CAN LIVELIHOOD APPROACHES ADEQUATELY EVALUATE THE DETERMINANTS OF FOOD INSECURITY TO INFORM INTERVENTIONS IN KENYA?

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DECLARATION

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As Research Supervisor, I agree to submission of this dissertation/thesis for examination.

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Prof. Sheryl Hendriks

As Research Co-supervisor, I agree to submission of this dissertation/thesis for examination.

Signed: ..... Date: .....

Prof. Gerald Ortmann

DEDICATION

I dedicate this work to my dear sister for her uncommon wisdom, to my mother for believing in me, sometimes without sufficient reason to do so, and to my father for his strong encouragement.

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ABSTRACT

Food insecurity has remained pervasive for most Kenyan livelihoods despite the implementation of substantive interventions by the government and its development partners, since it gained independence in 1963. The inability to isolate distinct determinants of food insecurity for each livelihood group has led to interventions and solutions that have entrenched food insecurity rather than mitigate it. The key impediment to a livelihood-level analysis of food insecurity is the use of data and information collected at district-level administrative units, coupled with the absence of a robust analytical methodology.

This study set out to identify determinants of food insecurity for three distinct livelihood groups in Kenya, namely the pastoral, agro-pastoral and marginal agricultural groups. The study also sought to empirically evaluate incremental impacts of identified determinants of food insecurity for each group. The outcomes were intended to inform the selection of particular indicators in order to target, monitor and identify important inter-relationships between variables for each livelihood group.

Few studies have applied heterogeneous ordered logit regressions to livelihood-level data to evaluate food security determinants among livelihood groups and a comprehensive livelihood analysis of the determinants of food insecurity has not yet been undertaken in Kenya. Yet, Kenyan livelihoods are highly diverse, and livelihood characteristics transcend administrative boundaries.

This study used a heterogeneous ordered logit to model determinants of food security in Kenya. The variables were: conflict, HIV/AIDS, rainfall, flooding, proximity to markets, migration patterns, food consumption sources, income contribution sources and own farm production. Results of significance tests and residual variability from the ordered logistic regression led to the identification of important determinants of food insecurity in each of the three livelihoods. The degree to which each of the variables was influential in accentuating food insecurity in each livelihood, was also evaluated. Determinants of food insecurity and their inter-relationships informed the selection of indicators for monitoring.

Proximity to markets seemed to have a marked impact on food security in the pastoral, agro-pastoral and marginal agricultural livelihood groups. Conflict was influential in determining food insecurity, particularly for the pastoral and agro-pastoral livelihood groups. HIV/AIDS prevalence in the community was critical in determining food security status for the marginal agricultural and agro-pastoral livelihood groups. Rainfall was an important determinant of food insecurity in all the groups. Flooding had no significant impact on food insecurity. The results showed that an increase in the number of food sources improved food security in the pastoral, agro-pastoral and marginal agricultural livelihood groups. A diversity of income sources improved food security in the pastoral and agro-pastoral livelihood groups. The pastoral migration pattern seemed to have a substantial impact on food security especially in the pastoral and agro-pastoral livelihood groups. Own farm production was also influential in determining food security in both groups.

The study outcome provides a basis for identification of important monitoring indicators including agro-climatic, trade and market processes, migration dynamics, income and food sources and the stability, settlement patterns, key livelihood and coping strategies in the three livelihood groups. The strong inter-relationships between variables suggest that multiple variables need to be monitored concurrently to address livelihood food insecurity in Kenya. The findings suggest that livelihood approaches are central to identifying determinants of food insecurity in Kenya. The outcomes of the study provide a basis for informing interventions intended to reverse food insecurity in Kenya for each distinct livelihood group. Further research could include an analysis of the impacts of seasonality, an in-depth analysis of the markets and their marked influence in affecting food security, and applications of similar methodologies to evaluate of the food insecurity of livelihood groups that were not covered in this study.

Outcomes of this work are expected to provide a basis for formulating livelihood-specific interventions in Kenya. The results will provide a platform for further interrogation of important determinants of livelihood food insecurity by governments, researchers, and development partners. Aspects of the methodologies applied in this study can be replicated in adjacent countries with food security and livelihood characteristics similar to Kenya, such as Ethiopia and Somalia.

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CHAPTER ONE

STATEMENT OF THE RESEARCH PROBLEM

1.1 Introduction to the research problem

Food insecurity has increased in sub-Saharan Africa since the early 1970s, despite large investment by intervening governments, donors and non-governmental organisations (NGOs) (Food and Agricultural Organisation (FAO), 2009). The Millennium Development Goals (MDGs), and the first goal in particular, are intended to reverse this trend by halving 1992 hunger levels by 2015 (Regional Strategic Analysis and Knowledge Support System (ReSAKSS), 2009). The first Millennium Development Goal (MDG) seeks to eradicate extreme poverty and hunger (ReSAKSS, 2009; Fan *et al.*, 2009a).

FAO (2010) estimated that 30 per cent of the 715 million people in sub-Saharan Africa suffered chronic food insecurity in 2009. Chronic food insecurity occurs when a population has continuous inadequate consumption that arises from conditions of poor food production, limited income and poor health (World Bank, 1986). Clover (2003) indicated that up to five per cent of the population in sub-Saharan Africa routinely faces outright threat of famine. Von Braun *et al*. (1998) described famine as a catastrophic disruption of the social, economic and institutional systems that provide for food production, distribution and consumption. Unfortunately, prospects for reversing growing food insecurity are bleak in the absence of decisive implementation of the MDGs (Diao *et al*., 2007).

Unlike most other regions of the world, the number of food insecure people in sub-Saharan Africa increased in 2008, resulting from the 2007-2008 global economic shocks and heightened food prices (FAO, 2010). In addition, food insecurity was exacerbated by high rates of population growth in the absence of concomitant economic growth, compounded by the impacts of Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) and on-going conflict (Fan *et al.*, 2009b; FAO, 2009).

Food insecurity in the Horn of Africa is even more pervasive than the overall levels in sub-Saharan Africa, with about 86 million people or 35 per cent of the total population considered undernourished in 2008 (FAO, 2009). Kenya is no exception. The Kenya Food Security Steering Group (KFSSG) (2009) noted that at least one-third of Kenya's population of about 36.5 million people are highly vulnerable to food insecurity. The proportion of undernourished people in Kenya increased from 24 (in the early 1980s) to 33 per cent in 2005 and was projected to remain at 30 percent in 2009 (ReSAKSS, 2009). In addition, nearly 25 per cent of all children younger than five years of age were stunted in 2009 (Kenya National Bureau of Statistics (KNBS) 2010a), indicating extended periods of under-nutrition.

While adequate national food supply does not necessarily guarantee household food security, Saad (1999) claimed that a small decline in national food supply usually results in a marked negative impact on household food security through price and income effects. Per capita food production in Kenya declined by 16 per cent between 1980 and 1993 (FAO, 2004) and the regional food deficit is expected to double in 15 years. In Kenya, about 65 per cent of the population resides in rural areas and the majority derive their livelihood from agricultural activities - both crop and livestock (Kenya National Bureau of Statistics (KNBS, 2010b).

Omilola and Lambert (2010) contended that the proportion of overall national spending allocated to the agricultural sector in Kenya declined from 6.5 per cent in the 1990s to 5.2 per cent in the 2000s to 1.9 per cent in 2009. Clover (2003) also argued that public investment in agriculture in Kenya had declined from 33 per cent of total aid in the late 1970s to only 10 per cent in 2003 and was lower than 10 percent by 2008 (Organisation for Economic Co-operation and Development (OECD)-FAO, 2009). Kenya was a food surplus country until 1998 (Ministry of Agriculture, 2009) but has now developed a structural deficit and is a net importer of all key staple cereals, pulses and livestock products (Kenya Food Security Steering Group (KFSSG), 2009). The decline underscores the precarious food security status of an estimated 75 per cent of the Kenyan population that derives its livelihood from agriculture (KNBS, 2010a).

Hussein (2002) suggested that understanding livelihood characteristics is critical in developing appropriate interventions that mitigate growing food insecurity. This is necessary to increase the

ability of households to mitigate and recover from shocks and natural hazards, including drought. Rychentnik *et al.* (2003) proposed that interventions should include policies and programmes or actions intended to bring about identifiable outcomes, and will often rely on strategies that are planned and implemented across sectors.

The case for developing and implementing well-informed, long-term multi-sector development options cannot be overstated. Devereux (2009) was explicit on this, stating that 'new famines' are becoming more visible, but are not necessarily a function of conventional factors such as the absence of food supply or non-responsive markets, but have more to do with the failure to formulate and implement responses that address the core underlying problems. Holzmann (2001) stated that policies, strategies and interventions that improve long-term capacities to cope with hazards must be at the core of any initiative intended to reduce food insecurity. Timmer (2004) contended that improved food security comes directly from government policies that integrate the food economy into overall development strategies. FAO (2004) claimed that many programmes intended to alleviate food insecurity are designed and implemented without the participation of rural households, making them ineffective and leaving millions hungry and malnourished.

Hussein (2002) emphasised the need to analyse food insecurity, to develop interventions and to formulate policies through the lens of livelihoods. He stated that proper understanding of food insecurity depends on how well people's experiences of hunger are understood based on their livelihood constraints and opportunities. Proper understanding of livelihood characteristics will inevitably enhance the formulation of programmes that promote livelihood food security.

However, in Kenya since data are mostly collected at district level, most recommendations are based on district-level administrative units, despite substantial intra-district household variability. Subsequently, salient differences between and across livelihoods in a given district are smoothed over, leading to over-simplification of proposed solutions.

Watkins (2003) argued that in a livelihood zone, people will share roughly the same socio-economic and cultural characteristics, and have a similar way of life or livelihood. While there

may be some differences within a livelihood zone regarding socio-economic endowments and other characteristics, a livelihood group is assumed to be homogeneous in key characteristics for the majority of people. It is therefore assumed that people living close to one another, with frequent interactions, employ similar methods for mitigating natural hazards and exploiting the economic environment. They are also subject to the same kinds of risks and hazards. As such, food security policies and interventions developed for a relatively homogenous area such as a livelihood zone are likely to be more accurate than those that run over diverse spatial units, such as administrative units.

1.2 Importance of the study

The purpose of this study is to identify the important determinants of food insecurity and to empirically evaluate their impact in the context of livelihoods across the country, based on a quantitative analysis. The identification of important determinants of food insecurity in the country's diverse livelihoods will provide a more informed understanding of underlying causes of food insecurity for each livelihood group in the country. The study aims to provide both the government and its development partners with a sound basis for decision-making by providing input to policy formulation for interventions that build the resilience of distinct livelihoods. Most interventions including those carried out by the Kenya Food Security Steering Group (KFSSG) and the World Food Programme (WFP) are predominantly focused on emergency interventions intended to address short-term emergency needs, in part due to the expediency that is required to mitigate the advancement of this on-going crisis.

This study informs important intervention and policy options not only for Kenya, but also for adjacent countries that share comparable livelihood options and are subject to similar shocks and hazards. Boudreau (1998) defines hazards as events such as drought or war that lead to shocks, including reduced crop and livestock production, which affect households' access to markets, food, and income. Such hazards are recurrent in a number of countries on the Horn of Africa, such as Kenya, Ethiopia, Sudan and Somalia. For example, pastoral areas of neighbouring countries such as Ethiopia, Kenya and Somalia which have similar agro-climatic conditions and livelihood characteristics are generally contiguous since livelihood groups tend to transcend national borders. While governance structures, types of institutions, and polices, differ from one

country to the next, similar methodologies are replicable even where determinants may not be identical. This study is also applicable in instances where different livelihood groups have similar food security outcomes (or classifications) because the type of variable and degree of influence of determinants will likely vary from one livelihood group to the next.

Kitchenman (2000) emphasised the need for food security analysis to capture the complexities of rural livelihoods. This study provides a holistic evaluation of the impacts of key characteristics inherent in Kenyan rural livelihoods on food security. Subsequently, the different facets of food security including internal livelihood capacities such as income and food sources have been evaluated. Exogenous factors such as market proximity, rainfall, conflict and HIV/AIDS have also been evaluated. Such an evaluation is critical in informing the policy-making process to ensure that resources are employed in a manner that achieves the stated objectives which seek to reduce livelihood-based vulnerability to food insecurity by strengthening livelihood productivities and resilience. By addressing the core limiting factors for food insecure livelihood groups, human capital and physical resources can be employed in a more cost-effective manner.

While data and information on the characteristics of different livelihood groups in Kenya have been collated by various organisations such as the (Kenya Food Security Steering Group (KFSSG), World Food Programme/Vulnerability Assessment and Mapping (WFP/VAM), Food and Agricultural Organisation (FAO), Famine Early Warning Systems Network (FEWS NET) and the Ministry of Agriculture, no empirical analysis of causality of food security outcomes for each disparate livelihood group has been conducted in Kenya. This study directly improves methodologies for evaluating food insecurity of premier food security institutions including FEWS NET, FAO and WFP, not only in Kenya but also in regional and international arenas. The outcomes or results from this work are expected to provide a platform for further interrogation of the determinants of livelihood food insecurity by governments, researchers and development partners. In addition, the methodologies applied in the study may be replicable in adjacent countries with similar food security characteristics, such as Ethiopia and Somalia.

1.3 Statement of the research problem

The purpose of this study is to identify the impact of the key determinants of food insecurity among three distinct Kenyan livelihoods and to recommend specific indicators to target and monitor the impact of programmes for each livelihood group.

1.4 Sub problems

The study is organised around three sub-problems:

Sub-problem 1: To identify determinants of food insecurity among distinct Kenyan livelihoods.

Sub-problem 2: To empirically evaluate the incremental impact of the determinants on food insecurity for each livelihood and food security category.

Sub-problem 3: To identify specific indicators to target and monitor the impact of programmes for each livelihood group.

1.5 Limitations of the study

The study relied on information and data collected on livelihoods, using a questionnaire. The data depended on the ability of the respondents to provide accurate answers. Extensive triangulation was applied to minimise these errors. However, some characteristics of livelihoods are qualitative and may not be adequately represented in a quantitative manner. For example, the role of coping strategies or intra-community relations is difficult to quantify and model. Subsequently, results obtained from modelling the impacts of the key determinants of food security may not have completely captured the contributory role of all the characteristics of livelihoods. Secondly, the study fails to capture transitory shocks and key temporal determinants of food insecurity due to the absence of panel data.

The study was based on rural livelihoods and did not explore urban food insecurity. The principal reason for this was that urban livelihoods are complex, dynamic and much more heterogeneous in terms of disparities in income, socio-economic opportunities and socio-cultural

constitution. Several urban sub-livelihoods required analytical methods and tools that differ markedly from those employed in the analysis of rural food insecurity, to achieve comparable results.

1.6 Assumptions of the study

The study assumed that livelihood characteristics would provide accurate inferences for household characteristics. While a livelihood group was assumed to be homogeneous in key household characteristics, inter-household variations invariably exist. It was therefore assumed that variations between households in a given livelihood group were not significant. Livelihood classifications are generally based on uniformity of the majority of the population in relatively small geographic units that circumvent wide disparities in key characteristics.

Limiting the study to traditional rural communities resulted from the assumption that these communities rely on a fairly limited range of natural resource based income generating activities. Watkins (2003) indicated that such an assumption would not hold for populations that are highly diversified and depend on a wide range of economic activities that are not natural resource based. Fortunately, this generalisation fits much of the population in Kenya and indeed, the Greater Horn of Africa region (FAO, 2008a).

The study made extensive use of secondary livelihood zone data developed by the Kenya Food Security Steering Group (KFSSG) and administered by technicians from government, the United Nations Agencies and NGOs. Questionnaires were employed at local levels in all 71 districts of the country. The assumption was that the questionnaires were consistently administered and that respondents in all the districts understood and answered the questions accurately.

1.7 Outline of the thesis

Chapter one has provided a background to the research question and defined the research problem. Chapter two provides a critique of livelihood approaches to food security analysis for the development of interventions. Chapter three presents categories of variables that impact food security among livelihoods. Chapter four expounds on the requirements and criteria for

appropriate intervention design. Chapter five outlines Kenya's food security institutional structures. Chapter six presents methods used in the identification of key determinants of food security, their degree of influence, and linkages between them. Results from the analysis are presented in Chapter seven. Conclusions and recommendations are outlined in Chapter eight which also provides suggestions on improvements to the study, and areas for further research. The following chapter evaluates livelihood approaches and their application in food security analysis and intervention design.

CHAPTER TWO

LIVELIHOOD APPROACHES IN FOOD SECURITY ANALYSIS

2.1 Introduction

It is a significant challenge for a food security analyst to ensure that all the elements that are or cause symptoms of food insecurity are adequately captured in any food security analysis (Hendriks and Maunder, 2006). The plethora of methods, both qualitative and quantitative, that are used to assess food security emphasise the difficulty in obtaining a uniform measure of food insecurity. Coates *et al.* (2006) argued that the causes and outcomes of food insecurity can be used on either side of a food security equation because of the close linkages between indicators of food insecurity and their outcomes. Livelihoods are multifaceted and exist in a complex and dynamic environment that is subject to a multiplicity of risks, hazards and opportunities. As a result, multiple measures are needed to fully represent the many dimensions of food security.

Although a substantial amount of research in food security has been conducted, and yet more is ongoing, additional work needs to be done. In particular, the development of a composite index or a set of critical key indicators, both qualitative and quantitative, that reflect the multiple facets of livelihood food security, are warranted. Evaluation of congruence and identification of divergences between qualitative and quantitative techniques are advisable to assess the relative strengths and constraints of each.

Ultimately, the objective of analysis techniques in livelihood analysis is to provide a basis for the formulation of required intervention or response options. Devereux (2009) stated that accentuation of food insecurity and livelihood failure is increasingly attributable to response failure, underlining the importance of appropriate measurement techniques.

For decades governments, international agencies and non-governmental organisations have grappled with the development of appropriate frameworks, methods and indicators in the measurement of food insecurity (Barrett, 2010). Calow *et al.* (2002) noted that while many

initiatives and studies provide useful insights regarding characteristics of the food insecure and necessary mitigation activities, most fall short of holistic analysis. Most analyses use artificially created units such as administrative boundaries as their units of analysis, while some employ measurement techniques that are determined by availability (or lack) of data. Usually, they attempt to strike a balance between adequately capturing the complexity of livelihoods and dealing with inadequate data, while simplifying the multi-faceted causes of food (in)security.

This chapter suggests that food security analyses conducted outside the framework of livelihoods may result in incomplete analyses and inadequate recommendations. Different methods have been employed in livelihood analysis because of the multiple determinants of food security inherent in livelihoods. The chapter provides a robust assessment of the complex nature of livelihoods that often lend themselves to a wide range of measurement techniques and explores the strengths and limitations of different techniques. The benefits and constraints of livelihood approaches are also outlined.

2.2 Livelihood frameworks in food security analysis

Calow *et al.* (2002) defined livelihood approaches as holistic, facilitating the understanding of multiple dimensions of food insecurity by minimising sector bias. The complexities are captured in the Department of International Development's (DFID's) (1999) Sustainable Livelihood Framework, where the internal characteristics of livelihoods are classified as human, financial, socio-cultural, social political, physical and natural assets. Normally, livelihoods are subject to a set of vulnerabilities (such as agro-climatic shocks and hazards, conflicts and price fluctuations), while operating within given institutional and policy environments. While many of the shocks and hazards are beyond the control of households, interactions between internal capacities, vulnerabilities, and the external environment, often determine the strategies that households adopt to promote or protect their food security.

Gladwin *et al.* (2001) stated that food security outcomes are a function of the interactions between internal livelihood characteristics and resources and institutional processes that inform livelihood strategies. Figure 2.1 depicts a livelihood framework adapted from DFID's 1999

framework and that of Duncombe (2007) and shows the nexus of interactions between livelihood assets and capabilities and the external environment. The interactions determine available livelihood options and resultant outcomes. Livelihood approaches recognise the interdependency and dynamic nature of livelihoods because abilities and assets are exchanged within and between livelihoods (United Nations, 2008). Livelihoods are dependent on internal factors, such as livelihood capital assets, and external factors, such as institutional set-ups and/or the policy environments. Food security outcomes are determined by interactions within and between livelihoods.

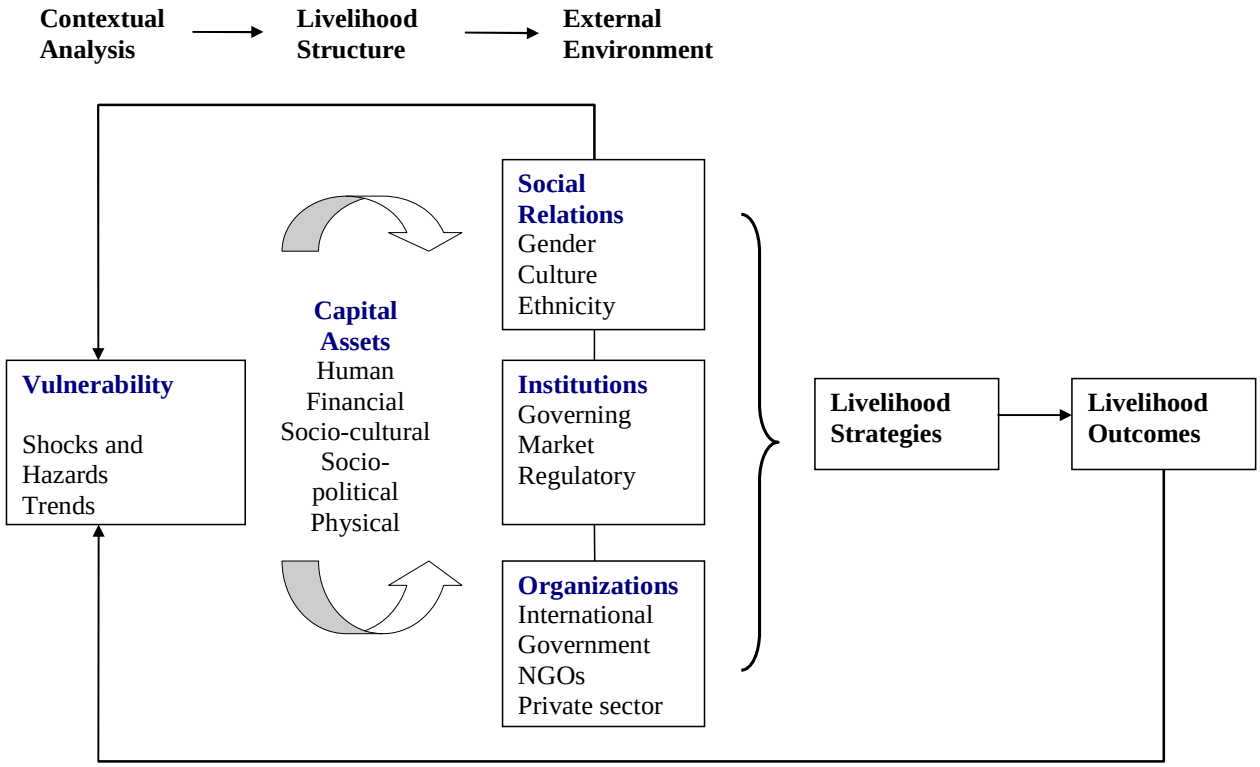

Figure 2.1: The livelihoods framework: adopted from DFID (1999) and Duncombe (2007).

Murray (2001) contended that livelihood analyses provide clear understanding of available opportunities for enhancing food security and overcoming constraints that limit the improvement of food security. A well-formulated livelihoods approach analyses key elements of the food security definition related to the availability, access and utilisation of food (FAO, 1996), and vulnerability to food insecurity (Maxwell, 1995). Devereux *et al.* (2004) claimed that livelihood

approaches reflect diverse and complex circumstances that people face and elaborate on the role of contextual factors in supporting or hindering food security.

2.3 Methodologies in livelihood food security analysis

Hendriks (2005) argued that holistic methodologies, such as livelihood approaches, pose significant empirical challenges because determinants of food security and characteristics of households are often diverse and inter-related. Webb *et al.* (2006) noted the complexity in food security analysis, stating that when households are subjected to shocks and hazards, they have to make multiple decisions. Some of these decisions include meeting immediate consumption needs, protecting assets and selecting coping strategies. To compound the challenges, data paucity, characteristic of most food insecure countries, limits the extent to which appropriate measurement tools can be applied (Maxwell, 1995). The complex nature of livelihood food security as illustrated by the livelihood framework, led to development of multiple measures and diverse methodologies in the estimation of food security. The nexus between internal livelihood characteristics and external influences that impact on food security outcomes, contribute to the complexity.

To address this complexity, both qualitative and quantitative approaches are used either separately or concurrently. Examples of qualitative methods, sometimes referred to as subjective measures, include experiential methods (Webb *et al.*, 2006), and coping strategy indexing (Maxwell, 1995). Quantitative methodologies commonly used in food security analysis include econometric methods, principal components analysis, and income accounting methods (Flamm, 1996). However, most methods usually include a mix of both quantitative and qualitative components. In many cases, outcomes from qualitative methodologies were fed into quantitative frameworks or tested for validity using quantitative methods such as principal component analyses (Coates *et al.*, 2003).

Table 2.1 presents a summary of techniques applied in food security analysis conducted by diverse practitioners, illustrating the opportunities and constraints of both qualitative and quantitative techniques.

Table 2.1: Methods applied in food security analysis, opportunities and constraints, 2009.

Method	Study	Opportunities	Constraints
Experiential Techniques	Coates *et al.* (2003)	Outcomes from qualitative analysis can be used in triangulating quantitative analysis. Analysis is conducted at the more detailed household level. Able to capture non-quantifiable information, including nuances. Close interaction with communities enhances interpretation of information. Useful tool for sudden onset disasters.	Findings are often not replicable from one setting to the next. Dependent on individual human perception that may be subject to factors such as socio-cultural norms. Dependent on ability of respondents to recall and uniformly interpret questions.
Coping Strategies Index (CSI)	Maxwell *et al.* (1999)	Provides a measure of vulnerability of households and sustainability of income sources. Identifies households that are most at risk of a food security crisis. The index can feed into multivariate analysis. The index is also a direct measure on intentional responses.	Emphasis on food self-sufficiency; as such the coping strategy index (CSI) does not adequately address other needs. Outcomes specific to individual samples and not comparable across samples. Focus on short-term strategies.
Income Accounting	Flamm (1996)	Provides comparison across units of analysis. Identifies most important income sources for analysis units. A fairly simply method to apply.	Income variables equally weighted. Captures only those variables for which data can be quantified. Assumes linear relationships between variables. Absence of contextual information.
Principal Components Analysis (PCA)	Manly (2004)	Able to detect relationships between variables. Generates a score from several variables. Makes use of co-linearity, which is unsuitable for linear regression. Able to extract coefficients from the variables or determinants when principal components are used as regressors.	Weights attached to variables are based on variance contributions and not underpinned by theoretical considerations.
Multivariate Linear Regression	Rahman and Nandini (1998)	Minimises subjectivity. Captures both covariate and idiosyncratic shocks. Coefficients of variables can be extracted. Useful when outcomes are continuous.	Contextual information may be lost in model specification. Data requirements are substantial. Independent variables need to be unbounded or interval. Assumption of independent explanatory variables not necessarily accurate.
Logit/Probit Regression	Gujarati (2002)	Allows dependent variable to have multiple outcomes, highly suitable in food security analysis. Odds ratio coefficients are generated. Useable when data distribution is normal. Works well for linear relationships. Restricts probabilities between 0 and 1.	Does not work for continuous dependent variables. Requires normally distributed data. Estimation of regression equation more time consuming. Assumption of independent explanatory variables not necessarily accurate.
Heterogeneous Ordered Logit/Probit Model	Williamson (2010)	Useful when the dependent variable is unobserved. Allows estimation of ordinal dependent variables. Accounts for heterogeneity of independent variable across categories making it practical in analysis of determinants of food insecurity across livelihood groups.	Mis-specification of the variance equation leads to biased results. Coefficients are difficult to interpret-comparison of coefficients across groups poses challenges in research. Assumption of independent explanatory variables not necessarily accurate.

