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Analysis of household food demand patterns in Laikipia County, Kenya

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ABSTRACT

In Kenya, arid and semi-arid lands (ASALs), comprise some 80% of the country and are characterized by high rates of food insecurity, natural resources degradation and unsustainable land management practices. This has led to a significant disruption of bio-diversity resulting in adverse impact on traditional food sources, income and other basic needs of many rural households, thereby leaving many households depending on the markets as their main source of food. Therefore, careful examination of food demand trends among the rural households serves as a precursor to effective planning, monitoring and evaluation of interventions as well as targeting assistance effectively. Guided by neoclassical theory of consumer demand, of a negative relationship between the quantities demanded and product's price, the study employed Linear Approximate Almost Ideal Demand System (LA/AIAIDS) model, applying Iterative Seemingly Unrelated Regression Procedure (ITSUR) to study food demand in Laikipia County, Kenya. The results indicate that food commodities are price inelastic; Maize, beans, meat and milk are necessities while fruits and vegetables and other foods (which include wheat products, rice, potatoes, sweet potatoes, millet and sorghum) are luxuries. The results suggests that income rather than price oriented policies will be more significant in addressing food insecurity. Secondly, food price regimes that support both supply and demand sides need to be applied for food security to be achieved; and lastly, the impact of demographic variables such as household size, education level of household head, gender and occupation should be considered in policy formulation.

Key words: Expenditure, food demand, households, land management practices

RÉSUMÉ

Au Kenya, les terres arides et semi-arides (TASA), représentent 80% des ressources en terre du pays et sont caractérisées par des taux élevés d'insécurité alimentaire, la dégradation des ressources naturelles et des pratiques non durables de gestion des terres. Cela a conduit à une importante perturbation de la diversité biologique induisant un impact négatif sur les sources traditionnelles d'aliments, les revenus et d'autres besoins fondamentaux de nombreux ménages ruraux, entraînant ainsi la dépendance de nombreux ménages vis-à-vis des marchés comme principale source d'aliments. Par conséquent, un examen attentif des tendances de la demande alimentaire des ménages ruraux sert de précurseur à une planification efficace, le suivi et l'évaluation des interventions ainsi que le ciblage de l'aide de façon efficace. Guidé par la théorie néoclassique de la demande des consommateurs, qui décrit une relation négative entre les quantités demandées et le prix du produit, l'étude utilise le Modèle d'Approximation Linéaire du Système de Demande Presque Idéale, l'application de la procédure de régression itérative sans corrélation apparente pour étudier la demande alimentaire dans l'arrondissement de Laikipia, au Kenya. Les résultats indiquent que les produits alimentaires sont inélastiques vis-à-vis du prix; le maïs, le haricot, la viande et le lait sont des nécessités tandis que les fruits et légumes et autres aliments (qui comprennent les produits du blé, du riz, les pommes de terre, patates douces, le mil et le sorgho) sont un luxe. Les résultats suggèrent que les politiques orientées sur le revenu seront plus importantes dans la lutte contre l'insécurité alimentaire que celles orientées sur le prix. Deuxièmement, les régimes de prix des denrées alimentaires qui prennent en compte aussi bien l'offre que la demande doivent être appliquées pour atteindre la sécurité alimentaire; et

enfin, l'impact des variables démographiques telles que la taille du ménage, le niveau d'éducation du chef de ménage, le sexe et la profession doivent être pris en compte dans la formulation des politiques.

Mots clés: Dépenses, demande alimentaire, les ménages, les pratiques de gestion des terres

INTRODUCTION

Despite the high agricultural potential, Kenya has continued to experience decades of food insecurity especially in Arid and Semi-Arid Lands (ASALs) areas, where it is quite prevalent, with sporadic cases of acute food insecurity leading to malnutrition and deaths (Sulo, 2005). The current food policy in Kenya only aims at food production and availability at national levels with very little tangible measures to translate to adequate household food security especially in high-risk areas (Sulo, 2005). Evidence shows that solving the food security issue from the production (supply side) point of view, which overlooks the demand side, does not solve the food security problem particularly the access of vulnerable groups to enough food (Kang'ethe, 2004). According to MAFAP (2013) report, 46% of the population in Kenya lives below the poverty line and 47% are food insecure (GoK, 2007). A particular reason for concern about the food demand pattern on poor households arises from the fact that the poorest people spend roughly three quarters of the incomes on staple foods (Babu and Sanyal, 2009). Therefore, knowing how these households respond to changes in income and food prices can help policy makers assess food needs and predict potential shifts in demand for different food products, an important aspect for the Stakeholders involved in the agricultural sector.

