from those estates were then selected systematically and interviewed in the third stage.

Quantities of each meat type consumed for the past one month and their associated expenditures were collected. The meat expenditures were then used to compute the ksh/kg for the meats. Household demographic factors (age, gender, household size, education level of the household head and his/her engagement in off-farm income) hypothesized to be influencing meat demand were also captured.

A total of 451 households in those towns were interviewed with the aid of a semi-structured questionnaire. However, four households were found not to have consumed any meat type and were dropped from analysis. A total of 447 households found to have consumed at least one meat type were thus used in this study for analysis.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

This chapter presents the results of the findings of the study.

4.1. DESCRIPTIVE RESULTS

Table 4.1 reports the household socio-economic characteristics. Although they are not determinants of demand, they do influence the consumption preferences of a particular household.

Variables	Minimum	Maximum	Mean
Age of household head	19	84	37.94
Education in yrs	0	18	10.18
Household size	1	13	3.62

Table 4.1: Household socio-economic variables

Source: Author's Calculations

The mean age of the household head was 40 years. The youngest household head was aged 19 years who was a male while the eldest was aged 84 years also a male. On the average, household heads had about 10 years of formal education (Table 4.1) which is equivalent to a secondary school education. The highest number of formal education years accomplished by the household heads were 18 years (which translates to university level) while some of the heads were found not to have attended any formal education. The mean household size was found to be around four members per household with the lowest having only one household member while the highest had 13 family members.

Variable		Frequencies (percentages)
Gender of household head	Male	77
	Female	23
Engagement in off-farm income	Yes	89
	No	11

Table 4.2: Frequencies of Household Head Gender and Engagement in off-farm income

Source: Author's Calculations

Out of the 447 households interviewed during the survey period, 77 percent were headed by males while 23 percent by females (Table 4.2). This shows that majority of the households were male headed. Furthermore, 89 percent of the household heads were engaged in off-farm income generating activities while only 11 percent did not engage in any off-farm businesses. This means that apart from relying on on-farm sources of income alone, majority of the households sought other off-farm income generating activities.

The above results present a general overview of the socio-economic factors of the households who were interviewed during the study period. These factors were then included in the demand estimation model for they were perceived to have had an influence on meat demand. Table 4.3 presents the mean kilograms (kgs) of meat consumed for one month, their associated prices per kg, budget shares and expenditures of the various households.

		mp none une onp		
Variable	Mean kgs	Price/kg (Kshs)	Mean expenditure	Budget shares
	consumed		(Kshs)	
Beef	2.4541	346.51	847.91	0.343522
Shoats	1.9624	400.17	754.34	0.2587796
Pork	1.0892	302.75	320.13	0.1429582
Chicken	1.8266	473.20	822.96	0.2547402

Table 4.3: Household meat consumptions and expenditures

Source: Author's Calculations

Beef has the highest mean consumption per kg which is about 2.5 kg, followed by shoats with about 2 kg, then chicken with about 1.8 kg and finally pork with about 1 kg. In terms of prices, chicken has the highest mean price per kg which is around Kshs 470 followed by shoats (goat & mutton) which is Kshs 400/kg, then beef Kshs 345/kg and finally pork about Kshs 300/kg. However, beef has the highest mean expenditure of Kshs 847.91 and budget share of 0.34352; while pork has the least mean expenditure of Kshs 320.13 and least budget share of 0.14296 (Table 4.3). The shoats have a mean expenditure of Kshs 754.34 and budget share of 0.25878 while chicken has a mean expenditure of Kshs 822.96 and budget share of 0.25474.

The higher budget share and expenditure allocation on beef by a majority of the people can be attributed to its availability in all the three towns where as; the low expenditure and budgetary allocations on pork can be attributed to its scantiness in some of the towns. The shoats and chicken were found to have almost the same budgetary allocations. All the budget shares add up to unity (Table 4.3) which conforms to the adding up condition of consumer theory. The meat consumption patterns shown above conform to the actual consumption patterns in the country where beef, for example is the commonly consumed meat type in the country while pork is the least. Also, chicken meat is the highly priced meat type of the four meats in the country while pork is the least priced meat type.