2.4 Considerations in application of qualitative and qualitative methods in food security analysis

Food security is determined by multiple factors, some quantifiable and others less so. Consequently, the analyst constantly aims to strike a balance between employing purely quantitative techniques that are generally viewed as more objective, versus qualitative tools that capture important but often non-quantifiable information. Such analysis may be difficult to extrapolate across samples. The use of the Coping Strategies Index (Maxwell, 1995) is an example of a useful and largely qualitative tool that may not be replicable across samples, yet is able to capture aspects of vulnerability that are crucial in determining food (in)security.

Qualitative methods, as outlined in Table 2.1, such as experiential methodologies and the Coping Strategies Index (CSI) can be applied in rural settings to measure food insecurity, especially in instances where data are scarce or where a sudden onset disaster such as a flood or conflict has occurred, and there is little or poor quantitative information (Maxwell *et al.,* 1999). The experiences of households regarding their own food security are increasingly used in the measurement of food security. Webb *et al.* (2006) claimed that there is a high demand for measures that more accurately reflect the experiences that households face. Coates *et al.* (2003) contended that food security can be assessed by experiential methods, through a set of questions that provide sufficient information on the status of food security within households or communities. Such questions probe sufficiency of food consumed in terms of quality and quantity, assurances of capacities to acquire food, and whether food security is assured for all individuals in the same unit. The extent to which these questions adequately cover the key elements of the livelihoods framework, is doubtful. Food security analysts face considerable challenges while using qualitative methods, such as experiential techniques, as many households may have little idea about institutional or policy matters.

Qualitative measures, unlike quantitative methods, are often limited by the inability to replicate findings across different communities as well as the inability to compare findings among individual households (Maxwell, 1995). In many instances, limitations are mitigated by applying qualitative techniques to triangulate or verify experiential information. As in most qualitative analyses, strong interactions between livelihood communities and researchers are

prerequisites to enhance understanding of the context. Quantitative methods may not require such interaction. Coates *et al.* (2003) argued that experiential methods are often based on the assumption that the respondents' perceptions regarding food security are fully captured in their responses, even though many of them may not be measurable.

Quantitative methods are also extensively used in food security measurement within livelihood approaches. The most commonly applied methods used to capture the complexity of livelihoods include multivariate linear regression (Hoddinott and Yohannes, 2002), and more recently, probabilistic methods (Migotto *et al*., 2005), principal components analysis (PCA) (WFP, 2005), and the income accounting method (Flamm, 1996). The following section provides applied examples of these methods.

Rahman and Nandini (1998) modelled food security among households in rural Asia using econometric regression. In the model specification, three dependent variables are used to reflect the multiple pillars in the definition of food security, namely availability, access, utilisation, stability and vulnerability. The key advantage of using regression analysis in food security measurement is its ability to capture both the covariate and idiosyncratic shocks that often characterise food insecurity (Christiaensen and Subbarao, 2004). Another major strength of econometric models is that coefficients of each of the determinants can be estimated. The contribution of each determinant to food security contributes critical input in the identification of appropriate interventions to address chronic food insecurity.

Several food security analyses are founded on a model of household income or the income accounting method. Mutunga and Maunder (1998) used the income accounting approach to model food security of Kenyan households at district levels. The model assumed that rural household income was obtained from a narrow set of activities that included on-farm production (crop, livestock and fisheries), off-farm activities and transfers. The total income for each district was derived from the summation of all the income sources for each unit of analysis. Total income per unit of analysis was compared with cut-offs that established different levels of food security, using recommendations from FAO and WHO (Flamm, 1996). The key drawback of the income accounting approach, unlike regression analysis or the PCA method, is that it can

neither detect relationships between variables nor weight coefficients. In addition, outcomes derived from quantitative methods are often viewed as insulated from the analyst's or respondents' subjectivity.

Increasingly, probability models such as the probit or logit models are being employed in estimation of food security. Gujarati (1995) stated that probability models are appropriate where there is a dichotomous dependent variable. For example, the dependent variable in a regression could depict the absence or presence of food security. Food security analyses, including Barry (2005), Karki and Bauer (2005), and Weinberg and Jitting (2000), have all used logit or probit models. The probit or logit models, which are similar, use a qualitative value such as 0 or 1 as dependent variable to determine whether there is food insecurity or not. The dependent variable is usually equal to 1 if there is household food security, and 0 if there is no household food security.

Advantages of probabilistic models are that they do not pre-suppose linear relationships between the dependent and independent variables and they are not encumbered by restrictions inherent in linear regressions. As such, the dependent variable needs not be normally distributed nor be unbounded (Pohar *et al*., 2004). A more complex specification is required if the food security status does not fall into either of these categories and is not dichotomous.

2.5 Adoption of livelihood approaches in food security analysis

Hussein (2002) noted that livelihood approaches became the dominant thinking regarding food security measurement from the early 1990s. Subsequently, there has been broad consensus that livelihood approaches are pivotal to food security analysis and measurement (Devereux *et al.*, 2004). The approach became central in the analysis of food security for several key organisations and governments including OXFAM (Young *et al.*, 2001), Christian Action Research and Education (CARE) (Frankenberger *et al.*, 2000), the Department for International Development (DFID) (Duncombe, 2007), the Food and Agricultural Organisation's (FAO's) Food Insecurity Vulnerability Information and Mapping System (FIVIMS) (Devereux *et al.*, 2004), the World Food Programme (WFP), Save the Children (SC) (Marsland, 2004) and the

Famine Early Warning Systems Network (FEWS NET) (Chopak, 2000). Devereux *et al.* (2004) stated that since the mid-1990s, livelihood-based food security analyses became central in the design of anti-poverty and famine prevention interventions for many of these agencies. The United Nations Comprehensive Framework for Action (United Nations, 2008) emphasises the need for intervention options that address all components of the livelihood, including strengthening livelihood capabilities and resilience, while ensuring that institutions are functioning well.

The actual implementation of approaches varies between agencies. However, in most instances, the overriding objective of using livelihood approaches is to improve understanding of the multiple determinants of food insecurity. Devereux *et al.* (2004) contended that livelihood approaches are intended to inform decision-making processes to alleviate food insecurity by implementing appropriate interventions and programmes. The goal of interventions, for many institutions, is to save lives and livelihoods through the design of anti-poverty and famine prevention interventions, projects, and programs.

OXFAM applies the livelihoods approach to the measurement of food insecurity across its projects and monitors four key areas that relate to the definition of food security. The areas are: availability of food, ability of livelihoods to meet household food needs, severity of hazard in terms of its impact on entitlement and nutrition, and processes that generate long-term vulnerability for each livelihood. Livelihoods are categorised according to their degree of food insecurity, and appropriate interventions are subsequently developed. CARE, as outlined in Frankenberger *et al.* (2000) adopted a livelihoods approach in 1994 as the cornerstone framework for measuring food insecurity and informing programming decisions intended to alleviate food insecurity across CARE's projects. CARE's application of the approach allowed for strategic choices regarding allocation of resources. The objective in apportioning resources is to increase the probability of effecting sustained positive change in food security.

Løvendal *et al.* (2004) claimed that in applying the livelihoods approach to food security, a livelihood profile is essential. The absence of a profile could lead to important parameters that determine food security being missed, leading to poor interventions and welfare losses. CARE

developed a livelihood profile for each zone, elaborating on the context around livelihoods by analysing data and information regarding conditions and trends, livelihood resources, institutional processes around livelihoods, livelihood strategies and livelihood outcomes (Frankenberger *et al.*, 2000). The approach brings cross-sector linkages in developing food security analysis to the fore. CARE's approach states that food production does not necessarily assure household food security. However, the ability to procure food beyond production and the critical need to secure livelihoods are important elements in CARE's livelihood approach.

The FAO/FIVIMS livelihoods model, just like the OXFAM and CARE models, is intended to address both transitory and chronic food insecurity. The FAO/FIVIMS approach to food security measurement makes extensive use of geographic information systems (GIS). Devereux *et al.* (2004) explained that the use of GIS techniques in livelihoods analysis enhances the spatial visualisation and identification of food insecurity, even over small areas. FIVIMS, FEWS NET and WFP all use GIS in mapping out food security outcomes derived from their livelihood-based food security analysis (Devereux, 2004; Chopak, 2000; WFP, 2004). Institutional variations in the application of livelihood approaches are usually a function of project objectives, internal capacities, and importantly, the complexity or the multi-dimensional nature of livelihoods, rather than caused by a lack of agreement that the livelihoods approach is fundamental to food security analysis.

2.6 Livelihood zones in the context of sustainable livelihoods approaches

Løvendal *et al.* (2004) contended that the goal of food security analysis is to formulate interventions aimed at alleviating food insecurity for individual households. However, they argued that measurement for each individual household for an entire population is often impractical because substantive resources are required. The livelihood approach is intended to mitigate the inability to carry out detailed household analyses by grouping households according to food security characteristics, rather than artificial geographic boundaries such as administrative units. However, the downside to this is that in most countries, data are collected and response options formulated and implemented on the basis of administrative units.

Devereux *et al.* (2004) stated that livelihoods may be defined in various ways. However, the overriding determinant of a given livelihood zone is uniformity in dominant income sources; the majority of people in a given livelihood group derive their food and income from a similar set of economic activities. A livelihood zone is a geographic entity that is roughly homogeneous in key agricultural, geo-physical, socio-economic, and cultural characteristics (Watkins, 2003). Livelihood zoning involves clustering households in a given geographic area into groups that are similar or nearly homogeneous in such key characteristics. Chambers (1989) stated that the attributes commonly used in separating different livelihood zones include:

- main sources of food and income
- similarity in the types of vulnerabilities or exposure to risks, shocks and stress, and difficulty in coping with them
- capital assets
- social relations
- institutional and organisational set-up
- livelihood strategies adopted by the majority of households in a given geographic area.

The attributes are captured in the livelihood framework in Figure 2.1.

The core assumption in livelihood zoning is that in any one livelihood zone, people roughly share the same way of life and are subjected to similar shocks and hazards. In addition, people in a given livelihood zone are likely to employ similar coping strategies when hazards strike because response opportunities and available coping mechanisms are relatively homogeneous (Watkins, 2003). Livelihood approaches provide a fairly uniform platform for analysis and response options without disaggregation into small unmanageable units that can only complicate food security analysis.

Watkins (2003) concluded that the more homogeneous a given livelihood zone is in terms of key characteristics (such as the type, number and proportion of different income sources) the more accurate the analysis of food security is for a variety of shocks and hazards. In other words, delineation of livelihoods into livelihood zones that results in high homogeneity within

livelihoods improves the effectiveness of predicting food security outcomes. In addition, livelihood approaches are most applicable to traditional rural communities that rely on a generally predictable range of resource-based income generating activities.

2.7 Benefits and constraints of livelihoods approaches in food security analysis

Livelihood approaches aid in the disaggregation of administrative level analysis that masks substantial sub-national differences (Watkins, 2003). Hussein (2002) stated that the differentiation between administrative level and livelihood analysis is achieved through identification of livelihood-specific factors that cause food insecurity, drawing upon both macro and micro linkages across livelihoods (Duncombe, 2007). The approaches, therefore, improve understanding of food insecurity in the context of opportunities and constraints (Young *et al.*, 2001) and facilitate identification of appropriate interventions, suited to each livelihood group (Løvendal *et al.*, 2004).

Calow *et al.* (2002) argued that one of the critical strengths of livelihood approaches is balanced emphasis among disciplines that avoids bias toward one or more sectors which may result in improper formulation of interventions. The shift away from sector-specific emphasis to holistic analysis suggests that programmes or interventions intended to address food insecurity should be formulated and implemented taking account of multiple facets of food security. Livelihood approaches promote the formation of multi-disciplinary and multi-institutional partnerships required to formulate and implement multi-sector contingency plans, interventions and programmes.

Young *et al.* (2001) stated that livelihood approaches facilitate integration between longer and shorter term risks because of the explicit interaction between external and internal environments. For example, longer term risks may include the degrading environment in pastoral areas, while immediate short-term nutritional or life-threatening risks may include destitution arising from the decimation of livestock after a severe drought. Livelihood approaches, therefore, provide a basis for more realistic analyses which reflect the circumstances that households face more accurately.

A clear, holistic understanding of livelihood dynamics as well as functioning of the external environment and its impacts on livelihood decisions is required in food security analysis, Knowledge of potential threats and opportunities also need to be well understood (Devereux *et al.*, 2004). The reality is that this may not be the case in many rural settings because the data are not readily available at the desired levels of disaggregation.

Livelihood approaches are not without challenges. Hussein (2002) is realistic about the challenges that the complexity of livelihoods pose to food insecurity analysis. A holistic approach, such as livelihoods, requires a clear understanding of all the dimensions of given livelihoods in an integrated fashion, including assets, food security strategies, levels of access to resources, vulnerabilities, macroeconomic factors, the policy environment, and types of risks and hazards (Coates *et al.*, 2003). Although analytical capacities are limited in most countries, such holistic understanding is desired for each livelihood type in each country.

The changes in the livelihood structure that may occur are an important consideration that may pose significant challenges in food security analysis and intervention design (Negi, 2007). Transformations in the livelihood structure that take place over time are sometimes subtle, posing significant challenges or inaccurate conclusions when revisions to the zoning are not conducted when these changes manifest. For example, a decline in crop yields over a period of time resulting from reduced fertility in predominately cropping livelihoods may not be adequately captured in instances where baselines are not regularly updated, compromising the analysis of food security outcomes.

Livelihood approaches are situated in diverse political environments that may or may not be impediments to the adoption of recommendations. For example, Calow *et al*. (2002) contended that recommendations from a food security analysis conducted within the context of livelihoods, can differ from those of governments and other development partners. These agencies may be more interested in implementing emergency interventions for political expediency than to solve immediate problems. While involvement in mitigation or long-term development initiatives may be more effective in enhancing food security, it is often more time-consuming and the impacts are not immediate.

Rass (2006) has also advocated for a multi-sector approach in employing livelihood approaches. A multi-sector approach highlights the complexity of decision-making processes that bring together governments, donors and NGOs in control of resources, joint identification, participation in, and ownership of projects or programmes. Devereux (2009) claimed that the high degree of collaboration required is often not easy to achieve and results in inadequate apportioning of responsibility if problems arise in decision-making or in implementation.

Another challenge for food security analysts is that regions, locations or livelihoods that are the most food insecure often also have the least amount of quality data and information (Pantuliano and Wekesa, 2008). Subsequently, the type of food security analysis is usually driven by available data and information. Needless to say, the outcome/s of such analysis often lacks the rigour and validity that accurately reflect the food security dynamics in the livelihood or unit of analysis. Since the ultimate goal of food security analysis is to develop appropriate policies, programmes and interventions that decisively alleviate livelihood food insecurity (Iram and Butt, 2004), absence of sufficient data and information often leads to implementation of interventions that are neither sufficiently comprehensive nor appropriate (Haan *et al.*, 2006).

Despite significant challenges in application of livelihood approaches, the benefits are critical. Livelihood approaches seek to model realities inherent in livelihood groups across national and sub-national levels. Analysis of food security outside the remit of livelihoods often tends to ignore factors that are not readily analysed either due to data paucity or lack of clear understanding of important linkages with livelihoods.

2.8 Summary

As the chapter suggests, livelihood approaches involve significant institutional, policy and socio-political challenges. Methodologies used for analysis are many and varied, and interactions between livelihoods are complex and dynamic since livelihoods are faced with multiple risks and hazards. Despite significant challenges in the application of livelihood approaches, there is broad consensus among key food security institutions that livelihood approaches should be central to food insecurity measurement. The following chapter provides a review of the indicators of food (in)security that livelihood approaches commonly employ.

CHAPTER THREE

INDICATORS OF LIVELIHOOD STRESS AND FAILURE

Most food security organisations have adopted livelihood approaches to food security measurement, as shown on Figure 2.1 in Chapter two. The key point of congruence among organisations lies in the assessment of interactions between internal livelihood capacities, vulnerabilities, and the external environment. Smith *et al.* (2000) stated that causes of food insecurity are many, broad and interrelated, which can be attributed to the complex nature of food security. In general terms, indicators of food security are broadly classified into climate and environmental; economic, production and market; conflict and political; governance and policies; and demographic and socio-cultural factors (Chopak, 2000). However, organisations all have specific analytical emphases, invariably determining the type of data or indicators used.

Livelihoods are linked to individual, household, national and global factors, further underscoring the complex relationships and determinants underlying food security (Gladwin *et al.*, 2001). Coates *et al.* (2003) emphasised that the goal of food security analysis is to identify important determinants of food insecurity that lead to the development of broad and appropriate interventions which address chronic food insecurity. Table 3.1 reflects a comparison of indicators used by some key food security organisations that operate globally and employ livelihood approaches - followed by a discussion of these indicators.

3.1 Climate and environmental factors

Climatic and environmental factors are critical components of livelihoods, shown in Figure 2.1, and determine vulnerabilities to climate-related hazards such as drought and floods. Climatic factors also inform the type of interactions and linkages with other components within livelihoods, determining the types of livelihood strategies that are appropriate as well as the type of interventions that are recommendable (Boko *et al.*, 2007).

Table 3.1: Key livelihood indicators used by organisations in food security analyses.

Institution	Emphasis	Livelihood Indicators
Food and Agricultural Organisation/ Food Insecurity Vulnerability Mapping Unit (FAO/FIVIMS)	Nutrition and health (Devereux, 2004)	**Socio-economic and political environment – national and sub-national** Agricultural sector, education, macro-economy, policy, natural resources, markets, household and livelihood characteristics, socio-cultural environment. **Performance of food economy indicators** Food availability, food access, stability of food access, food consumption and food utilisation and nutritional status. **Child care practices** Feeding practices, nutrition, eating habits, intra-household food distribution. **Health and sanitation** Hygiene, water quality, sanitation, food safety and quality.
Famine Early Warning Systems (FEWS)	Internal and external livelihood interactions and spatial outcomes (Chopak, 2000)	**Agro-climatic and agricultural production** Remote sensing and ground station rainfall and vegetation data, crop and livestock production indicators and season progress data. **Health and nutrition** Anthropometric survey data, child care practices and disease outbreaks. **Socio-economic indicators** Prices, markets, incomes, expenditures and consumption. **Macro-economic indicators** Exchange rates, inflation rates and cross border trade. **Demographic and livelihood zone data** Population census, migrations, livelihood characteristics and structure. **Bio-physical and mapping data** Land use, land cover, administrative boundaries, settlements, roads. **Vulnerable populations** Geographic location, characteristics, on-going responses and gaps. **Risk factors** Hazards – droughts and floods, price and policy fluctuations and conflict.
Christian Action Research and Education (CARE)	Livelihood relationships (Frankenberger *et al.*, 2000)	**International relations** International markets, donors and international organisations. **National relations** Markets, government and civil society relations. **Local relations** Markets, government and political structures, and community relations. **Household factors** Intra household gender relationships and generational structures. **Environmental factors** Resource use trends, climate cycles and disease outbreaks.
OXFAM	Nutrition and livelihood food security (Young, *et al.*, 2001)	**Food availability** Food production indicators – output, yields, market mechanisms and prices. **Food access** Identification of key livelihood groups by degree of access and method of acquiring food. **Severity of food insecurity - risk to lives** Ability of people to feed themselves and impact on nutritional status. **Severity of food insecurity - risk to livelihoods** Nature of external shocks and ability to cope with shocks.
Save the Children (SC)	Household food economy (Marsland, 2004)	**Sources of food and income, wealth groups** Crop and livestock production, fishing, gifts, wild foods, income from exchange of household production and labour, and wealth categories. **Socio-economic indicators** Market trends, government policies and interactions, seasonal access to food and income, expenditure patterns, non-market factors - savings and assets. **Shocks and hazards** Impacts of shocks and hazards (climate changes, conflict, price and policy fluctuations) on household food availability and income. **Coping strategies** Type, frequency of use and expandability of income sources.

Haile (2005) argued that climate is one of the most important factors impacting food security in sub-Saharan African countries where food security is largely dependent on rain-fed agriculture. Mati *et al.* (2005) noted that in most of the Horn of Africa, rainfall is low, unreliable, poorly distributed and a key determinant of food insecurity in the region. Funk and Brown (2009) contended that many countries in the Horn of Africa are subject to extreme weather variability that results in droughts and floods. The weather hazards have deepened and are occurring with increasing regularity, negatively impacting food security (Funk *et al.*, 2010; Funk *et al.*, 2011).

Douglas (2009) claimed that the frequency of flooding episodes over the past 10 years have increased with severe detrimental impacts on food security, damaging infrastructures and productive capacities. FEWS NET (2006) indicated that in the pastoral areas of Kenya, impacts of poor agro-climatic conditions including drought and floods have heightened food insecurity by compromising productivity and causing decimation of livestock. Traditional coping mechanisms have been eroded by increasing poor seasons that reduce the capacities of drought-affected livelihoods to plan for and adopt new production initiatives. Noojin (2006) and Christiaensen and Subbarao (2004) stated that there a clear relationship between food insecurity and the number of drought years has emerged in the arid and semi-arid areas of sub-Saharan Africa over the past four decades.

Pinstrup *et al.* (1997) argued that food security and the environment are inextricably linked and that food security can only be sustainable when the natural resource base is soundly managed to support livelihoods. Environmental degradation and loss of forest cover results in declining fertility and productive capacities of lands in many food insecure countries in the Horn of Africa (FAO, 2004). Prospects are grim and land degradation continues to be a pervasive problem since nearly two billion hectares of land have been degraded and millions of people have been affected (Wiebe, 2003). FAO (2002) attributed the rapid rate of land degradation to unsustainable use of resources in marginal lands arising from rapid changes in demography including migrations, population concentrations and high population growth rates.

KFSSG (2009) claimed that as droughts have extended and intensified, drought-prone livelihoods have exhausted their traditional coping strategies. Coping strategies that are

detrimental to the environment, such as charcoal and firewood production, are being increasingly employed. Thrupp and Megateli (1999) contended that food insecurity exacerbates further food insecurity and leads to the exploitation and degradation of resources in order to survive, further compounding food insecurity.

3.2 Economic, production, and market factors

Economic, production, and market factors interact with other attributes within livelihoods, such as vulnerabilities and internal capacities to determine the type of livelihood strategies that are viable. Iram and Butt (2004) stated that economic security is a prerequisite to food security and is related to sufficient, stable income coupled with manageable expenditures. In addition, household income is a good predictor and an important determinant of household calorific adequacy and in turn food security (Flamm, 1996). However, production systems in sub-Saharan Africa are characterised by multiple shocks – climatic, political and economic (Pavanello, 2000). Recurrent shocks and hazards erode the asset base of livelihoods and compromise capacities to achieve economic security.

Over half of the domestic product of most countries in sub-Saharan Africa is derived from agricultural production (USAID, 1996). Yet, assistance to agriculture has declined over the past decades, from 33 per cent of total aid to 10 per cent in 2003 (Clover, 2003). USAID (1994) argued that low investment in agriculture and production technologies maintains food production at subsistence levels, and so opportunities for expanding the income base are absent. Population growth in sub-Saharan Africa grew faster than production growth over the past several decades (FAO, 2008b). Production growth is lower in the most food insecure countries. In addition, even positive growth in per capita national agricultural production hardly assures improvement in food availability, especially among the most vulnerable households (FAO, 2004).

Neufeldt *et al.* (2010), Hengsdijk *et al.* (2005) and Acharya (2007) noted that income diversification has the potential to mitigate food insecurity by spreading risk across different enterprises. Hassan *et al.* (2005) and Murray (2002) argued that diversity in food production

sources confers food security to households through linkages with improvement in nutrition levels. Many food insecure populations in sub-Saharan Africa, including Kenya, depend on a narrow set of weather-dependent income generating opportunities (UN, 2000). Subsequently, there are few opportunities to avert or spread risk. Smith *et al.* (2000) suggested that food insecure livelihoods are also vulnerable to exogenous economic decisions that compound traditional shocks such as the rise in global food prices in 2008.

Christiaensen and Subbarao (2004) argued that proximity to markets is an important determinant of food security. Tembo and Simtowe (2009) and Babu and Sanyal (2009) stated that closeness to markets provides access to food, credit, better terms of trade and interventions. Yet, markets situated in food insecure areas are often characterised by heightened marketing costs which include risk and high transport costs coupled with limited market information (Tangka *et al.*, 2002). Simmonds (2006) argued that resource poor farmers are unable to exploit the benefits of market liberalisation because they have little contact with markets that are poorly integrated. Market liberalisation that is carried out in the absence of concomitant improvements in the trade infrastructure has increased food insecurity because of a lack of equity in terms of trade and competition (Barraclough, 1996).

3.3 Conflict and its impacts

While conflict and political factors are often outside the control of households, they are nevertheless a growing consideration for most institutions in assessing vulnerabilities and in informing intervention design (Seddon, 2004). Food insecurity is both a cause and effect of many crises in the Horn of Africa region (USAID, 1996). Thrupp and Megateli (1999) stated that the Greater Horn of Africa is probably one of the most food insecure regions of the world and has been the epicentre for wars and conflict over the past 20-30 years. Theisen *et al.* (2010) claimed that scarcity of environmental resources is one of the major factors that precipitate conflict. Predisposing factors include erosion of traditional conflict-solving mechanisms, increasing supplies of small arms from past and current regional conflicts, movement of pastoralists from degraded environments into cropping areas, and erosion of traditional coping mechanisms (Omosa, 2005; Buhaug *et al.*, 2010). The African Union (AU, 2006a) and (FAO, 2006) argued that conflicts are increasingly more important in exacerbating food insecurity than

natural disasters. Conflicts often lead to destruction of food systems by depressing incomes from production and also compromising the coping capacities of those whose production systems are adversely impacted (Messer and Cohen, 2004).

The impacts of shocks and hazards such as droughts are usually more devastating in fragile or failed states (Clover, 2003). For example, while livelihood characteristics and weather patterns in pastoral areas of southeastern Ethiopia, northeastern Kenya and southern Somalia are generally similar, food insecurity deteriorated to the famine level among Somali pastoralists in July 2011 (FSNAU, 2011) and to emergency level in Kenya and Ethiopia during the same period (FEWS NET, 2011). Alinovi *et al.,* 2007 contended that dysfunctional institutions in failed states entrench food insecurity because markets do not function appropriately, infrastructures are not facilitative and interventions cannot be implemented effectively in crisis situations.

Donker and Ohiokpehai (2005) stated it is widely recognised that whatever the causes of conflicts, they impact negatively on livelihood food security through the loss of human life and livestock by reducing the productive capacity of both households and livestock. Jaspars and Maxwell (2009) also noted that conflict reduces access to grazing resources after well-defined dry season grazing areas and stock routes are rendered unusable by conflict. Areas prone to livestock raiding are increasingly synonymous with areas of increased food insecurity, often manifesting in higher rates of child malnutrition (Tanner-Grobler, 2006; Geinitz and Reinhard, 2003). Although conflict is increasingly pervasive in food insecure pastoral livelihoods, development interventions pay little attention to conflict mitigation and prevention (Seddon, 2004).

3.4 National policies

Implementation of policies that are intended to alleviate food insecurity is problematic in most food insecure countries because of governance and political considerations (Maunder and Wiggins, 2006). Donker and Ohiokpehai (2005) contended that the relationship between food security and governance is complex because of inter-linkages between cause and effect. However, institutions are central to the formulation and implementation of policies. The role of organisations in formulating and implementing policies Serrat (2008) underscores the value of

organisations in the sustainable livelihoods approach shown on Figure 2.1, arguing that food security outcomes are not just dependent on livelihood assets and vulnerabilities but also on institutions. Leach *et al.,* (1998) noted that institutions may either be formal or informal yet play both an important role in the legislation and implementation of policies across sectors. Scoones (1998) contended that institutions are crucial in ensuring that the complex livelihood characteristics and processes are knit together and can determine the extent to which livelihood strategies are adopted. Institutions, therefore, can confer or deny access to resources to implement livelihood strategies, and impact outcomes depending on the extent to which they are facilitative.