One notable factor that contributes to the problem is insufficient information on food demand, which leads to food security interventions approaches that are inapt. Knowledge on food demand patterns of a particular region or country is useful for policy formulation in addressing major policy issues related to food security (Ananda *et al.*, 2003). The purpose of this paper is to provide estimates of own-price, cross-price and expenditure elasticities and estimates of the effects of socio-economic and demographic characteristics for rural Laikipia County in Kenya using recent survey data, to bridge the information gap on food demand trends in the County.

Laikipia is one of the Kenyan districts that has persistently faced the problem of food insecurity expressed by the peoples inability to access enough food. The district has continued to rely on relief food from the government and other organizations almost every year (GoK, 2001). Households rely on markets which accounts for about 70% of the food requirement compared to own food production (GoK, 2000). Similarly, the share of food budget in the household

total expenditure is about 80% compared to non-food expenditure (GoK, 2000). Despite widespread concern about the impacts of food prices and income on food demand of poor households, limited information is available on actual impacts on poor people in Laikipia County. Only with careful examination of food demand behavior at the household level is it possible to tell whether or not demand for food is sensitive to economic conditions.

The specific objectives of this study were to

- a) examine the effect of household's income and food prices on household food demand,
- b) identify the impact of income changes on household food demand patterns, and
- c) investigate the influence of household characteristics on food demand decisions.

The following hypothesis were explored;

- a) H_0^1 : Household food Income and food prices have no significant effect on household food demand,
- b) H_0^2 : Varying household income levels have no significant influence on future household food demand pattern, and
- c) H_0^3 : There is no significant relationship between household characteristics and household food consumption behaviour.

MODEL SPECIFICATION

The Neoclassical theory of consumer demand holds that a negative relationship exists between the quantity demanded for a particular product and the product's price. The theory assumes that consumer demand is derived from constrained utility maximization. The basic axiom of the utility maximization process is that a rational consumer will always choose a most preferred bundle of goods from the feasible set of consumption bundles allowed by his budget. Consistent with this theory, the study employed Linear Approximation Almost Ideal Demand System (LA/AIDS) model as developed by Deaton and Muellbuer (1980a, 1980b). This model is popular for empirical studies since it is a flexible concept of demand system and useful for estimation with desirable properties.

The equation was analyzed using the AIDS model that takes the following budget share form;

$$W_i = \alpha_i + \sum_k \gamma_{ik} \ln P_k + \beta_i \ln (x/p) + \mu_i \dots \dots \dots (1)$$

Where:

W_i - The budget share of good i ; P_k - Price of good k ; β_i - Expenditure coefficients; γ_{ik} - Price coefficients; x - Total expenditure; μ_i - Random disturbance assumed with zero mean and constant Variance; $\ln p$ - Translog price index defined by:

$$\ln p = \alpha_i + \sum_k \alpha_k \ln P_k + 0.5 \sum_k \sum_i \gamma_{ik} \frac{P_k}{P_i} \ln \frac{P_k}{P_i} \dots \dots \dots (2)$$

The influence of the demographic variables in household, on food demand patterns were analyzed using the Translating method proposed by Pollack and Wales (1981). The intercept of eq 1. (α_i) was modified by the translating method as:

$$\alpha_i = p_{i0} + \sum_{k=1}^s p_{ik} d_k \dots \dots \dots (3)$$

$i = 1, \dots, n$

Where:

d_k is demographic variables and p_{i0} and p_{ik} are estimated parameters. Therefore after incorporating eq.3 to eq. 1, the resulting equation was:

$$W_i = p_{i0} + \sum_{k=1}^s p_{ik} d_k + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln (x/p) + \mu_i \dots \dots \dots (4)$$

