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THE DETERMINANTS OF FOOD INSECURITY IN TURKANA

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List of Abbreviations

ae	Adult equivalent
AHM	Agricultural Household Model
AIDS	Acquired Immune Deficiency Syndrome
FAO	Food and Agricultural Organisation of the United Nations
GDP	Gross Domestic Product
HH	Household
HIV	Human Immune Virus
IFPRI	International Food Policy and Research Institute
KIHBS	Kenya Integrated Household Budget Survey
KIPPRA	Kenya Institute of Public Policy and Research
LDC	Less Developed Country
OLS	Ordinary Least Squares
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
UNU	United Nations University
USA	United Sates of America
USAID	United States Agency for International Development
WHO	World Health Organisation

Dedication

This paper is dedicated to all the unembraced children of Turkana who have to bear the burden of chronic hunger all year round. Images of your situation were my inspiration.

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Above all, my greatest gratitude goes to the almighty God for the wonderful gift of life. There is no way to thank you enough.

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Abstract

Twenty seven years after the publication of the widely-acclaimed work "the socio-economic determinants of food consumption and production in rural Sierra Leone", the agricultural household model used by John Strauss remains a powerful tool for the analysis of household behaviour in low-income agricultural economies. This current paper uses data from a household budget survey and the framework provided by the agricultural household model to investigate the determinants of household food insecurity in Turkana County of Kenya. It establishes that environmental factors, geography and household characteristics, specifically demography, play a significant role in explaining food insecurity among the people of this community. A complementary study is required to deconstruct further the role of production-related characteristics such as land size and land quality, input prices and mechanization since the data used could not establish any clear association with per capita calorie intake in Turkana.

Relevance to Development Studies

Food security has been a major development challenge to countries within the horn of Africa for a very long time. Lack of accurate and reliable information about the food insecure populations has been identified as one of the reasons why policy and interventions have not been very successful in this region. It is my conviction that this study will provide insight and the necessary information towards the solution and development of the Turkana Community.

Keywords

Food insecurity, per capita calorie-intake, severe water shortage, the Agricultural household model.

Chapter 1 Introduction

Food security has remained a serious development challenge in Kenya for a very long time. Accurate measurement of the country's real food security status has equally remained a very challenging exercise further complicating effective targeting of the food insecure households, planning for them and adopting the necessary interventions. It is noted that Turkana County, one of the country's 47 administrative structures, has for many decades remained on food insecurity alert in the country even during fairly stable times when the rest of the country recorded bumper harvests. As a party to the millennium declaration of the year 2000, when reducing the number of the hungry by half by the year 2015 was made the bull's eye, the country needs her food security statistics now more than ever. These statistics could only be accurate and reliable if taken at the smallest level possible, the household, not just because these are the units of access to food by the majority, but also because extending food security analysis to the national level not only disguises and blurs the real picture, but is equally vulnerable to measurement errors.

The common underlying causes of food insecurity at all levels have been noted to relate very closely with drought, crop failure, civil strife and a diminishing resource base as well as limited access to productive resources, leading to one of the most dreaded types of human suffering, malnutrition. This position is supported by the works of Uzma and Butt (2004) in their analysis of household food security in Pakistan. Evidence is also available to suggest that household food security has a very weak link with national food availability as shown in a recent study by Smith and Haddad (1999), implying that a country maybe food secure but the interaction of a number of factors may limit access to this food by the units through which people access it, the household. Accessibility to food therefore poses the greatest test to a country's food security, a situation that is vindicated by a study in Pakistan by Uzma and Butt (2004) that confirms that most of the food-insecure children, an integral and binding factor in a household, can be found in countries with a net surplus in food availability. Revelations that Sub-Saharan Africa remains the only region with a huge problem of food availability,

when the rest of the world is more concerned about access to their food supplies, signifies a problem. A major problem.

In this study, I explore the question about the determinants of household food insecurity in Turkana County, a region found to the North-western tip of Kenya. I shall consider several factors related to the production characteristics of the household that have a direct connection to the geography, location, the environment as well as the physical infrastructure of this region and that may be related to agricultural communities. I have used the Agricultural Household Model, AHM, to provide the theoretical framework for analysing household behaviour, linking both the production and consumption decisions of the household to determine their optimal choices. Relying on the data provided by the Kenya integrated Household Budget Survey, KIHBS, 2005-2006; the study begins by providing a background and little history about the problem in Turkana. The study's objectives are declared here followed by a thorough literature review, taking a blow by blow journey through the major contributions to the subject by the gurus of food security analyses. The evolutionary path of the subject of food security is traced to show how the discourse has matured over time to accommodate different perspectives and elements of food hitherto ignored in earlier approaches. In chapter two, a conceptual foundation to the subject of food security is provided, tracing the roots of the current discourse to the late 1940s during the Universal Declaration of human rights by the United Nations. The three components of food security are explained here. This chapter also shares with the reader the theoretical framework that has influenced the analysis of food security at the level of the household in recent times, effort being made here to remind the reader that the household is used in the analysis purely as an aggregation of its individual members whose preferences and welfare must remain the objective function. A section is included that guides the reader through the link between the conceptual framework, the theoretical approach and the empirical strategies adopted in the study. The type of data used in the study and how it was analysed concludes this chapter.

Chapter three presents the results and findings of this paper in a clear and concise manner. Descriptive statistics and simple OLS

output are used to link the study variables, caution being taken to avoid jargon. The causality, or lack thereof, between daily per capita calorie intake as the key dependent variable of the study and the various explanatory variables used is discussed in the last section of this chapter. The paper concludes with my recommendation and own critique in chapter four.

1.1 Statement of the problem

Food insecurity among the people of Turkana is an old problem. The production system in this county has for a long time revolved around livestock which is not only a means of the people's livelihood but also a necessary part of their mechanism of ritual and mystic affairs. During ancient times when geographical borders did not exist and territorial expansion was not restricted by geo-politics, the threat to ecological balance through human activities was not as pronounced as it is today. International boundaries has ensured that pasture for livestock is limited and access to better public health and veterinary services by the people has meant that population pressure from both man and livestock has allowed a growth in imbalance in the ecosystem. Both man and stock have succumbed to this imbalance during times of prolonged drought in Turkana. Consequently, trade has had to be practiced by the people to bridge the shortfall from domestic acquisitions. This is very typical of a pastoralist lifestyle.

Polygamy is a common practice and while men gather together in groups to drink traditional liquor for most of the day with peers, their many wives comb the harsh terrain hawking their labour or looking for food to keep their large families fed. Their low incomes are used to support their subsistent needs. Land among the Turkana people is communally owned and land adjudication, a key requirement by government for any land to be developed in the country, has not been conducted. Agriculture, although being practiced by the local community, has not been allowed to replace pastoralism in order of importance. Development assistance by donor agencies such as World Vision, Oxfam, USAID, UNHCR, UNICEF and other faith-based organizations led by the Catholic

Church alongside other state-sponsored-interventions have become synonymous with the name Turkana in Kenya. This situation paints the picture of a people under constant watch for food support, creating a cyclic situation that has affected not just the people's daily lives but also human capital development in the area.

1.2 Relevance and Justification

Food insecurity in Northern Kenya generally, and among the Turkana community specifically, has led to immense human suffering for decades and denied households a meaningful and dignified sustenance. The problem has been so big that most households consider themselves as third class citizens owing to the differences in the quality of life between the households in Turkana on the one hand and the rest of the country on the other. The existence of tens of thousands of refugees at the Kakuma refugee camp, serving displaced persons from the conflict in Southern Sudan, and open since the year 1992, has more than complicated an already complex problem. Unfortunately, attention has traditionally been channelled towards addressing the humanitarian situation and not the root cause of the problem. It is my hope that this study will bridge the knowledge gap that has eluded a full disclosure of the problem for so long.

Map 1: Major settlements in Turkana

Source: IRC Kenya, (2010)[1]

[1] http://www.rescue.org/sites/default/files/resource-file/IRC_LivingOn_online-1.pdf accessed 15th Nov 2011.

1.3 Research objectives

Many Kenyans believe that food insecurity in an agrarian economy where agriculture contributes a net output of 19% to the national GDP, World Bank (2010) and accounts for up to 70% of the total national labour force, KIHBS (2006), is unacceptable. The contribution of this massive number of people to the national GDP is an indicator to the level of the country's development in agriculture. Turkana County has attracted a lot of research on subject matters ranging from ethnography, livelihood and adaptation strategies among many others. While indeed these studies do acknowledge that Turkana households have for decades found food security an elusive challenge, and hence studies on their coping strategies, research has yet to be undertaken to explain the determinants of this situation.

Research plays a fundamental role in providing insight and understanding about socio-economic interactions and processes. Revelations made about such insight, if acted upon, and particularly in the context of a life and death situation that households in Turkana have to contend with, fundamental improvements on the effectiveness of programmes and interventions can be realised.

There is a widely-held perception that government policies and programmes have alienated the people of Turkana County and hence made them vulnerable to food insecurity. Another widely-held hypothesis argues that the geography, infrastructure, locality, the environment, ethnography, culture and anthropology of the people of Turkana have colluded to deny them food security. The core objectives of this research will therefore revolve around the following motivations.

i. To explore the causes and determinants of household food insecurity among the people of Turkana.

ii. To examine the competing hypotheses with respect to the causes of food insecurity in the County.

I shall take the position that food insecurity in Turkana is the result of several factors working together to deny the people of this region stability. The identity of these factors remains unknown.

1.3.1 Main research question

What determines household food insecurity in Turkana County of North-western Kenya?