Unstable political systems contribute greatly to the inability of livelihoods to attain their productive capacities largely through poor policies (USAID, 1996). Resultant food insecurity promotes economic, social, political and environmental instability. Muggah and Griffiths (2002) stated that many of the instabilities, including conflict and flow of arms, transcend national borders. Yet, there is limited regional integration between governments to address cross-border conflict dynamics in a coherent fashion (Hameso, 2008).

Effective food security policies and programmes require multi-sector approaches that account for economic, social, cultural and ecological constraints at local levels (Iram and Butt, 2004). However, improved agricultural production policies are central to alleviating food insecurity among rural households because of overwhelming dependence on agricultural production (Agboola *et al.,* 2004). Jones (2002) argued that allocation of resources to any one sector needs to be supplemented by investment in other sectors such as health, education and infrastructure because of the multi-faceted nature of food security. Lack of clarity regarding food security policies also impacts food security; the government of Kenya allowed imports of genetically modified maize grain for milling while upholding the ban on genetically modified seed (the Standard 15th July, 2011). However, a significant proportion of the Kenyan population remain sceptical that the proposed stringent measures will be implemented (KFSSG, 2011). Lack of clarity regarding management of imports severely constrained imports of maize grain during 2011. Subsequently a significant shortfall in national maize supply sustained prices well above normal levels in 2010 and most of 2011, further compromising purchasing capacities of food

insecure households that purchase the overwhelming proportion of cereals from the market (KFSSG, 2011).

Nori *et al.* (2005) claimed that most food insecure livelihood groups, such as pastoralists, are minorities in the political context and governance structure. As a result, national policies pay inadequate attention to the development of marginal areas, limiting attention to food insecurity. Policies that promote inequitable distribution of resources and other productive assets accentuate food insecurity (Hameso, 2008). The AU (2006b) underscored the point, observing that governments in sub-Saharan Africa often prioritise urban infrastructure while rural roads remain dilapidated, heightening transport costs and food prices among food insecure households. Producer prices remain low, while input prices are high, compromising agricultural production in rural areas already prone to food insecurity (KFSSG, 2008a).

Nath (2009) noted that implementation of critical environmental policies is inadequate in most food insecure areas. Conservation-oriented farming practices are not incorporated into farming regimes, in part due to population pressure (Pinstrup *et al.*, 1997). Unfortunately, non-enforcement of environmental policies has resulted in unsustainable use of land, further exacerbating food insecurity (Kugelman and Levenstein, 2010). The size of land holdings is an important determinant of food security, especially in non-arid areas (Christiaensen and Subbarao (2004). An estimated 20 per cent of Kenyan agricultural land is considered high potential while about 80 per cent is low potential (Waiganjo and Ngugi, 2001). Olson *et al.* (2004) argued that the Kenyan tenure system is characterised by lack of equity in access to land for all groups, with a few elite large landowners in high potential areas interspersed among the majority of millions of subsistence farmers. Odhiambo and Nyangito (2002) noted that *de facto* land tenure regimes differ across the country and result in incoherent practices that invariably impact food security because large tracts of land remain unused while large populations remain landless, contributing to food shortages and heightened prices. Informal settlements in urban centres exemplify variability in the country's land tenure regime where 40 percent of the population resides in five per cent of the land (Nyamwaro, 2009). The land tenure system in many drought-prone areas, including most pastoral areas, is based on communal access to land (Boli, 2005). Okoti *et al.* (2004) contended that communal land use patterns contribute to degradation of the rangeland,

particularly during droughts, because traditional grazing patterns are subverted resulting in degradation of the environment. During droughts, environmental resources such as trees are cut down for charcoal production, a coping strategy, accelerating soil erosion and reducing future productivity of the range resource (KFSSG, 2010). Okoti *et al.* (2004) argued that loss of rangelands has a marked impact on exacerbating household food insecurity. Pastoralism is synonymous with the most insecure form of land ownership because of absence of a defined ownership regime, promoting proliferation of conflict among pastoralists competing for communal resources. Coffman (2006) also suggested that absence of a clear tenure system in pastoral areas causes sedentarisation of pastoralists and proliferation of pastoral 'urban' settlements without concomitant amenities.

There is a disproportionate concentration of funding toward emergency programmes by both governments and donors (United Nations (UN), 2000). Subsequently, alleviation of short-term food insecurity is carried out at the expense of long-term development programmes. Tadesse and Shively (2010) argued that large quantities of food aid beyond certain thresholds have resulted in production disincentives that undermine production and food security. In many cases, mid to long-term programmes implemented concurrently with emergency programmes are difficult to sustain once the emergency ends or subsides, because attention shifts to other development initiatives (Longley and Wekesa, 2008).

Government policies on production, prices and markets often enhance rather than alleviate food insecurity through distortion of prices for both inputs and outputs (Simmonds, 2006). Such policies are detrimental to investment in production, markets and storage in rural areas (USAID, 1994). Macroeconomic policies and trends have a profound impact on household food security (Timmer, 2004). In Kenya, the inflation rate increased for the 14th month running in November 2011, rising to nearly 20 percent, as compared to 3.84 percent in November 2010 (KNBS, 2011). The rise in the consumer price index to 125.2 in October 2011 as compared to 106.74 (KNBS, 2011) in October 2010, underlies the impacts on household food security for the majority of market-dependent food insecure populations. The rate of inflation is also accentuated by a 30 per cent depreciation of the Kenyan currency (Kenya Shilling) within the same period, for a country that is a net importer of most staple food commodities. In addition, the Kenyan currency

is overvalued with respect to key trading partners (Pollin and Heintz, 2007). The overvalued exchange rate results in substantial terms of trade imbalances (Gerrard *et al.,* 2003). The overvalued currency is a disincentive to export-oriented agricultural output, and stagnates local production due to unfavourable competition with undervalued import commodities (Kristinek and Anderson, 2002). Gerrard *et al.* (2003) stated that an overvalued exchange rate adversely impacts household incomes and food security as employment opportunities reduce in a declining agricultural sector. Ronge *et al.* (2005) stated that although 75 per cent of the Kenyan population depend either directly or indirectly on agricultural production, implicit taxation in the sector including import and export taxes, and price distortions, reduce competitiveness and farm incomes, further compromising household food security. In addition, governments have liberalised markets and services with adverse outcomes in marginalised livelihoods, due to non-concomitant liberalisation of other sectors (Barraclough, 1996). For example, privatisation of disease control, in the absence of a functional trade infrastructure, compromises livestock production, the main source of food and income for the severely food insecure pastoral livelihoods in parts of the Horn of Africa.

3.5 Demographic characteristics

Dynamics within livelihoods, including demographic characteristics and socio-cultural inclinations, constitute important livelihood characteristics that determine which livelihood strategies are viable (Gladwin *et al.*, 2001). Population pressures in sub-Saharan Africa and in the Horn of Africa in particular, are intense. According to FAO (2008c) the population of the Horn of Africa has tripled from 61 million to 186 million over the past four decades. The population of Kenya more than doubled from 16 million in the early 1980s to 35.6 million in 2010 (KNBS, 2010b). However, USAID (1996) argued that services such as health, education and infrastructure have not grown at the same rate as the population.

As a result of the land pressures, land sizes are declining and becoming too small to be viable. Christeansen and Subbarao (2004) stated that land holdings are an important determinant of household food security because they determine the species of livestock that is reared and crop enterprises that are engaged in. Brauch *et al.* (2003) argued that demographic changes that lead

to migration, population concentration and rapid growth rates result in the unsustainable use of resources. Consequently, productive capacities of land are reduced, exacerbating food insecurity (Wiebe, 2003). Rapid demographic changes have a detrimental impact on household food insecurity by increasing dependency burdens and reducing average consumption per capita (Christiaensen *et al.,* 2003).

Kennedy (2003) stated that HIV/AIDS affects every dimension of food insecurity. Importantly, the disease has direct impacts on agricultural production, the main livelihood strategy for food insecure households (Gillespie, 2006; FAO, 2003). Significant demographic changes have occurred as a result of impacts of HIV/AIDS in most food insecure countries in sub-Saharan Africa. Noojin (2006) stated that HIV/AIDS compromises livelihood food security by removing skilled household members from productive activities, minimising available resources, creating labour shortages, increasing dependents that include the sick, and increasing the link between malnutrition and HIV/AIDS. The projected loss in the agricultural labour force to HIV/AIDS in eastern and southern Africa is a worrisome 13-27 per cent increase from 1985 to 2020 (USAID, 1996). While there are gaps in understanding the magnitude of the impacts of HIV/AIDS among pastoralists, Morton (2006), Habib and Jumare (2008) observed that HIV/AIDS prevalence among pastoralists in sub-Saharan Africa is rising, such as among the Fulani nomads. Adeyi *et al.* (2001) argued that little medical attention is given to vulnerable populations and this is likely to exacerbate food insecurity. Prodlouck (2007) stated that it is necessary to incorporate the likely impacts of HIV/AIDS when formulating livelihood strategies among vulnerable populations.

Adherence to some cultural practices also tends to accentuate food insecurity. For example, even in highly food insecure pastoral communities in the Turkana District and in the Horn of Africa in general, exclusive breast-feeding was practised by less than 10 per cent of lactating mothers (Tanner-Grobler, 2006). The seemingly strong positive correlation between the absence of exclusive breast-feeding and acute malnutrition underscores the adverse impacts of some cultural practices. Cultural considerations, such as the role of women in society, often contribute to elevating food insecurity. Gladwin *et al.* (2001) noted that most women in Africa are not

permitted to own key productive resources, primarily land and capital, although they account for 60-80 percent of food crop production.

The next chapter is a literature review of the requirements for appropriate intervention design that takes cognisance of the multiple factors that influence food security among rural populations. This study is motivated by the key objective of providing a framework that can be used to develop actionable interventions in Kenya. Important processes that facilitate implementation of the outcomes of this study are expounded in Chapter 4.

CHAPTER FOUR

FORMULATION OF EFFECTIVE INTERVENTION DESIGN TO MITIGATE FOOD INSECURITY AND LIVELIHOOD FAILURE

4.1 Introduction

This chapter describes the key elements of effective intervention design in the context of complex and diverse livelihoods. Scoones (2010) stated that the dynamics and linkages within livelihoods are complex and challenge the formulation of interventions for food security. Nevertheless, the formulation of interventions, projects and programmes should take cognisance of the multi-faceted environment which represent the realities that households face. The chapter provides a framework that is essential for bridging the gap between food security outcomes and required interventions. Donors, development partners and some governments are often unwilling to support initiatives that lack logical processes for implementation and for which the measurement of success is vague (Buchanan-Smith and Davis, 1995). Substantial financial, human and physical investment has been expended in managing food insecurity without any meaningful reversal in food insecurity (FAO, 2009). Devereux (2006) attributed this, in part, to inadequate attention to intervention design that is cognisant of livelihood characteristics and institutional capacities, and absence of clear feedback mechanisms that incorporate the monitoring and evaluation of interventions. This finding suggests a disconnect between analysis of food insecurity and formulation of interventions. The outcomes of this study are intended to inform policy response options implemented through a well-defined framework and logical sequence of processes. It is essential, therefore, to complement an analysis of food insecurity with an explanation of the desirable environment that is required to ensure that formulated responses, interventions, and projects are successfully implemented.

4.2 Intervention design is dependent on the type and stage of the food security problem

Tefft *et al.* (2006) outlined the nexus between the temporal dimension and causality of food insecurity as critical inputs to intervention design that range from emergency interventions,

safety net programmes and disaster risk management, to long-term interventions that build sustainable livelihoods. The design of an intervention mechanism needs to be cognisant of the type, stage and severity of the food security problem that is to be addressed (FAO/FSAU, 2006). Hart (2009) argued that chronic food insecurity is not necessarily of lower severity than transitory food insecurity and advocates for a nuanced understanding of characteristics of the food insecurity problem. Such understanding affects intervention design and also the urgency and timing of interventions. Without doubt, it is clear that apart from the multiple facets of the food security problem, the dynamic nature of exogenous factors such as policies add to the complexity. The following section elaborates on different broad types of intervention.

4.2.1 Emergency interventions

Emergency interventions are often intended to solve immediate problems with the main goal of saving lives and preserving livelihoods (to a more limited extent). In a typical emergency situation, a precipitous shortfall in household food supply may arise from a slow-onset disaster such as drought, or from sudden-onset disasters such as floods and conflict. Maxwell (2006) observed that in most instances, food aid is the largest single principal response in food security emergency situations. In Kenya, food security interventions target livelihood groups that suffer chronic food insecurity, namely, the pastoral, agro-pastoral and marginal agricultural livelihood groups (KFSSG, 2010). A significant proportion of interventions are of the short-term emergency-type intended primarily to save lives and to mitigate decimation of livelihoods - to a lesser extent. Up to 75 percent of resources are allocated to the provision of food rations as opposed to non-food livelihood-building interventions (Longley and Wekesa, 2008). Nevertheless, in practice, intervention design for emergency interventions requires a cross-sector approach that includes all key sectors and transcends urgent food needs to include water, sanitation, health, nutrition and livestock health needs which often manifest during emergencies (KFSSG, 2009). Examples of a mix of cross-sector emergency interventions include General Food Distributions (GFDs) when large populations are assessed to suffer a precarious food deficit, Food for Assets (FfAs) and cash transfers (Maxwell *et al.,* 2008); therapeutic and supplementary feeding programmes (Navarro-Colorado, 2007); market-based interventions that increase supply in markets and access to food (Peppiat *et al.,* 2001); provision of water (UN-

OCHA, 2008); and livestock interventions including prevention and control of an upsurge in diseases (GoK, 2008; Freeman *et al.*, 2008).

4.2.2 Livelihood resilience building interventions

The key objective of resilience-building interventions is to strengthen livelihood capacities to withstand hazards without a debilitating decline in the productivity of rural households (Rass, 2006; USAID, 2003)). Interventions intended to build livelihood resilience are often of a longer duration than emergency interventions (Lautze, 1997). Interventions intended to protect livelihoods (Hedlund, 2007) also tend to follow or run concurrently with the tail-end of emergency interventions (Mourey, 2000). The time frame for their implementation falls between the short and medium term. Intervention design needs to take account of the type, objective and desired time frame of proposed interventions because the reality is that most interventions are invariably resource as well as time-bound.

Most resilience-building interventions seek to phase out distribution of food without necessarily withdrawing support from households that may not have attained appreciable productive capacities (Goodman, 2004). Some of the commonly applied resilience-building interventions are:

- provision of seeds and tools in cropping areas that may have suffered severe crop loss as a result of drought or floods (Remington *et al.*, 2002)
- social protection interventions such as cash transfers and safety net projects (Devereux, 2006)
- integrated health and nutrition management of vulnerable child and lactating mothers to strengthen productive capacities while mitigating production shortfalls in the event of shocks or hazards (Collins, 2004)
- reduction of vulnerability to an upsurge in livestock diseases that would compromise the recovery process (Aklilu and Wekesa, 2003)
- implementation of strategic boreholes that reduce clustering of livestock around few functional water sources and in so doing, a reduction of the likely spread of disease and proliferation of conflict, to strengthen livelihoods (Young *et al.*, 2001).

In most instances, governments and development partners are more focused on saving lives and livelihoods during emergencies, and pay less attention to the restoration of livelihoods to pre-crisis levels. Subsequently, households approach additional shocks or hazards in a weakened state, perpetuating food insecurity.

4.2.3 Livelihood-building interventions

Interventions that are intended to create and sustain strong self-supporting livelihoods are normally integrated, multi-sector long-term interventions that may take several years to achieve. Longer term livelihood-building interventions are carried out most successfully when there are no on-going active shocks or hazards and if there are bridges linking with shorter-term interventions (CARE, 2008). Catley (2007) stated that in most cases, the intervention design for longer term interventions cuts across several sectors simultaneously because of substantial linkages between sectors due to the complex cross-sector factors that determine the viability of livelihoods. Longer term interventions need to focus on reducing both urban and rural food insecurity (Stamoulis and Zezza, 2003). Longley and Wekesa (2008) suggested that a strong focus on emergency interventions has resulted in an inability to develop and implement long-term interventions that build strong self-supporting livelihoods.

The cost of implementing short-term emergency such as relief food distributions invariably supersedes that of long-term interventions (KFSSG, 2008b). However, efforts required to implement longer term interventions require a high degree of collaboration across sectors. The absence of immediate results that demonstrate significant improvements in food security tends to minimise the priority of implementing long-term development interventions by governments and development partners (Pantulino and Wekesa, 2008). Examples of long-term interventions that promote self-supporting livelihoods include the development of viable trade infrastructures in potentially surplus-producing areas (Sarris and Morrison, 2010). Increasingly, interventions that aim to create sustainable livelihoods need to incorporate adaptation to climate change across all sectors (Ludi, 2009).

Many rural livelihoods that suffer chronic food insecurity are situated in areas where research, development and extension facilities are scarce or not prioritised (Markakis, 2004). Pavanello (2000) noted that national policies prioritise development in productive areas, where returns to investment can be guaranteed. Although the creation of self-supporting livelihoods is critical in addressing food insecurity, commitment by governments and development partners in implementing longer term interventions remains lukewarm (Nyamwaro, 2009).

4.3 Requirements for an effective intervention design

The following sections outline the processes and considerations that are necessary to develop appropriate intervention design intended to alleviate food insecurity, in the context of diverse livelihoods.

4.3.1 Appropriate assessment methodology for assessing extent and characteristics of food insecurity

Frankenberger *et al.* (2005) claimed that one of the major drawbacks in assessing food security needs and the formulation of appropriate cross-sector interventions is the absence of a comprehensive and coherent assessment methodology. Levine and Chastre (2004) pointed out that when food security assessments are conducted, the information used in decision-making is often sparse and inconsistent. Maxwell and Watkins (2003) argued that paucity of appropriate information for decision-making inevitably results in the adoption of projects and programmes that fail to adequately address the core food security problem under investigation. Maxwell and Watkins (2003) emphasised the need for an assessment methodology that encompasses comprehensive information and analysis. Tanner-Grobler (2006) argued that methodologies should be founded upon relevant baselines that enable comparability of food security outcomes across livelihoods or prescribed units of analysis. The United Nations Development Programme (UNDP) (2007) postulated that methodologies need to clarify different ways in which shocks or hazards might impact on livelihood options, and provide input to response planning.

However, the reality in most of sub-Saharan Africa is that food security data and information systems that feed into assessment methodologies are rudimentary in many instances, limiting the

extent to which unambiguous analysis is conducted (Pavanello, 2000). Maxwell *et al.* (2008) added that an appropriate and rigorous assessment methodology enables proper identification of food insecure populations or livelihood groups and their geographic locations. Transparent and comprehensive assessment methodologies are able to provide a basis for greater accuracy in the estimation of numbers of food insecure populations (Haan *et al.*, 2006). An inadequate basis for this estimation of numbers and locations of the food insecure is perhaps one of the most contentious issues that delays or circumvents delivery of interventions. The common perception by development partners, in the absence of an appropriate assessment methodology, is that analyses are inconclusive and unverifiable (Anema, 2002). Lack of clarity limits the extent to which the required type, scale and location of needs can be articulated.

Webb *et al.* (2006) argued that food security is multi-faceted and assessment tools need to capture multi-sector characteristics of food in(security) to include food, water and sanitation, health and nutrition, agriculture and livestock, and education. Tools and methodologies employed during food security assessments are dependent on the objective of the assessment, the stage of crisis (Tefft *et al.*, 2006), the characteristics of food insecurity (Barrett and Maxwell, 2005), the geographic extent of the crisis (Qureshi, 2007) and the livelihood group (Devereux *et al.*, 2004). In most instances the tools and methods used are sector-specific, intended to verify the scale, severity, and location of the food insecurity.

Maxwell *et al.* (2008) pointed out that there is not necessarily a standard measure for food security, most likely because of the complexity and linkages around various indicators of food security. Nevertheless, an appropriate assessment methodology needs to be supported by a credible and transparent classification system that allows for comparable analysis across different livelihood zones, regions, and even countries (FAO/FSAU, 2006). An appropriate classification system should therefore also be robust enough to relate indicators to defined thresholds that categorise food insecurity.

A major incentive for adoption of proper and transparent assessment methodologies has arisen from the growing scarcity of resources (Frankenberger *et al.*, 2005). Donors and development partners are increasingly reluctant to engage in projects and programmes that are not well

articulated. Recommendations on required response options are more likely to be adopted by key donors, development partners, and governments, when underpinned by methodologies that are transparent and self-evaluating. Decron *et al.* (2006) suggested that successful implementation of projects and programmes require the participation of recipient communities. Communities are more inclined to participate when their needs and requirements are objectively assessed. Participation is enhanced when recommendations from assessment methodologies follow through from a recognisable, logical process.

Well-articulated assessment methodologies are critical to ensure wider and more effective participation of key development partners in a beneficial and collaborative manner (Maunder and Wiggins, 2006). However, appropriate assessment methodologies are not always popular when the objectives of governments and intervening institutions transcend the need to resolve the core food security problems.

4.3.2 Understanding the food security problem and stage of crisis

Barrett and Maxwell (2005) suggested that understanding complexities inherent in a food security crisis, including impacts on livelihoods, available coping strategies and appropriate responses are a prerequisite in the formulation of appropriate intervention designs. Some of the peculiarities around food security lie in the evolution of the problem – whether the cause of the crisis is a slow or sudden onset. Devereux (2006) outlined that understanding the different characteristics of the food insecurity problem is critical in formulating appropriate intervention designs. Makoka (2008) observed that drought is perhaps the most recognisable slow onset disaster with respect to food security analysis. Floods and conflicts are examples of sudden onset disasters that tend to impact livelihoods in the Greater Horn of Africa, where Kenya is situated (Funk *et al.*, 2008).

Qureshi (2007) indicated that in addition to understanding the type of food security problem, it is important to understand its geographic extent in the livelihood, country, region, or unit of analysis. The spread of the crisis enables an evaluation of the level of human, financial and physical capacities that form an integral part in any intervention strategy. Food security crises

that are widespread require a higher degree of institutional collaboration and co-ordination and possibly greater leverage of resources compared to localised crises (Core Group, 2010). It is also important that undue focus is not given to food security crises that are localised and can, in most instances, be addressed by local or regional governments without the need for disproportionate national or international responses. In so doing, governments and development partners give due attention to geographic locations and livelihoods that require specified interventions, employing limited resources optimally among competing needs.

4.3.3 Cognisance of livelihood type and characteristics

Devereux *et al.* (2004) argued that understanding the internal and external capacities, environments, and characteristics of livelihoods, is important in formulating appropriate intervention designs. Inherent in livelihoods are distinct vulnerabilities, exposure to risk, and coping strategies to circumvent a reversal in food security (Webb and Rogers, 2003). Such characteristics often enhance or impede livelihood productivities, determine capacities to withstand shocks and hazards, and provide input for the selection of intervention options. Calow *et al.* (2002) suggested that since livelihoods have multiple dimensions, it is important that intervention design avoids bias toward any particular facet. This suggests that multiple tools and methods are coherent across different livelihoods are required to properly capture the complexities of livelihoods that Coates *et al.* (2003) described. For example, similar livelihoods, for example one located close to a border market and another in the hinterland, will have significantly different livelihood strategies at their disposal, as will livelihoods that have access to enabling institutional structures. Maxwell *et al.* (2008) argued that implicit in livelihood strategies are competing objectives and trade-offs often have to be made and incorporated in intervention design.

While disparate livelihoods have distinctive characteristics, they nonetheless have crucial intra-linkages, especially among those that are close to each other. There is often lack of knowledge about livelihood linkages which are critical in determining the interdependence of livelihoods and how they impact food security outcomes (Maunder and Maxwell, 2001). A typical example for drought-affected pastoralists is an instance where there is the ability to access alternative

grazing resources in an adjacent livelihood (because of inherent livelihood linkages) that is less affected by the agro-climatic shock. Absence of beneficial livelihood inter-relationships tends to accentuate vulnerabilities and the impacts of shocks and hazards (Hussein, 2002). Effective intervention design will necessarily incorporate the main intra- and inter-livelihood linkages and livelihood dependencies. The dependencies establish the contributions of those linkages to the type, scale, and location of necessary interventions.

4.3.4 Evaluation of institutional structures and capacities

Hemrich (2003) advocated for intervention design that takes account of balanced involvement of both government and local and international non-governmental organisations in food security interventions. However, a key impediment to institutionalisation of a sustainable mechanism for delivering food security interventions is often the inordinate contributions of international organisations because of limited capacities of local institutions (Sahley *et al.*, 2005). In order to achieve the required balance of collaboration, it is recommended that a comprehensive mapping of relevant agencies is conducted. This would include government representation, local and international non-governmental organisations and the United Nations Agencies. The mapping process involves evaluation of the discipline or specialisation that key institutions are engaged in, within the areas of interest and the extent of the institutions' coverage of operations. Shoham (2005) argued that most agencies focus on a limited number of specific interventions and this creates intervention gaps if they are not accounted for in intervention design.

Governmental or non-governmental agencies have specified mandates, areas of interest and prescribed funding sources. There are significant actual and potential linkages and synergies among agencies but little or no co-ordination (Saleth and Dinar, 2007). The synergies are mostly borne by a combination of implementing projects and programmes in the same geographic area, and are motivated by the overall objective of alleviating food insecurity. Detailed identification of the areas of symbiotic or value-addition among institutions is critical in ensuring that human, financial and institutional resources are efficiently allocated (Buchanan-Smith and Davis, 1995). Most food security interventions are funded by governments, local and international NGOs, and development partners. Due to the multi-sector nature of food security problems, interventions

are most effective if they are collaboratively carried out by multiple agencies with a functional co-ordination mechanism (Maunder and Wiggins, 2006). However, the extent to which diverse institutions are open to collaborating with partners is limited, attributed in part to competition for resources among agencies. A leadership role by governments could to some extent improve co-ordination among agencies to enable implementation of interventions without duplicating resources.

The administration of food security interventions in diverse livelihoods often exposes additional and sometimes unanticipated needs that need to be addressed (Rass, 2006). For example, a food intervention may not be viably implemented in the absence of water or sanitation interventions because of hygiene concerns (KFSSG, 2009). Subsequently, the contributions by various institutions and their capacities as partners need to be assessed in terms of the viability of expanding their roles beyond their core mandates. Appropriate monitoring and evaluation mechanisms include appraising capacities of different institutions to engage in activities beyond principal areas of interest (Johnson-Welch *et al.,* 2000).

4.3.5 Appropriate monitoring and evaluation mechanism

An effective intervention design includes a mechanism for evaluating success in meeting stipulated objectives within set parameters. Reily *et al.* (1999) emphasised the need for an appropriate monitoring and evaluation mechanism in programmes that are intended to alleviate food insecurity. Incorporating monitoring and evaluation in intervention design enhances accountability and confidence among all participants while quantifying the impacts of interventions (Reily *et al.,* 1999). Apart from ensuring that administrative, logistical and financial specifications are adhered to, Carletto (1999) argued that quantification of direct and indirect impacts of different interventions ensures that resources and efforts are properly used. A monitoring system needs to assess performance against set benchmarks (Gervais *et al.,* 2003). The benchmarks should be set at each stage and for each component of the intervention process from development and implementation of the assessment methodology to delivery of the various interventions (Buchanan-Smith and Davis, 1995). A properly functioning evaluation system provides information on the replicability of successful interventions while presenting vital

information on what pitfalls to avoid in selection and in the implementation of various intervention options.