To avoid difficulties caused by the non-linearity of parameters (price index in eq 1), the Stone index was used to linearize the AIDS model to LA/AIDS (Linear Approximate Almost Ideal Demand System) model (Moschini, 1995). The Stone index p^* is defined as

$$\ln p^* = \sum_i W_i \ln P_j \dots \dots \dots (5)$$

Substituting equation 5 into eq.4 the Linear Approximate Almost Ideal Demand System (LA/AIDS) results as follows:

$$W_i = p_{i0} + \sum_{k=1}^s p_{ik} d_k + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln (x/p^*) + \mu_i \dots \dots \dots (6)$$

The uncompensated own (Mashallian elasticity) price elasticities, $e_{ii}^{LA/AIDS}$ were calculated using the formula as follows:

$$e_{ii}^{LA/AIDS} = - \delta_{ij} + \frac{\gamma_{ij}}{W_i} + \frac{\beta_i}{W_i} \dots \dots \dots (7)$$

δ_{ij} refers to Kronecker delta that is unity if $i = j$

The compensated cross price elasticity

$$e_{ii}^{LA/AIDS} = \frac{\gamma_{ij}}{W_i} + W_j \dots \dots \dots (8)$$

Expenditure (income) elasticity, e_i were calculated from the coefficient using the following expression:

$$e_i = 1 + \frac{\beta_i}{W_i} \dots \dots \dots (9)$$

$$\sum \gamma_{ij} = 0 \text{ (Homogeneity)}$$

$$\gamma_{ij} = \gamma_{ji} \text{ (symmetry)}$$

$$\sum_i \alpha_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0 \text{ (Adding up restriction)}$$

The above equation (Eq. 6) was applied to each of the five food groups. In estimating demand systems, one faces the difficulty of missing prices. This study adopted the approach proposed by Cox and Wohlgenant (1986) whereby the cluster price (in this case the division) of the food item is substituted for the missing price. This means that non-consuming households or those with no price for food are assumed to face average prices for that division.

RESULTS AND DISCUSSION

Table 1 presents the estimated regression coefficients of the major food commodities in Laikipia County. The explanatory power of the independent variables as measured by R-squared is reasonably strong especially for meat and milk where the equation explains 60% of the variation. For other commodities the equations explain between 35 and 61%. Out of the total 60 coefficients, 31 coefficients (52%) are statistically significant at 95% level. All price coefficients are significant at 95% level. The expenditure coefficients are statistically significant in 3 of the 5 equations.

The test statistic of the log likelihood for the food demand system is 38.67, which is greater than the critical value of 14.02 at 95% significance level and 6 degrees of freedom. Based on this result, the null hypothesis of no household characteristics effects on food consumption is rejected at 95% level, thus demonstrating the importance of these factors in influencing food demand for households in Laikipia County. Similar results were observed by Agbola (2003) in South Africa thus signifying the importance of household characteristics in explaining food demand. From Table 1, it is observed that own price coefficients for all food commodities are positive and significant. This suggests that any price increase associated with

Table 1: Parameter estimates of extended LA/ AIDS for food demand in Laikipia County

Budget share	Price of maize	Price of beans	Price of fruits and vegetable	Price of meat and milk	Price of other foods	Food expenditure	Household size	Age of the household head	Sex of the household head (female)	Education level of the household head	Off-farm employment	Constant	R-squared
Maize	0.0892* (4.40)	-0.0161 (-1.65)	-0.0545* (-2.59)	-0.0022 (-0.25)	-0.0071 (-0.70)	-0.0123 (-1.06)	0.0241	0.0012*	0.0614*	-0.0550	0.0261	0.1383	0.3892
Beans	0.0207 (1.33)	*0.0652 (8.37)	-0.0021 (-0.12)	-0.0141* (-2.01)	0.0103 (1.27)	-0.0026 (-0.28)	0.0203*	0.0006	0.0132	0.0020	-0.0312	0.0102	0.5673
Vegetables and fruits	-0.0578* (-3.84)	-0.0359* (-4.69)	0.0809* (5.85)	-0.0073 (-1.26)	- 0.0179* (-2.78)	0.0155* (2.02)	0.0028	0.0001	0.031	0.0478*	0.0194*	0.2119*	0.6110
Meat and milk	-0.0135 (-0.65)	-0.0118 (-1.39)	0.0042 (1.28)	0.0624* (10.66)	0.0037 (-1.01)	-0.0173* (-2.37)	0.0056	-0.0004	- 0.0533*	0.1533*	0.0022	0.1477*	0.6038
Other foods	-0.0365 (-1.69)	0.0167 (-0.52)	-0.0228 (0.9)	-0.0457* (-3.81)	0.0259* (2.00)	0.0099* (3.66)	-0.0528*	-0.0013*	0.0364*	0.4318*	0.0243*	0.4919*	0.3584