1.3.1.1 Sub-Questions

1 Can households' characteristics explain the food insecurity in Turkana?

2 Can geographic characteristics and the lack of infrastructure of the County explain the food insecurity?

3 Can policy choices explain the food insecurity?

While indeed it will be a challenge responding to all these questions exhaustively and convincingly from the available data, an attempt will be made to attend to the fundamental issues. The other potential challenge that is envisaged in the study is the concern from my critical readers worried about the reliability of the data used in the study to comprehensively provide a good material for the analysis of household behaviour. Information generated by government institutions have been treated with a lot of caution in research, the motivation behind their generation being the contentious issue to critical analysts. However, this is a valid concern but which stays beyond the capacity of the current work to fully shield itself from. Household Budget Surveys have become the most important sources of critical data on household expenditure, farm production and consumption and it is my trust that the process that generated the dataset used in this study was professionally guided.

1.4 Literature Review

Food security has historically been analysed at national, regional and global levels whereby emphasis focused on food supplies compared to the requirements at those levels. This position is shared by the work of Foster (1992). According to the World food summit (1974), food security was defined as the "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices", United Nations (1975). However, due to the increase in

observations attributed to insufficient food intakes by particular population groups and sections of the society, food availability notwithstanding, the approach has been devolved up to the sub-national, household and individual levels as shown by Foster (1992) and the concept equally broadened beyond the narrow concept of food supplies only.

The Food and Agricultural organization of the United Nations, FAO, expanded the concept of food security in 1983 to incorporate a secure 'access' by 'vulnerable populations' to the available food supplies, FAO (1983), obviously influenced by the magnanimous work of Sen (1981) on entitlements and deprivation. However, this definition was to further change in the mid-1990s to accommodate and reflect the complex arguments of nutrition and human rights in food security. This is captured in the official definition adopted by the FAO at the world food summit in 1996, thus;

> "Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life", FAO (1996)

It has now become logically acceptable to adopt the household level as the social unit to analyse the problem of food security, while bearing in mind the intra-household characteristics associated with the individuals' age, gender and physiology. However, according to Maxwell (1996), by taking this approach, it must be recognized that the household is just an aggregation of the individual members whose food needs and requirements must be met. In adopting this latter day approach to assess the household food insecurity in Bangladesh, a developing country, Faridi and Wadood (2010) use the Agricultural household model, AHM, to determine the household demand for both home-produced output and market-acquired purchases against the requirements of the household as is determined by their gender, age and the physiological profile of its members. They find out that the total amount of land owned by the household has a very significant contribution to food security. Their study establishes that a 1% increase in land size leads to a 5.1

likelihood of a household being food secure, (Faridi and Wadood, 2010: 12). Adopting the same AHM approach to analyse household food insecurity in Southern Ethiopia, the border region with Turkana county of Kenya, Shiferaw, Kilmer and Gladwin (2003) interrogate the role of production-related factors towards the household's food security index. They find that the adoption of improved variety of seeds in farming, use of larger farm sizes by households in agricultural production and the use of high quality land, as indexed by soil quality, are associated with higher food security status among the households in Southern Ethiopia, (Shiferaw Kilmer and Gladwin 2003:18-19). They also examined the relationship between food security and household socio-economic profile and discover that the household size has an inverse relationship with food security (Shiferaw, Kilmer and Gladwin 2003: 20-21). This would obviously imply that a large household finds itself with lower per capita food availability, significantly straining their acquisitions. They also report that the development of the marketing and social infrastructure as measured by the time taken to get to the nearest market significantly affects household food security.

Writing more recently and using the same food energy balance approach as proxy for household food security in Pakistan, Uzma and Butt (2004) examined the relationship between maternal characteristics, household-specific characteristics, including socio-economic variables, and food security. Mother's age and mother's education were included as maternal characteristics to capture phenotype. The findings indicate that there is a strong positive correlation between the mother's age and the household food security. The argument being made here being that experience enables the mother to be in a better position to offer food security to the household, having learnt and mastered the demands and food requirements of her household members by age and sex and activity levels. They also establish that household income plays a critical role in offering the household food security, with the high-income households coming out as more able to enjoy more calorie-intake than their low-income counter parts, Uzma and Butt (2004:7-9).

Availability of food is affected by both demand side and supply side factors. I will analyze the factors determining the

availability of food, as a proxy to food security, among the people of Turkana, amidst imperfections in the factor market, using the Kenya Integrated Household Budget Survey, 2005-2006. To the best of my knowledge, no study has been done on the determinants of household food insecurity in Turkana County and this paper will be a clear eye opener on the Turkana question.

Chapter 2 Methodology and conceptual framework

In this section, the method used to conduct the research is identified. It begins by defining the concept of food security then proceeds to share with the reader an in-depth analysis of the agricultural household model, the theory used to link the study variables. A section is included that shares with the reader why the AHM was preferred in this study and not the alternative options available to the author. The empirical difficulties associated with the assumptions made in the model are included as a caveat to the reader and the chapter concludes with the analytical approach and tools used to deconstruct the findings of the study.

2.1 The conceptual framework

Food security has existed in international development literature since the early 1940s. Recent research, (Norhasmah, Zalilah, and Asnarulkhadi, 2010) confirms that over time, different definitions have been incorporated to the original conventional understanding of food security and the main reason for this is to try to accommodate the broad range of food related issues and to completely and comprehensively reflect the complex function of food in human society. Modern literature on the subject recognizes the year 1948 as the first time food security was formally recognized by the international community as a development concern when the subject was duly mentioned in the same light with human rights. This was during the Universal Declaration of Human Rights which recognized the right to food as a core element of an adequate standard of living, (Maxwell and Smith, 1992) and (Norhasmah, Zalilah, and Asnarulkhadi, 2010)

For the first three decades after the 1948 Universal Declaration, focus revolved around national and global food supplies. According to Maxwell and Smith (1992), this was to change at the beginning of the 1980s when the household level captured the attention of practioners and researchers. Focus was shifted from evaluating food security at the global and national arena to the household and individual levels. Up to the present day, food security analysis has been dominated by this focus. This is in line with the recognition of the fact that the food vulnerable populations and

communities are themselves households made up of members who provide the building block to the analysis and who eventually bear the brunt of the problem. This position justifies the treatment of food insecurity as an experience at the level of the household which is an aggregation of individuals.

During this latter day approach, three main components of food security have been identified. These are;

- Food accessibility
- Food availability/sufficiency
- Food absorption

2.1.1 Food accessibility

This has been described as a phenomenon of the 1980s and the question has been whether or not the individual and the household are able to have access to food. The contribution of Sen (1981) to this debate is hugely influential through his work on food entitlements. Household income together with its other socioeconomic characteristics such as household size, level of education of the household head among other socio-economic features of the household is an essential element that determines food accessibility at the household level.

Studies have established that as households become poorer, more specifically weak in their entitlements, they become more vulnerable to food insecurity. Contributions by Swift (1989) reveal that as households increase their entitlements, through investments, they are more able to shield themselves from vulnerability and can even use the community as buffer stock from food vulnerabilities as (Maxwell and Smith, 1992) show in their study.

2.1.2 Food availability

Food security and nutrition literature has defined this concept in various ways. However, on the development front, it has been described as a function of production and food imports and therefore it could be viewed as the subject of food acquisitions at the disposal of the household for purposes of consumption. Individual household

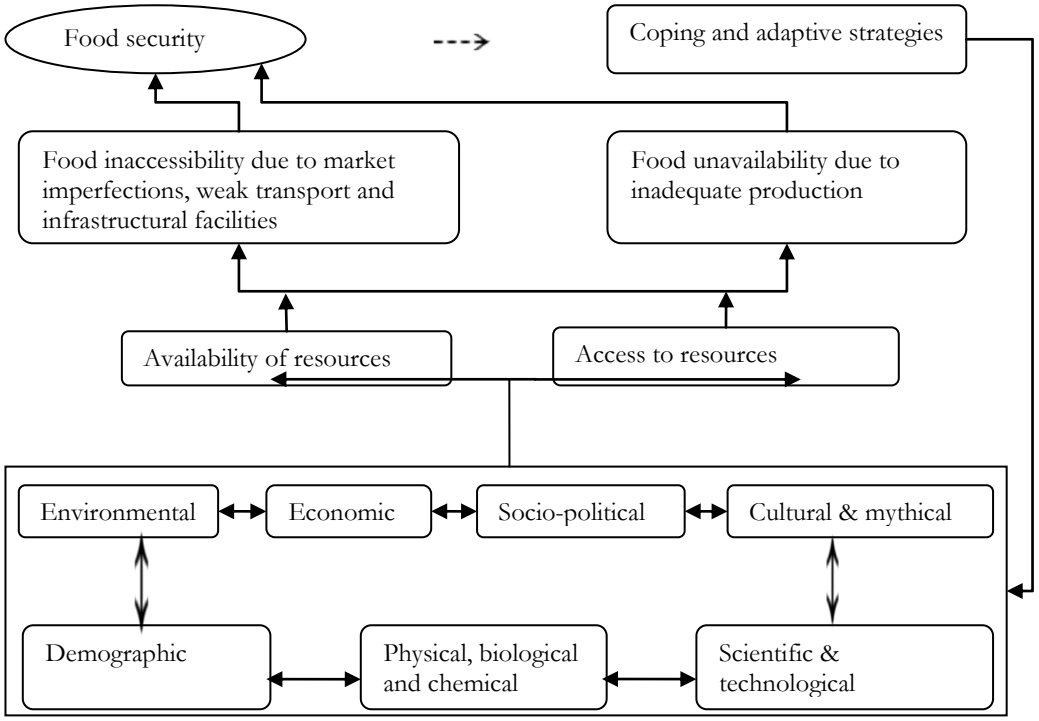
members may derive both nutritional benefits and energy from their food acquisitions. To capture a household's food availability index, these two components are critical and differentiation of the household members in terms of age, sex and gender is necessary to reflect their different needs and requirements. Literature recognises food availability as dependent on a number of factors key of which include the production characteristics of the household, the environment, technology, culture and mythology among many others.

2.1.3 Food absorption

This component of food security has been incorporated as an appreciation of the fact that both food accessibility and food availability do not necessarily explain the health benefits derived by the household members from their access and consumption of the available food. The prevalence of diseases such as cholera, diarrhoea and malnutrition are key indicators of lack of proper health hinting to poor food absorption by the household members.