Maxwell *et al.* (2008) contended that food security monitoring and evaluation systems are often fairly complex because of diverse livelihood characteristics. Subsequently, an evaluation system that is both flexible and has the capacity to recognise salient differences in livelihood characteristics across different sectors is desirable. Evaluations of impacts of food security interventions that do not take cognisance of internal and external livelihood characteristics may impede the performance of responses or interventions (Calow *et al.*, 2002). The interactions and linkages between different livelihoods within a proximate geographic location, which may minimise or enhance the performance of the interventions, also need to be incorporated into an effective evaluation mechanism.

An intervention process that is backed up by effective monitoring and evaluation systems often generates greater confidence among participants from beneficiaries to implementers and funding institutions. Buchanan-Smith and Davis (1995) suggested that the absence of a credible evaluation mechanism is a key impediment that leads to lack of action by development partners. A transparent system will not only ensure that consensus regarding implementation decisions is arrived at much quicker, but will also motivate greater engagement by a wider cross-section of partners (FAO, 2008d). Most funding decisions are impeded or delayed by lack of clear evidence that the resources provided have achieved desired objectives. Paucity of evidence could result from the absence of objective and competent monitoring systems or a lack of transparency at each stage of the process, whether administrative, logistical, technical assessment, or implementation.

The following chapter demonstrates the food security institutional and intervention structures which form the basis of food security monitoring, vulnerability analysis and intervention design in Kenya.

CHAPTER FIVE

KENYA'S FOOD SECURITY ORGANISATIONAL STRUCTURES

5.1 Analysis of food security mechanisms in Kenya

Intervention mechanisms in Kenya are set up against the backdrop of fairly diverse livelihood groups and broadly constituted organisational structures. Figure 5.1 is an illustration of the organisational structure responsible for food security monitoring, vulnerability assessment and intervention design. Section 5.3 explains the characteristics of diverse livelihood groups. Appendix B shows the Kenyan livelihood map and Appendix C photographs of diverse livelihoods groups.

5.2 Multi-organisational food security co-ordination structures in Kenya

The food security intervention design in Kenya is conducted within a multi-organisational and multi-sector co-ordination structure (Swift, 2000). The Kenya Food Security Steering Group (KFSSG) is the principal food security organ, charged with the responsibility of food security monitoring, early warning, and drought management (Nyamwaro, 2009). The KFSSG was initiated in 2000 and is chaired by a technical representative from the Office of the President and comprises a cross-section of organisations including the ALRMP, WFP/VAM, UNICEF, OCHA, FEWS NET, OXFAM/GB, CRS, CARE, World Vision and the European Union.

Key functions of the KFSSG are:

- instituting mechanisms to co-ordinate the management and dissemination of information.
- establishing and facilitating the functioning of sector working groups.
- facilitating mitigation and response through a co-ordinated response mechanism.
- providing technical advice and guidance on food security and drought management to the Government of Kenya (GoK), donors, and partners.
- developing appropriate food security and nutrition assessment instruments.
- conducting food security assessments, data analysis and reporting.
- providing capacity strengthening for partners through its technical working group.

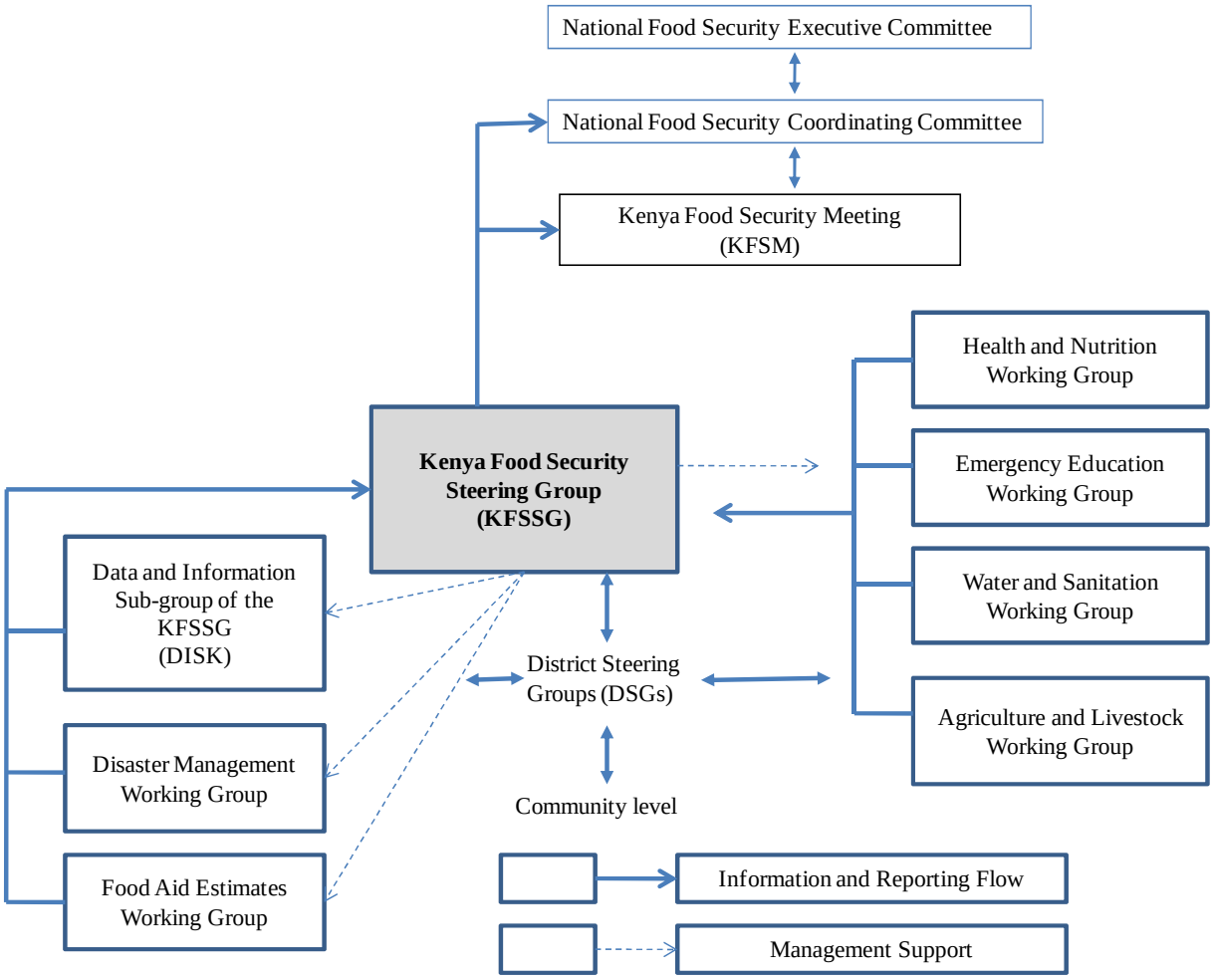

Figure 5.1: Kenya food security co-ordination structures: data and information sub-group of the KFSSG (2008).

While the co-ordinated and collaborative KFSSG food security organisational context in Kenya has enhanced the ability of the GoK, NGOs, and donors, to more urgently translate information into decision-making, response implementation remains challenging. The early warning system in Kenya, in general, provides timely and comprehensive information on a regular basis, but response bottlenecks tend to limit the extent to which recommendations are implemented (Darcy and Harvey, 2006). Shoham (2001) stated that the KFSSG's multi-organisational, multi-sector constitution occasionally results in conflicting interests deriving from specific organisation mandates and, to some extent, political pressures. Such considerations may affect the

interpretation of food security outcomes and recommendations on intervention design. For example, the GoK may opt to distribute emergency relief food outside the areas that are collectively assessed to require such distributions, as it seeks to fulfil other objectives, not excluding political expediency, deviating from channelling food commodities through one single distribution system, which is through the World Food Programme.

Nevertheless, the KFSSG has accomplished a number of tasks, over the years, which include:

- establishment of mechanism for the flow of information from local to national levels, including development of food security databases
- formation of functional sector working groups that improve the balance between implementation of food and non-food interventions
- development of multi-sector assessment methodologies, and collaborative implementation of assessments
- development of detailed national livelihood zoning
- institution of a community-based targeting mechanism
- establishment of a single joint national monthly food security report
- expansion of vulnerability assessments to include urban vulnerability analysis
- capacity strengthening of food security analysis and methodologies for government and NGO food security officers both at national and local levels (GoK, 2010).

5.3 Kenyan livelihood characteristics

Livelihood stratification allows for descriptions on how households obtain their food and income (Boudreau, 1998) and elaborates on the livelihood assets, vulnerabilities, and institutional context which defines livelihood strategies and outcomes that can be adopted (DFID, 1999). Kenyan food security is characterised by highly diversified livelihoods, in part attributable to a similarly variable agro-ecology coupled with a stratified socio-economic, physical, and socio-cultural environment (KFSSG, 2008c). Up to 80 per cent of the geographic area comprises pastoral, agro-pastoral, and marginal agricultural livelihoods (Waiganjo and Ngugi, 2001). Other important livelihoods include the mixed farming, high potential livelihood; the mixed farming, high potential zone, largely cereal and dairy; and the urban livelihood. The following sections

detail distinguishing structural and food security characteristics for each of the key livelihood groups. Appendices B and C depict the Kenya livelihoods map and some sample photographs, respectively. However, the descriptions do not evaluate the impacts of these characteristics on food security outcomes. The livelihoods data and information were obtained from a joint survey by the WFP, ALRMP, FAO, MoA and FEWS NET (KFSSG, 2008c).

5.3.1 The pastoral livelihood group

The pastoral livelihood is situated in the northern, northwestern, northeastern and the eastern parts of the country. An estimated three million persons reside in the pastoral livelihood accounting for about 10 per cent of the total national population (KNBS, 2010b). The Kenyan pastoral livelihood is characterised by the occurrence of repeated shocks and hazards that have become more frequent extending for longer periods, particularly over the past 10 years, at least (USGS, 2009). The major hazard afflicting the pastoral livelihood is drought; about four serious droughts have been experienced in the livelihood over the past 10 years alone: in 1999-2001, 2003, 2005-2006, 2008-2009, 2010-2011 (USGS, 2009). Other critical shocks include debilitating conflict, episodic floods and more recently, the dramatic rise in food and non-food prices which has compromised pastoral terms of trade (ALRMP, 2008). Pastoralists are highly dependent on predominantly livestock assets and most pastoralists derive most household income from livestock and livestock products (KFSSG, 2008c). Consequently, any shock or hazard that impacts adversely on livestock productivity tends to cause inordinate loss of food security.

5.3.2 The agro-pastoral livelihood group

The agro-pastoral livelihood is situated in the northwestern parts of Baringo, Marakwet, Keiyo, Laikipia, West Pokot and Samburu; and in the southern Maasai rangelands in Kajiado, Narok and Trans Mara districts. An estimated 1.5 million persons reside in the agro-pastoral livelihood (KNBS, 2010b). The agro-pastoral livelihood is considered less vulnerable to agro-climatic shocks as compared to the pastoral livelihood, principally because of the relatively higher rainfall levels which average 500-700mm annually (USGS, 2009). The settlement pattern is a

combination of nomadic pastoralism and sedentarisation of household members involved in crop production. A significant proportion adopts agro-pastoralism as an insurance strategy in the event that livestock production experiences shocks that may lead to decimation of their herds. However, most agro-pastoralists still consider pure pastoralism the more superior way of life and only revert to growing crops if they lose their herds to drought, disease or conflict.

While crop production is an important income and food source for agro-pastoral households, livestock production remains the predominant contributor of income for the majority. Crop output in the agro-pastoral livelihood has only measured impact in compensating for losses in livestock productivity, because droughts have adversely impacted crop production over the past decade (USGS, 2009).

5.3.3 The Marginal agricultural livelihood group

The marginal agricultural livelihood is situated in the southeastern and western lowlands. An estimated 6.5 million persons reside in these areas (KNBS, 2010b) where farmers predominantly grow crops and rear a limited number of indigenous cattle and goats. Income is derived from crop, livestock, off-farm activities and remittances (KFSSG, 2008c). Farm households are deficit-producers of both crop and livestock output and a large proportion of household food needs are met from market purchases. The labour pattern in the marginal areas is characterised by out-migration; in search of labour opportunities to diversify income sources and bridge production and household food gaps (KFSSG, 2009).

Annual rainfall amounts are low, ranging between 600-1000mm, and the rainfall patterns are erratic in these bi-modal areas. The major hazard that characterises the areas is drought, (USGS, 2008) which has been occurring with increasing frequency and greater severity than in the pastoral areas (USGS, 2009). While near-total crop failures are recurrent during droughts, uncharacteristic above average crop production is often associated with El Niño events, as in 1998, 2006 and 2009. However, the unprecedented rise in food and non-food prices from October 2007 through to early 2010 has been a major shock to farm households residing in the livelihood (KFSSG, 2008a).

A significant proportion of households migrated from adjacent high potential areas after extensive land sub-division in the highlands and unfortunately maintained highland farming practices after moving into the marginal agricultural lowlands (FEWS, 1996). Consequently, maize is grown on up to 80 per cent of the land put under cereals and pulses. High stunting rates of over 35 per cent (KFSSG, 2009) are often reported in the lowlands, indicative of households that have undergone prolonged periods of under-nutrition.

5.3.4 The high potential mixed farming livelihood group

The high potential mixed farming livelihood is situated in the central, eastern, western and Nyanza highlands. An estimated 10.5 million persons reside in this densely populated livelihood that is characterised by extensive land sub-division (KNBS, 2010b). Although highly fertile, farm holdings average between 1-4 acres per household, leading to increased migrations to the more marginal agricultural areas where population densities are lower (FEWS, 1996). Farmers in the high potential zone grow food and cash crops, and rear high-yielding improved livestock breeds. However, farmers practice intensive farming because of the relatively smaller land sizes. The favourable agro-climate is generally highly reliable, conducive to agricultural production with annual rainfall levels ranging between 1,500-1,700mm, in a largely bi-modal rainfall pattern (USGS, 2008).

5.3.5 The high potential cereal and dairy livelihood group

The high potential cereal and dairy zone is situated primarily in the Rift Valley highlands and is considered to be Kenya's 'grain basket' - home to an estimated four million persons (KNBS, 2010b). The zone is characterised by heavy rainfall throughout most of the year, ranging from 1,600 - 1,700mm (USGS, 2008). The cereal and dairy zone is characterised by a distinct uni-modal rainfall pattern, where the long rains are the principal production season, unlike in all other zones which have two distinct seasons (KFSSG, 2008a). Maize is the principal crop grown in the zone, while high-yielding dairy cattle breeds are the main livestock reared. Land sizes are fairly large and average 5-20 acres. Most of the households' cereal needs are met from on-farm production in a livelihood that is overwhelmingly surplus-producing. The zone accounts for

close to 50 per cent of overall national maize output, the country's key staple (MoA, 2009). A poor, though rare, production season in the zone is synonymous with a widened national cereal deficit, such as in the 2009 production season where the zone reported an estimated 25 per cent production shortfall (MoA, 2010).

Household income is determined largely by producer-prices for maize and milk, often set by government marketing institutions. Most of the maize produced in the 'grain basket' is sold to the National Cereals and Produce Board (NCPB), while the milk is sold to the New Kenya Co-operative Creameries (KCC) (KFSSG, 2008a). Farmers in the high potential cereal and dairy zone constitute a strong lobby group that tends to influence determination of producer-prices, often set above prevailing international market prices. The pricing regime is intended, ostensibly, to promote the production of the country's key staple to ensure the national maize supply. While high producer prices are favourable to key producers, they are detrimental to purchasing capacities of close to 70 percent of the Kenyan population who are deficit maize producers. Impacts of heightened cereal prices, on food security, for non maize-producing households, situated predominantly in the urban and pastoral livelihoods, is also often detrimental.

5.3.6 The urban livelihood group

The urban livelihood zones are situated in all major urban centres across the country and is home to about 14 million persons, close to 35 per cent of the Kenyan population in 2010 and expected to grow to 50 per cent in 2030 (KNBS, 2010b). The growth in urbanisation has accelerated rapidly from the early-80s when only 18 per cent of the country's population resided in urban areas (Mitullah, 2003) as compared to the present. Yet there is no clear evidence to suggest that migration to urban areas has resulted in appreciable food security gains. The largest urban centres are Nairobi, Mombasa, Kisumu and Nakuru. The urban livelihood is perhaps the most complex livelihood with wide variability in terms of income profiles, production patterns, sources of food and income, socio-cultural characteristics and ethnic composition (Nyamwaro, 2009).

An estimated 7.8 million of the urban population reside in informal settlements, commonly referred to as slums (KNBS, 2009). Unfortunately growth in amenities has not equalled and supported the rapid growth in population. According to KNBS (2010b), only 40 per cent of the population have access to communal water facilities, sanitation levels are poor, and the majority of urban slums do not have waste disposal facilities. Urban dwellers are overwhelmingly market dependent sourcing over 90 per cent of their food needs from the market (KFSSG, 2008c). A significant proportion of people residing in slums represent populations that have fallen out of agrarian production systems as a result of livelihood losses, following the impacts of a succession of droughts, conflicts, floods and extensive land sub-division. Most are unable to meet their food needs on a regular basis (Nyamwaro, 2009).

Urban households often employ a wide range of coping strategies to mitigate the impacts of shocks that lead to a sudden reduction in disposable income and constrained food access. Urban households often 'borrow' from non-food expenditures such as health care, school fees and transport to finance purchases of food (Mitullah, 2003). While many of these 'borrowings' might bridge immediate food gaps, they often compound rather than alleviate food security in the future by reducing productive capacities.

5.4 Needs assessments and vulnerability analysis in Kenya for intervention design

The decision-making process in the design of interventions in Kenya is often based on diverse objectives, in part due to the participation of multiple institutions and a cross-section of sectors. Usually the overriding objective is the need to quantify the immediate, medium and long-term impacts of shocks and recurrent hazards such as floods and droughts on household and livelihood food security. There is also a need to realise a common understanding of the scale, location, and character of the food insecurity to guide interventions and mitigation activities which appropriately respond to immediate, medium and long-term needs at local and national levels. While the participation of multiple organisations is commendable, a dominant institution or sector is sometimes able to leverage its own preference on the intervention type and resources, skewing the balance of the overall intervention package (Shoham, 2001). For example, a well articulated water intervention may attract resources toward the water sector at the expense of

health and nutrition interventions due to the specialty or preference of the development partners or donors.

The Kenya Food Security Steering Group (KFSSG) has over the years developed an assessment methodology that is underpinned by sector-specific analysis. The sectors include health and nutrition, agriculture and livestock, water and sanitation, food, and education. The methodology is regularly updated and revised to take cognisance of the emergence of new shocks and to incorporate evolving methodologies. The type of data collection instruments applied in such assessments are dependent on the objective of the assessment, the type and stage of the shock or hazard, or the status of food (in)security, to ensure that proper information is collected and appropriate interventions measures are developed (KFSSG, 2009). Assessment teams are broadly constituted and incorporate multiple institutions which cut across all key sectors to promote a balanced multi-disciplinary assessment of food security applying household, focus group, community, district-level, and market interviews.

Assessment teams often complement field data and information collection, with available secondary data such as results from nutrition surveys and monthly food security reports from the technical working groups of the KFSSG and the Arid Lands Resource Management Project (ALRMP). The key field data collection includes: agro-climatic data, crop and livestock production, trade and market data, nutritional data, estimates of number and location of vulnerable population, and on-going cross-sector interventions including their scale, coverage, and duration (KFSSG, 2008b).

While the assessments are generally well planned and executed, gaps in consistency and availability of data and information at the desired level of analysis impedes unambiguous determination of the depth and character of food insecurity, limiting informed intervention design. Technical capacities at both the local and national levels require significant expansion to achieve appropriate levels of data collection, analysis and reporting.

5.5 Decision making processes and challenges

The sector working groups comprising the ALRMP, GoK, the UN, NGOs and key line ministries, are responsible for developing an implementation plan once the results of the assessments are finalised and available funding is established. The outcomes of the assessment are presented to the Kenya Food Security Meeting (KFSM), the open food security forum that is constituted across government, non-governmental organisations, and also across all key sectors. The objective of the KFSM is to establish a consensus on the results and suggested intervention options. The scale of the food security problem may precipitate an international appeal, which is usually formulated and carried out collectively by the government and international agencies.

While the KFSSG is widely viewed as a credible institution, the key drawback in Kenya has been the limited funding provided for non-food sectors, in part due to the absence of a well-defined mechanism that provides credible response analyses. For example, up to 70 per cent of required food interventions were financed, while less than 30 per cent of required non-food interventions were funded during the drought emergency of 2009 (KFSSG, 2009). Subsequently, non-food sector working groups have tended to prioritise only the areas with the highest levels of food insecurity or potential losses because of recurrent funding gaps which leave significant needs unattended. Although the articulation of required type and scale of interventions is often consistent with assessment findings, gaps in resources render responses fairly imbalanced, skewed toward solving immediate food needs with less emphasis on meeting complimentary non-food sector needs. A better understanding of food security causality would facilitate rationalising funding toward areas that are more likely to mitigate underlying food insecurity. Few interventions aimed at strengthening the resilience of livelihoods on a sustained basis are implemented, leaving households vulnerable to the next shock, even in periods that follow comprehensive food intervention. The inadequacy of the interventions tends to promote superficial recovery but resilience is not improved. This study aims to improve understanding of food insecurity causality that will promote the implementation of medium to longer term interventions and shift the emphasis from an overwhelmingly short-term focus.

The following chapter outlines the methodology used in identifying the determinants of food insecurity and their influence on each livelihood group. The chapter develops a framework for applying techniques that capture the multiplicity of characteristics among different livelihood groups and their impacts on food (in)security.

CHAPTER SIX

METHODOLOGY

6.1 Introduction

This chapter introduces the theoretical framework, problems and sub-problems, describes the research design and presents the empirical model adopted for the study. The variables used are defined and the data, sources and methods used in the data analysis are detailed in this section.

6.2 Theoretical framework

This study tests the hypothesis that stratification of livelihood groups according to key characteristics helps to strengthen the analysis and understanding of food insecurity causality. Duncombe (2007) and DFID (1999) stated that distinct livelihood groups have a common set of characteristics that include internal capabilities, external physical, policy, and socio-economic environments, and vulnerabilities to shocks and hazards. Consequently, external events such as conflicts, drought or floods will have similar impacts on people within a particular livelihood group, but may have a very different effect on livelihood groups that are dependent on other assets and activities**.** Devereaux (2006) observed that the potential of the livelihoods-based analytical framework for generating improved approaches to food security measurement is very promising because the approach can identify causal factors behind food insecurity among diverse groups in different contexts. Watkins (2003) argued that food security analysis conducted using stratified livelihood data and information can result in increased estimation accuracy, improve predictive modelling, and reduce the number of variables requiring monitoring for a given livelihood group. As such, outcomes from the analysis of causes of food insecurity can provide a basis for formulating appropriate monitoring and mitigation options without necessarily incurring major additional data collection and analysis costs. Maxwell (1995) emphasised this point, arguing that while food security analysis is multifaceted, the availability of continuous data for key variables is often problematic, underlining the potential benefits of a stratified livelihood approach. The following sections outline key considerations in the theoretical framework.

6.2.1 Complexity in the causes of food security

Webb *et al.* (2006) and Drimie and Casale (2008) stated that causes of food insecurity are multiple and complex and interconnected with causal linkages. The complexity makes it difficult to define feasible data collection and analysis strategies that will provide policy makers with accurate, disaggregated, and relevant information. The type of analysis that decision makers require needs to be able to identify the causal variables and how they can be controlled to reduce the risks of exposure to heightened food insecurity. Policy makers will also what to know why some livelihood groups are more exposed to shocks and food insecurity than others. Sen (1986) discounted the traditional focus on food supplies and production as the key determinant of food insecurity. Drèze and Sen (1989) advocated for a richer framework, encapsulated as entitlements decline, which includes demand side and market variables, as opposed to food availability decline alone. While Drèze and Sen (1989) suggest that food availability decline variables are not critical, Devereux (2006) sees that the appropriate livelihoods framework includes a broad consideration of both sets of variables. Coates *et al.* (2003), Maunder and Wiggins (2006), Maxwell and Watkins (2006) and Casale *et al*. (2007) also placed emphasis on the need to include both entitlements and availability variables to adequately capture the complexities of food insecurity and causality that livelihoods analysis provides.

6.2.2 Policy analysis requirement for disaggregated and accurate synthesis

Løvendal *et al.* (2004) contended that while policy analysis requires disaggregated, accurate synthesis, it is often difficult to collect and synthesise data on all the many dimensions. The primary problem of complexity is the need for policy-relevant data synthesis which is relatively uncomplicated to interpret. In addition, and from a practical perspective, monitoring and analysis cannot consider all the factors that may cause food insecurity (Hussein, 2002). There is therefore a trade-off between completeness of analysis and outlay of data and analysis. Aggregate solutions at administrative levels such as the district level, do not account for the high level of heterogeneity within districts and are inappropriate for most food security analyses (Watkins, 2003). Accurate food security monitoring and design of the appropriate long-term solutions will therefore require disaggregated data based on fairly homogenous livelihood attributes. The

process of fine-tuning targeting means that the smaller the units of aggregation, the more precisely resources are matched with needs. The gains in the effectiveness of interventions can be achieved at a higher level of precision.

6.2.3 Data collection is costly, secondary data scarce, and analytical capacity constrained

Data collection is particularly expensive for a multi-faceted discipline such as food security Løvendal *et al.* (2004). In addition, secondary data are scarce, and analytical capacity is constrained in many food insecure countries. The key challenge with 'granular' data is the cost of collection where the more the disaggregation, the finer the sample size. Currently, national data on income and expenditure patterns in Kenya are only aggregated to district levels (KNBS, 2010a). Watkins (2003) argued that national data systems are weakest in precisely the countries where the food insecurity risk is most precarious. For example, in Kenya, statistical data were collected for administrative representation such as the Kenya integrated budget survey which is only representative at the district level. Administrative boundaries do not necessarily capture livelihoods. The key question is how the data collection and analysis burden can be reduced while capturing the key dimensions of food insecurity. The study seeks to apply livelihood zone data and information to respond to this question.

6.2.4 Analysis by livelihood groups optimises data collection and analysis in data scarce environments

Analysis of food security outcomes by livelihood characteristics may optimise data collection and analysis in data-insufficient environments (Haan *et al.*, 2006). Causality can have distinct geographic patterns according to livelihood groups (Watkins, 2003). The concept of livelihoods offers a possible key. The impact of key shocks and risks will depend in large part on the livelihood characteristics. This is the 'exposure' concept of the vulnerability equation (Dilley and Boudreau, 2001). How far a risk or shock impacts on key dimensions of well-being or food security such as consumption, health, and markets, depends on the structure of household income, expenditure, and assets, and on the cultural and environmental context (DFID, 1999). There is a growing realisation that livelihoods are highly affected by geography. The concept of

a livelihood group relies on the existence of relatively homogenous households living in the same geographic area. More homogeneity means more statistical inference for a given sample size and more reliable parameter estimates for modelling (Watkins, 2003). However, diversity between groups suggests that key model parameters will differ between livelihood groups, such as key income or expenditure elasticities and some variables may simply be irrelevant in some livelihood groups.

The foregoing discussion confirms that using livelihood analysis enables classification of distinct livelihood groups such that key characteristics are generally homogenous in a given livelihood group but more markedly varied across groups. In Kenya, distinct livelihood groups include pastoral livelihood, agro-pastoral livelihood, marginal agricultural livelihood and high potential livelihoods. The livelihoods groups can be re-defined in ordinal terms based on the severity of the food insecurity that defines each group. In other words, the various livelihood groups defined in ordinal terms can be used as relative measures of food insecurity.