Source: Estimates from field survey data 2007. *significant at 0.05%. Values in parenthesis are t-values. Other foods Include wheat products, rice, potatoes, sweet potatoes millet and sorghum

these commodities will lead to an increase in their respective budget shares though in some cases the increase is marginal. Comparable findings were reported from a study in India (Abdulai *et al.*, 1999) that food demand is quite responsive to the changes in own prices.

Since the budget share (not the quantity consumed) is the dependent variable, a positive and statistically significant expenditure coefficient means that the budget share increases with increase in income, suggesting that the expenditure elasticity would be greater than one and so the commodity is a luxury good. This is the case for fruits and vegetables and other food group, which include wheat flour, rice, potatoes, millet and sorghum. Categorizing fruits and vegetables as luxuries for Laikipia households is in conformity with a study done in Tanzania (Ananda *et al.*, 2003), but contrary to that from South Africa (Agbola, 2003) which presents them as necessities. These varied observations can be attributed to the differences in household income levels. However, relatively cheap millet and sorghum may have low budget shares and thus overshadowed by wheat flour, rice and potatoes which are normally high priced. This may also indicate the shifting from the traditional food commodities such as millet and sorghum in the diets.

From Table 1, it is observed that the expenditure coefficient for maize, beans, and meat and milk are negative implying that these commodities are necessities. Given that if expenditure coefficient is less than zero, budget share decreases when total expenditure increases (Ananda *et al.*, 2003). Notable observation is for meat and milk, which despite being associated with high income population in Kenya, appears to be a necessity to Laikipia communities. This is because majority of households in Laikipia depend on Agro pastoral and pastoral activities for their livelihoods.

The effect of selected household characteristics on food demand is also presented in Table 1. The coefficients on household size suggest positive relationship with budget share of maize and beans. Their budget shares increases by 0.0272 and 0.0238 respectively every time there is an additional member in a household. But a negative relationship is observed for other foods which shows that budget share declines by 0.0528 every time there is an additional member. These results are similar to those of Abdulai (2004), who obtained positive and significant coefficients for cereals and pulses but negative for meat, fruits and vegetables as well as milk and milk products. Family size however, had no statistically significant effect on fruits and vegetables and meat and milk but the relationship was positive. This observation means that

for a household to feed additional members from a limited budget, food expenditure need to be adjusted downwards focusing on cheaper food commodities such as maize and beans, away from expensive ones like those in other food group, which include wheat products and rice. In food demand studies in Sub-Saharan Africa, Teklu (1996), reported that an increase in household size induces a re-allocation of food budget away from the food groups that are income-elastic towards income inelastic food staples. Therefore in the case of Laikipia County, as household size increases subsistence requirements increases too, which leads to an increase in the consumption of maize and beans since they are staples. The negative relationship between household size and other foods could be attributed to their high prices which is not sustainable in an expanding household size. The age of household head shows positive relationship with budget share of maize and negative to other foods. This means that the older generation tends to rely more on staple commodities for household food security. The older generation though less educated and with limited sources of income have their tastes and preferences on staple foods developed over time. These factors may influence choice of necessities rather than the luxuries. Other studies have also found a positive relationship between age of the household head and demand for staple foods (Agbola, 2003; Quang, 2008). In addition; maize in Laikipia is easily accessible compared to other foods for food security. Education exhibits positive relationship with demand for meat and milk, fruits and vegetables and other foods. Similar observation was made by Abdulai (1999) in household food demand analysis in India, where educated household heads appeared to influence the consumption of relatively expensive commodities. This is probably due to the fact that the more educated household heads are more likely to secure employment outside the farm, which enhances household income. As a result these household can afford the luxury food groups. Besides, more educated household heads may have the ability to use technology to enhance food production especially fruits and vegetables using Micro Irrigation.