This component of food security has thus been included in food security analysis to provide a holistic framework. In this study, therefore, household food insecurity has been defined as the negative balance between the household's per capita calorie intake from their food acquisitions and the daily per capita calorie requirements of its individual members as determined by their age and gender.

Figure 1 Processes responsible for food insecurity



Adapted from: Misselhorn, A., (2005)

The figure above presents the conceptual framework of the processes responsible for food insecurity. In this analysis, six potential causes of food insecurity can be identified namely; environmental factors (weather), economic factors, socio-political factors, cultural & mythical factors, demographic as well as physical factors (geography and infrastructural). Poor development of the physical infrastructure and transport as well as weak marketing linkages could greatly impair the household's access to the available food supplies. Alternatively, inadequate production that falls short of the requirements of the people could lead to food insecurity. Therefore, food insecurity could be the result of both demand side (demography, cultural and mythical variables) as well as supply side (scientific and environmental factors).

2.2 Theoretical Framework

In this study, food security is modelled within the framework of the consumer demand and production theories in the context of the Agricultural Household Model, hereafter (AHM), as used by Strauss (1983) and applied in more recent works by Shiferaw, Kilmer and Gladwin (2003). The AHM is applied in this study because Kenya is a low-income country with peasant agriculture occupying the dominant position as the major occupation of most of her rural population. This is a perfect environment to apply the model. The model will help in analysing the link between production characteristics and consumption requirements of the household and how the two sides interact to define the household's food security.

Under the AHM model, an agricultural household operates like a firm: both as a consumer and a producer of its own goods. With the assumption of "separability" of consumption choices from production decisions, the AHM model can help determine the household's optimal choices. Food availability as a component of food security was used to measure the household food security. The household is taken to derive both quantitative and qualitative satisfaction from its consumption decisions. The quantitative satisfaction comes in the form of calories from its food intake while the qualitative utility derives from both the health and nutritional benefits of her consumption basket. These decisions are determined by its production decisions taken in the previous farming season. These two; qualitative and quantitative aspects of food, define the availability of food, an important component of food security. In this study, however, I will dwell on the quantitative aspects of the available food as is measured by the per capita calorie intake by the household members to satisfy their needs, preferences and requirements that vary according to their age and sex. This per capita calorie intake will be the subject in my model as the dependent variable.

2.1.4 Household utility function

According to Strauss (1983), the household's utility function can be defined as:

$$U = U(c, q, l) \quad (1)$$

Whereby c is the common staple food that is produced by the household, while q and l are the market-purchased good and leisure respectively. In a market with imperfections in both land and labour institutions, the household loses its ability to maximise its utility from the market-acquired food material due to a breakdown of the concept of seperability. In such a situation, q could be expanded to accommodate food acquisitions from other sources such as stocks from previous harvesting, food grants and gifts from relatives to enable the household to maximise her utility. Thus q would become a vector of all food acquired from all these sources other than the household production. To develop the theoretical foundation, however, it is assumed that the seperability principle[2] holds. Kenya has a very diverse diet but the most common staple foods are those derived from cereals and cereal products which find their way virtually into every meal in most households across the country. Maize is the most popular staple food crop in the entire country and equally within Turkana County, it occupies a position that is similar to that of both millet and sorghum which, due to resilience to harsh weather, have traditionally occupied the base of the food pyramid among the people as the most widely used cereals. Maize crop can thus be used as the most popular household-produced good in the study and the outcome would be extended to cover all the goods consumed by the household. An increase in the production of Maize is hypothesized to raise the level of household food security owing to its popularity in the County. To optimize her utility of these food items, namely c, q, l, the household will be confronted by the limits imposed by her income, time to allocate between work and leisure as well as the production-related factors such as land, farm-technology, household capital and labour.

With this foundation, therefore, the household's objective function can then be identified as:

[2] This principle submits that a household is able to separate her consumption decisions from the production decisions. In adopting this assumption, therefore, the household is presumed to be able to make the two decisions independent of each other.

$$\mathrm{Max}U(c,q,l,\mathrm{H}) \quad (2)$$

Whereby;

U = *The household* Utility function that is assumed to observe all the fundamental axioms for optimization.

c = Maize

q = market-purchased good

l = Leisure (Treated as a commodity whose utility has an opportunity cost)

H = the vector of the household's demographic profile

This utility must be optimized subject to her resources, budget (Income) and time constraints as outlined below:

$$F(c, G, L, A, K) = 0 \quad (3)$$

$$P(C\text{-}Q) + wL^h + rA^h \leq F(L, A) - w(L - L_f) - r(A^m) + Ъ \quad (4)$$

$$P(C\text{-}Q) + wL^h + rA^h - F(L, A) - w(L - L_f) - r(A^m) + Ъ \quad (5)$$

$$T = L + l \quad (6)$$

Whereby;

$$L = L^f + L^h \quad (7)$$

$$A = A^f + A^m \quad (8)$$

$$E^A = A^f + A^m \quad (9)$$

$$E^L = L^f + L^m + l \quad (10)$$

- We let E^A be the HH land endowment
- E^L the HH labour endowment
- r is the price of a unit of land
- Superscript m→ the item is sold by the HH to the market.
- Superscript h→ the item is hired from the market by the HH
- Superscript f→ the item is used on the HH farm from its endowment.

Furthermore, F (L, A) is the household's implicit production function that is defined by the two factors; Labour (L) and Land (A). C is the good produced by the household, Maize, G represents the on-farm technology employed by the household, Ъ represents the vector of all non-farm income that adjusts to balance the equation. $(C - Q)$ Is the marketed surplus from farm production of good C and P is the price of farm produce C.

If we allow

$\Pi = F(L, A) - rA - wL = HH = \text{Profit}$ (11)

And substitute for equations (7) to (11) into equation (4), then

$P(C-Q) + wL \leq \Pi + wE^{L} + rA^{E} + Ъ$ (12)

The left hand of this equation stands for the HH expenditure bill while the right hand side represents the receipts for the HH. This Equation (12) has special significance to the household. If we uphold the assumption of a well-behaved utility function exhibiting linear non-satiation, then an increase in the HH profit will mean an increase in the HH utility. This separation of the consumption decisions from the production decisions of the HH is the separability property concept. For the HH to achieve its optimal utility consumption, the full-income level that yields maximum profits must be attained. These profits must be incorporated into the HH budget constraint in order to maximize its consumption of Maize and leisure. This means that the HH must adopt the prevailing market rates for rents (r) and wages (w). However this property only works when the assumption of complete markets prevails. In this study, however, the following features of the county restrict the model, as specified in equation (12), from functioning accordingly.

- Turkana has a very expansive topography that lacks proper infrastructure. Critical physical amenities and public goods like roads, and commodity markets are very poorly developed. This leads to high transactions costs and inefficiency in labour market information communication. The County also faces a lack of skilled and well-trained labour on agricultural technology. The labour market, therefore, has myriad imperfections.
- Land adjudication (identification of private land rights) has not been done by the central government in more than 90 % of the County. Most of the land is held in trust for the people by the local government as trust land. Virtually all HH have no titles to their land holdings. The land market is therefore virtually non-existent in the County.

These multiple imperfections lead to a breakdown of the seperability property and the HH can no longer maximize profits under the model as specified in equation (12). These multiple imperfections necessitate the re-arrangement of equation (12) so that

both the HH utility function and its production function as specified in equation (3) are equally affected.

To derive the new production and utility functions facing the households in Turkana, some restrictions will be imposed on the model. These include the following;

- It is assumed that the household operates in a unitary setting that has only one person. All the members of the HH have to pool together their income for their own good and one 'dictator' makes decisions for everybody. The assumption fits very well within the context of the Turkana community where the polygamous household is ruled by a husband whose' many wives must bring back to the homestead her earnings from the days labour.
- It is also assumed that the household utility is transferable between the various household members. The transferrable utility framework here again implies that the household operates like one decision-maker. This assumption is necessary to ensure that the household's Pareto frontier is not affected by the decisions of the individual members. This leaves room again to the power-savvy husband or leader of the household to reign supreme.
- With the imperfect market, we allow M to be the upper limit on the amount of labour that the HH can supply. This provision again fits well within the Turkana context whereby it is mostly women that sell their labour while their spouses and young men pursue their pastoralist tradition.

With these assumptions, the HH's utility problem as defined in (2) above then changes to;

$$\text{Max } U(c, l) \tag{13}$$

Subject to;

$$PC = F(L^f + L^h, E^A) - wL^h + wL^m \tag{14}$$

Whereby

$$l + L^f + L^m = L^E \tag{15}$$

$$L \leq M \tag{16}$$

The optimal amount of labour and output that yields optimal profits has been established. It is further assumed that the constraint in (16) is binding because the study area is purely an LDC rural region with the majority of its HHs practicing subsistent agriculture.

These HHs are large and have abundance in labour. Due to the lack of clearly-defined land rights, most of these HHs also have very little land compared to the large number of their members. This helps to ensure that the provisions of equation (16) above are binding.

Having established these positions, equation (14) can then be re-written as

$$PC = F\ (E^L - M - l,\ E^A) + wM \qquad (17)$$

This new equation confirms that under the prevailing imperfect factor markets (labour and land), the Turkana HH no longer maximizes profits such that the production decisions depend on both their preferences and endowments in labour and land. Under this particular situation, both production and consumption decisions are jointly determined and cannot be taken separately anymore. Seperability principle breaks down.

After solving the HH maximization problem above, the demand function facing the household for good c can therefore be written as;

$$C^* = wM + F\ (L^f, E^A), \qquad (18)$$

This is the HH demand function that will be estimated in the empirical model.