6.2.5 Theoretical model

The theoretical strand of literature used to underpin the investigation is derived from one of a number of food security frameworks, the sustainable livelihoods framework (DFID, 1999) and Duncombe (2007) shown in figure 2.1. According to the livelihoods framework, food security outcomes are determined by a multiplicity of factors that are broadly motivated by contextual considerations, internal livelihood characteristics and the external environment (Duncombe (2007). Gladwin *et al.* (2001) contended that food security outcomes are a function of interactions between livelihood characteristics, resources and institutional processes. The assumption is that the interactions of the different components provide a range of income-generating options or livelihood strategies that are viable for livelihood groups (Murray, 2001). Consequently, the different types of strategies that are adopted by livelihoods groups ultimately determine food security outcomes for those livelihood groups.

The constructs of the food security framework summarised in figure 2.1 constitute the key factors that determine food insecurity. According to the livelihoods framework, vulnerability of

households is the context within which households are situated. Chambers (1989) postulated that vulnerability or the exposure to risks, shocks and hazards and the difficulty in coping with them impacts food security outcomes. Heightened vulnerability to hazards, shocks and trends, such as droughts, floods, heightened food prices and conflict tends to accentuate food insecurity, thus the positive relationship between vulnerability and food insecurity (Noojin (2006), Christiaensen and Subbarao (2004) and Douglas (2009)). Sen (1981) contended that assets, including human, financial, social-cultural, socio-political and physical capitals, which constitute internal livelihood characteristics in the livelihood framework, confer entitlement to households. Such capital assets include diversity of income sources, land sizes, productivity of land, livestock herd sizes and social and political status (Murray, 2001). Therefore Neufeldt *et al.* (2010) and Simmonds (2006) argued that, in general, increased access to of assets proffer a negative relationship with food insecurity.

The livelihood framework postulates that the social relations, institutions and organisations constitute the external environment that livelihood groups are subject to (DFID, 1999). Social relations such as gender, culture and ethnicity determine strategies that livelihood groups are able to adopt. For example, Gladwin *et al.* (2001) contended that certain cultural norms in Africa stipulate that women are disallowed from owning productive resources such as land. Such norms tend to compromise livelihood strategies that may be adopted because women account for 60-80 percent of agricultural production in sub-Saharan Africa (Gladwin *et al.*, 2001). Tanner-Grobler (2006) also stated that some cultural practices among pastoralists in the Horn of Africa tend to worsen access to nutrition among pastoral livelihood groups. However, the relationship between social relations and food insecurity is not always positive. Strong kinship ties between pastoral communities in the eastern Horn of Africa tend to mitigate food insecurity by expanding coping capacities for food insecure households through remittances or transfers (KFSSG, 2008c). In such instances the relationship between food insecurity and social relations is a negative one.

Institutions constitute an important construct of the sustainable livelihoods framework and form another component of the external environment (Duncombe, 2007). Institutions include governance structures, market and trade institutions and regulatory mechanisms, as shown on the DFID's livelihoods framework. Functions of institutions include development of policies for:

production, taxation, land tenure systems, pricing of food and non-food commodities, implementation of macroeconomic fundamentals such as exchange rates and monetary trends, formulating environmental policies and development of the trade infrastructure that length or shorten market access. Timmer (2004) argued that the role of institutions in facilitating or constraining adoption of livelihoods strategies has a profound effect on livelihood outcomes. Therefore, the relationship between food insecurity and institutions can either be positive or negative depending on the type of policies that are formulated and implemented.

Government, non-governmental and private sector organisations are also important components of the sustainable livelihoods framework shown in figures 2.1 and 6.1 and also constitute the external environment of livelihood groups (Duncombe, 2007). The organisations, both government and non-governmental have capacities to mitigate food insecurity and to also build resilience of livelihoods depending on the performance and appropriateness of interventions, projects and programs that are implemented. Calow *et al.* (2002) noted that success in providing a conducive external environment depends on how well organisations are harmonious and coherent in implementation of appropriate interventions. Devereux (2009) underscored this point by stating that livelihood dysfunction is largely attributable to response failure by organisations. Therefore, the relationship between organisations and food insecurity can either be positive or negative, depending on the performance of relevant organisations.

The theoretical model, derived from the DFID livelihoods framework, emphasises the important nexus between the different components of the framework. The sustainable livelihood framework is therefore, valuable in the following specific areas: First, it provides an analytical framework that leads to understanding and complex and dynamic factors by linking livelihood characteristics, trends and the external environment to livelihood strategies (Devereux *et al.*, 2004). Secondly, it provides a framework for understanding how and why disparate livelihood groups are impacted in different ways ((Løvendal *et al.*, 2004). Thirdly, the framework lays emphasis on multiple interactions between explanatory variables (Casale *et al*., 2007)). Distinct determinants of food insecurity may occur together, although the form and measure of interaction may differ significantly from one livelihood group to another (Young *et al.*, 2001). Interactions between the constructs of the framework enable deeper understanding regarding the

complexity and linkages between determinants and are therefore vital for formulation of intervention options.

As an analytical tool, the livelihoods framework captures both chronic and transitory factors that determine food insecurity. According to (Webb *et al.*, 2006), the decision and choice of the analytical method depends on resources, time constraints, type of data available, nature and objectives of the study and the type of users, among other factors. Due to paucity of panel data in Kenya and most other countries in sub-Saharan Africa, many empirical studies have not adequately captured both chronic and transitory food security simultaneously. Key socio-economic variables with temporal dimension and other important transitory shocks are best suited for dynamic models with account for both temporal and spatial dimensions.

In this regard, transitory shocks such as the post-election crisis and macro-economic variables with a temporal dimension such as fluctuation in global food and non-food prices and exchange rate shocks cannot be adequately analysed using cross-sectional data. However, transitory shocks tend to occur periodically, and depending on their intensity, may not affect the food security classification markedly. For example, the impacts of drought would likely constitute chronic food insecurity in drought-prone livelihoods such as pastoral and marginal agricultural areas which suffer recurrent drought (KFSSG, 2009). However, drought can be classified as a transitory event among high potential livelihood groups because drought occurs less frequently, such as once in about ten years, and may not result in a shift in the food security classification.

6.3 Research design

The purpose of this study was to establish the empirical determinants of food insecurity in Kenya and their influence, in the context of livelihoods, to inform livelihood-based intervention design. Table 6.1 summarises the specific sub-problems, methods employed, and data used to evaluate the sub-problems. Understanding the exact causes of food insecurity in disparate livelihoods is critical in informing interventions, policy, and programme design.

Table 6.1: Sub-problems in the analysis of food security in Kenya, 2008.

Sub-problem		Methodology employed	What data were used
1.	Identify determinants of food insecurity among four distinct Kenyan livelihoods.	A heterogeneous ordered logit model was used with the food insecurity status as the dependent variable and the specified determinants as independent variables (Williamson, 2006). Diagnostic tests were used to evaluate suitability of the model. Marginal effect and significant tests were used to evaluate determinants of food security across livelihood groups (Powers and Xie, 2008).	The study made use of livelihoods survey data collected by the Kenya Food Security Steering Group (KFSSG, 2008c); survey data from the Ministry of Health; and agro-climate data extracted from remotely sensed images; and were informed by the World Food Programme's vulnerability assessment (2004) and KFSSG (2008c).
2.	Evaluate the incremental impact of the determinants on food insecurity for each livelihood.	Marginal effects generated from the heterogeneous logit model were used to evaluate the incremental impacts of the determinants.	The same data for sub-problem 1 were used in sub-problem 2.
3.	Identify the specific indicators to target and monitor impacts of programmes for each livelihood group.	The analysis of the outcomes of the heterogeneous ordered logit model, in particular the most significant variables, provided input in the identification of indicators to target. In addition, development of an interaction variable provided important information on the identification of indicators through their synergistic relationships.	Results were generated from the marginal effects of the heterogeneous logit model, using data from sub-problem 2.

6.3.1 Preparation of the dataset

A number of steps were followed to prepare the data set for evaluating the three sub-problems. The first sub-problem was the identification of food security among three Kenyan livelihoods that were deemed to suffer the most food insecurity (KFSSG, 2008a). The steps followed are outlined below.

Step 1: The data were exported from the KFSSG's livelihoods database in Microsoft Access version 2003, into the STATA 11 statistical software package (StatSoft 1985-2009).

Step 2: The data editor in STATA 11 was used to check the data for outliers and anomalies - such as extreme or missing values.

Step 3: Summary statistics were obtained and the error terms established.

Step 4: All the data were assembled using a data abstraction tool. The matrix columns represented the variables and the observations were entered into rows. The number of observation units, called sub-locations, assigned to the livelihoods, ranged between 2,900 and 3,000 - well above the 30 observations required, as per the central limit theorem (Grinstead and Snell, 1997). Although data were collected for 6,320 observation units which covered the whole country, the livelihoods considered for the study covered about 3,000 observation units. In particular, the urban livelihood group that accounts for 35 per cent of the country's population was not within the scope of the study. The data were then ready for the regressions for addressing the three sub-problems. The second and the third sub-problems used the data and results prepared in sub-problem 1.

The key variables analysed empirically included: the main sources of food and income, output of key crops, migration patterns, market distances, and types of hazards that impact on food security such as HIV/AIDS, floods and conflict. The dependent variable used to investigate sub-problem 1 was the food security status of the livelihood group which had four levels or categories, shown in Table 6.2, namely: extreme food insecure, highly food insecure, moderately food insecure, and generally food secure where ordinal values of 1, 2, 3, and 4 are assigned, respectively, in each of the livelihood groups. The classifications for the food security status for each livelihood were obtained from the KFSSG livelihood survey (KFSSG, 2008c) and verified using the World Food Programme chronic vulnerability analysis of Kenya (WFP/VAM, 2004).

The classification of food security was based on the number of years of hunger prevalent in the livelihood during a 10 year period. In instances where interventions were instituted, the years where food aid was required to avert widespread hunger, were also used. The data for the number of years hunger was experienced were obtained through a survey instrument using both community interviews and historical records. Identification of the years of hunger was conducted for the March to June long-rains season, for the October to December short-rains season, and in-between both seasons. If hunger was experienced for 7-8 years out of 10, the livelihood group

was classified as extremely food insecure, 5-6 years as highly food insecure, 2-4 years as moderately food insecure, and one or less than one year as generally food secure.

The fundamental variables in the conceptual framework capture chronic food security since the baseline data used were cross-sectional. As postulated in the theoretical framework, baseline data used in this study does not include transitory variables. Table 6.3 presents an explanation of the variables, their sources, and the reasons for their inclusion in the study. The explanatory variables in Table 6.3 were informed by a review of the literature detailed in Chapter Three and summarised in Table 6.3.

Table 6.3 presents an explanation of the variables, their sources, and the reasons for their inclusion in the study. The explanatory variables in Table 6.3 were informed by a review of the literature detailed in Chapter Three and summarised in Table 6.3.

6.3.2. Data sources and measurement

The data used in this study were obtained from the livelihoods survey conducted by the Kenya Food Security Steering Group (KFSSG, 2008c). Data were collected for 6,320 units across the country. The units are geographic areas obtained by digitising the map of Kenya for each of its 71 districts. Prior to the livelihood survey, the Kenyan national map was digitised at sub-divisional level, leading to 2,000 geographic units. These were deemed by the survey team as not homogeneous enough for a detailed livelihood survey that would enable assigning of unique livelihood groups for each observation unit. The map was then further digitised to 6,320 units. The survey teams interviewed community groups in the observation units or livelihood groups, which were digitised and labelled sub-locations.

A survey of communities intended to characterise disparate livelihood groups, was carried out by the KFSSG. Surveys were conducted for the livelihood groups in each of the 71 districts. The team of officials who were selected were specialists in various disciplines, including crops, livestock, fisheries, nutrition and health, conflict, water and sanitation, education, and statistics. The questionnaires were field tested and then administered to officers in the government ministries and local NGOs residing in all 71 districts of the country. The data were validated in

six regional validation exercises and consultative processes by identifying significant anomalies. For example, an unlikely lack of contiguity in characteristics across bordering livelihood groups was addressed by reviewing the technical reports, and through discussions. A repeat survey was carried out in instances where serious anomalies were detected during the validation process.

The agro-climate data for rainfall and prevalence of flooding were spatially extracted from satellite images for the livelihood units (USGS, 2008). The remotely sensed data on rainfall were recorded from the images on a daily basis, but have been disseminated on a dekadal (10 day) basis since August 1995. The images cover the entire country and the data are given in the form of estimated millimetres of rainfall and extent of flooding. The data could be extracted from the images either for a given point (latitude and longitude) or for any polygon, such as a livelihood or administrative unit. The data for the analysis were extracted using mapping software called ARCVIEW version 3.2.

The data on HIV prevalence rates were obtained from the Kenya AIDS Indicator Survey (KAIS) that was conducted in 2007 for the 15-64 years age group (KAIS, 2009). The research used normalised weights for the data to avoid generating incorrect standard errors and confidence intervals. The survey results were valid for estimation of proportions and means at any aggregation level (KAIS, 2009). The normalisation of the data was carried out to ensure that the characteristics of the HIV/AIDS household data could be represented at various levels and units of analysis.

The KAIS is said to be the first national, population-based survey anywhere in the world that included testing for cluster of differentiation 4 (CD4) cells among those infected with HIV, a measure that is critical for understanding the HIV epidemic and planning prevention, care and treatment service. In addition, the national sero-prevalence survey by KAIS covered the 50-64 years, typically considered to be low risk (KAIS, 2009). The inclusion of the 50-64 age group in the research was based on the realisation that in reality the 50-64 age group was no longer necessarily low risk.

Table 6.2: Summary of food security categories and associated livelihood groups in Kenya, 2008.

Livelihood	Food security category, determined by KFSSG (2008c) and WFP/VAM (2004)	Characteristics of livelihood group
Pastoral livelihood	Extremely food insecure	Predominant in the north, south, northwest and northeast. Highly variable agro-climate with recurrent droughts and low total annual rainfall ranging between 250-400 mm. Overwhelming dependence on livestock where at least 80 per cent income is derived from livestock and products. High dependence on poorly integrated markets including high average market distance index of 0.72-0.85 compared to 0.39 – 0.44 in the high potential mixed farming zone. Market purchases account for about 65 per cent of food needs.
Agro-pastoral livelihood	Highly food insecure	Annual rainfall averages between 500-700 mm and is highly variable, leading to frequent crop failures. Livestock production key income source accounts for over 50 of total household income and crop production for about 30 per cent. On-farm production meets 30 per cent of food needs, while food purchases close to 60 percent of household food needs.
Marginal agricultural livelihood	Moderately food insecure	Predominant in south-eastern coastal lowlands and the lakeshore. Production characterised by low and poorly distributed rainfall ranging between 600-1,000 mm per year. Short-rains season more reliable and accounts for close to 70 per cent of crop output, especially in south-eastern lowlands. Maize accounts for close to 80 per cent of the cropped land in an unsuitable agro-ecology. About 40 per cent of the income is derived from crop production, 30 per cent from livestock, and 30 per cent from off-farm activities including remittances. Labour pattern: close to 20 per cent of household members are out-migrant labourers.
High potential mixed farming livelihood	Generally food secure	Predominant in the highlands of central, eastern, western Kenya and Nyanza. (Check) Rainfall 1,350-1,700 mm per annum and is highly reliable. Food purchases represent about 55 per cent of food basket and crop output provides 42 per cent. Market distances are low, large number of market participants, thus minimising transaction costs.

(Source: Kenya Food Security Steering Group (2008c)

Table 6.3: Description of livelihood variables in the analysis of Kenyan food security, 2008.

Variable		Measurement	Studies informing the choice of the variable
1	Food Security Status (FSS_i) (Dependent variable)	The categorical variable that captured the extent of livelihood food insecurity. The four categories were: (1) extremely food insecure, (2) highly food insecure, (3) moderately food insecure , and (4) generally food secure. A score of 7-8 years was classified as extremely food insecure, 5-6 years as highly food insecure, 2- 4 years as moderately food insecure and one or less than 1 year as generally food secure. Source of data: Kenya Food Security Steering Group (2008c) and World Food Programme/Vulnerability Analysis and Mapping unit (WFP/VAM, 2004); Haan *et al*. (2001).	FAO (2008b) and Christiansen and Subbarao (2004) stated that food insecurity is pervasive in Kenya and is worsening in spite of substantive interventions by governments and international development partners. The proportion of food insecure people in Kenya rose from 24 per cent (in the early 1980s) to 33 per cent in 2005 and projected to increase in 2009 (ReSAKSS, 2009).
2	Conflict (CON)	This variable captured whether the livelihood is situated in a conflict-prone area and how prevalent conflict was - obtained from livelihood survey data. The number one suggested that households were in an area where conflict was prevalent and zero where there was none. Source of data: Kenya Food Security Steering Group (KFSSG) (2008c).	Messer and Cohen (2004) noted that conflict is a key explanatory variable impacting food security adversely by disrupting production and social systems. The AU (2006a) stated that conflict tends to accentuate food insecurity even more than natural disasters. Pastoral areas, that are most prone to conflict, are also synonymous with the most insecure land tenure regime. Subsequently, the working hypothesis holds that conflict is a significant determinant of food security and was positively related to food insecurity.
3	HIV/AIDS (HIA)	This variable informed the HIV/AIDS prevalence among households in the livelihood, where a livelihood is located in an area where there was a likelihood of having a moderate, high or very high chance of HIV/AIDS infection. 1=Moderate (5-10 percent); 2=High (10-15 percent); 3=Very High (15-20 percent). Source of Data: Kenya AIDS Indicator Survey (2009).	Kennedy (2003) stated that the impact of HIV/AIDS affects all the dimensions of food insecurity. Nagoli *et al.* (2009) expounded on this by stating that productive resources that would be used to enhance and sustain food security are often re-directed to the management of the disease. Morton (2006) stated that there are significant gaps in analysis and understanding of how HIV/AIDS impacts on livelihoods, compromising intervention design. Therefore, it is hypothesised that prevalence of HIV/AIDS was positively related to food insecurity.
4	Rainfall (RAFL)	The variable measured the volume of annual rainfall in millimetres from remotely sensed data, for each of the 6,302 observation units over 13 years, constituted into livelihood groups. Source of data: United States Geological Survey (USGS) (2008).	Haile (2005) contended that climate is one of the most critical factors impacting food security. Noojin (2006) also stated that there was a clear relationship between food security and the number of drought years in sub-Saharan Africa. The working hypothesis is that adequate rainfall was negatively related to food insecurity.
5	Flooding (FLO)	This dummy variable captured the prevalence of flooding. The score was determined by the frequency of flooding during the long and short-rains season. The number one indicated that severe annual flooding was prevalent in the area over a period of 10 years and a zero meant that flooding was not prevalent in that livelihood. Source of data: USGS (2008).	Funk *et al*. (2011) noted that extreme weather variabilities including droughts and floods are increasingly frequent. Douglas (2009) noted that flooding compromises food security by causing destruction of livelihood assets, displacements, impeded access to markets, and often results in outbreaks of disease. Therefore, the assumption is that flooding was positively related to food.
6	Own farm Production (OFP)	The variable measured the proportion of total food consumption from food produced on the farm. Source of data: Kenya Food Security Steering Group (2008c).	Agboola *et al.* (2004) claimed that agricultural production lies at the centre of alleviating food insecurity among rural households, many of whom are dependent on agricultural production. FAO (1998) noted that lowered production growth was a characteristic of food insecure households. Therefore, it is assumed that own farm production is negatively related to food insecurity.

Table 6.3 Continued: Description of livelihood variables in the analysis of Kenyan food security, 2008.

Variable		Measurement	Studies informing the choice of the variable
7	Proximity to Markets (PM)	The variable defined the distance from markets, where the shorter the distance to a market, the lower the score. The proximity to market analysis, obtained from WFP/VAM (2004), involved spatial analysis using Geographic Information Systems. "Cost Surface" analysis was conducted after deriving a "Friction Surface" using PCA for the attributes: road type (different types of roads were assigned different friction values), water bodies (very high friction), slopes (higher slope equals higher friction), and market locations. After deriving a continuous cost surface for all places in Kenya (in the arbitrary units of Grid Cell Equivalents, GCE), total GCEs were extracted for each livelihood, divided by the area of that livelihood. This provided a single characterisation of overall proximity to markets across livelihood. The IDRISI GIS and remote sensing software were used for the analysis. The scores ranged from 0.1377 to 0.9230 A higher score means lowered access to markets. Source of data: WFP/VAM (2004).	Christiaensen and Subbarao (2004) contended that proximity to markets is an important determinant of food security, particularly in areas that are traditionally food insecure. Bhatta (2010) also noted that proximity to markets affects food security directly stating that people residing near roads tended to have better food security. Tembo and Simtowe (2009) and Babu and Sanyal (2009) stated that closeness to markets confers access, not just to food but also to credit and better terms of trade and interventions, thereby enhancing food security. Tangka *et al.* (2002) stated that the longer the distance from markets, the higher the transaction costs and, ultimately, the higher the cost of products. Therefore, given the definition of and measurement of this variable, it was assumed that proximity to market was positively related to food insecurity.
8	Food Consumption Source (FCS)	The variable captured the diversity of food sources. The variable depicted the per cent of food sources in a given observation unit as a ratio of total number of food sources in a given livelihood group. The higher the ratio, the greater the diversity of food sources available to the household. Source of data: Kenya Food Security Steering Group (2008c).	Hassan *et al.* (2005) argued that diversity of food sources had strong linkages to nutrition and food security. Neufeldt *et al.* (2009) stated that diversification in food production and consumption was a critical strategy in mitigating food insecurity for climate-vulnerable livelihoods. Murray (2001) claimed that larger variety of food sources tended to increase food security. Therefore, the assumption was that food consumption source is negatively related to food insecurity.
9	Migration Patterns (MP)	The variable captured migration patterns of livelihood groups. The different migration patterns are: 1=fully nomadic, 2=semi-nomadic and 3=fully settled. The higher the score, the more sedentary the households in that livelihood group were likely to be. Source of data: Kenya Food Security Steering Group (2008c).	Migration patterns have direct impacts on food security. KFSSG (2008c) noted that production strategies range from nomadic pastoralist to sedentarised farming practices. Migration patterns tended to impact on food security through increased risks of conflict, disease and loss of animals during migrations, proximity to markets, and credit facilities. In this regard, it is hypothesised that the migration pattern was negatively related to food insecurity.
10	Income Contribution Source (ICS)	The variable captured the diversity of income sources and depicted the per cent of income sources in a given observation unit as a ratio of total number of income sources in a given livelihood group. The higher the ratio, the greater the diversity of income sources available to the household. Source of data: Kenya Food Security Steering Group (2008c).	Acharya and Cohen (2008) contended that a lack of diversity in income sources increases food insecurity among rural households by increasing exposure to risk. Hengsdijk *et al.* (2005) argued that income diversification impacts on food security prospects by improving livelihood resilience and allocation of labour across enterprises. Therefore, the income contribution source was assumed to be negatively related to food insecurity.

In the collection of data on the prevalence of HIV/AIDS, the Kenya National Bureau of Statistics with partners, including the World Health Organization, National AIDS Council, United States Centres for Disease Control and UNAIDS, were guided by the national sampling frame (KAIS, 2009). The sampling frame was a two-stage frame stratified with 1,800 clusters. Each cluster had 100-149 households. Clusters were sampled from each stratum with probability proportionate to their size and households were randomly sampled from each of the selected clusters. HIV/AIDS testing for the selected population was conducted by trained laboratory technicians and laboratory scientists. The HIV/AIDS variable used in the study informed the HIV/AIDS prevalence livelihood where a household resided in an area with the likelihood of having low, medium, or high chances of HIV/AIDS infection (Quick, 2010).

6.4 Steps in conducting the analysis

A number of steps were followed in conducting the analysis for each sub-problem. The steps are outlined below:

6.4.1 Sub-problem 1: Identifying the determinants of food security among four livelihood zones Kenya livelihood groups

Step 1: An ordered logit model was estimated using all the variables presented in Table 6.3, and detailed in section 6.3.

Step 2: The parallel odd assumption was tested using the overall logit model (o-model) test in STATA. (The parallel odd assumption in ordered logit models assumes that coefficients do not change across livelihood groups). This assumption was violated leading to the adoption of the heterogeneous ordered logit model.

Step 3: The following diagnostic tests were used to assess reliability of heterogeneous ordered logit model: a log-likelihood ratio was used to evaluate goodness of fit, a link test was estimated to assess whether the model was correctly specified, and a t-test was used to assess the significance of parameter estimates.

Step 4: The estimated values for all the variables together with the test statistics were tabulated.

Step 5: The significant coefficient estimates of the variables were identified for further analysis in the second sub-problem.

6.4.2 Sub-problem 2: Evaluate the incremental impact of the determinants on food security for each livelihood group

Step 1: All the significant variables were identified from the results of the heterogeneous ordered logit model obtained in the first sub-problem.

Step 2: The incremental impacts, otherwise called the marginal effects (slopes), were obtained using mfx (margin) command in STATA, for variables that have statistically significant coefficients.

Step 3: The test statistics, significance and signs of the outputs were observed.

Step 4: A summary of the marginal effects was tabulated for all variables that have statistically significant coefficients.

6.4.3 Sub-problem 3: To identify the specific indicators to target and monitor impacts of programmes for each livelihood group

Step 1: The outcomes of the t-ratios in sub-problem two were used to obtain the statistically significant variables to monitor food security analysis to inform intervention design.

Step 2: The important synergistic relationships between variables that provided more information in the selection of monitoring indicators were evaluated by developing an interaction variable.
Step 3: The interaction term between several pairs of variables was created by multiplying the two variables from the heterogeneous ordered logistic model and the result saved as a new variable. Interaction terms were added to the model, one at a time. The significance of the

variable coefficients and model specification were also evaluated. An interaction is formed by the product of two or more predictors and used as a new variable (Quick, 2010).

Step 4: The test statistics, the significance and the signs of the estimated coefficients of the variables were observed after estimating several interactions.

Step 5: Important interactions between the variables were tabulated, highlighting the significant ones.

6.5 The empirical model

This study was informed by key characteristics and considerations in livelihood grouping (Watkins, 2003), based on key elements of the sustainable livelihoods framework, which are outlined in Figure 2.1. The variables selected for the study are informed by the literature review. To reiterate, the indicators of food insecurity are broadly classified into climate and environmental; economic, production and market; conflict and political strife; governance and policies; demography; and socio-economic factors (Chopak, 2000).

More specifically, based on the theoretical literature, food security is a function of the following variables and may be expressed as:

$$Y^{*} = f(\text{Conflict, HIV/AIDS, rainfall, flooding, market proximity, food consumption source, migration pattern, income consumption source, own farm production}) \quad (6.1)$$

where Y* is the unobservable latent variable and the different variables are defined in Table 6.3.

Since Y* is not measurable, one can define an observed ordinal variable, Y, that is a function of Y*. In this study, the severity of food insecurity that defines the various livelihood groups can be used for this purpose (see 6.5.1).

By defining an observed ordinal variable Y, the relationship between food security status and the different explanatory variables may be written in an econometric equation as:

$Y_i = X'\beta + \varepsilon$ ……..……..…….. (6.2)

where Y_i is food security status based on the different livelihood groups, i =1, 2, …, J; X is a matrix of observations on the explanatory variables; β is a vector of coefficients that are to be estimated; and ε is a vector of error or disturbance term, which follow a certain statistical distribution.

The theoretical model developed in equation 6.1 provided a basis for the empirical model in this study. Equation 6.2 was estimated using a heterogeneous ordered logit model to help in the analysis of food security in the different livelihood groups in Kenya. The theoretical literature shows that food security classification differs across livelihood groups due to distinctly different economic, agro-climatic, demographic, geographic, social, institutional, and policy characteristics that are specific to each livelihood group (Watkins 2003). Williamson (2010) established that a heterogeneous ordered logit model improves fit when data is pooled across heterogeneous categories. Allowing residuals to differ across categories will therefore account for possible heterogeneity across diverse livelihood groups.