Female headed households may be considered a case where women have full decisions making authority (Marie *et al.*, 2004). From the results, female headed households had a negative effect on budget shares of meat and milk and positive impact on maize and other food groups. This may be due to the fact that female-headed households usually have lower incomes. However, positive relationship to other foods may reflect women's responsibility in preparation of foods and their attention to dietary diversity requirements of their households. Women are generally responsible for selecting food purchased to complement staple foods and to balance their households' diet (World Bank,

2009). Another study in Africa by Teklu (1996) reported that income controlled by women has a higher likelihood of improving the food intake of individuals in the households than income controlled by men. This is supported by the positive correlation of beans, fruits and vegetables budget shares with female headed households despite the fact that they are not significant. Furthermore, households headed by women have been shown to provide more nutritional food for their households than those headed by men (Kennedy and Peters, 1992).

Households where the head is employed outside the farm, have positive correlation to the demand of fruits and vegetables and other foods. This could be attributed to higher purchasing power and possibility that these household heads are also educated. The results are consistent with the findings by Chang (2008) who reported that households where the head works off-farm are positively correlated with food expenditures.

Effect of Income on food demand

The expenditure elasticity for the various food categories are presented in Table 2. Expenditure (income) elasticity for all food groups are positive, implying that these food commodities are normal goods and an increase in income will lead to higher consumption. These results are similar to those of other studies from other countries and regions. For instance, Abdulai *et al.* (2004) in a cross-sectional household food demand study in Tanzania observed positive expenditure elasticity in six food groups. In other African countries, studies reveal that the level of food expenditure increases with income (Tesfaye, 2002). Similar work done in Rwanda, reported that as income increases households purchase more expensive calories confirming that ‘quality’ calories are positively related to income increases (Braun *et al.*, 1991).

From Table 2 income elasticities for fruits and vegetables and other foods are greater than unity hence these commodities are luxuries. However, it should be noted that food group indicated as luxury/necessity good is regarded as luxury/necessity commodity

according to total food expenditure and not according to total household expenditures. This implies that an increase in income will have more than proportional increase in the expenditure share for their demand. For example, other foods with expenditure elasticity of 1.1 imply that a 10% rise in food expenditure will lead to a 11% increase in other foods expenditure share.

It is not unusual to group fruits and vegetables as luxuries for a low income region which is mostly semi arid and relies on neighboring Counties for fresh fruits and vegetables supplies. This is more so for fruits which are less consumed as compared to vegetables (Marie *et al.*, 2004). These results are consistent with other studies done in Tanzania (Ananda *et al.*, 2003). The study by Marie (2004) reported that demand for fruits and vegetables increases with higher incomes. Laikipia County is characterized by low income levels hence tend to focus on more affordable commodities for their food requirements.

Income elasticity for maize, beans and meat and milk are positive but less than one. This implies that their demand is inelastic and an increase in income will lead to a proportionate decrease in budget shares of each of these food commodities and that they are necessities. Expenditure elasticities of staple foods are positive and less than one, but decrease with an increase in income level (Teklu, 1996). Therefore as income level increases African consumers shift from starchy staples to processed cereal products.

In order to understand how income changes influence household expenditures on food, marginal expenditure shares were derived following the approach proposed by Powel (1974). The marginal expenditure share is estimated as the product of the expenditure elasticity and the budget share for each food category. The results are shown in Table 2. They show that for an increase in future incomes, households would allocate more proportionately their incomes on other foods, fruits and vegetables, and less proportionately on maize, beans, meat and milk.