Equation (18) therefore implies that efficiency in production by the household has a direct bearing on her consumption. This means that what is decided with respect to the mode of production has direct implications for consumption and vice versa since consumption and production decisions are interrelated. Empirically this means that income is endogenously determined so that exogenously determinable factors such as the prices of inputs and outputs, household endowments with respect to production factors such as labour as well as land quality have an influence on the model provided above.

However, there are particular challenges associated with the assumptions made with regard to the unitary model used in the theoretical approach in the study. It is important to highlight these challenges so that future contributions to the study of food security in Turkana County can be properly guided. First, the unitary model used in the study makes the critical assumption of a benevolent leader who will distribute the household resources equally and act in

the best interest of his/her members. It has been observed that this does not always happen and there are household heads who have mortgaged assets to acquire selfish personal gratification like purchase of drugs and alcohol. Traditional liquor is rampant in Turkana County and such misdemeanour cannot be ruled out. Secondly, the use of a welfare function that wholly represents the preferences of the different household members is very difficult to fulfil. Social literature has shown the theoretical difficulties associated with this assumption. As Haddad et al (1993) shows, it is very difficult to attain.

2.2 Empirical strategy and estimation techniques

Having established the demand function facing the HH, it is possible to estimate the amount of food, in kilogrammes, available in the food items acquired by the household members. In the empirics, two cereal products, maize and millet, will be used, remembering to accord them equal weight in the household diet as outlined already in the theoretical model. The HH food availability, despite capturing the food quantity at the disposal of the members of the HH, however, fails to incorporate the nutritional value of such food. However, the objective is to determine food availability and therefore nutritional considerations, while remaining extremely important, is a necessary concern for future research. These acquired food quantities will then be converted into calories using the food calorie-conversion table for use in Africa as prepared by the Food and Agricultural organisation of the United Nations.

According to Shiferaw, Kilmer and Gladwin (2003), household food security can be captured by the relationship below:

$$C_n^* = C_n - \Phi_n \quad (19)$$

In this relationship, C_n denotes the n^{th} household daily food availability in kilo calories from the consumed food items and Φ_n represents the household's daily food requirements in kilo calories. For all situations when $C_n - \Phi_n b \geq 0$, the n^{th} household will be taken to be food sufficient (secure) and otherwise for all situations when $C_n - \Phi_n \leq 0$. If food security is treated as a binary outcome, then the household with $C_n - \Phi_n > 0$ (or $\check{Z}=1$) will be assumed to be food

secure whereas households with $C_n - \Phi_n < 0$ (or $\check{Z}=0$) will be taken to be insecure.

Assuming a linear relationship between food security and geographical location of the County in Kenya, and to further show that the food security situation in Turkana County is different from the rest of the country, the following regression will be estimated.

$$C_n^* = \beta_0 + \beta_1 (D_1 \text{Turkana}) + \beta_i (D_i X_i) \quad (20)$$

The simple OLS regression will be used to estimate these parameters. Whereby,

$(D_1 \text{Turkana})$= Dummy; 1 if Turkana

$D_i X_i$ = the Dummy for the i^{th} County in the country that is included in the regression. It is expected that the parameter for the Turkana dummy (β_1) will be significantly large and negative, barring any measurement errors and data entry and management errors, compared with the other parameters, β_i, a clear indication that Turkana is worse off in terms of food security compared with the rest of Kenya. This would equally imply that Turkana County pulls down the food security status of the country generally.

To understand the influence of additional covariates in this study, and the impact of their inclusion in the regression, particularly on the Turkana dummy, these variables, which are assumed to be related to both the supply-side and demand–side of the market, will be added, each at a time, and their interaction with the Turkana dummy interrogated, very patiently and keenly. The covariates that reduce the significance of Turkana in the regression will be the subject of interest in this study. It is expected that these covariates will assume the shape of the household's structural and socio-economic profile as well as the county's geographical, environmental and locational characteristics. The ordinary least squares (OLS) will be used to estimate this linear relationship.

In addition, a logistic regression model could also be estimated for food security for Turkana. If δ is taken to be the probability of household food security, then from equation (19) a logistic regression can be specified such as below:

$$\delta = \text{Prob}(\check{Z}=1) = \text{Prob}\, C_n^* > 0 \quad (21)$$

And

$$\text{Ln}(\delta/1-\delta) = \text{Prob} \sum_{j=1}^{n=k} \beta_j X_{ij} + \varepsilon_i > 0 \quad (22)$$

However, it is determined that the ordinary least squares method, OLS, is adequate to help the current study realise its objectives and shall be adopted since both the OLS approach and the logistic modelling of food insecurity approach yield similar findings albeit different interpretations.

2.3 Discussion on data and explanatory variables.

Data from the Kenya integrated Household Budget Survey, KIHBS; 2004-2005, was used for this study. KIHBS was a comprehensive exercise conducted by the Government of Kenya to provide indicators necessary for measuring, monitoring and analysing living standards and poverty in Kenya. This survey has been used as a baseline for continued monitoring of key poverty and welfare indicators in the country. Stratified multi-stage sampling design was used to collect the data. Information touching on the household income, expenditure, farm-production and input alongside other valuable household-level characteristics made the data a rich tool for the analysis of food security.

Food availability at the household level is estimated using the total amount of energy in all the different forms of maize grain and millet, the two staple food items used in the study. This total sum is then treated to fit the household profile by dividing it by the total number of days, seven in total, and the HH members to arrive at the per capita acquisition by each household member per day. The mean of this number, from the sample of Households used in the study, is taken to represent the mean of the population of the entire county in terms of food acquisition[3].

To estimate the total energy requirements of the household, the gender, age, physiology and body size of the members of the household members are crucial considerations. However, the Kenya Integrated Household budget survey only disaggregated household

[3] Even though food acquisition does not necessarily mean that the entire food acquired was consumed by the HH, in this study it is assumed that this is the case. A more accurate method would be to conduct a consumption survey which however, has its unique budgetary constraints.

members by their age and gender as either adults or children and as male or female. This is bound to undoubtedly generate or lead to some classification error in my analysis. This is a major weakness in the current analysis because other than the considerations of age and gender, it is known that individuals may vary in their food requirements on the basis of their body size, level of activity and physiology. Furthermore, sick members of the household may have specific diet requirements that are not incorporated in the study.

Secondly, lactating and pregnant women may also have unique calorie requirements to support their conditions and these are definitely considerations that were not captured in the survey. It was hard to shield this study from these challenges in the current study and they are weaknesses that have to be highlighted for future research. The total energy requirement for the sample population will then be estimated and the average projected for the whole population. The differential between the two variables will then be used as the food security index for the household. A total of 22439 observations were used in the regression, representing the number of observations that reported using the two food items during the reference period of 7 days of the survey. Out of this a total of 284 observations were recorded in Turkana County. Because most households reported their acquisitions in metric units and not the monetary value, the metric quantities were used in the study. The two food items were acquired by households in different forms as indicated below:

Table 1: Different forms of the maize and millet cereals used in the study

Food item	Form acquired	Calorie equivalent/100gm [4]
Maize	Loose grain	357
	green	383
	flour	353
	Sifted flour	368
Millet	Loose grain	329
	flour	333
	Other flour/grain	333

[4] Source: FAO food composition table for use in Africa (1968)

Due to the imperfections in both the labour and land markets in Turkana County, the households are not able to maximize their profits as outlined in the model. This greatly impairs their ability to maximize their utility, and to attain their Pareto frontier, they will need all the food resources that they can acquire, including food grants and donations over the reference period, purchases from the market, food stocks and own-farm production. These acquisitions are all calculated to determine the household's total food availability. Food acquisitions used in the analysis are therefore derived from the following sources namely; Household own production, purchases from the market, household own-stock and all the acquisitions from any other sources within the reference period of the survey. It is expected that all these other sources will work to complement the household own-production which is expected to act as the main source of food supplies for the household members.

A normative rather than actual energy requirement for the different members of the household was used to estimate the per capita energy needs of the household, given their different needs depending on age and sex, which has already been reported above. For purposes of analysis, children below the age of 5 years were treated as 'sexless' so that their energy requirements were taken to not depend on their gender. The adult age category of 30 to 60 years was used as the reference point for calculating the household adult equivalents.

The metric quantities for each food item were reported in different units. To enable for calculation of the household acquisition and data management, all these quantities were first converted into kilogrammes as a common unit. Calorie intake per capita per day was used in the study as the dependent variable. Factors related to the household's farm-production behavior such size of land size, cost of pesticides, expenditure on inorganic and organic fertilizers, type of parcel of land used by the household (whether communal or private or trust land), soil texture, the quantity of fertilizers used and expenditure on farm implements were all used as explanatory variables. The socio-economic characteristics of the household, the household's structural profile as well as the geographical location of

the counties and households were equally used as exogenously determined variables.

The household's structural profile that was studied here included household size together with the household composition by gender and age. The availability of water and related facilities was also considered as part of the household's socio-economic profile and to see whether they impact on food availability. This was necessary considering that Turkana is an arid region and a proxy for the scarcity of water is necessary to provide insight on the situation in this place. Besides, water is paramount in any economic undertaking is crucial. The data also captured the effects of different types of shocks and their impact on food availability at the household level was tested in the analysis. Some of the shocks that were listed by the households included drought, an increase in crop prices, death of the head of the household, death or theft of livestock as well as the death of a family member. While the shocks associated with the household characteristics like death were not expected to have any unique effects on Turkana as a region, those that were linked to natural events like drought and famine would have considerable impact on economic activities particularly food production. This justified their inclusion in the regression. The Ordinary Least Squares method (OLS) was used to estimate these relationships.

2.4 Analytical procedures

In this section, I provide insight on the procedure that was used to process and decompose the information used in the study. The procedure used in this section will show how the conceptual order was integrated into the empirical approach.