The following section outlines the detailed research design, estimation procedure and justification for the choices.

6.5.1 Fitting the ordinal logit model

The analysis started with fitting an ordered logit model. The standard logit and probit models provide a method for estimating unobserved dependent variables that can be assigned a set of binary numbers, zero and one (Wooldridge, 2003 and Greene, 2003). However, when a dependent variable has more than two categories and the values of each category has sequential order, where a value is higher than the previous ones, one can use an ordered logit model. One of the justifications for using the ordered logit model is that y is actually a collapsed or limited version of the latent variable, Y* (Williams, 2010).

In this study, even though Y*, in this case food insecurity, is an abstract construct, it can be measured by assigning an ordinal value to each livelihood based on the level of intensity of food insecurity that characterises each group. According to KFSSG (2008c) and WFP/VAM (2004), the pastoral, agro-pastoral, marginal agricultural, and high potential mixed farming livelihoods are respectively characterised by extreme food insecurity, high food insecurity, moderate food insecurity, and general food security (Table 6.2).

Therefore, the food insecurity status, Y_i, can be categorized and take values i =1, 2, 3 and 4 such that:

$$Y_i = \begin{cases} 1\ [\text{extremely food insecure}], & \text{if } 0 < Y_i^* < \alpha_1 \\ 2\ [\text{highly food insecure}], & \text{if } \alpha_1 < Y_i^* < \alpha_2 \\ 3\ [\text{moderately food insecure}], & \text{if } \alpha_2 < Y_i^* < \alpha_3 \\ 4\ [\text{generally food secure}] & \text{if } Y_i^* > \alpha_3 \end{cases} \quad \text{..... (6.3)}$$

where i = represents the food security category and the α_j represents cut off points or threshold parameters that define each category. Ordinal values are assigned to each category in equation 6.3, which depict the order but fail to measure the interval between categories. Threshold parameters are therefore introduced to determine cut-off points or distinct thresholds that differentiate one livelihood group from another.

Assuming Y* follows a logistic distribution, it follows that:

$$Y_i^* = \Lambda(X_i'\beta) = \frac{e^{X_i'\beta+\varepsilon}}{1+\sum_{i=1}^{4} e^{X_i'\beta+\varepsilon}} \text{..... (6.4)}$$

Where: - $X'\beta + \varepsilon$ is the latent regression model specified in equation (6.1).

$\Lambda(.)$ is a standard logistic (probit) cumulative density function bounded between $0 < \Lambda(.) < 1$

β, represents a vector of parameter estimates for each independent variable defined in the latent regression model in equation 6.1

From equation 6.4, the logistic regression model is non-linear in parameters. β coefficients measure the natural logarithm of predicted probabilities odds ratio rendering β coefficient difficult to interpret, since it cannot be interpreted as in the estimated coefficients of the ordinary least squares regression. Therefore, response probabilities are estimated such that probability that Y_i is in J is given as follows:

$$P(\text{Yi} = J|\text{X}) = \Lambda\left(\alpha_{j-1} \leq X'\beta + \varepsilon \leq \alpha_j\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6.5)$$

The marginal effects ($\Delta P(Y_i = J)/\Delta x$) are obtained from the ordered logit model estimation (odds ratios) so that the importance of each of the coefficients for disparate food security categories and in turn, livelihood groups, can be deduced from the results (Powers and Xie, 2008).

6.5.2 Proportional odd assumption

Ordered logit models are very useful in estimating discrete dependent variables of an ordinal nature. However, one of the major limitations of the ordered logit and probit model is using the model when the proportionality odds assumption is violated. The figure below demonstrates threshold parameters and observed response given marginal change in an explanatory variable.

Figure 6.1 illustrates a typical ordered response model. Increasing one unit of a given independent variable such as rainfall while holding coefficients (β) and cut-off points (α's) constant, translates into a parallel shift of the probability distribution to the right as shown by the dotted curve (Greene, 2003). Essentially, the ordered logit assumes that the estimated coefficient and threshold parameters (β and α) are constant since the shift caused by a unit change is parallel to the original mass function. The model also assumes that variance (σ^2) is constant across livelihood groups. Williamson (2010) argued that the coefficient β_k and threshold parameter α_k are related such that:

$\beta_k = \frac{\alpha_k}{\sigma}$ for $k = 1,\ldots,K$ where σ is the standard error. ……..……..…..... (6.6)

Given this relation, when the variance (σ^2) is homoskedastic, the ratio specified in equation 6.5 is the same across livelihood groups, and the proportional odds assumptions holds, then the ordered logit model estimates are unbiased. However, if residuals vary across groups, a problem of heteroskedasticity arises as the ratio expressed in equation 6.6 varies. Hoetker (2007a) contended that the presence of differences in residual variation, however small, may lead to biased parameter estimates. Violation of proportional odds assumptions might be ignored if homogeneity across categories can be justified. However, the objective of this study was to estimate the significance of each determinant across each category, accounting for heterogeneity across livelihood groups, leading to the introduction of the heterogeneous ordered logit model.

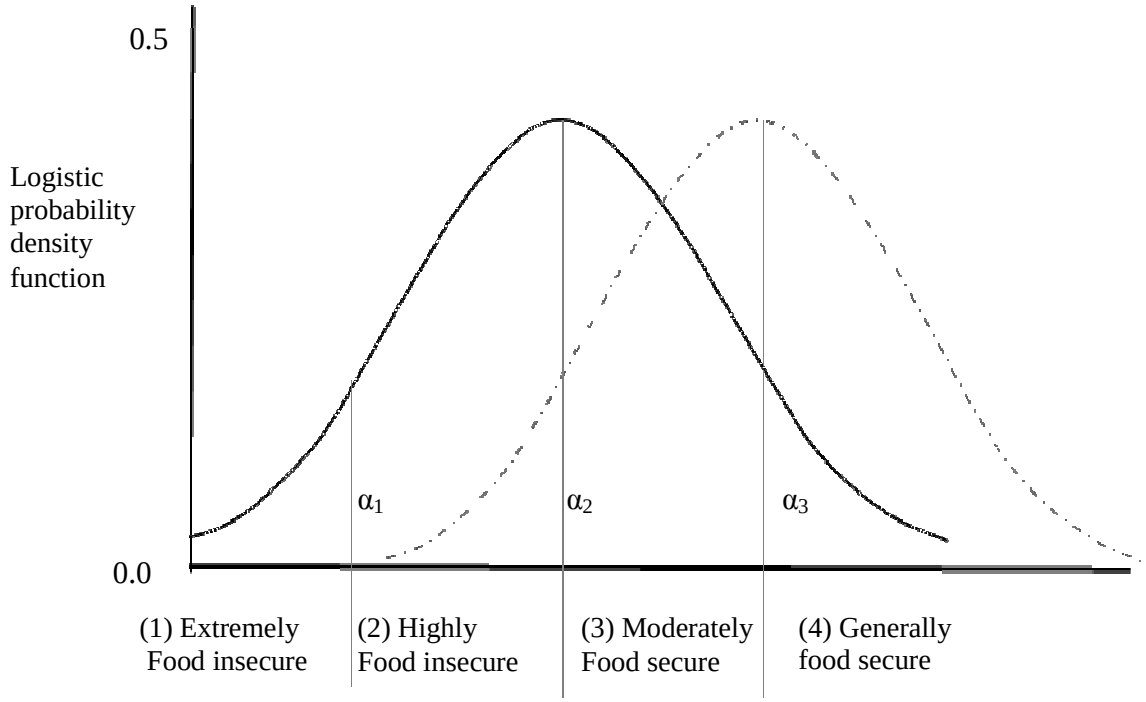

Figure 6.1: Probability density function showing observed responses and thresholds.

(Source: Greene, 2003: pp. 738).

6.5.3 The heterogeneous logit model

The heterogeneous ordered logistic regression model introduced by Williamson (2010) estimates ordered logit but assumes heteroskedasticity of residuals across categories. The model simultaneously estimates two equations: the first equation, referred to as the choice model, which

estimates the latent regression using ordered logit model; and the second equation which estimates the variance equation expressed as:

$\sigma^2_i = \exp(\sum_1^j z_{ij}\gamma_j)^2$ ..... (6.7)

Where z represents a vector of j values for the i^{th} observation. z defines groups with different residual values in the underlying latent variable. Coefficient γ shows how z affects changes in variance captured by the log of (σ^2). The variance equation indicates how the underlying latent variable is scaled for each case, i.e. it reflects differences in residual variability that, if left unaccounted for, would cause values to be scaled differently across cases (Williamson, 2010). The full model shows how the choice and variance equations are combined to estimate the probability for any given outcome.

Given equation (6.3), the probability that Y_i is in J category is given as:

$$P(\mathrm{Yi} = J|X) = \Lambda\left(\alpha_{j-i} \leq X'\beta + \varepsilon \leq \alpha_j\right) = \Lambda\left(\frac{\alpha_j - \beta' X}{\sigma_i}\right) - \Lambda\left(\frac{\alpha_{j-1} - \beta' X}{\sigma_i}\right) \quad \text{..... (6.8)}$$

where σ_i is the standard error obtained from equation (6.7).

It is important to note that if σ_i=1, then equation (6.8) collapses to equation (6.5), and the heterogeneous ordered logit model yields exactly the same results as a standard ordered logit model. The presence of heterogeneity is therefore tested using a simple likelihood test called overall model test. The null hypothesis assumes that the variance is homoskedastic (i.e. $\gamma = 0$). Failure to reject the null hypothesis means that ordered logit model will suffice, however, if the null is rejected, a heterogeneous ordered logit model is adopted.

Marginal effect estimates are vital in inferential analysis as they are easy to calculate and interpret. From the heterogeneous ordered logit model, marginal effects simply measure change in probability of observing Y_i is in J category with respect to a unit change in a given independent variable.

6.5.4 Estimating the heterogeneous ordered logit model

The heterogeneous logit model is a special case of heterogeneous choice models which attempts to correct for heteroskedasticity (Williamson 2010). Heterogeneous ordered logit models are estimated using an ordered general linear model (oglm) in STATA (see Williams, 2010). This model is used to estimate both linear and non-linear models with the default model being the ordered logit model. The ordinal linear general model is a user-written programme formally adopted by STATA in 2010 which has gained popularity due to its ability to estimate heteroskedastic models. It uses maximum likelihood (MLE) to estimate parameters (Williamson, 2010).

Maximum likelihood plays an important role in estimation as it often yields efficient and consistent results even in situations where relaxing Gauss Markov assumptions is difficult, such as when non-linearity and multi-co-linearity are present (Wooldridge, 2003). Given a large data sample, asymptotic properties of MLE makes it possible to estimate unbiased and efficient estimators even when important Gauss Markov assumptions are violated. However, it is important to note that MLE does not solve for endogeneity and therefore correct specification of the model is indispensable (Greene 2003). Williamson (2010) noted that probabilities and marginal effects calculated from ordered general linear models and general ordered logit models are similar and the choice of model is mostly an empirical issue.

Wooldridge (2003) held that while the significance of each variable from the base model can be inferred from the coefficient estimates, the signs of the coefficient of ordered choice models are only significant in determining the direction of lowest and highest categories. In this regard, if the parameter estimate is positive, that is, $\beta_i > 0$the probability observed in the highest category, that is, $Pr(Y_i = 4|X)$ increases as independent variable X_i increases. However, the probability of the lowest category has opposite signs to the coefficient of the base model. If the coefficient of an independent variable X_i is positive, that is, $\beta_i > 0$, $Pr(Y_i = 1|X)$, the probability of the highest category decreases as the independent variable increases. The signs of marginal effects of the intermediate categories are not always inferred from the base mode because of the ambiguity caused by the off-setting effect from subtracting successive probabilities. STATA, by default,

calculates marginal effects (mfx) based on mean values of explanatory variables $\overline{X}$. Using the mean values of explanatory variables has two main limitations:

- It leads to loss of information to the extent that no explanatory variable may actually be observed at its mean values.
- STATA treats categorical explanatory variables as continuous and uses mean values to estimate marginal effects which may be unrealistic and sometimes misleading.

Wooldridge (2003) recommends the use of average marginal effects. These estimate the expected values conditional on independent variables [E(Y/X)] and compare different values of the explanatory variables to obtain a marginal effect for discrete X_i. Average marginal effects are based on observed values such that the marginal effect is computed for each case and an average obtained using each of the computed effects.

6.5.6 Reference categories for discrete variables

The latent regression model includes both continuous and discrete explanatory variables. While continuous variables can readily be interpreted based on change in the probability of observing an outcome belonging to a particular category caused by one unit change, discrete variables can only take finite values. STATA chooses one category of a discrete explanatory variable as the reference category and marginal effects are estimated by change from the reference category (say 0 to 1) holding other variables at their means. STATA, by default, assigns category one as the reference category which is then omitted from the analysis. If the chosen category consists of majority of the observations, this might lead to loss of information and possibly biased estimates. To circumvent this problem, suitable reference categories are chosen for discrete variables with more than two categories. In this study, the reference categories assigned for HIV/AIDS is 3 (a very high prevalence) and for migration patterns 1 (a fully nomadic migration pattern).

Results from the estimated model were used to identify important determinants of food security in Kenya and their influence for each livelihood group in responding to sub problems 1 and 2, as shown in Table 6.1. The objective of sub problem 3 was to identify variables to monitor and to

also identify synergistic relationships between them. Significant variables from the outcomes of the marginal effects were used to inform the specific indicators to target and monitor the impacts of programmes for each livelihood group. In addition, synergistic relationships between variables provided important input into the selection of indicators to monitor. The extent of the relationships and differences between variables were obtained by multiplying interacting variables from the original set of variables and creating a new variable that was regressed in the optimal heteroskedastic logistic regression (equation 6.5). Diagnostic tests including identification of significant variables were also conducted. The results of the analysis are presented in the following chapter.

CHAPTER SEVEN

RESULTS AND DISCUSSION

7.1 Introduction

This chapter presents the results from model estimation and a discussion of the analysis. It begins with presenting the descriptive statistics followed by the discussion, organised by each of the three sub-problems. Inferential statistics were used to explain the data and outcomes of the model. A detailed analysis of each variable is carried out after the discussion of the descriptive statistics.

7.2 Descriptive statistics

The descriptive statistics for continuous explanatory variables are presented in Table 7.1. Frequency and percentage distribution for discrete variables are presented in Table 7.2. The number of observations from the livelihood data for the variables ranged between 2708 and 2768. The sample size was considerable and consistent with the central limit theorem that requires the number of observations to be greater than 30 (Grinstead and Snell, 1997). The minimum and maximum values depended on the range of individual variables.

Table 7.1 presents the average annual rainfall which has a wide spread ranging from 250mm to 1700mm. The mean and standard deviations were 901 and 418 millimetres respectively. The distribution of market proximity approached normality with a mean score of 0.501 and a relatively low standard deviation estimate of 0.177. Table 7.1 presents food consumption source, income contribution source, and own farm production's distribution which were widely dispersed as shown by the range, mean, and standard deviations. It is important to note that the use of cross-sectional data has limitations in empirical analysis because the data may not capture the dynamics of variables over time. The use of cross-sectional data also results in pooling or concentrating data around the mean, resulting in loss of information.

Table 7.1: Summary of descriptive statistics for determinants of food security in Kenya, 2008.

Variables	Measured as	Data source	Observations (n)	Mean	Std. Dev	Mode	Median	Min	Max
Rainfall	Millimetres of rainfall	USGS (2008)	2768	901.04	418.34	1200	900	250	1700
Proximity to Market	Distance index	WFP/VAM (2004)	2768	0.501	0.177	0.81	0.449	0.137	0.923
Food Consumption Source	Number of food sources accessed by a particular livelihood group as a percentage of total number of food sources	KFSSG (2008c)	2768	37.29	13.36	11	10.83	11	70
Income contribution source	Number of income sources available to a particular livelihood group as a percentage of total number of income sources	KFSSG (2008c)	2768	12.01	15.49	0	3	0	100
Own Farm Production	Proportion of food consumed from on-farm production	KFSSG (2008c)	2768	41.298	34.589	0	10	0	100

Table 7.2: Summary of frequency and of food security and discrete explanatory variable in Kenya, 2008.

Variables	Measured as	Data source	Observations (n)	Categories	Frequency	Percentage
Food insecurity	Prevalence of hunger	KFSSG (2008c)	2768	Extreme food Insecurity	292	10.5
				High food insecurity	967	34.9
				Moderate food insecurity	1017	36.7
				General food security	492	17.8
HIV/AIDS	Prevalence of HIV/AIDS	KIAS (2009)	2768	Moderate HIV/AIDS	2061	74.5
				High HIV/AIDS	342	12.4
				Very High HIV/AIDS	365	13.2
Conflict	Prevalence of conflict	KFSSG (2008c)	2768	No Conflict	1960	70.8
				Conflict	808	29.2
Migration pattern	Type of migration pattern	KFSSG (2008c)	2722	Fully nomadic	636	23.4
				Semi -nomadic	624	22.9
				Fully Settled	1462	53.7
Flooding	Prevalence of flooding	USGS (2008)	2708	No flooding	2116	78.1
				Flooding	592	21.9

7.3 Results from the regression analysis

The following section outlines the results of the regression analysis including the diagnostic results, significance of variables, and marginal effects.

7.3.1 Diagnostic tests

Table 7.3 presents diagnostic tests, variable coefficients, and relevant statistics derived from the model estimation using the heterogeneous ordered logit model. However, diagnostic tests for the ordered general logit model showed that the parallel odds assumption was violated as per step two in section (6.4.1). The likelihood ratio test has a Chi-square (25) of 933.00 with a probability value of 0.000 (see Appendix D). The null hypothesis of homoskedastic variance was rejected which means that the general ordered logit model was not consistent with the sample data used in this study. The heterogeneous ordered logit model was adopted and other diagnostic tests are detailed in the following section.

Several diagnostic tests were examined, such as the model's predictive power, the likelihood ratio which has a chi-square distribution; the model's explanatory power, the pseudo R-square; the specification test; and the significance of the coefficients. Table 7.3 also presents the two sets of equations estimated from the heterogeneous logit model consisting of a choice equation and a variance equation. The Chi-square statistics tests the null hypothesis that all the regression coefficients in the model are equal to zero against the alternative that at least one of the predictors' regression coefficients is not equal to zero. The estimated value of the log-likelihood ratio (chi-square statistics) was 3845.4 and was significant at the one percent level. Therefore, the null hypothesis that all coefficients are equal to zero is rejected, and the model has good predictive power.

Moreover, the pseudo R-square, also known as McFadden's pseudo R-squared, indicated that about 56 per cent of the variation in food security was explained by the variables in the regression. This estimated value of R-square is reasonably high for a cross-section data and implies that the model specification is sound and gives a good fit.

Table 7.3: Summary of diagnostic tests, coefficients and their respective p values of the heterogeneous ordered logit model for Kenya, 2008.

Goodness of fit			
Log likelihood	-1535.59	N=2708	
LR test: Chi(df)	3845.4	(df=20)	
Prob> chi2	0.000		
Pseudo R square	55.6		
Specification test (Linktest):	**Coefficients**	**Z Statistic**	**P value**
Hat	0.837	12.04	0.000***
Hatsq	0.03	0.03	0.976
Choice equation			
Conflict	-1.382	-3.85	0.000***
HIV/AIDS 1	3.307	4.14	0.000***
HIV/AIDS 2	3.8608	3.91	0.000***
Flooding	0.056	0.34	0.734
Migration pattern 2	4.8299	3.63	0.000***
Migration pattern 3	3.9424	3.5	0.000***
Market proximity	-6.5693	-3.53	0.000***
Rainfall	0.0056	4.05	0.000***
Own farm production	0.0079	3.12	0.002***
Food consumption source	0.0372	3.03	0.002***
Income contribution source	0.0409	3.62	0.000***
Variance equation ln(sigma)			
Conflict	-0.5085	-3.86	0.000***
HIV/AIDS 1	-0.0391	-0.35	0.725
HIV/AIDS 2	0.3443	2.60	0.009*
Flooding	0.3260	4.27	0.000***
Market proximity	0.9537	3.15	0.002***
Own farm production	0.0013	1.46	0.144
Income contribution source	0.01	5.13	0.000***
Food consumption source	-0.01	-2.81	0.005**
Rainfall	-0.0001	-1.03	0.302

***Significant at 99 per cent level of confidence
**Significant at 95 per cent level of confidence
*Significant at 90 per cent level of confidence

7.3.2 Regression model analysis

This section presents the results of the significance tests and estimated average marginal effects of specific variables while holding other variables at observed values. Average marginal effects estimated at observed values are more representative than the use of marginal effects at mean (Wooldridge, 2003: pp.503). Table 7.4 presents the average marginal effects of each variable while holding other variables at observed values.

Marginal effects are more informative than coefficients and easy to interpret as they provide a simple rationale of evaluating the impact of a change in the independent variable and differences in predicted probabilities across dependent variable categories. However, in non-linear models, predicted probability estimates and testing statistical significance of the coefficient has to be complemented by testing statistical significance of the difference in probability across all dependent variable categories (Hoetker, 2007: pp.335). Table 7.5 presents a summary of the significance of variables across livelihood groups, obtained from the heterogeneous ordered logit model.

7.4 Discussion of marginal effects of determinant of food security in Kenya

This section presents the results and discussions of the second sub-problem which evaluated the incremental impacts of the determinants on food security on each livelihood group. In general, incremental impacts, otherwise called the marginal effects, capture the impacts on dependent variables when the explanatory variables increase by one unit. The y-axis represented the food insecurity status, while the x-axis represented each of the nine selected variables outlined in Chapter Six. However, the coefficients obtained from the heterogeneous logit model cannot measure the impact of the explanatory variable on the dependent variable, since they cannot be interpreted the way the coefficients from the classical regressions are interpreted (Powers and Xie, 2008). Here, the marginal effects were generated by transforming the coefficients (odds ratios) from the heterogeneous logit model to slopes using the mfx (margin) command function in STATA 11 (Greene, 2007).

Table 7.4: Coefficients of base model and average marginal effects for each explanatory variable holding other explanatory variables at observed values for Kenya, 2008.

Explanatory Variable	Base model coefficient	Explanation of category	Average Marginal effects: dE(y/x)/dx
Conflict dy/dx from 0 to 1	-1.3817***	Pastoral livelihood	0.324***
		Agro-pastoral livelihood	0.255***
		Marginal agricultural livelihood	-0.337**
		High potential livelihood	-0.242*
Flooding	0.0561	Pastoral livelihood	X
		Agro-pastoral livelihood	X
		Marginal agricultural livelihood	X
		High potential livelihood	X
HIV/AIDS dydx from 3 to 1	3.3068***	Pastoral livelihood	-0.128**
		Agro-pastoral livelihood	-0.339**
		Marginal agricultural livelihood	0.336***
		High potential livelihood	0.159**
HIV/AIDS dydx from 3 to 2	3.8608***	Pastoral livelihood	-0.021
		Agro-pastoral livelihood	-0.39**
		Marginal agricultural livelihood	0.415***
		High potential livelihood	0.015
Migration pattern dy/dx from 1 to 2	4.8299***	Pastoral livelihood	-0.457**
		Agro-pastoral livelihood	-0.015*
		Marginal agricultural livelihood	0.419**
		High potential livelihood	0.023*
Migration pattern dy/dx from 1 to 3	3.9425***	Pastoral livelihood	-0.455***
		Agro-pastoral livelihoods	-0.247***
		Marginal agricultural livelihood	0.439**
		High potential livelihood	-0.264**
Market proximity	-6.5693***	Pastoral livelihood	0.212***
		Agro-pastoral livelihood	0.24***
		Marginal agricultural livelihood	-0.421***
		High potential livelihood	-0.032
Food consumption source	0.0372***	Pastoral livelihood	-0.0012**
		Agro-pastoral livelihood	-0.0014 **
		Marginal agricultural livelihood	0.0009*
		High potential livelihood	0.0019***
Income contribution source	0.0409***	Pastoral livelihood	-0.0012**
		Agro-pastoral livelihood	-0.0013 **
		Marginal agricultural livelihood	0.0004
		High potential livelihood	0.0032***
Rainfall	0.0056***	Pastoral livelihood	-0.00018***
		Agro-pastoral livelihood	-0.00021***
		Marginal agricultural livelihood	0.00007**
		High potential livelihood	0.0003***
Own farm production	0.0080***	Pastoral livelihood	-0.0002**
		Agro pastoral livelihoods	-0.0003**
		Marginal agricultural livelihoods	0
		High potential livelihood	0.0006***

***Significant at 99 per cent level of confidence
**Significant at 95 per cent level of confidence
*Significant at 90 per cent level of confidence
X - variable is not significant

Table 7.5: Summary of significant variables by livelihood group in Kenya, 2008.

Food security status	Livelihood	Level of significance of selected variables from the marginal effects, by livelihood group							
		Conflict	HIV/AIDS (very high to high)	Rainfall	Proximity to markets	Migration pattern (fully nomadic to semi-nomadic)	Food consumption source	Income contribution source	Own farm production
Extremely food insecure	Pastoral Livelihood	0.324***	-0.021	-0.00018***	0.21***	-0.457**	-0.0012**	-0.0012**	-0.0002**
Highly food insecure	Agro-pastoral livelihood	0.255***	-0.39**	-0.0002***	0.24***	-0.015*	-0.0014**	-0.0013**	-0.0003**
Moderately food insecure	Marginal agricultural livelihood	-0.337**	0.415***	0.00007**	-0.42***	0.419**	0.0009*	0.0004	0
Generally food insecure	High potential livelihood	-0.265*	0.015	0.0003***	-0.032	0.023*	0.0019***	0.0032***	0.0006***

***Significant at 99 per cent level of confidence
**Significant at 95 per cent level of confidence
*Significant at 90 per cent level of confidence

In ordered logit models, marginal effects measure the difference (an increase or decrease) in the probability of observing an outcome falling into category j, in this case, the food (in)security outcome, when the independent variable changes by one unit. The dependent variable is ordered, based on the severity of food insecurity. Lower categories with lower values suggest higher intensity of food insecurity while higher categories measure lower intensity of food insecurity or higher food security status, that is, 1=extremely food insecure (pastoral livelihood); 2=highly food insecure (agro-pastoral livelihood); 3=moderately food insecure (marginal livelihood); and 4=generally food secure (high potential mixed farming livelihood). Therefore, if the difference in probability in the lower categories is positive, it follows that the probability in the higher level categories will be negative. Marginal effects across livelihood groups will always sum to zero (Wooldridge, 2003: pp. 502). The marginal effects were derived for the four different livelihoods. The high potential mixed farming zone was classified as generally food secure and is therefore not the main focus of the study but was used as a reference category.

7.4.1 Conflict variable

The conflict variable was estimated by the prevalence of incidents over a ten year period at the livelihood group's level (KFSSG, 2008c). The impact of conflict on food insecurity was measured by the transformation of the coefficients from the heterogeneous logit model into marginal effects (changes in probability). The marginal effects, shown in Table 7.4, measure the difference in probability of observing food insecurity in conflict relative to non-conflict areas while holding other variables at observed values. Conflict had a positive relationship with food insecurity and the probabilities were significant in all livelihood groups suggesting that conflict increases the probability of observing food insecurity. However, conflict prevalence was a key determinant of food insecurity in the pastoral and agro-pastoral livelihood groups. The coefficients in both pastoral and agro-pastoral livelihood groups were significant at the 99 percent level of confidence. The presence of conflict increases the probability of being extremely food insecure (of being in the pastoral livelihood group) by 33 percentage points. The presence of conflict increased the probability of being highly food insecurity (of being in the agro-pastoral livelihood group) by 26 percentage points. The coefficient of residual variability, shown in Table 7.3, was -0.5 demonstrating that variability in food insecurity reduces in conflict-prone areas as compared to non-conflict prone areas.