Table 2: Effect of income on food demand

Food item	Food share	Income coefficient	T - test	Income elasticity	Marginal income share
Maize	0.2603	-0.0123	-0.3	0.9527	0.248
Beans	0.2213	-0.0026	-0.51	0.9882	0.2187
Vegetables and fruits	0.1618	0.0152	2.02	1.0939	0.177
Meat and milk	0.2017	-0.0173	-3.13	0.9142	0.1844
Other foods	0.1549	0.017	2.18	1.1098	0.1719

Source: Estimates from field survey 2007; *significant at 0.05%

Table 3: Effect of prices (own-price) on food demand

Food item	Price coefficient	T-test	Own-price elasticity
Maize	0.0892	4.40	-0.6101
Beans	0.0652	8.37	-0.6936
Vegetables and fruits	0.0813	5.85	-0.5915
Meat and milk	0.0624	10.66	-0.6049
Other foods	0.0259	2.00	-0.8229

Source: Estimates from field survey 2007; *significant at 0.05%

Effect of prices on food demand

Prices being another determinant of food demand affect both the volume and the structure of household food consumption. For instance when there is reduced purchasing power resulting from price increases, households will reduce their food demand and also switch from consumption of expensive to cheaper food commodities which may compromise the quality of food. Besides, price is a major indicator of both supply and demand in food markets. Large increases in food prices negatively affect the ability of consumers to meet their food requirement, especially within less privileged groups. Ivanic and Martin (2008) in their study on implication of higher global food prices for poverty in low income countries observed that poverty levels increase mainly due to negative impact of higher prices of staple foods. At the household level, prices determine how much money is used to meet food requirements. The estimated uncompensated own price elasticities are presented in Table 3. The results show that all food items have own price elasticities that are significantly different from zero at the 95 percent level and carry the expected negative sign. Consistent with demand theory, there exist an inverse relationship between changes in own-price elasticities and quantities demanded. From the study, demand for these commodities will decrease by between 5.9% and 10% for every 10% price increase.

All food commodities under investigation have inelastic demand. This implies that price increases proportionately more than the quantity demanded decreases, a characteristic for goods regarded as necessities. These are the commodities that form the food basket of people in Laikipia County and for any effort to guarantee food security in these households; the focus should be on these food commodities.

CONCLUSIONS AND POLICY IMPLICATIONS

This study accomplished two major goals. The first was to present a demand model that enabled estimating income and price elasticities for food demand, while the second was to provide income and price elasticities for aggregate consumption in Laikipia County. The

study results are similar to those obtained in other studies. Low-income households spend a greater portion of their budget on food as compared to non-food items. Staple food items like maize account for larger share of food budget. Further, Laikipia households are responsive to changes in incomes and food prices and therefore make adjustments to their food demand patterns when prices and incomes change. However, the study results indicate that these adjustments to prices and income are not uniformly across food commodities. The study further provide evidence that the demand patterns of households in Laikipia County are aligned to socio-economics of the area. For instance meat though associated with medium to high income household is a necessity to Laikipia County households. The study further revealed that socio-economic and demographic characteristics are important in determining household food demand.

Several policy implications arise from this study. First, income oriented policies will be more effective in influencing food demand patterns than price policies. Thus income augmenting strategies are key for improving food demand than the current food security options employed by the government. Secondly, a comprehensive policy is needed to provide sufficient incentives for farmers to produce, and to keep food prices low for the low income sections of the population to access food they need. Thirdly, it is very important to incorporate the meat sector as an integral part of the food policy targeting ASAL areas. Most current food policies have limited their attention to the high potential areas, especially promotion of cereal production in general and maize production in particular. This has denied majority of population who depend on pastoralism for their livelihoods. Thus, quality intervention strategies to develop meat and milk sectors as sources of household food supply are needed in Laikipia and other arid and semi-arid Counties. Lastly, it is essential for the government to formulate food policies that incorporate socio-economic characteristics since households' consumption vary and demand patterns are aligned with socio-economic and demographic characteristics.

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STATEMENT OF NO CONFLICT OF INTEREST

We the authors of this paper hereby declare that there are no competing interests in this publication.

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