2.4.1 Estimating the Household adult-equivalents

To determine the value of the adult-equivalent scale to be used in calculating the calorie requirements for children, boys, girls, adult men and women within the household, I estimated the mean calorie requirements for all these age and sex groups, taking the male adult age group of 30-60 years as the reference group with a value of 2900 Kilocalories in accordance with FAO, WHO and UNU (1985). The re-

sulting conversion factors ranged between 0.284 to 1.03 for children below 1 year and male adults of 18 to 30 years old. The reference category assumed a conversion factor of 1. The complete table for these adult conversion factors is provided in the appendix.

2.4.2 Estimating the household calorie availability

Due to the imperfections in both the land and labour markets in Turkana County, households would have to mobilize all their resources and endowments to maximize their utilities. As a result, all the sources of household consumption; including own-production, stock, purchases as well as consumption from donations and grants, were pooled together to determine total household consumption from the two cereal products used in the estimation (maize and millet). The different forms of the two goods meant that each form had a different calorie composition and the FAO food composition table for use in Africa was used to calculate the total food calories available for consumption from each source. The calorie available from each source was then summed up to get the per capita intake per day after dividing by the household size and the number of days that made the reference period (7 days). My regressions and summary statistics were performed by using this daily per capita calorie intake as the dependent variable. The study's analytical procedures were performed with Stata version 11.2 (Stata Corp., College Station, USA).

3 Results and Discussion

In this section, the results of the study are presented accompanied with a discussion of these outcomes. The study used the Ordinary Least Squares, (OLS), to estimate the parameters of the individual dummies of each region (county) against daily per capita food intake as the dependent variable. Keen interest was on the Turkana dummy and the statistical significance of its contribution to national food index compared with other counties. Additional variables that were hypothesized in the model as related to food security were then added each at a time and their statistical significance and the effect of its interaction with the Turkana dummy was noted. Variables that reduced the statistical significance of this dummy were used to answer the research question. Additional information from the descriptive statistics was incorporated to help in deconstructing these outcomes.

3.1 Results

In general, the results support the hypothesis that food availability is affected by the geographical location of the household. The inclusion of additional socio-economic, physical as well as environmental variables to test their significance was helpful to show that food security is determined and influenced by a variety of factors. Calorie intake per capita per day was used as the dependent variable in this study while the explanatory variables were divided into different categories as either production-related, household-related, physical factors, environmental and socio-cultural factors. Statistical tests were conducted on the parameters of the regions to determine their respective contributions to national food security as well as their own food security indices. The results of this regression and the accompanying test are provided in table 3 below. Marsabit County was used in the regression as the base category. This county has similar geographic, physical as well as infrastructural characteristics as Turkana, alongside the fact that both counties are located in Northern Kenya as border neighbours. Communities in the two counties are predominantly pastoralist. It can be noted that all the counties located towards the northern part of Kenya return negative

contribution to national food security. Mandera, Garrissa and Wajir posted negative effects on food security as did Isiolo County. Turkana County showed the second highest vulnerability in terms of food security with a coefficient of -0.64 after Mandera County that had the highest with a figure of -0.758. The results also indicate that food security is positively related with the production of grains since most of the food secure regions in the country such as Kakamega, Nandi and Butere-Mumias are surplus producers of cereal products. The intercept for the per capita food intake was positive 5, showing that the country has a positive food balance sheet.

Table 2 : Per capita calorie intake and food requirements for Turkana STATA output.

Variable	Obs	Mean	Std. Dev.	Min	Max
INTAKE_PC_~Y	284	207.7462	226.4725	0	2059.167
kcal_req_1	284	1.39e+07	417409.7	1.30e+07	1.45e+07

.

Table 2 shows that per capita calorie requirements for Turkana County exceeded by far the per capita food intake. In the measurements, all the adult-equivalents were higher than the daily per capita food intake, probably suggesting an underestimation of food availability for the household. More information about the household adult equivalents across all age groups and gender is contained in Appendix A.

Table 3 OLS regression of per capita calorie intake across the regions.

Variable(Region)	Coefficient	std error	Region(Variable)	Coefficient	std-error
Nairobi	-0.0874	-0.0975	kisumu	0.602***	-0.106
Kiambu	-0.13	-0.0991	Kuria	0.541***	-0.113
Kirinyaga	0.148	-0.105	migori	0.519***	-0.101
Muranga	0.506***	-0.107	nyamira	0.515***	-0.108
Nyandarua	0.193*	-0.103	rachuonyo	0.599***	-0.104
Nyeri	0.271***	-0.0966	Siaya	0.676***	-0.105
Thika	0.00488	-0.102	Suba	0.757***	-0.109
Maragua	0.183*	-0.102	bondo	0.626***	-0.104
Kilifi	0.748***	-0.119	nyando	1.132***	-0.104
Kwale	0.532***	-0.109	baringo	0.209**	-0.105
Lamu	0.0894	-0.108	bomet	0.485***	-0.116
Mombasa	0.0286	-0.108	Keiyo	0.443***	-0.107
taita_taveta	0.369***	-0.109	kajiado	0.300***	-0.106
tana_river	-0.00847	-0.0963	kericho	0.443***	-0.109
Malindi	0.730***	-0.133	koibatek	0.388***	-0.108
Embu	0.190*	-0.0997	laikipia	0.206*	-0.119
Isiolo	-0.0577	-0.109	marakwet	0.438***	-0.107
Kitui	0.845***	-0.103	nakuru	0.401***	-0.0988

Makueni	0.389***	-0.0978	nandi	0.716***	-0.1
Machakos	0.249***	-0.0965	narok	0.492***	-0.11
Mbeere	0.338***	-0.1	samburu	0.152	-0.0973
meru_central	0.244**	-0.102	transmara	0.428***	-0.114
Moyale	0.361***	-0.107	trans_nzoia	0.458***	-0.105
Mwingi	0.624***	-0.102	turkana	-0.648***	-0.105
Nyambene	0.0144	-0.103	uasin_gishu	0.328***	-0.101
Tharaka	0.486***	-0.0947	west_pokot	0.827***	-0.107
meru_south	0.0676	-0.0986	Buret	0.562***	-0.105
Garissa	-0.214*	-0.126	bungoma	0.394***	-0.103
Mandera	-0.758***	-0.112	Busia	0.281**	-0.113
Wajir	-0.138	-0.113	mt_elgon	0.783***	-0.103
Gucha	0.697***	-0.116	kakamega	0.667***	-0.103
homa_bay	0.557***	-0.105	lugari	0.393***	-0.109
Kisii	0.727***	-0.103	butere_mumias	0.832***	-0.103
Teso	0.545***	-0.108	Constant	5.654***	-0.0831
Vihiga	0.578***	-0.109			
			Observations	**19,454**	
			R-squared	**0.084**	

Whereby *** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at 1%, 5 % and 10 % respectively.

It is hard to explain why Nairobi returned a negative coefficient of -0.0874. Part of the possible explanation could be that this is mainly an industrial city and its contribution to the country's agricultural development could be through industrial processing and manufacturing of agricultural produce.

Table 4 OLS regression of per capita intake per day across the rural areas[5].

Variable(Region)	*Coefficient*	*std error*	*Variable(Region)*	*Coefficient*	*std-error*
Kiambu	-0.0488	-0.108	migori	0.614***	-0.112
Kirinyaga	0.153	-0.112	nyamira	0.488***	-0.117
Muranga	0.561***	-0.114	rachuonyo	0.661***	-0.112
Nyandarua	0.158	-0.109	siaya	0.756***	-0.115
Nyeri	0.252**	-0.104	suba	0.817***	-0.118
Thika	0.0543	-0.114	bondo	0.922***	-0.115

[5] The regression results here only include the rural parts of the counties. This distinction was made to analyze areas that have similar consumption and production patterns with Turkana. This would also put together counties and areas that share similar household statistics such as poverty indices and geographical characteristics.

Maragua	0.211**	-0.106	nyando	1.270***	-0.113
Kilifi	0.781***	-0.133	baringo	0.228**	0.114
Kwale	0.578***	-0.117	bomet	0.467***	-0.121
Lamu	0.215*	-0.114	keiyo	0.436***	-0.115
taita_taveta	0.634***	-0.124	kajiado	0.400***	-0.122
tana_river	-0.00876	-0.1	kericho	0.392***	-0.12
Malindi	0.918***	-0.146	koibatek	0.399***	-0.114
Embu	0.308***	-0.112	laikipia	0.192	-0.127
Isiolo	-0.077	-0.118	marakwet	0.486***	-0.113
Kitui	0.878***	-0.109	nakuru	0.467***	-0.108
Makueni	0.393***	-0.102	nandi	0.825***	-0.108
Machakos	0.361***	-0.104	narok	0.489***	-0.114
Mbeere	0.277***	-0.105	samburu	0.323***	-0.106
meru_central	0.318***	-0.112	transmara	0.387***	-0.117
Moyale	0.410***	-0.114	trans_nzoia	0.434***	-0.112
Mwingi	0.628***	-0.106	turkana	-0.722***	-0.109
Nyambene	0.0477	-0.108	uasin_gishu	0.354***	-0.119
Tharaka	0.503***	-0.0986	west_pokot	0.797***	-0.113
meru_south	0.0252	-0.104	buret	0.533***	-0.11
Garissa	-0.0756	-0.142	bungoma	0.430***	-0.118
Mandera	-0.756***	-0.117	busia	0.19	-0.135
Wajir	0.00742	-0.133	mt_elgon	0.781***	-0.112
Gucha	0.783***	-0.128	kakamega	0.737***	-0.116
homa_bay	0.709***	-0.114	lugari	0.453***	-0.125
Kisii	0.689***	-0.117	teso	0.522***	-0.117
Kisumu	0.836***	-0.121	vihiga	0.586***	-0.118
Kuria	0.591***	-0.132	butere_mumias	0.864***	-0.116
			Constant	5.663***	-0.0872
			Observations	**14,412**	
			R-squared	**0.097**	

Whereby *** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at 1%, 5 % and 10 % respectively.

