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Full Length Research Paper

An assessment of the demand for meat in Central Kenya

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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 significant thus 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.

Keywords: Meat demand, AIDS model, elasticities, Socio-economic factors, Central Kenya. Kindly include two additional keywords.

INTRODUCTION

Livestock plays important roles among many Kenyan households in contributing towards household food and nutritional security. Animals are also a key source of proteins from meat, milk and eggs for human diets; and serves as a source of households' income, employment and foreign exchange earnings (Agricultural Sector Development Strategy, 2010). 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). Information on these meat consumption patterns, the magnitude and direction of response of meat to price changes, incomes and other household demographic characteristics in the country is a key ingredient to policy makers in making informed investment decisions in the livestock sector. However, this information on the Kenyan livestock sector is not well understood thus necessitating the importance of more studies articulating these aspects in the country.

On average, the country produces 320,000 metric tonnes (MT) annually of beef meat worth Kshs 62.1 billion of which

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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; that is, 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). 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).

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. 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 the region. 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. However, apart from knowing the economic importance of the various meats in Central Kenya, it is also important for policy makers to have a clear understanding of the demand structure and consumption patterns of the meats in that region in which to base their policy formulation decisions. However, this information on the consumption patterns and the magnitude as well as direction of response of meat to changes in prices and incomes are not well known. 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. Therefore, this study will be a remedy to this problem by providing policy makers 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.

Theory and Analytical Model

In analyzing 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 adding-up 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 analyze 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. Among the systems approach models to demand analysis, the Almost Ideal Demand System (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 model 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 has the property of consistent aggregation from micro to the market level and allows for non-linear 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). The AIDS model which is used in this study according to Deaton and Muellbauer (1980) in budget shares of *n*-good system is given by;

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

where;

w_i is the budget share associated withthe 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, 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;

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

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

$$\ln p^* = \sum_{i=1}^{n} \overline{w}_i \ln p_i \quad (3)$$

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

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 (1) through the translation method. Heien and Wessells (1990) points out that the translation method preserves the linearity of the model and is modified by;

$$\alpha_i = \rho_i + \sum_{j=1}^{n} \rho_{ij} d_j \quad (4)$$

where; d_j is the j^{th} demographic variable.

After substituting equation (4) into (1), the final equation is then given by;

$$w_i = \rho_i + \sum_{j=1}^{n} \rho ij\, d_j + \sum_{j=1}^{n} r_{ij} \ln p_j + \beta_i\{lnX - \sum_{i=1}^{n} \overline{w}_i \ln p_i\} \quad (5)$$

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). 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).

The inverse Mill's ratio for each meat type is then used as a variable in the second-stage regression hence the model to be estimated is given by;

$$w_i = \rho_i + \sum_{j=1}^{n} \rho ij\, d_j + \sum_{j=1}^{n} r_{ij} \ln p_j + \beta_i \{ln X - \sum_{i=1}^{n} \overline{w}_i \ln \eta_i = \frac{\beta_i}{w_i} + 1 + \varepsilon_i \quad (6)$$

ρ_i, ρ_{ij}, r_{ij}, β_i and ω_i are parameters to be estimated; R_{ih} is the included inverse Mill's ratio.

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 (6), 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, Alston *et al.,* (1994) developed a formula of computing the Marshallian (uncompensated) and Hicksian (compensated) price elasticities; and income elasticities of good *i* with respect to good *j* as;

$\varepsilon_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i$ Marshallian own-price elasticities

$\varepsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \left(\frac{w_j}{w_i}\right), i \neq j$ Marshallian cross-price elasticities

$\ell_{ii} = -1 + \frac{\gamma_{ii}}{w_i} + w_i$ Hicksian own-price elasticities

$\ell_{ij} = \frac{\gamma_{ij}}{w_i} + w_j, i \neq j$ Hicksian cross-price elasticities

$\eta_i = \frac{\beta_i}{w_i} + 1 + \varepsilon_i$ Income elasticities

Data

The data used in the study is derived from a cross-sectional survey of 451 households carried out in three towns of Central Kenya namely; Njabini, Ol-kalou and Mwea towns between June and August 2012. 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 Kshs/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.

RESULTS AND DISCUSSIONS

Descriptive Results

Table 1 presents the mean kilograms (kgs) of meat consumed for one month, their associated prices per kg,

Table 1. Household meat consumptions and expenditures.

Variable	Mean kgs consumed	Price/kg (Kshs)	Mean expenditure (Kshs)	Budget shares
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

Source: Author's Calculations.

budget shares and expenditures of the various households.

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 one 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 1). 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 1) 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.

Econometric Results

Table 2 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.

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 2). This shows that overlooking the non-consumers of various meat types would have resulted in biased and inconsistent parameter estimates. The results of Table 2 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 which 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

Table 2. Constrained ML coefficients of household socio-economic profiles.

Share	Age of head	Gender	Education	Household size	Offarminc ome	IMR	R^2	p-value
Beef	-0.0013 (0.165)	0.0009 (0.962)	0.0002 (0.872)	0.0018 (0.032) [b]	0.0137 (0.135)	-0.2354 [a] (0.000)	0.18	0.00
Shoats	0.0004 (0.689)	0.045 [b] (0.069)	0.0040 [a] (0.012)	0.0019 (0.726)	0.0069 [a] (0.001)	-0.0839 [a] (0.002)	0.20	0.00
chicken	0.001 [b] (0.048)	-0.045 [b] (0.024)	0.0036 [a] (0.017)	0.0139 [a] (0.002)	0.0031 (0.910)	-0.0916 [a] (0.000)	0.50	0.00

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

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

The price effects of the four meat types in Table 3 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. The expenditure coefficients (β_i) in Table 3 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 presents the theoretical demand restriction tests for homogeneity and symmetry using the wald test.
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 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 5 reports the Marshallian elasticities of the various meat types.

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 gross-substitutes 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 later in Table 6 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 own-prices than to cross-prices.

Table 3. Constrained ML estimates of 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)	-	-

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

Table 4. Wald test for Homogeneity and Symmetry restrictions.

Parametric restriction	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

Source: Author's Calculations.

Table 5. 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**

Source: Author's Calculations.

Table 6 below gives the Hicksian elasticities of the meat types.

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) cross-price 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.

Table 7 presents the expenditure elasticities of the four meats.

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

Table 6. Hicksian (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**

Source: Author's Calculations.

Table 7. Expenditure elasticities.

	Beef	Shoats	Chicken	Pork
Expenditure elasticity	1.000984	1.065231	0.851875	1.143503

Source: Author's Calculations.

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.

Since all the expenditure elasticity estimates for all the meat types are positive, any future increase in income will result in increased meat consumptions. 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.

CONCLUSIONS AND RECOMMENDATION

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 considera-

tion.

Livestock development initiatives 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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