Heightened conflict is fairly synonymous with extended periods of drought (Omosa *et al*., 2005). Most conflict in the pastoral areas of Kenya is resource-based, arising from competition over scarce resources, and tends to increase during drought periods. Theisen *et al.* (2010) found that there was a clear correlation between scarcity of environmental resources that results in drought and a rise in the number of conflict incidents. Okoti *et al.* (2004) also demonstrated that the insecurity of land tenure among pastoralists tends to exacerbate conflict in the pastoral livelihood group arising from competition over resources – water, pasture and browse. However, inter-clan conflicts in the pastoral livelihood are also an additional source of insecurity, where reciprocal raids occur despite peace initiatives by governments and development partners (ALRMP, 2008). Buhaug (2010) underlined the importance of non-climate related factors in exacerbating conflict in pastoral areas, suggesting that drivers of conflict are multi-faceted. Conflicts in pastoral and agro-pastoral areas often lead to loss of livestock and decimation of livestock holdings. In

addition, most conflict incidents result in loss of lives, particularly of herders at their most productive age-groups. An additional source of vulnerability in the pastoral livelihood arising from conflict and insecurity is impeded access to grazing and water sources, compromising livelihood productivity (Jaspars and Maxwell, 2009). Messer and Cohen (2004) suggested the reason that conflict is a key factor influencing food insecurity is due, in part, to its disruptive impacts on productive and social systems. The erosion of productive capacities from the loss of key livestock assets is often sudden and extensive, constraining a quick return to pre-conflict productive capacities once the active conflict has ended.

Pastoralists and agro-pastoralists depend on markets to access 60-90 per cent of their food needs and are also heavily dependent on markets to trade livestock (KFSSG, 2008a). However, conflict disrupts markets by increasing the risks involved in accessing markets for both traders and consumers. Bandit attacks lead to the closure of key markets and incur high transaction costs due to the risks associated with participating in trade. It is therefore not surprising that areas reporting chronic conflict are synonymous with high rates of child malnutrition, an outcome indicator of food insecurity (Tanner-Grobler, 2006). Geinitz and Reinhard (2003) explained that heightened malnutrition in conflict areas is detrimental to future production prospects because human productive capacities are eroded, leading to structural deficits.

The outcome of the marginal effects analysis suggests that interventions that mitigate and prevent conflict are central to reducing food insecurity in pastoral and agro-pastoral areas. Development interventions pay little attention to conflict mitigation and prevention of crises in general, beyond addressing the immediate impacts of conflict on households, notably provision of emergency interventions (Seddon, 2004). The absence of a decisive redress of the immediate, medium and long-term impacts will only serve to accentuate the importance of conflict in determining food insecurity in the pastoral and agro-pastoral livelihood groups which will likely continue to suffer severe food insecurity as long as the impacts of conflict linger on.

The outcome of the analysis suggests that while conflict impacts both pastoral and agro-pastoral groups, the impacts are less severe in the agro-pastoral livelihood group. Agro-pastoralists combine nomadic pastoralism and crop farming as their key livelihood strategies (KFSSG,

2008a**).** The agro-pastoral livelihood group is situated in areas that have a more favourable agro-climate compared to the pastoral livelihood (Funk *et al.,* 2008), suggesting that competition for environmental resources such as water, pasture, and browse may not be as intense as in the pastoral areas. Adoption of a wider range of production enterprises tends to mitigate the impacts of livestock production failures, mostly as a result of drought. Because of the adoption of a semi-agrarian production strategy, agro-pastoralists migrate less often than pastoralists, reducing the probability of conflict occurring during migration.

Geographically, agro-pastoralists are situated a greater distance from the conflict-prone borders of southern Sudan, north-western Uganda, southern Ethiopia and eastern Somalia. Subsequently, conflict is lower than in the pastoral livelihood which lies adjacent to these volatile borders. While conflict does occur in agro-pastoral areas, the prospects for recovery are much better than those of pastoralists who tend to lose their sole asset, livestock, whenever conflict strikes. Agro-pastoralists are to some extent able to compensate for such losses through income generated from crop production.

The marginal effects of the conflict variable are consistent with the expectation that conflict contributes substantially to food insecurity in pastoral and agro-pastoral areas. Conflict is a distinct feature of the pastoral livelihood with most pastoralists falling under the extremely food insecure category (Theisen *et al.,* 2010). The relationship between food insecurity and conflict in the marginal agricultural livelihood group suggests that an increase conflict will reduce the probability of observing moderate food insecurity, a better state than highly or extremely food insecure. However, the prevalence of conflict in the marginal agricultural livelihood group is generally very low.

7.4.2 HIV/AIDS variable

The prevalence rates of HIV/AIDS were measured using categorical values. In estimating marginal effects, ‘very high’ prevalence rates (3) of HIV/AIDS were used as the reference category as described in section 6.5.6. The results in Table 7.4 illustrate that in general an increase in HIV/AIDS prevalence accentuated food insecurity. HIV/AIDS was a key determinant

of food insecurity in the agro-pastoral and marginal agricultural livelihood groups. Relative to very high HIV/AIDS prevalence rates, the high prevalence rates of HIV/AIDS decreased the probability of being highly food insecurity by 39 percentage points. However, high prevalence rates increased the probability of being moderately food insecure by 41.5 percentage points. The impacts of HIV/AIDS in determining food insecurity were limited in the pastoral and high potential livelihood groups. The coefficient of residual variability of 0.34, from the variance equation in Table 7.3, shows that variability in food insecurity increases when the prevalence rates of HIV/AIDS are high relative to very high levels.

Kennedy (2003) underscored the importance of HIV/AIDS in influencing food insecurity by stating that the impacts of HIV/AIDS affect every dimension of long-term food security. HIV/AIDS has a direct impact on agricultural production because the disease minimises household productivity and the ability to participate in economic activities (Gillespie, 2006). The dependency burden increases and children are often drafted into the labour force, ostensibly to compensate for the loss of participation of other members (Nagoli *et al.*, 2009). In addition, household resources are usually redirected towards the management of the disease, constraining purchasing capacities and elevating food insecurity (FAO, 2003).

The prevalence of HIV/AIDS is critically linked to macro, meso and micro-environments (Løevinsohn and Gillespie, 2003). Livelihood characteristics are manifested in the meso-environment which encompasses attributes such as community structures, gender movements, type of farming systems, and cultural norms. The outcomes of the marginal effects in this study show that the greatest impacts of HIV/AIDS were in the marginal agricultural livelihood group situated around Lake Victoria and the south-eastern and coastal lowlands as well as the agro-pastoral livelihood groups. The HIV/AIDS variable also seemed more significant among settled farming systems than among nomadic farming system households. The marginal agricultural livelihood was characterised by substantial movement of labour, particularly in the south-eastern and coastal lowlands as well as in the fishing lake region. Labour migrations lead to long periods away from home and promote behaviour that promotes the spread of the virus. The resulting impacts usually permeate entire production systems, not just through loss of productive household members but often through loss of productive assets. Asset liquidation such as the

sale of livestock and other production inputs arises from the need to fill income and food gaps and to cover medical costs. The decline in food security tends to persist in the long-term because negative coping strategies continually erode productive capacities.

HIV/AIDS prevalence accentuated food insecurity in the marginal agricultural and agro-pastoral livelihood groups. It is likely that interventions to redress HIV/AIDS may be fairly ineffective because they are not integrated within overall rural production systems. Perhaps intervening institutions perceive HIV/AIDS to be a medical or health problem and pay less attention to mitigating its impacts on livelihood systems. Traditionally, institutions perceive food insecurity to be an agro-climatic problem and are more adept at responding to the impacts of drought on livelihoods rather than those of HIV/AIDS. The result is that interventions intended to mitigate food insecurity can only achieve a certain level of success, as suggested by intractable underlying food insecurity in the marginal agricultural and agro-pastoral livelihood groups.

There are gaps in understanding of the impact of HIV/AIDS on communities that engage in purely nomadic pastoralism (Morton, 2006). The marked influence of HIV/AIDS in increased food insecurity in the agro-pastoral livelihood group was rather unexpected. However, it lends credence to research that indicates that HIV/AIDS prevalence is rising - even among communities that are not fully sedentary (as argued by Habib and Jumare, 2008). Kenya's agro-pastoral livelihood group is situated in an environment that has limited trade, health care and other amenities. Adeyi *et al*. (2001) stated that food insecurity could in part, be due to a lack of access to required medical services, leading to accelerated loss of productive household members. The agro-pastoral livelihood group is heavily dependent on livestock, which contributes 60 per cent to household income (KFSSG, 2008c). The sale of livestock to meet medical costs and fill income gaps tends to increase household vulnerabilities over the long-term. Once sold, livestock is not easily recoverable because it takes time for animals to reproduce.

While the migration of pastoralists is seasonal and extensive, strong community structures and cultural norms seem to mitigate pre-disposing behaviour that promotes HIV/AIDS infection. However, it is clear that the pastoral livelihood is vulnerable to the impacts reported in both the marginal agricultural and agro-pastoral livelihoods. Habib and Jumare (2008) stated that the

transmission potential of HIV/AIDS among pastoral communities is rising. As pastoralists migrate to newly-created 'urban' centres after either losing their livestock to drought or in search of alternative income-earning livelihood options, community structures tend to erode. The pastoral livelihood group was classified as extremely food insecure and the introduction of an additional shock through an increase in the prevalence rates of HIV/AIDS could be catastrophic. Increasing prevalence rates among pastoralists amidst poor access to amenities suggests that future impacts of increased prevalence of HIV/AIDS on food insecurity could be severe. Pastoralists depend almost exclusively on livestock sales to finance health costs, which could have serious repercussions for food security. To facilitate pre-emptive action, a deeper understanding of trends and the likely future implications of increased HIV/AIDS prevalence rates among pastoral communities is required.

The results from marginal effects were significant. Proudlock (2007) contended that it is critical to take account of the impacts of HIV/AIDS when planning adoption of different livelihood programmes. Different strategies are required for each livelihood because the contribution of HIV/AIDS to food insecurity varies substantially across the livelihood groups. However, decision-making is constrained by insufficient empirical analysis regarding the nexus between HIV/AIDS and livelihood food security that would properly guide responses.

7.4.3 Rainfall Variable

The rainfall variable provided by the United States Geological Survey (USGS) measured the average amount of rainfall in millimetres over a 27-year period. Table 7.4 shows the changes in probabilities across the four livelihood groups given an increase in one millimetre of rainfall annually. The results also show that the probabilities were significant in all livelihood groups, particularly in the pastoral, agro-pastoral and high potential livelihood groups. Figure 7.1 is a graphical representation of the distribution of probabilities of food insecurity across livelihood groups. An increase in one millimetre of rainfall decreased the probability of being extremely food insecure and of being highly food insecure by 0.018 and 0.02 percentage points, respectively. It is important to note that the unit of rainfall is one millimetre per year, so the change in food insecurity is considerable. A millimetre increase in annual rainfall increased the probability of being moderately food insecure and generally food secure by 0.007 and 0.03

percentage points, respectively. The results also suggest that rainfall is an important determinant of food insecurity in all livelihoods groups.

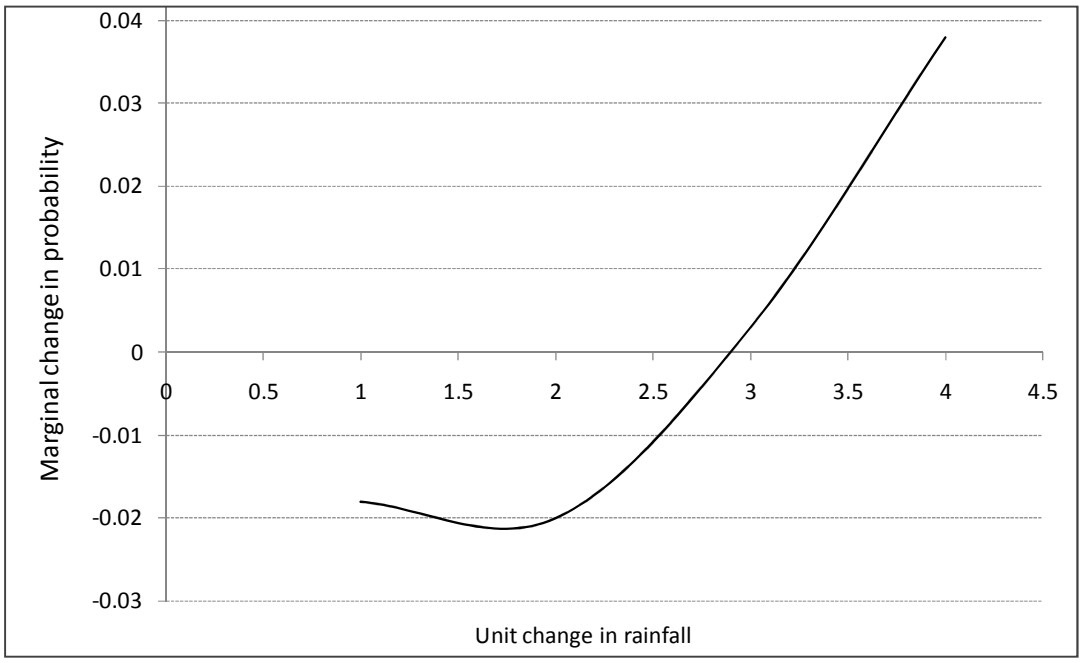

Figure 7.1: Marginal effect of rainfall in Kenya, 2008.

Climate is one of the most important factors influencing food security in sub-Saharan African countries, where food security is largely dependent on rain-fed agriculture (Haile, 2005). In most of the greater Horn of Africa, rainfall is low, unreliable, poorly distributed and a key determinant of food insecurity (United Nations, 2000). Many countries in Africa are subject to extreme weather variability result in droughts, floods and other weather hazards (Funk, 2011). Shocks are deepening and occurring with increasing regularity, negatively impacting food security. Noojin (2006) and Christiaensen and Subbarao (2004) concluded that there is a clear relationship between food insecurity and the number of drought years over the past four decades in the pastoral, agro-pastoral and marginal agricultural areas of sub-Saharan Africa. Thrupp and Megateli (1999) explained that food insecurity leads to exploitation and degradation of environmental resources, further compounding food insecurity.

About four serious droughts were experienced in Kenya over the past 10 years (1999-2001, 2003, 2005-2006 and 2008-2009), primarily affecting the pastoral, agro-pastoral and marginal

agricultural livelihoods (Funk, 2011). The outcomes of the marginal effects are consistent with expectations that rainfall is an important determinant of food insecurity across all the livelihood groups. The pastoral livelihood is often the most drought-affected with average annual rainfall amounts of under 450 millimetres (Mati *et al.*, 2005).

The marginal effects show that poor agro-climatic conditions, particularly rainfall, have heightened food insecurity in the pastoral livelihood by compromising the productivity of livestock. Livestock is the key source of food and income for pastoralists contributing close to 90 per cent of pastoralist household income (KFSSG, 2008c). Any shock or hazard that negatively impacts on livestock production would invariably adversely affect pastoral food security because of the overwhelming importance of livestock in these livelihoods. Poor rains and drought often cause deterioration of key environmental fundamentals such as pasture, browse, and water. Lengthy livestock migrations in search of grazing resources result in deterioration in health conditions including the decimation of herds during severe drought periods. Such livestock produce less milk and fetch lower prices in markets, compromising pastoral terms of trade, purchasing capacities and household food security.

The results support the expectation that declining rainfall would adversely affect food insecurity through the adoption of undesirable coping strategies. As droughts have extended and intensified, drought-prone livelihoods, having exhausted their traditional coping strategies, routinely employ coping strategies that are detrimental to the environment - such as charcoal and firewood production (KFSSG, 2009). Such practices have caused deforestation, leaving soils bare and accelerated erosion, while endangering the future production of other livelihood groups. Other coping strategies, such as sand harvesting, reduction in the frequency and composition of meals, and slaughtering calves to save the mothers, tend to weaken future food security and resilience.

The marginal effects of the rainfall variable also suggest a similar important influence on food insecurity in the agro-pastoral livelihood. While average annual rainfall amounts in the agro-pastoral livelihood are higher than in the pastoral livelihood, ranging between 600-700 millimetres per annum, the livelihood is nevertheless prone to drought (Mati *et al.*, 2006). The

slightly lower impacts of rainfall on food insecurity could be a reflection of the greater production options for agro-pastoralists who rear livestock and grow crops. Increased product diversification tends to confer greater prospects for mitigating food insecurity and ensuring resilience, in the event that livestock and/or crop enterprises fail (Neufeldt *et al.,* 2010).

The marginal effects also showed that rainfall was an important determinant of food insecurity in the marginal agricultural livelihood. Crop production is the principal livelihood strategy in the marginal agricultural livelihood despite relatively low annual average rainfall (600-700 millimetres per annum). While there was greater diversification in income sources in the marginal agricultural livelihood, most income sources were dependent on agro-climatic factors, particularly rainfall. Crop, livestock and labour migration are key sources of income in the livelihood (KFSSG, 2008c). A substantial proportion of household members in the marginal agricultural livelihood derive their income from labour on farms in neighbouring high potential districts. However, a significant proportion of household members also engage in off-farm income-generating activities due to their proximity to key urban centres.

Rainfall on its own is however not necessarily an overwhelming contributor to food insecurity. Multiple shocks that afflict vulnerable livelihoods tend to compound the impacts of drought (Pavanello, 2000). This study focused on rural households where the predominant livelihood activities are agricultural in nature and dependent on rain-fed production, for the most part, for both crop and livestock production. However, the capacity of livelihoods to ensure food security is also dependent on factors exogenous to the rainfall determinant, such as the availability of markets, impacts of conflict, and land degradation. Some of the compounding factors tend to negate the positive impacts of good rains.

7.4.4 Market proximity variable

Proximity to markets was a score developed using principal component analysis to capture the distance from markets, generated by surface mapping of key roads in Kenya, as shown in Table 6.4. Table 7.4 demonstrates the change in probability given a unit change in the distance index. The results show that there is a positive relationship between distance to markets and food

insecurity. Figure 7.2 is a graphical representation of the distribution of probabilities of food insecurity across livelihood groups. Market proximity was a key determinant in the pastoral, agro-pastoral and marginal agricultural livelihood groups.

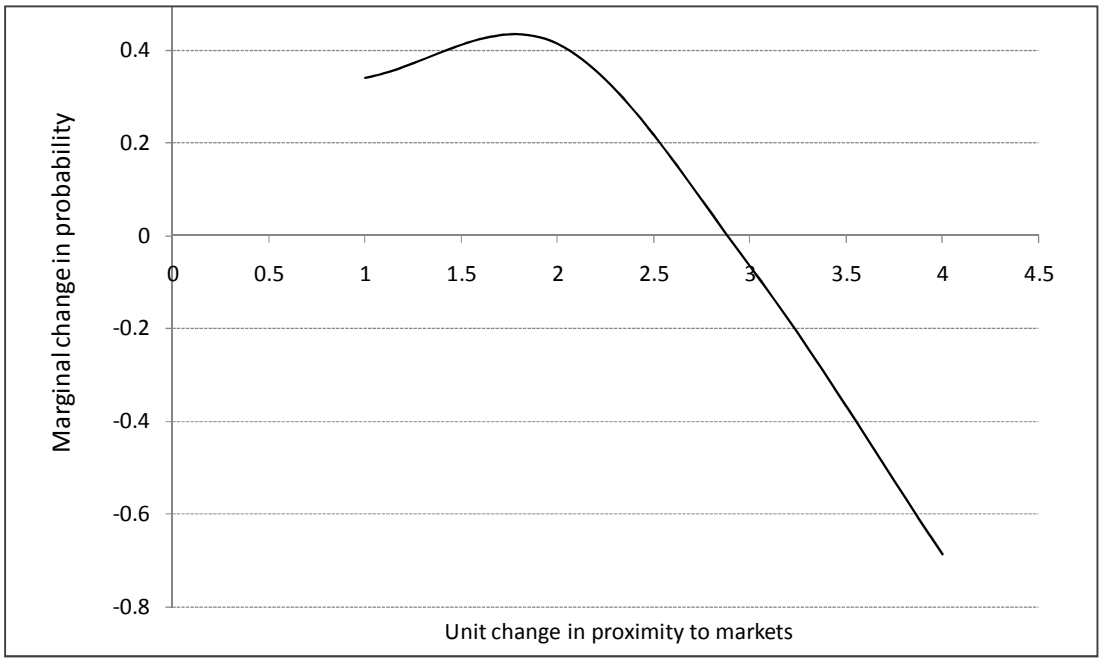

Figure 7.2: Marginal effect of market proximity in Kenya, 2008.

A unit increase in the distance index increased the probability of being extremely food insecure (of being in the pastoral livelihood group) by 21 percentage points and the probability of being highly food insecure (of being in the agro-pastoral livelihood group) by 24 percentage points. A unit increase in the distance index decreased the probability of being moderately food insecure (of being in the marginal agricultural livelihood group) by 42 percentage points. The influence of market proximity in determining food insecurity in the high potential livelihood group was insignificant. The coefficient of the residual variability of 0.95, from the variance equation in Table 7.3, was significant at 99 per cent confidence level and demonstrated that variability in food insecurity increased as market distances lengthened.

The results in this study support the findings of Christiaensen and Subbarao (2004) that proximity to markets is an important determinant of food security, particularly in areas that are traditionally food insecure. Bhatta (2010) supported this, stating that people who live nearer

good roads generally have better food security than those who do not. In addition, Simmonds (2006) contended that the physical and trade infrastructure at the disposal of most households situated in food deficit areas were rudimentary and constrain optimal market performance. Tembo and Simtowe (2009) and Babu and Sanyal (2009) stated that closeness to markets confers access, not just to food but also to credit, better terms of trade, and interventions. Importantly, Tangka *et al.* (2002) stated that the longer the distance from markets, the higher the transaction costs and ultimately, the higher the cost of products.

Barraclough (1996) argued that market liberalisation had been conducted in the absence of concomitant improvements in market access and trade infrastructure, resulting in increased food insecurity because of a lack of equity in terms of trade and competition. Poor terms of trade generally do not support viable household access to cereals and other food and non-food items during poor seasons, resulting in even further reduced incomes. Resource poor farmers are unable to exploit the benefits of market liberalisation because the markets are poorly integrated (United Nations, 2000).

The results of the marginal effects are consistent with the body of literature alluded to in previous paragraphs which indicate that markets do have a substantial influence on food insecurity. The identification of market distances as a key determinant of food insecurity suggests that underlying the market distances are opportunities and constraints that either alleviate or exacerbate food insecurity.

The pastoral livelihood group is reliant on markets to trade livestock and products such as milk, and purchasing virtually all other food and non-food commodities from the market. However, the long distances between pastoral markets have resulted in poor market integration in the pastoral livelihood group. Subsequently, there is limited price transmission between surplus and deficit markets, such that pastoralists far removed from key markets often receive relatively low prices for their livestock, while paying higher than average prices for other food and non-food commodities. Terms of trade are often skewed against pastoralists because they are generally price-takers for both their marketable output as well as for food and non-food purchases (KFSSG, 2008a). The high transaction costs arising from a combination of poor infrastructure

and high costs of security due to conflicts that cause recurrent market disruptions tend to compound the impact of long distances between key markets. Lowered bargaining capacities amidst heightened transaction costs invariably constrained purchasing capacities of households in the pastoral livelihood, supporting the results of the marginal effects that showed a negative and significant impact on food security.

The marginal effects showed that food insecurity was similarly impacted by market proximity in the agro-pastoral and marginal agricultural livelihoods. Although the two livelihood groups have more diverse production options than the pastoral livelihood, lengthy distances to markets seem to accentuate food insecurity. Apart from high transaction costs, poor bargaining positions and inability to access the benefits that accrue from favourable market integration, the two livelihood groups also face considerable opportunity costs. The travel time required to access markets tends to remove household members from other productive activities, foregoing income. The three livelihoods under discussion source substantive proportions of their food from markets, resulting from the fragile drought-prone production systems that limit viable production options. Dependency on poorly functioning distant markets is a major source of vulnerability to food insecurity as shown by the results of the marginal effects.

The importance of proximity to markets as an influence on food insecurity is a critical finding because of the overwhelming dependence on markets as the main source of food and income for the three livelihood groups. The outcome of the analysis demonstrated that improving market access is key to mitigating high levels of food insecurity especially in the pastoral, agro-pastoral, and marginal agricultural livelihood groups - traditionally the most food insecure. However, it was clear from the characteristics of these livelihoods that there were more complex linkages between market distances and other factors such as integration of markets and transaction costs. While market distances contributed substantially to food insecurity, other compounding factors such as the viability of the trade infrastructure, and facilitators and constraints to optimal market performance, need to be considered. The outcomes of the marginal effects with respect to the influence of market distances is an important input for decision making in terms of policy formulation and intervention design for all three livelihood groups.

7.4.5 Migration patterns variable

The migration pattern variable was measured using categorical values for each of the three patterns, namely fully nomadic, semi-nomadic and the fully settled. The fully nomadic category was used as the reference category, as described in section 6.5.6. The results show that the migration pattern was a key determinant in the pastoral livelihood group. The results in Table 7.3 suggest that nomadic migration patterns seem to enhance food insecurity. The semi-nomadic migration pattern decreases the probability of being extremely food insecure by 45.7 percentage points, relative to the fully nomadic pattern. However, the probability of being highly food insecure changed only marginally, most likely due to the fact that the majority of agro-pastoralists practise semi-nomadism. The results for the marginal agricultural and high potential livelihood groups are not meaningful because nomadic and semi-nomadic migration patterns are not characteristic of the two livelihood groups. Interestingly, results from the marginal effects suggest that sedendarisation (movement from nomadic and semi-nomadic to fully settled) reduces the probability of being extremely and highly food insecure by 45.7 and 23 percentage points, respectively.

One distinguishing characteristic among pastoral and agro-pastoral livelihood groups is the migration pattern. Migration patterns are closely linked to land use and production systems (Boli, 2005). The outcome of the marginal effects suggests that nomadic migration patterns associated with the pastoral livelihood group tends to heighten food insecurity. Okoti et al. (2004) argued that the nomadic migration pattern is characterised by communal use of land by pastoralists, contributing to degradation of the rangeland. Kugelman and Levenstein, (2010) also stated that environmental policies are poorly enforced resulting in unsustainable use of land. The lowered productivity of rangeland negatively impacts food security among the pastoral livelihood group and their nomadic migration pattern also limits diversification of production. Livestock production is the overwhelming source of food and income for the pastoral livelihood group (KFSSG, 2008c), increasing their vulnerability to food security because of the absence of alternative income-generating alternatives. The nomadic migration pattern in Kenya is also characterised by droughts that often lead to decimation of livestock, further compounding food insecurity.

The semi-nomadic migration pattern typical of the agro-pastoral livelihood group is associated with considerable levels of food insecurity (KFSSG, 2008a). While crop production provides an additional source of food and income for agro-pastoralists, nomadic livestock production remains the predominant production system. The limited contribution of crop output in the agro-pastoral livelihood group is attributed, in large measure, to frequent and lengthy droughts (Funk, 2008). In addition, many agro-pastoralists adopt cropping production systems after losing their livestock to drought and often lack the requisite skills and financing required for profitable crop production. Although the study suggests that a fully settled pattern confers food security to livelihood groups, it is likely that poor production regimes, recurrent droughts, and limited enforcement of environmental polices contribute to reducing productivities in the pastoral, agro-pastoral and marginal agricultural livelihood groups.