The results presented in Table 4.3 shows that different Kenyan households have different consumption patterns on all the meat types. This is shown by differences in budget shares, mean consumptions in kilograms and expenditure allocations on the meat types. An F-test ($F_{cal}=52.86$; $F_{crit}=2.61$) of mean meat consumptions indicates that the consumption patterns of the meats are statistically different hence we fail to reject the first hypothesis which states that the consumption patterns of all meats are not the same for all households in Central Kenya.

4.2 ECONOMETRIC RESULTS

Table 4.4 below gives the maximum likelihood coefficients of the AIDS model for the various household socio-economic profiles, inverse mill's ratio and goodness of fit as shown by R^2 .

Share	Age of	Gender	Educatio	Househo	Offarmin	IMR	\mathbf{R}^2	p-
	head		n	ld size	come			value
Beef	-0.0013	0.0009	0.0002	0.0018	0.0137	-0.2354 ^a	0.18	0.00
	(0.165)	(0.962)	(0.872)	(0.032) ^b	(0.135)	(0.000)		
Shoats	0.0004	0.045 ^b	0.0040 ^a	0.0019	0.0069 ^a	-0.0839 ^a	0.20	0.00
	(0.689)	(0.069)	(0.012)	(0.726)	(0.001)	(0.002)		
chicke	0.001 ^b	-0.045 ^b	0.0036 ^a	0.0139 ^a	0.0031	-0.0916 ^a	0.50	0.00
n	(0.048)	(0.024)	(0.017)	(0.002)	(0.910)	(0.000)		

 Table 4.4: Constrained ML coefficients of household socio-economic profiles

Figures in parenthesis are *p*-values. ^a, ^b, and ^c are significant at 1%, 5% and 10% respectively Source: Author's Calculations

All the three equations of the model are significant as portrayed by the *p*-values. Moreover, all inverse Mill's ratios for the three equations are significant at 1 percent level of significance (Table 4.4). This shows that overlooking the non-consumers of various meat types would have resulted in biased and inconsistent parameter estimates. The results of Table 4.4 indicate that age of the household head has a positive and significant influence on the consumption of chicken but insignificant on the other meat types. This connotes that the older the household head, the higher the budgetary allocation was devoted to chicken consumption. More so, although age of the household head had no significant influence on the other meat consumption patterns, aged household heads had a positive influence on shoats' consumption but a negative influence on beef consumption.

The gender of the household head had a positive and significant influence on shoats' consumption but a negative significance on chicken consumption. The results mean that male headed families devoted more budgetary allocations to shoats' consumption while female headed families spent more on chicken consumption. Also, due to positive influence of gender on beef, male headed households spent their budgets on beef consumption.

As expected, education of the household head, household size and engagement of heads in off-farm income generating activities positively influenced the consumption of all the meat types. Households led by people who are more educated are presumed to live a luxurious life and consume high valued foods like meat. An increase in household members led to an increase in budgetary allocations to all the meat types.

This information on increase of household members and budgetary allocations conform to results of De Silva *et al.*, (2010) who found a positive influence of the household size on the consumption of the meat and meat products in Sri Lanka. The number of children in the household was found to be the priority determinant influencing the preferences in consumption of meat and meat products. A household with a high number of people is more likely to have people with different tastes and preferences for various food commodities.

Engagement of household heads to off-farm activities had a positive influence on all the meat types signifying an increase in budgetary allocations and consumptions to the meats. This is because as the households' disposable incomes increase, they devote more of it in purchase and consumption of high priced foods.

The probable reason for this change in consumption patterns is that households who have salaried employment have greater certainty in their source of income. According to Musyoka *et al.*, (2010), engagement in business and in salaried employment creates income expectations and may lead to changing patterns of household food demand. In addition, it is assumed that in line with economic theory, as households' income increases, expenditure on food also increases but not proportionally (Musyoka *et al.*, 2010).

Table 4.5 presents the maximum likelihood parameter estimates of the various meat prices and expenditures.