Table 5 : OLS regression of calorie intake across the urban areas

Region (Var)	Coefficient	std error	Region(Var)	Coefficient	std-error
Nairobi	-0.0145	-0.255	kisumu	0.303	-0.271
Kiambu	-0.255	-0.268	kuria	0.530*	-0.277
Kirinyaga	0.149	-0.294	migori	0.369	-0.27
Muranga	0.231	-0.303	nyamira	0.642**	-0.285
Nyandarua	0.411	-0.294	rachuonyo	0.457	-0.279
Nyeri	0.373	-0.268	siaya	0.550**	-0.275
Thika	-0.0201	-0.268	suba	0.602**	-0.289

Maragua	-0.384	-0.353	bondo	0.123	-0.271
Kilifi	0.719**	-0.296	nyando	0.799***	-0.278
Kwale	0.414	-0.291	baringo	0.197	-0.282
Lamu	-0.751**	-0.316	bomet	0.645*	-0.371
Mombasa	0.102	-0.259	keiyo	0.507*	-0.29
taita_taveta	0.00723	-0.274	kajiado	0.224	-0.269
tana_river	-0.0995	-0.331	kericho	0.620**	-0.282
Malindi	0.108	-0.334	koibatek	0.342	-0.309
Embu	0.0698	-0.265	laikipia	0.305	-0.325
Isiolo	0.0508	-0.291	marakwet	0.134	-0.311
Kitui	0.646**	-0.301	nakuru	0.308	-0.268
Makueni	0.307	-0.309	nandi	0.418	-0.274
Machakos	0.008	-0.267	narok	0.494	-0.371
Mbeere	1.005***	-0.318	samburu	-0.165	-0.266
meru_central	0.126	-0.272	transmara	1.661***	-0.536
Moyale	0.174	-0.296	trans_nzoia	0.608**	-0.298
Mwingi	0.0203	-0.5	turkana	0.112	-0.331
Nyambene	-0.235	-0.308	uasin_gishu	0.365	-0.263
Tharaka	0.0145	-0.328	west_pokot	1.020***	-0.303
meru_south	0.395	-0.295	buret	0.826**	-0.328
Garissa	-0.501	-0.306	bungoma	0.404	-0.267
Mandera	-0.776**	-0.337	busia	0.448	-0.274
Wajir	-0.273	-0.276	mt_elgon	0.836***	-0.279
Gucha	0.514*	-0.294	kakamega	0.607**	-0.269
homa_bay	0.159	-0.28	lugari	0.353	-0.275
Kisii	0.842***	-0.268	teso	0.658**	-0.284
butere_mumias	0.835***	-0.27	vihiga	0.597**	-0.289
			Constant	5.581***	-0.25
			Observations	**5,042**	
			R-squared	**0.089**	

In addition, *** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at 1%, 5 % and 10 % respectively.

Table 4 above provides the OLS regression results of per capita calorie intake per day across the rural areas. The major cities, Nairobi and Mombasa are dropped from the regression. This could be due to the explanation already advanced that these are predominantly designated as urban areas. It is noted that there is a considerable drop in the coefficient for Turkana from -0.648 to -0.722 further revealing that the rural parts of Turkana are more food insecure than

the urban parts. Interestingly, while the coefficient for Rural Turkana showed a decline, the coefficients for the other rural areas in the country showed a pattern of upward movement, indicating an improvement in food security. This seems to suggest that as you move to the rural areas from the urban centres, there is the associated improvement in food security across the country. However, for Turkana, this is not the case. Urban Turkana seems to be more food secure than rural Turkana.

It is also noted that the mean per capita calorie intake nationally improves slightly from 5.654 to 5.663 when the regression is performed for the rural areas as and when the urban areas are included respectively. From table 5, it can be noted that Turkana County has a positive coefficient of 0.112 for its urban centers. This is a clear indication that its urban areas are food secure even though this situation is not significant. Generally, however, the results largely conform to the expectations of the research and the hypotheses of the study can therefore be advanced to explain the observations of the additional regressions and the descriptive analysis.

Other than the locality of the county, the other explanatory variables tested in the regression showed different impacts on food security as table 6 below indicates.

Table 6: OLS results of food availability by various explanatory variables

VARIABLES	logINTAKE_PC_DAY		Standard errors in parentheses
	Coefficient	**std-error**	***** p<0.01, ** p<0.05, * p<0.1**
Loghhsize	-0.569***	(-0.0411)	
logttcost_water	-0.00598	(-0.0269)	
logtttoqeue_water	-0.0152	(-0.0223)	
Rural	0.342***	(-0.0716)	
hiv_aids	-0.127	(-0.162)	
chronic_illness	0.0298	(-0.0843)	
severe_water_shortage	-0.228**	(-0.091)	
loss_reg_assistance	-0.0894	(-0.312)	
loss_employment_salary	-0.0274	(-0.209)	
business_failure	-0.28	(-0.211)	
how_store_water	0.071	(-0.0439)	
value_shock	-4.40E-07	(-6.92E-07)	
Protestant	-0.121**	(-0.0603)	
Constant	6.493***	(-0.276)	

Whereby *** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at 1%, 5% and 10% respectively.

In this table, the variables severe_water_shortage, logttcost_water and logtttoqeue_water are included in the regression as proxies for the scarcity of water (environmental factors). The idea is to interrogate any potential role played by environmental factors on per capita calorie intake by the household. They both return significant. The other variables, namely Protestant, how_store_water and loghhsize are included as household characteristics. The inclusion of these variables helped to examine the predicted role of household characteristics and the household's socio-economic profile on per capita calorie intake.

Table 7: Explanation of explanatory variables used in the regression

Variable	Explanation
Loghhsize	The natural log of household size
logttcost_water	The log of the total cost of water for the household
logtttoqeue_water	The log of the total time taken to queue for water
Rural	The dummy for location of the county, 1 if rural
hiv_aids	HIV-virus occurrence as a shock in the household
chronic_illness	Chronic illness as a shock
severe_water_shortage	Severe water shortage as a shock to the household
large_sale_price_crops	Effect of sale price of crops on hhold calorie intake
loss_reg_assistance	Loss of regular assistance to the household
loss_employment_salary	Loss of employment
business_failure	Business failure
livestock_death_theft	Livestock death and or theft
how_store_water	How the household stores water
value_shock	Value of household shock
Protestant	Protestant as religious orientation

Table 7 provides an explanation of the independent variables used in the regression. Continuous variables used in the regression were logged to check for any outliers and to also make the data easier to manage. Categorical variables were not logged since this problem is not anticipated from them.

3.1.1 Descriptive analysis of production-related explanatory variables

In the study, only 33 households within Turkana reported being involved in farming. This is a fairly small number but it equally goes

on to show the level of participation by households in agricultural production in Turkana.

The mean landholding per household within Turkana was estimated to be 0.5 hectares against the national average of 2.5 ha. This is extremely small and may not be adequate to support the requirements of the household with food given that land size is assumed to be positively related to farm production. From this amount of landholding, it is not surprising that all the variables related with household farm production have very low mean values, a clear indication of peasant farming. It could not be determined in this study whether the lack of clearly-defined land rights was responsible for this meagre land-holding or whether other explanations related to maybe weather, geography or other variables were responsible. An answer to this question is surrendered to future study. It is worth to note that no household reported any expenditure on long-term crops or on land reclamation, probably alluding to the nature of production in this part of the country.

Equally interesting is the fact that no household within Turkana in this survey reported paying for fertilisers in its organic or in-organic forms, probably showing that households do not engage in commercial or large-scale farming. The little in-organic fertiliser used by some households may have been received from the government or the stock from the previous farming season. All the labour used in the farms is indicated as not having been paid for, suggesting that it may have been drawn from the household pool or offered in kind by relatives.

3.1.2 Descriptive analysis of household characteristics

Several variables related to the household were examined in the study. As a proxy for water scarcity, the amount of time taken to get water for various purposes in Turkana was estimated and all turned to be above the national average. This was equally true for the average time taken to queue for water which was almost five times higher in Turkana compared to the rest of the country. This shows the influence of the environment on household's lives in the County. It was hypothesised that variables that have a direct connection with

the environment would have an influence on food security and this impact has been shown to have a significant effect in the regression.

Table 8: Descriptive statistics of production-related explanatory variables

Variable	Mean		n=Observations		Definition
	Turkana	**National**	**Turkana**	**National**	
size_acres	0.5848485	2.519464	33	15624	Size of the land used by the household for farming
Expenditure_irrigation	0	56.22336	33	15634	Expenditure on irrigation in Ksh
qty_inorganic_ fertilisers	6.666667	72.87854	3	13593	The quantity of inorganic fertilisers used in Kg
Cost_inorganic_fertiliser	0	1405.391	33	15634	Average Cost of inorganic fertiliser
Cost_organic_fertiliser	0	304.0118	33	15634	Average Cost of organic fertiliser
Expenditure_implements	0	96.80881	33	15634	Expenditure on farm implements
Expenditure_labour	0	129.8292	33	15634	Total household expenditure on farm labour
Expenditure_pesticides	1.515152	354.6281	33	15634	Total household expenditure on pesticides in Ksh
Expenditure_farm_repair	90.90909	1402.487	33	15634	Total household expenditure on farm repair Ksh
total_expenditure_farm	110.6061	3043.774	33	15634	Total household expenditure on farm output Ksh
Expenditure_longtermcrop	0	108.8516	3	11816	Total expenditure on long-term crops
Expenditure_reclamation	0	174.2329	3	12058	Total expenditure on land reclamation