Share	Beef	Shoats	Chicken	Pork	Expenditure(β_i)
Beef	0.162179 ^a	-0.11814 ^a	-0.07065 ^a	0.026619	0.0003381
	(0.000)	(0.000)	(0.000)	(0.545)	(0.985)
Shoats	-0.11814 ^a	0.124226 ^a	0.043556 ^a	-0.04964 ^c	0.0168804
	(0.000)	(0.000)	(0.005)	(0.085)	(0.344)
Chicken	-0.07065 ^a	0.043556 ^a	0.123419 ^a	0.002411	-0.0377335 ^a
	(0.000)	(0.005)	(0.000)	(0.870)	(0.007)
Pork	0.026619	-0.04964 ^c	0.002411	0.020608	0.020515
	(0.545)	(0.085)	(0.870)	-	-

Table 4.5: Constrained ML estimates of meat prices and expenditures

Test of the overall significance (x_{15}^2) = 214.65

Figures in parenthesis are *p*-values. ^a, ^b, and ^c are significant at 1%, 5% and 10% respectively Source: Author's Calculations

The price effects of the four meat types in Table 4.5 satisfy both the symmetry and homogeneity restrictions as implied by consumer theory. Out of the 16 constrained price estimates, 11 of them are significant which shows the reliability of the parameter estimates.

With regard to test of the overall significance of the parameter estimates indicated by x^2 , all the estimated meat price parameters are statistically significant. The calculated value of x^2_{15} is 214.65 and exceeds the critical value (x^2_{15} = 25) at the 5 percent level of significance (Table 4.5). This leads us to reject the second hypothesis which states that Central Kenya meat consumers are not responsive to price changes.

The expenditure coefficients (β_i) in Table 4.5 measure the change in the budget share of the i^{th} commodity with respect to a change in total expenditure and indicates whether a commodity is a necessity ($\beta_i < 0$) or a luxury ($\beta_i > 0$). Three of the meats (beef, shoats and pork) turned out to be luxuries while chicken turned out to be a necessity. The positive expenditure coefficients for the three meat types conforms to *Bennett's law* which states that as income rises, consumers reallocate their food budget away from low valued starchy food stuffs to higher-cost sources of vitamins and proteins such as fruits, vegetables and animal products (Tiffin and Tiffin, 1999). The results therefore imply that there is a likely increase in budgetary allocation and consumption of the meats as income increases.

Table 4.6 presents the theoretical demand restriction tests for homogeneity and symmetry using the wald test.

Table 4.6: Wald test for Homogeneity and Symmetry restrictions							
Parametric restriction	1 Calculated $x^2, 0.05$	Critical x^2 , 0.05	Degrees of freedom				
Homogeneity	0.0003	7.81	3				
Symmetry	0.0009	7.81	3				
	1	7.01	5				

The wald test results for homogeneity provided a chi-square statistic of 0.0003 which lies below the 5 percent critical value of the chi-square distribution with three degrees of freedom (7.81) hence we fail to reject the homogeneity restriction. The wald test for symmetry on the other hand has a chi-square statistic of 0.0009 which also lies below the 5 percent critical value of the chi-square distribution with three degrees of freedom (7.81) thus we also fail to reject the symmetry restriction.

The findings of Table 4.6 suggest that the empirical results are theoretically consistent with symmetry and homogeneity restrictions and thus are valid for this functional specification. They also show that the data conforms to the theoretical restrictions of demand. Therefore, the AIDS model was thus estimated with symmetry and homogeneity restrictions imposed. According to Attfield (1985), the acceptance of the homogeneity restriction can be interpreted as an acceptance of the exogeneity of expenditures. Thus, the model does not consider the consumption of other food products and changes in income are considered to be exogenous.

Table 4.7 reports the Marshallian elasticities of the various meat types.

Table 4.7: Marshallian (uncompensated) elasticities								
Shares	Beef price	Shoats price	Chicken price	Pork price				
Beef	-0.528230	-0.343920	-0.205676	0.077488				
Shoats	-0.456543	-0.536836	0.168314	-0.191820				
Chicken	-0.277358	0.170983	-0.477778	0.009465				
Pork	0.186201	-0.347220	0.016865	-0.876360				

All the uncompensated own-price elasticities possess the expected negative signs hence consistent with consumer theory. The negative own-price elasticities for the meats suggest that the corresponding demand curves are downward sloping, thus satisfying the law of demand. Pork has the highest own-price elasticity (-0.876) implying that the demand for pork is highly responsive to any changes in its own price compared to the other meat types.