Table 9: Socio-economic characteristics and household demography

Variable	Mean		n=Observations		Definition
	Turkana	**National**	**Turkana**	**National**	
tttget_water_livestock	15.92606	11.86385	284	22439	Average time to get water for livestock(in mins)
hhsize	6.788732	5.385356	284	22439	The average household size
tttget_water_drinking	30.81338	13.84776	284	22439	Average time taken to get drinking water in mins
tttget_water_bathing	33.49296	13.32666	284	22439	Average time taken to get bathing water in mins
tttget_water_cooking	30.8169	13.45551	284	22439	Average time taken to get cooking water in mins
tttoqeue_water	52.01761	11.78065	284	22439	Average time taken to queue for water in minutes
ttcost_water_drinking	34.40845	14.00143	284	22439	Total cost of water for drinking in Ksh
ttcost_water	41.27465	98.73132	284	22439	Total cost of water in the household in Ksh.
PC_INTAKE_DAY	207.7462	1012.214	284	22439	Per capita calorie intake per day
hhae	5035.089	5045.639	284	22439	Household adult equivalent

Table 10: Disaggregation of the data by age and gender and the accompanying calorie requirements

id_hh	child0_1	child1_2	child2_3	child3_5	ma15_7	ma17_10	ma110_12	ma112_14	ma114_16	ma116_18	ma118_30	kcal_req
1	96	208	183	408	213	293	193	208	200	181	722	1.45E+07
2	96	216	219	415	220	308	198	187	224	169	724	1.43E+07
3	117	209	228	430	224	294	168	161	154	169	744	1.39E+07
4	113	212	201	433	232	306	187	184	189	182	716	1.44E+07
5	108	207	222	399	227	281	164	185	175	163	718	1.38E+07
6	88	196	200	401	225	273	153	190	163	161	714	1.39E+07
7	88	202	168	386	212	271	194	170	170	150	729	1.42E+07
8	89	193	212	374	213	286	181	175	186	177	732	1.40E+07
9	79	195	180	391	207	288	165	175	169	168	697	1.36E+07
10	74	197	185	356	225	281	143	151	176	134	686	1.30E+07

Table 11: Disaggregation of the data by age and gender and the accompanying calorie requirements

id_hh	ma130_60	ma160p	fem5_7	fem7_10	fem10_12	fem12_14	fem14_16	fem16_18	fem18_30	fem30_60	fem60p	kcal_req
1	752	186	208	318	190	186	197	179	776	800	207	1.45E+07
2	720	172	214	305	195	175	159	166	777	791	189	1.43E+07
3	688	178	209	276	164	171	183	142	829	768	192	1.39E+07
4	766	165	237	289	191	186	186	182	786	799	159	1.44E+07
5	751	183	203	294	167	184	150	154	746	767	194	1.38E+07
6	759	167	198	293	174	187	202	152	798	777	163	1.39E+07
7	794	182	210	325	203	185	208	172	760	787	191	1.42E+07
8	758	150	222	272	182	173	169	186	760	803	171	1.40E+07
9	748	166	208	284	193	187	160	161	741	743	182	1.36E+07
10	698	177	163	282	171	157	164	167	720	720	169	1.30E+07

The Kenya Integrated Household Budget Survey 2005-2006 disaggregated the household members on the basis of gender and age. Tables 10 and 11 above show the gender of the various age groups and sexes and the accompanying calorie requirements. It is shown in the summary statistics that the per capita food intake per day for Turkana households averaged 207.7 kilocalories against the national average of 1012.2 kilo calories. This is a very large variation which probably reflects the dire state of affairs in Turkana County.

Table 12 provides a decomposition of households in Turkana by gender and their location within the County. The table seems to suggest that there is a fair balance between males and females in the rural areas of Turkana. However, the situation changes considerably in the urban parts of the county and the scale tilts in favour of the males. It seems plausible that more men can be found in the urban areas of the county probably as a strategy to look for greener tidings to support their folks in the rural areas. A closer look at this male dominated urban population reveals that it is comprised of people between the ages 11 to 47 years. Among the Turkana community, this is a highly productive age category that can engage in any kind of employment to support their households in the rural areas. Table 13 provides a decomposition of Turkana households by size and their location within the County.

Table 12: Distribution of households by sex and location in Turkana.

Sex	Location		Total
	Urban	Rural	
Male	17	133	150
Female	9	125	134
Total	26	258	284

Table 13: Distribution of household size in Turkana by urban and rural

Household size	Location		Total
	urban	Rural	
1	7	0	7
2	2	10	12
3	3	15	18
4	5	23	23
5	0	34	28
6	4	45	38
7	2	55	47
8	0	14	57
9	1	16	14
10	0	7	17
11	0	12	7
12	0	22	12
13	0	2	2
14	0	2	2
Total	26	258	284

Table 13 seems to show that rural households are larger in sizes compared to their counterparts in the urban centres.

To interrogate the possible association between marital status and per capita food intake, table 14 below was used to disaggregate observations by location. It is noted that the urban dwellers have either never married or are monogamous, giving them more degrees of freedom to seek greener pastures in town away from the hassles and bustles of rural life where food insecurity is higher.

Table 14: Marital status, urbanization and food security in Turkana County.

Marital status	Location		Total
	Urban	Rural	
Monogamous	5	33	38
Polygamous	0	22	22
Living together	0	3	3
Separated	0	3	3
Widow or widow	0	8	8
Never married	11	95	106
Total	16	164	108

Table 15: Households affected by shocks in Turkana County and their location

Who affected by shock	Location		Total
	Urban	Rural	
Own household only	14	117	131
Some other household too	0	11	11
Most households in community	3	55	58
All households in community	9	75	84
Total	26	258	284

Table 15 shows the distribution of households by those that were affected by shocks and their location within Turkana. Rural households seem to feel the brunt of shocks according to this table. This table helps to highlight the vulnerability of rural households in Turkana to the dangers of food insecurity.

Table 16: Main source of water for cooking in rural households in Turkana.

Main source of water for cooking	Location		Total
	Freq.	Percent	Cum
Public tap	26	10.08	10.08
Tubewell/borehole with pump	44	17.05	27.13
Unprotected dugwell/springs	77	29.84	56.98
River/ponds/streams	111	43.02	100.00
Total	258	100.00	100.00

Tables 16 and 17 show the main sources of water for households in both rural and urban households. This is a good proxy for water scarcity in Turkana. It is noted that a very large population of the people depend on nature (the environment) for water. Rivers, ponds and springs are the main sources of water indicating that the Turkana people have a deeper interaction with the environment as a source of water.

Table 17: Main source of water for cooking in rural households in Turkana

Main source of water for cooking	Location		Total
	Freq.	Percent	Cum
Piped into plot/yard	20	76.92	76.92
Public tap	6	23.08	100.00
Total	26	100.00	100.00

To interrogate the importance of food grants and donations to the people of Turkana in supporting their per capita food intake, table 18 below shows the distribution of households that were severely affected by its withdrawal. It is noted that no urban household treated a withdrawal of food aid as a shock. The rural households were the ones most affected, again revealing their vulnerability.

Table 18: Descriptive statistics for shocks experienced by households after the loss of regular assistance to households in Turkana.

loss of regular assistance	Location		Total
	urban	Rural	
No shock	20	245	271
Shock	0	13	13
Total	20	258	284

To help identity the households affected by severe water shortage in Turkana, table 19 below provides a decomposition of their location. It is noted that almost all the households that felt the severity of the shortage, with the exception of only two, are located in the rural areas, the part of Turkana that is already identified as more food insecure. This seems to confirm the higher dependency of rural households on natural sources of water as shown in table 16 above.

Table 19: Descriptive statistics for severe water shortage in Turkana County by location

Severe water shortage	Location		Total
	Urban	Rural	
No shortage	24	208	232
Shortage	2	50	52
Total	26	258	284

Table 20: OLS regression coefficients for Turkana County for both rural and urban households in terms of per capita food intake.

Location	Coefficient	Std deviation	P-value
Urban Households	0.1118083	0.330638	0.735
Rural Households	-0.7224084	0.1093397	0.000
Both rural and urban HH	-0.6481787	0 .1047182	0.000

Table 20 seems to suggest that food insecurity is more severe in rural Turkana than in the urban centres. This is in contrast with most of the country whereby the rural areas are the major sources of food. For most of Kenya, food is transported from the rural areas to the urban areas. For Turkana, food is transported from the urban areas to the rural areas. As table 21 clearly shows, most of this food supply comes from grants and some are acquisitions from the market. This confirms the results of the regression in tables 4, 5 and 6 above.

Table 21: Descriptive statistics of household consumption by food source

Food source	n	Mean(Kg)	Std deviation
Gifts and grants	284	1.401408	2.811033
Own stock	284	0	0
Own production	284	0	0
Purchases	284	2.21919	2.826892

This table shows the household consumption in Turkana by food source. It is evident from this table that Turkana households are dependent on the market and food grants for their household consumption.

3.2 Discussion

On the basis of the 2005-2006 KIHBS, all the estimations of the household adult-equivalents exceeded the calculations of the calorie availability as predicted by per capita calorie-intake. This would probably suggest an underestimation of the values of food availability per capita for the household members. The estimations for the household adult-equivalents are shown in appendix 1. A critical look at the different variables examined in the study is made below.

3.2.1 Food security and geographic location

A regression of Per capita food intake as the dependent variable against the Counties reveals that Turkana County does make a negative contribution to national food security and is indeed extremely food insecure. The coefficient for Turkana increases considerably to a large statistically significant and negative value when the regression is performed for the rural households less the urban households, confirming that households that are found in the distinctively rural areas of Turkana are in a more worse off situation compared to those in urban centres. This is in stark contrast to most of the country whereby households found in the rural areas are food secure because agricultural production in Kenya is mostly practised in the rural areas where large and productive agricultural land are to

be found. The regression for rural areas omits both Nairobi and Mombasa due to a lack of observations and this is expected due to the fact that these are the largest cities in the country and are much urbanised. Exclusion of the urban areas from the regression increases the influence of Turkana to national food insecurity and this underscores the gravity of the problem in rural households of Turkana County. This is captured in table 4 above.
It is therefore highly probable that the geographical location of the Turkana households puts them at a disadvantage compared with the rest of the country in terms of their ability to attain food security.