Beef and pork, shoats and chicken, as well as chicken and pork turns out to be grosssubstitutes to one another. However, a better measure of the substitution effects between any two food categories is the Hicksian price elasticities as they measure only substitution effects devoid of income effects. This is discussed in Table 4.8 below. In all cases, the cross-price elasticities are found to be smaller than own-price elasticities in absolute terms. This means that the consumer demand for the commodities is generally more responsive to their ownprices than to cross-prices.

Table 4.8 below	y gives	the Hicksian	elasticities	of the	meat types.
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Table 4.0. Incestan (compensated) elasticities								
Shares	Beef price	Shoats price	Chicken price	Pork price				
Beef	-0.184370	-0.000398	0.137846	0.421010				
Shoats	-0.197764	-0.261176	0.427094	-0.066964				
Chicken	0.022618	0.425723	-0.260771	0.264205				
Pork	0.329159	-0.204262	0.159823	-0.712890				

 Table 4.8: Hicksian (compensated) elasticities

All the compensated own-price elasticities are also negative and smaller in magnitude than their uncompensated counterparts hence theoretically consistent. The own-price negativity condition also satisfies the concavity requirement of the underlying (true) cost function implying that the underlying Slutsky matrix also conforms to the negative semi-definite requirement. The cross-price Hicksian effects for the meats indicate that beef and chicken, beef and pork, shoats and chicken, as well as chicken and pork acts as gross-substitutes to one another. The change of sign from negative (uncompensated) to positive (compensated) crossprice elasticities for beef and chicken imply that the income effect for those meat types outweighs the substitution effect.

Beef and pork for example being considered as Hicksian-substitutes means that if the price of beef decreases by 1 percent, its demand increases for it has become cheaper where as the demand for pork decreases by 0.329. Similarly, if the price of pork decreases by 1 percent, its demand increases where as the demand for beef decreases by 0.421. On the other hand, for complements like beef and shoats, a 1 percent decline in price of beef results to 0.198 increase in demand for shoats, whereas a 1 percent decrease in price of shoats is associated with 0.0004 increase in demand for beef. The same explanation applies to all the other substitutes and complements.

The results of the own-price elasticities for the meats were compared with other studies from other countries and presented in Table 4.9 given below. Some of the studies include Lazaridis, (2003) in Greece for the period between 1987-1988; Taljaard *et al.*, (2004) in South Africa between 1970-2000; Jabarin, (2005) in Jordan; Bett *et al.*, (2012) in Kenya;

Alboghdady and Alashry (2010) in Egypt between 1990-2005, and Karagiannis *et al.*, (2000) in Greece between 1958-1993.

Table 4.7 Comparison of own-price elasticities of meat demands								
Study	Μ	Marshallian elasticities			Hicksian elasticities			
	Beef	Shoats	chicken	pork	Beef	Shoats	Chicken	pork
Lazaridis, (2003)	-0.804	-	-0.619	-0.133	-0.277	-	-0.393	-0.041
Taljaard <i>et al</i> .,	-0.750	-0.468	-0.35	-0.37	-0.161	-0.277	-0.193	-0.305
(2004)								
Jabarin, (2005)	-0.76	-3.06	-1.02	-	-0.55	-2.88	-0.41	-
Bett et al., (2012)	-0.663	-	-	-	-0.549	-	-	-
Alboghdady and	-0.420	-	-0.704	-	-0.131	-	-0.482	-
Alashry (2010)								
Karagiannis et	-1.76	-0.46	-0.72	-1.06	-1.24	-0.32	-0.55	-0.93
al., (2000)								
Current	-0.528	-0.537	-0.478	-0.876	-0.184	-0.261	-0.261	-0.713
study								
C A (1								

Table 4.9 Comparison of own-price elasticities of meat demands

Source: Author

The results in Table 4.9 shows that all own-price elasticities for both uncompensated and compensated in all the studies are negative thus satisfying the law of demand. A majority of the elasticity estimates of the studies compares well with those of the current study. This shows that the estimates of the current study can be used for making meaningful investment decisions in the livestock sector.

Table 5.1 presents the expenditure elasticities and marginal expenditure shares on the meats.

Table 5.1: Expenditure elasticities and Marginal expenditure shares								
	Beef	Shoats	Chicken	Pork				
Expenditure elasticity	1.000984	1.065231	0.851875	1.143503				
Marginal shares	0.343860	0.275660	0.217007	0.163473				

The expenditure elasticities for all meat types are positive i.e. greater than zero. This implies that they are all normal goods. The positive expenditure elasticities on all the meat categories connote that the demand for meats is responsive to the allocated income. Therefore, any increase in income will lead to higher consumptions. Three of the meat types (beef, shoats and pork) have expenditure elasticities greater than one, ranging from 1.00098 for beef to 1.14350 for pork, hence classified as luxury commodities in the country. Only chicken with expenditure elasticity of 0.85188 can be classified as a necessity in the country. This might be the case because chicken is reared by a majority of households in the country hence readily available for consumption.

The results compare well with study by Musyoka *et al.*, (2010) in the country who classified beef and beef products as luxuries with expenditure elasticity of 1.01; and Bett *et al.*, (2012) who classified indigenous chicken meat as a necessity with expenditure elasticity of 0.8537. However, the results are contrary to study by Bett *et al.*, (2012) who classified beef as a necessity in the country with expenditure elasticity of 0.8455.

The expenditure elasticities on the meats greater than unity imply that any future increase in income will result in more than proportionate increase in their consumption. This is because all the expenditure elasticity estimates for all meat types are positive. For instance, a 1 percent increase in the consumers' income would increase the demand for beef by 1.00098; shoats by 1.06523; chicken by 0.851875 and pork by 1.143503.

Table 5.0 above also gives the marginal expenditure shares; which is the product of the expenditure elasticity and the budget shares for each meat type. The results compares well to those of the budget shares of the meats whereby, beef has the highest marginal share of 0.3439 while pork has the least marginal share of 0.1634. The results implies that in case of any future increase in meat expenditures, beef will receive the highest allocation while pork the lowest.

CHAPTER FIVE: CONCLUSIONS AND POLICY RECOMMENDATIONS

From the results, beef was found to have the highest budget share of 0.3435 and was highly consumed by a majority of households in the study area. This means that it is the most preferred meat type in the in Central Kenya and in the country as a whole. Therefore, to counteract any future deficits of this meat type and ensure that both domestic and international beef demands are met without compromising consumer welfare, appropriate measures should be put in place to ensure that it is produced in large quantities. By so doing, domestic beef consumer demands will be guaranteed and also obtain surplus for exports.

With respect to high and positive expenditure elasticities ranging from 0.85 for chicken to 1.14 for pork, enhancing consumers' income would be appropriate since it will lead to increased meat consumptions. This move will be a big boost especially to the low income households who are unable to purchase the high valued commodities like meat. Additionally, the results of the marginal elasticities indicate that any future increase in the incomes of meat consumers will also lead to increased meat consumptions.

Chicken turned out to be a necessary commodity in the country with expenditure elasticity of 0.85. This means that it can play an important role in ensuring nutritional and food security for many Kenyan households. Therefore, it is recommended that chicken production should be promoted across the country. This would be a viable move because chicken requires a small space to rear with no competition for space with other livestock and crops hence a cost-effective enterprise to venture in.

In conclusion, in order to increase meat consumptions in the country, increasing people's incomes particularly the rural poor households, and reducing meat prices would be an effective strategy for it will uplift their relative purchasing power. This in turn will positively influence their meat consumption patterns hence improvement in their nutrition status. The foregoing discussion implies that the potential to increase domestic consumption of meat especially to the low income households exists but this can only be harnessed through affordable meat prices and higher household incomes. As the Government focuses on increasing livestock productivity, consumer concerns should similarly be given due consideration. Livestock development strategies must thus adjust to the ever changing consumer demands and confront any marketing inefficiencies that may prevent the transmission of productivity gains into consumer gains.

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