3.2.2 Food security and household characteristics

From the regression results it would seem that the household demographic profile has a considerably large influence on food security. It is determined that nationally, household size has a negative contribution to food security. Large households reduce per capita food availability effectively increasing household food insecurity. It is noted that although this effect was detected across all households in Turkana, it was more significant for rural households than it was for those that are found in the urban parts. This highlights again the gravity of the problem in rural households of Turkana, everything else notwithstanding, compared to their urban counterparts. In the rural parts of the County, it was established that the household size ranged from 1 to 24 members whereas in the urban centres, the household size ranged from 1 to 10 members.

It is also confirmed that even though there is a fair balance in household composition by sex and location (rural and/or urban), it appears that urban households have twice as many male members as the rural households. This confirms that more males can be found in the urban households than females, leaving females more exposed to the dangers of food insecurity in the rural areas. Table 9 clearly seems to suggest that urban households have fairly fewer members compared to their rural counterparts in Turkana County, dealing a serious blow to per capita food availability in the rural households where food availability is already constrained. The data also appears to suggest that there is a close association between food security and marital status. The rural areas of Turkana where the most food

insecure are located are made up of large family units' while most of the people found in the 'less secure urban centres' of the County are either monogamous or have never been married. This would seem to indicate that household members, in an attempt to improve their welfare, leave the challenges associated with food insecurity in the rural areas to seek greener pastures in towns.

The data also shows that there exists a very close link between economic shocks, the location of the household within Turkana; whether rural or urban, and food security. Table 15 seems to suggest that for most of the time when the shocks occurred in the rural areas, those affected were mostly members of the same household although the effect of the shock was also reported by most households within the community. The urban areas reported lower number of households affected by the same shocks.

3.2.3 Food security and production characteristics

All the production-related variables such cost of farm labour, expenditure on long term crops, expenditure on farm implements, land size and expenditure on land reclamation were tested on their relationship with per capita food intake. None was found to have any statistically-significant effect on Turkana.

It is noted that mean consumption from own production and own stock is equivalent to zero and that the only source of consumption for households in the County is grants and the market. This is a very precarious situation which means that a withdrawal of these grants is likely to emanate into a considerable shock for households in the County. The importance the market as a source of food material for households also highlights the sensitive role of consumer goods prices on food security for the households of this region. Any increase in the prices of these goods would most likely lead a negative impact on food security in Turkana.

3.2.4 Food security and socio-economic characteristics

It is determined that a number of socio-economic variables seem to have a direct correlation with food security in Turkana. The cost of water is noted to have a considerable negative impact on household food security. Even though this influence was not statistically

significant, its contribution to the problem in Turkana cannot be underestimated. It is equally noted that the cost of water contributes more to the problem in the urban centres of Turkana than the rural parts of the County. This could be because water can only be supplied by the market and this costs money whereas in the rural areas, water can be obtained from communally-owned boreholes, springs, tube-wells or ponds and seasonal rivers. The total time taken to queue for water is also found to be positively related with food insecurity in Turkana County. The rural households spend between zero to 300 minutes queuing for water as opposed to the urban households that spend a maximum of 20 minutes on the queue for water. The time taken to queue for water is used in the study as a proxy for the scarcity of water for both rural and urban households. This much time could considerably reduce a household's commitment to the search for food. As table 9 shows, Turkana households spend an average of 52 minutes on the queue for water, way above the national average of 12 minutes. It is also noted that loss of regular assistance has a direct relationship with food insecurity among the people of this region. Even though this influence is not statistically significant, it is noted to be big. It is also observed that the households that are affected by a withdrawal of regular assistance came from the rural households. This probably points fingers at the role of grants and relief support in food insecurity whereby an attitude and culture of dependency is created that ends up working against the interest of the recipients. All the households that lost regular support were found in the rural areas, regions already exposed to food insecurity, worsening their situation.

3.2.5 Food security and environmental factors

It was hypothesised that environmental factors would have an impact on food security in Turkana county. It is noted that severe water shortage has a statistically significant influence on per capita calorie intake for the households in Turkana. This influence was found to be statistically significant at both the 5% and 10% levels. This is captured in table 3 above. Table 19 confirms that water shortage was reported in 50 rural households out of the 52

households in Turkana. This again seems to suggest that rural households are more affected by water shortages than their urban counterparts. Such severe shortages would therefore mean that households cannot engage in economic activities, given the importance of water in agricultural production.

Food insecurity is also noted to be positively related with large increases in the sale prices of crops. This relationship is found to be statistically significant. Furthermore, the manner in which households store water is found to have a positive relationship with food insecurity. Virtually all the households included in the survey in Turkana reported storing their water in either jerry cans or buckets and only two reported that they do not store this precious commodity at all. These jerry cans and buckets are very small containers that may not offer sufficient storage for water to a community that has reported severe water shortage as a chronic problem.

4 Conclusion and Recommendations

The main focus of this study was to investigate the determinants of food insecurity in Turkana County in North western Kenya. I have attempted to interrogate the role of different factors in explaining this chronic problem by using the dataset generated by the Kenya Integrated Household Budget Survey, KIHBS, 2005-2006. In the study, I used a key component of food security, food availability, as measured by the amount of kilocalories available in two food items most commonly consumed by the people of this County, maize and millet, in their various forms. The study classified these factors as production-related, household-related, environmentally-related, culturally-related, physically-related or as factors related to the socio-economic profile of the county

This study confirms that there exists a lower per capita calorie intake in Turkana compared to the rest of the country with the exception of Mandera County. It is also confirmed that the per capita calorie intake in Turkana falls way below the average kilocalorie requirements for all age and sex categories. The main findings of the paper are that severe water shortage, household size and geography are the three most important factors that undermine the ability of the Turkana community to attain food security. Another very important key finding of the study is that food production in the County of Turkana is too low and most households have to depend on food grants and purchases from the market for their daily consumption. Though caution is warranted in interpreting the evidence provided by my regression and summary statistics, there is adequate and very strong argument that severe water shortage is the most important determinant of food insecurity in Turkana. In making this claim, I am not saying that these are the only factors responsible for food insecurity in Turkana County. Rather, the evidence provided by this study support and point towards this conclusion. The lack of food and any food stocks from the households' own-production is a clear pointer to the problems and challenges being experienced by the production side of the market in Turkana. Since land related characteristics as well as the variables related to the use of farm inputs and equipment have tested insignificant in the analysis, it

would seem easy to look towards the other production related characteristics in the analysis.

Other than the water shortage problem, the other factors could be described as the supporting cast. Given the harsh physical infrastructure in the County coupled with high transaction costs associated with transport and marketing of agricultural produce from the food surplus parts of Kenya into Turkana, food grants occupy a central position in this part of Kenya. A withdrawal of this support has been shown to have a significant effect on the Turkana households. The study also seems to suggest quite clearly that the rural parts of the County are more food insecure than its major urban parts such as Lokichogio and Lodwar. From the results of this study, it is not easy to statistically determine or isolate the role of government policy towards the situation of food insecurity in Turkana. The hypothesis that government policy has contributed to the problem in the region there lacks valid evidence. However, it is fairly clear that supply-side factors; namely geography and weather, alongside a very strong demand-side factor; namely the household size as a demographic variable, have a strong causal relationship with the situation in the area. However, there are two areas in which further research is still required. First, the use of a data set that has the family profile disaggregated by not just age and sex but also physiology, body size, and whether the female members of the household are pregnant or not. This would contain and subdue any fears of classification errors in the analysis. Secondly, a dataset that is tailor-made to measure food security would be highly necessary to complement the findings of this study. One probable approach would be to conduct a consumption survey that would generate raw data from the households. This kind of data would record the entire food intake by household members including wastages, food eaten by visitors and those given out to domestic animals. Food eaten by household members outside of the homestead would also be captured and this would provide the best estimate of the volume of food available to the household.

Thirdly, the study did not establish any link between food insecurity in Turkana County and the production-related variables such land size, land quality as proxied by land texture and the cost

and quantity of farm inputs used in farming. While it is possible that these variables have no direct contribution to the problem in Turkana, it would help to conduct an impact evaluation to isolate completely any potential role of these factors from the problem of food insecurity in Turkana County. Interventions need to direct resources towards irrigation, water harvesting and family planning in Turkana. The burden of proof shifts to those who argue that government policy has undermined food insecurity in the land of Turkana.

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APPENDICES

Appendix 1. Adult-equivalent conversion factors for estimated calorie requirements according to age and gender[6].

Age(years)	Kilocalories	ae conversion-factor
Children		
child 0_1	820	0.283
child 1_2	1150	0.397
child 2_3	1350	0.466
child 3_5	1550	0.534
Boys		
ma 15_7	1850	0.638
ma 17_10	2100	0.724
ma110_12	2200	0.759
ma1 12_14	2400	0.828
ma1 14_16	2650	0.914
ma1 16_18	2850	0.983
Men		
ma1 18_30	3000	1.034
ma1 30_60	2900	1.000
ma1 60p+	2450	0.845
Girls		
fem 5_7	1750	0.603
fem 7_10	1800	0.621
fem 10_12	1950	0.672
fem 12_14	2100	0.724
fem 14_16	2150	0.741
fem 16_18	2150	0.741
Women		
fem 18_30	2100	0.724
fem 30_60	2150	0.741
fem 60p+	1950	0.672

[6] Author's own calculations based on FAO,WHO and UNU (1985) as published by Smith and Sibandoro (2010)

Appendix 2 Concepts and definitions

Rural area:

In the Kenya Integrated Household Budget Survey, 2005-2006, a rural area was used to describe centres with a population estimated at less than 2000 people during the 1999 National Population and Housing Census.

Urban area:

This comprises urban centres whose population was estimated at 2,000 or higher during the 1999 Population and Housing Census.

Household:

This comprises a person or a group of people living in the same compound (fenced or unfenced), answerable to the same household head and sharing a common source of food and/or income. Domestic servants and other workers
residing with the family members were included in the Survey as household members

Land adjudication:

Issuance of title deeds by the government to private land-owners.