7.4.6 Food consumption source variable

The food consumption source variable measured the diversity of sources for each livelihood group. The results in Table 7.4 demonstrate that greater diversity of food sources reduces food insecurity. Figure 7.3 is a graphical representation of the distribution of probabilities of food insecurity across livelihood groups. The food consumption source variable was significant in all livelihood groups, but most significant in the high potential livelihood group at 99 per cent confidence level. In the pastoral and agro-pastoral livelihoods, a percentage point increase in the food consumption source decreased the probability of being extremely food insecure and highly food insecure by 0.12 and 0.14 percentage points, respectively. In the marginal livelihood, a unit increase in food consumption source variable slightly increased the probability of being moderately food insecure by 0.09 percentage points and increased the probability of being food secure by 0.19 percentage points. The coefficient of residual variability, from the variance equation in Table 7.3, shows that the residuals variability coefficient is -0.01 and was significant at 95 per cent level of confidence. This suggests that as the diversity of food sources increased, the variability in food insecurity declined.

Diversity of food sources has strong linkages to nutrition and food security (Hassan *et al.*, 2005). Absence of recommended food groups attained through consistently balanced diets has been shown to have detrimental impacts on birth weights, cognitive ability, timely maturation, as

well as learning capacities. Such impacts tend to affect the productive capacities of household members in the long run. Diversification of food production and consumption was a critical strategy in mitigating food insecurity among climate-vulnerable households (Neufeldt *et al.*, 2010). Murray (2001) also showed that increased diversity of food sources tended to increase food security among vulnerable households.

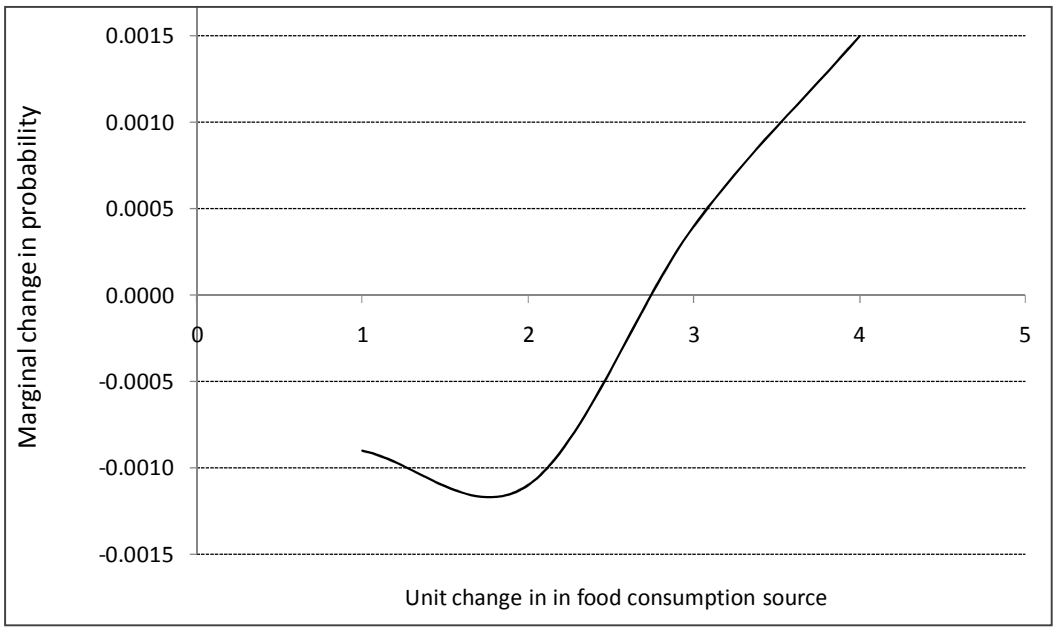

Figure 7.3: Marginal effect of food consumption sources in Kenya, 2008.

The study of the marginal effects showed that increased diversity of food sources reduced food insecurity in the pastoral and agro-pastoral livelihoods but had a more marked impact in upholding food security in the high potential livelihood group. The pastoral livelihood group derived most of their food from livestock and livestock products. Most other food groups were sourced from markets and fraught with significant challenges like long distances, lack of access, high transaction costs, and the absence of bargaining capacity.

The outcome of the marginal effects suggests that an expansion in alternative sources of food would reduce food insecurity, ostensibly by mitigating the impacts of the 'failure' of the predominant food source, which is livestock (Neufeldt *et al.*, 2010). However, the exact impact of a diversification of food sources may not be fully evaluated because the diet of the majority of

pastoralists and agro-pastoralists is confined to a fairly narrow set of food groups, even in favourable seasons. Most markets in pastoral areas also supply a limited range of foodstuffs, in part due to high transaction costs and a fairly rudimentary trade infrastructure in these areas (KFSSG, 2008a). Nevertheless, this finding regarding the importance of market proximity (section 7.3.5) offers useful information for the design of interventions that would result in significant mitigation of food insecurity. It is likely that improvements in the functioning of markets (including their integration with surplus markets) would promote production and access to other food commodities apart from livestock.

Adequacy of both production and access in terms of quantities purchased and consumed are an important consideration in pastoral and agro-pastoral livelihood groups. Markets in both these livelihood groups also supply a fair selection of food commodities, both in livestock and crops. However, bottlenecks in the marketing system, including the proximity to markets and resultant high transaction costs, would suggest that access to the required quantities of food may be limited by prohibitive prices. While the required diversity of consumption may be achieved, the quantities may be compromised, providing a basis for further investigation.

7.4.7 Income contribution source variable

The income consumption source variable measured the diversity of sources for each livelihood group. The results in Table 7.4 demonstrate that greater diversity of income sources reduced food insecurity. Figure 7.4 is a graphical representation of the distribution of probabilities of food insecurity across livelihood groups. The marginal effects of the income consumption source variable were significant in the pastoral, agro-pastoral and high potential livelihood groups.

A unit increase in the diversity of income sources decreased the probability of being extremely food insecure and highly food insecure by 0.12 and 0.13 percentage points, respectively. A unit increase in the income contribution source increased the probability of being food secure by 0.32 percentage points. The coefficient of residual variability from the variance equation, in Table 7.3, shows that the residuals variability coefficient is 0.01 and significant at 95 per cent level of

confidence. This suggests that as the diversity of income sources increased, variability in food security similarly increased.

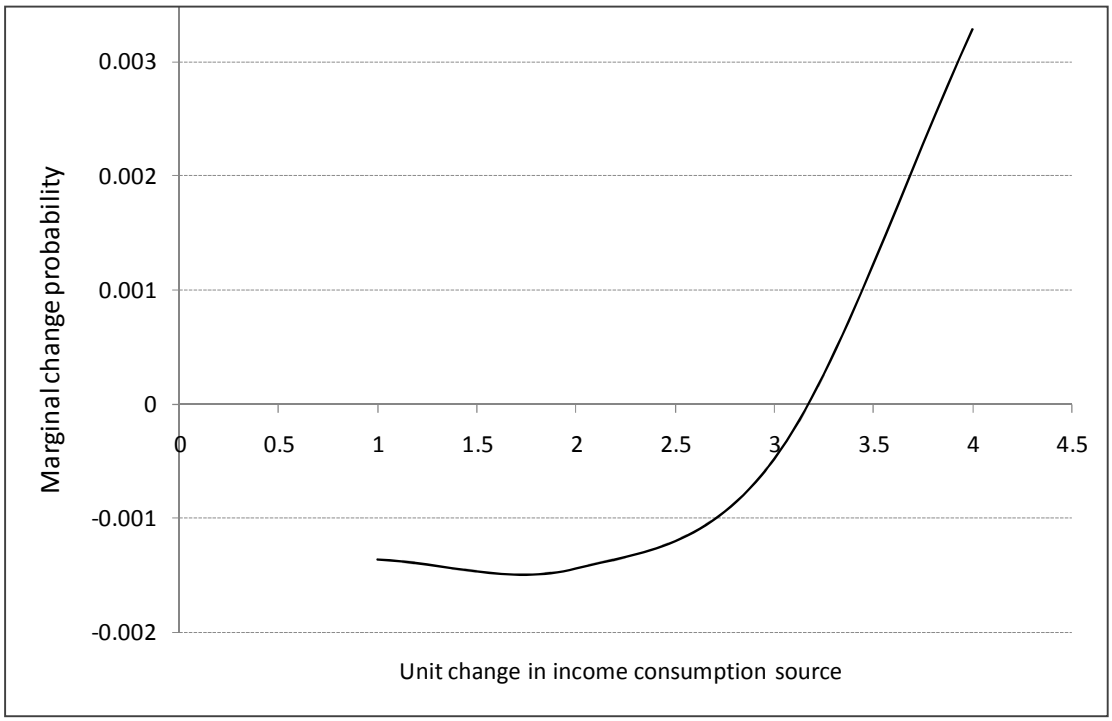

Figure 7.4: Marginal effects of income contribution source in Kenya, 2008.

Diversity of income sources reduces exposure to risk and improves food security among rural households (Acharya and Cohen, 2008). Income diversification provides farm households with better food security prospects by improving livelihood resilience and labour allocation across enterprises (Hengsdijk *et al.,* 2005). Bonnard (2000) underscored the importance of diversified income sources as not only spreading the risk across several enterprises, but also improving the stability of income. A more predictable income stream is likely to enhance food security by facilitating planning for appropriate production options. The outcome of the marginal effects seemed to support the proposition that diversity of income sources reduces food insecurity by spreading the risk against the decline or collapse of one or more of the other income sources.

The pastoral livelihood and to some extent the agro-pastoral livelihood, are characterised by fairly rudimentary trade infrastructures. Poorly functioning markets in addition to hazards such as conflicts and recurrent drought in the pastoral livelihood limit the scope for adopting income-

generating alternatives. While the scope for adopting more enterprises is wider in the agro-pastoral and marginal agricultural livelihoods, most alternatives are directly or indirectly related to the agro-climate. Apart from crop and livestock production activities that depend directly on seasonal weather patterns, income generated from wage labour is also affected by rainfall patterns to a large extent.

In many food insecure households, coping strategies tend to become livelihood strategies, particularly when shocks and hazards such as drought continue for extended periods. Some coping strategies have become livelihood strategies, such as the logging of trees and shrubs to produce charcoal, and tend to endanger future productivities of livelihoods. In such instances, increased income sources may not necessarily increase by any substantial margin the extent to which food insecurity is mitigated. The outcomes of the marginal effects motivate the identification and implementation of livelihood strategies that are not only diverse but also productive.

7.4.8 Own farm production

The variable 'own farm production' refers to the proportion of food that farmers (crop and livestock) obtain from household farm production. Results in Tables 7.3 and 7.4 generally show that increase in own farm production had a negative influence on food insecurity. The positive coefficient indicates that increase in own farm production reduces the likelihood of food insecurity. The marginal effect of own farm production was highly significant at 99 per cent confidence level in the high potential livelihood group and at 95 per cent confidence level in the pastoral and agro-pastoral livelihood groups. A unit increase in own farm production decreased the probability of being extremely and highly food insecure by 0.02 and 0.03 percentage points, respectively. A unit increase in own farm production, however, increased the probability of being food secure by 0.06 percentage points.

The pastoral, agro-pastoral and marginal agricultural livelihood groups obtain a significant proportion of their food needs from the market, humanitarian assistance, or remittances. The pastoral and agro-pastoral livelihood groups rear indigenous livestock which are generally fairly

unproductive, attributed to a combination of poor agro-climatic conditions, poor production practices and significant reduction in livestock holdings resulting from drought, conflict and disease (KFSSG, 2008c). These factors have severely constrained the contribution of livestock output to household food security.

The lower impact of own farm production to household food security for pastoral and agro-pastoral livelihood groups are also attributed to low productivity of crop enterprises. Increased and extended droughts have reduced productive capacities of livelihood groups because resources and productive assets are eroded when households adopt coping strategies such as distress livestock sales. Extensive land degradation arising from sand harvesting and charcoal production, which have become alternative livelihood strategies, is severely compromising output from own farm production. Consequently the extent to which pastoral, agro-pastoral and marginal agricultural livelihood groups can enhance household food security is limited.

The contribution of own farm production in enhancing food security is highly significant in the high potential livelihood group. However, the mixed farming livelihood group is characterised by relatively wide diversity in production enterprises. The production system constitutes food crops, cash crops and livestock. Cash crops tend to dominate cropped areas because returns are higher and the trade infrastructure is functional (KFSSG, 2008a). The livelihood group is situated close to markets for the sale of their output and for purchasing food commodities. While the output from food crops is relatively low, households obtain significant income from cash crops and livestock and use it to purchase additional food and non-food commodities.

The outcomes from the second sub-problem have produced interesting results and almost all variables included in the model estimation are found to have significant influence on the probable outcome of food insecurity. Conflict, proximity to markets, and rainfall are highly significant determinants of food insecurity in the pastoral livelihood. However, migration patterns, own farm production, income contribution, and food consumption sources also determine food insecurity. Rainfall, conflict and market proximity variables were highly significant in the agro-pastoral livelihood group. However, HIV/AIDS prevalence rates, migration patterns, own farm production, income contribution and food consumption sources,

were also determinants of food insecurity. HIV/AIDS prevalence and proximity to markets were highly significant determinants of food insecurity in the marginal agricultural livelihood group. Conflict, rainfall and food consumption sources also determined food insecurity. It is also clear from Tables 7.4 and 7.5 that determinants of food security have differing influences on the likely outcome of food security, depending on the livelihood group. The distinction between livelihood groups is critical because it enables the formulation of appropriate interventions that will redress food insecurity from the context of inherent differences between livelihoods.

The discussion of the significant variables, including an analysis of interaction variables obtained from the heterogeneous logit model is used to answer the third sub-problem and is presented in the following section. For the purpose of this analysis, the model presented in table 7.4 did not include interaction terms. According to Wooldridge (2003), if two models have relatively equal predictive power, with respect to pseudo R^2, a shorter model is more a parsimonious representation of the relationship. From an econometrics perspective, (Wooldridge 2003) noted that if pseudo R square is relatively unaffected, inclusion of significant interaction terms may be justified even though the model is not parsimonious. In all models with interaction variables (presented in appendix E), pseudo R square ranged from 55.68 to 57.28 which is within the neighbourhood of pseudo R square of 55.6, in the model presented in table 7.3. Therefore, given the objectives and scope of this study, inclusion of interaction variables is handled separately in the subsequent section.

7.5: Identification of indicators to target and monitor impact of programmes on specific livelihoods groups

This section presents the results and discussions of the third sub-problem which identified the indicators to monitor for each livelihood group. The indicators would be targeted and used in the monitoring impacts of programmes intended to reduce food insecurity in relevant livelihood groups. The outcome of the regression clarified that certain food security determinants were discriminatory, influencing particular livelihood groups. An evaluation of the synergistic relationships between the variables was conducted to identify interactions and linkages between

determinants. The interactions were important in providing additional information regarding the choice of monitoring indicators.

The estimation of predicted probabilities in non-linear models that include interaction terms and their corresponding standard errors provides information as to whether the interaction terms are statistically significant in each category (Greene, 2003: pp. 675 and Hoetker, 2007: pp. 335-6). It is important to mention that inclusion of two or more interaction terms in all scenarios led to misspecification of the model. To this end, one interaction variable was included at a time and results presented in Appendix E. Table 7.6 shows the coefficient of significant interaction terms and important diagnostic tests that reflect goodness of fit. All scenarios where inclusion of interaction terms led to misspecification or substantive decrease in pseudo R^2 relative to the model presented in table 7.3 were excluded from the study.

Table 7.6: Outcomes of important synergistic relationships between variables that provide input to the selection of appropriate indicators to monitor in Kenya, 2008.

Livelihood	**Level of significance of selected variables from the marginal effects, by livelihood group**				
Interaction term	**Coefficient**	**Pseudo R square**	**Log likelihood**	**LR Chi2 (df)**	**Insignificant variable**
Rainfall and food consumption source	-0.00005***	56.08	-1518.73	3879.1 (21)	Flooding
Income contribution source and food consumption source	-0.0013***	56.13	-1517.07	3882.43 (21)	Flooding
Market proximity and food consumption source	0.572***	57.28	-1477.31	3861.94 (21)	Flooding and income contribution source
Rainfall and income contribution source	-0.000023**	55.68	-1532.63	3851.3 (21)	Flooding
Market proximity and income contribution source	0.0073**	55.70	1521.16	3874.23 (21)	Flooding, food consumption source
HIV/AIDS and income contribution source	0.0262**	55.78	-1529.34	3857.87 (21)	Flooding and income contribution source

***Significant at 99 per cent level of confidence
**Significant at 95 per cent level of confidence
*Significant at 90 per cent level of confidence

The coefficient of the interactions between: (1) market proximity and food consumption source, (2) rainfall and food consumption source, and (3) income contribution source and food consumption source, were significant at 99 per cent confidence level. The coefficients of: (1) market proximity and income contribution source, and (2) rainfall and income contribution source, were significant at 95 per cent level of confidence. The coefficient of HIV/AIDS and income contribution source interaction was significant at 90 per cent level of confidence. Table 7.7 presents a summary of significant interacting variables across livelihood groups. Appendix E shows detailed results of the interaction terms, while Appendix F summarises the indicators that require to be monitored for each variable. Model (iii) in appendix E shows that after inclusion of the interaction terms, namely, income contribution source and proximity to market, income contribution source was insignificant at 90 percent level of confidence. This result suggests that income contribution source may not have its own partial contribution but rather occurs jointly with proximity to market variable.

Table 7.7: Outcomes of important synergistic relationships between variables that provide input to the selection of appropriate indicators to monitor in Kenya, 2008.

Livelihood	Important interaction terms by livelihood group
Pastoral livelihood group	Rainfall and food consumption source Rainfall and income contribution source Market proximity and income contribution source Proximity to markets and food consumption source Income consumption source and food consumption source
Agro-pastoral livelihood group	Rainfall and food consumption source Rainfall and income contribution source Market proximity and income contribution source Proximity to markets and food consumption source Income consumption source and food consumption source HIV/AIDS and income consumption source
Marginal agricultural livelihood group	Rainfall and food consumption source Market proximity and income contribution source Proximity to markets and food consumption source HIV/AIDS and income consumption source
High potential livelihood group	Rainfall and food consumption source Rainfall and income contribution source Proximity to markets and food consumption source Income consumption source and food consumption source

7.5.1 Selection of indicators for the conflict variable

The conflict variable was most influential in determining food insecurity in the pastoral livelihood and agro-pastoral livelihood groups. Conflict was attributed, in part, to competition over diminishing water, pasture and browse in the pastoral and agro-pastoral livelihood groups. A clear understanding of projected performance of agro-climatic indicators, ahead of the onset of the season, would provide a basis for governments and development partners to institute mitigation and preventive measures in the pastoral livelihood. The key indicators to monitor in pastoral areas are agro-climatic indicators including rainfall, vegetation, and pre-season forecasts. The length of rainfall seasons and the spatial and temporal distribution of rainfall are also important indicators to monitor. Since a significant proportion of conflict is motivated by inter-clan relationships, an understanding of clan dynamics would facilitate the implementation of measures that promote inter-clan relations while mitigating reciprocal attacks. The number and impact of on-going peace processes need to be monitored to identify areas of possible intervention. While the impacts of conflict are widespread, the epicentres of conflict are fairly localised, suggesting that data and information on the indicators need to be highly disaggregated to ensure that targeting is effective.

7.5.2 Selection of indicators for the HIV/AIDS variable

The HIV/AIDS variable was also influential in determining food insecurity in the marginal agricultural and agro-pastoral livelihood groups. The indicators to monitor would be relevant to both livelihood groups. Identification of the numbers and locations of the most affected populations is the critical first indicator which would provide a basis for investigating the type of livelihood strategies adopted in the two livelihoods and whether or not they predispose people to infection. For example, the growing prevalence of HIV/AIDS in the agro-pastoral livelihoods, such as in the Maasai rangelands of Kajiado and Narok (KAIS, 2009), requires attention.

Analysis of the interaction of the HIV/AIDS variable and the income contribution source demonstrated that diversity of income sources impact or has a relationship with HIV/AIDS in the marginal agricultural and agro-pastoral livelihood groups. The outcome suggested that the selection of indicators for monitoring the HIV/AIDS variable includes extensive analysis of the

linkage between diversity of income sources and HIV/AIDS prevalence, including the type and stability of these sources. HIV/AIDS affects all facets of food security, including availability, access, utilisation and stability (Kennedy, 2003). The indicators that provide useful information for monitoring include: production patterns that provide information on the sources of income and food, food consumption scores, dietary diversity, amount of disposable income spent on food, and access to medicare. These are important indicators that would inform programmes formulated to decelerate the impacts of the disease.

7.5.3 Selection of indicators for the rainfall variable

The estimated change in probabilities or marginal effects suggested that rainfall was an important variable in determining food insecurity in all four livelihood groups. Key indicators to monitor are agro-climatic: rainfall performance, the length of season, and pre- and continuous seasonal forecasts. Monitoring rainfall indicators in pastoral areas over an extended period of at least 20 years is critical as it would provide information on how rainfall trends relate to food insecurity. The analysis of the synergistic relationships of rainfall shows that rainfall has strong interactions with the food consumption source and income contribution source variables, underlining the critical role of rainfall in determining food security in Kenya. Multiple indicators need to be selected for monitoring. The food consumption source variable requires monitoring of the relative proportions of food obtained from farm production, market purchases, gathering, remittances, and food aid, as they relate to rainfall performance.

7.5.4 Selection of indicators for proximity to markets variable

Proximity to markets seemed to be a critical determinant of food insecurity across the pastoral, agro-pastoral and marginal agricultural livelihoods. With the exception of the high potential livelihood zone, all three livelihoods were heavily dependent on markets to source a substantial proportion of their food needs and to trade their seasonal produce. The time taken by households to travel from households to markets informs access to food commodities and also needs to be monitored. Analysis of the interaction of markets with other variables showed inter-linkages with the food consumption source and the income contribution source. In particular, the

interaction between markets and the food consumption source was significant in all livelihood groups (Table 7.7 and Appendix E).

Factors that determine locating markets in a prescribed area need to be identified. Trends in population movements and the creation of new settlements that may lead to new market centres, particularly in pastoral areas, are indicators that need to be identified. Identification of the characteristics of markets in the three livelihoods zones is also important because the structure, conduct, and performance of markets determine access and facilitates exchange processes. It is necessary to evaluate the type and quality of key roads; information flow processes; the numbers and type of actors; the characteristics of the value chain; marketing margins; the price fluctuations, type, quality and quantities of products traded; and seasonality and market impediments.

7.5.5 Selection of indicators for the migration patterns variable

This study demonstrates that the type of migration pattern influences food security for livelihood groups. In particular, the nomadic migration patterns of pastoral and agro-pastoral livelihood groups tended to accentuate food insecurity. However, the fully settled pattern associated with the high potential mixed livelihood group tended to improve food security considerably. The key distinguishing characteristics of the migration patterns that promote food security need to be monitored. In particular, the features that characterise the fully settlement pattern, such as land tenure systems, need to be monitored. Progress toward enforcement of environmental policies that promote viable land use, availability of grazing resources such as watering points along migration routes, agro-climatic indicators that determine grazing patterns and conflict indicators that have the potential to disrupt migration patterns also requires close monitoring.

7.5.6 Selection of indicators for the food consumption source variable

The food consumption source variable measured the diversity of food sources and their impact on reducing food insecurity. Analysis of the marginal effects showed that food consumption sources were most significant in the high potential livelihood group. The food consumption source variable requires monitoring with regard to the relative proportions of produce obtained

from the farm, market purchases, hunting and gathering, remittances, and food aid. Trends in relief food distributions and the constitution of the food basket are also important indicators in monitoring the food contribution source determinant. This indicator will provide additional information on the proportion of food that is sourced from external interventions. In addition, indicators that determine utilisation of food such as health and hygiene need to be identified. The rates of child malnutrition need to be monitored for the pastoral livelihood to triangulate information on dietary diversity and food consumption sources. The food consumption source variable had strong interactions with market proximity, rainfall, and the income contribution source, as alluded to in the preceding section.

7.5.7 Selection of indicators for the income contribution sources variable

The analysis of marginal effects demonstrated that increased sources of income tended to reduce food insecurity for the pastoral, agro-pastoral and high potential livelihood groups. Important indicators to monitor for each livelihood would be the key livelihood strategies and related sources of income, the proportion of income from each of the sources, and the stability of each of the sources. It would also be important to make a clear distinction between livelihood and coping strategies. While some coping strategies provide additional sources of income, they may be detrimental to long-term enhancement of food insecurity, if for example they cause adverse impacts on the environment. One such common coping or livelihood strategy is charcoal production which often leads to land degradation. Analysis of the income contribution source indicated that diversity of income sources was influenced by rainfall, market proximity, food consumption source, and HIV/AIDS, emphasising the need to monitor multiple indicators concurrently.

7.5.8 Selection of indicators for the own farm production variable

The study demonstrated that own farm production has some influence in determining food security in the pastoral and agro-pastoral livelihood groups. However, it had more influence on the high potential mixed livelihood group. Indicators that enhance own farm production particularly for the pastoral, agro-pastoral and marginal agricultural livelihood groups require monitoring. Unlike in the high potential mixed farming livelihood group, diversity in income

sources is limited for these three groups and production is agrarian-based. Key indicators to monitor include agro-climatic conditions including rainfall and vegetation, selection of production enterprises such as high yielding drought-tolerant species for crop and livestock, livestock husbandry and agronomic practises, pest and disease surveillance for both crop and livestock, and monitoring of market prices for the input and output markets which impact production.

The identification of indicators to target and monitor the impact of programmes on specific livelihood groups requires the selection of both direct as well as indirect indicators to monitor and target. Inter-relationships between variables suggest that there may be substantive compounding effects that call for a co-ordinated and holistic selection process to take account of the synergies between and across the variables. Critically, a high degree of disaggregation in the collection of the data and information for the indicators is crucial to ensure that key programmes take full cognisance of salient livelihood characteristics and their interactions. A summary of the outcomes of the analysis, potential improvements in the methodology and analysis, and overall conclusions are presented in the following chapter.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

The chapter draws general conclusions from the study findings and makes recommendations based on the outcomes of the analysis of the three sub-problems. The objective of the study was to apply a livelihoods approach in establishing the causes of food insecurity in four distinct livelihood groups in Kenya. The livelihood groups of main concern are the pastoral, agro-pastoral, and marginal agricultural livelihoods and the comparative category, namely the food secure category. The estimated influence of each identified determinant on the likelihood of observing a particular food security outcome was evaluated. Variables that were important in influencing food insecurity for each livelihood group were identified. The identification of specific determinants for each livelihood group and the extent to which they alleviate or elevate food insecurity is vital in informing intervention design with the aim of reducing intractable food insecurity in Kenya.

The case for using livelihood approaches in Kenya is even more urgent since the implementation of the new constitution in 2010. The country has been delineated into 47 larger and more diverse administrative units called counties, instead of the previous 71 districts. The use of counties as administrative centres underlines the need for applying livelihood-based methods in data collection, food security monitoring, and in intervention planning. Formulation of interventions by administrative levels invariably results in allocation of resources without cognisance of these distinctions, minimising the impacts of interventions.

The study employed a heterogeneous ordered logit model. The ordered logit model was selected since the dependent variable is ordered, that is, from the extremely food insecure category one, highly food insecure category two, moderately food insecure category three to the food secure category four. The explanatory variables used in the empirical model were based on the theoretical literature. Important determinants were evaluated from the estimated model, based on the levels of statistical significance of the variable coefficients, residual variability, and the

results of various diagnostic tests. Marginal effects were then used to evaluate the influence of each determinant on the likelihood of observing a particular food insecurity outcome. Identified determinants and their values and inter-relationships were used to inform the selection of indicators to be used in intervention design.

8.1 Conclusions

The study tested the livelihoods approach to identifying key factors that cause food insecurity in Kenya. The study outcomes showed that conflict, HIV/AIDS, rainfall, proximity to markets, food contribution sources, migration patterns, income contribution sources, and own farm production were important determinants of food insecurity. The study results are useful in ensuring that important indicators specific to each livelihood group are incorporated in the formulation of interventions that seek to reverse growing food insecurity in Kenya. The study also demonstrated that livelihood approaches are appropriate to differentiate between factors that cause food insecurity among distinct livelihood groups.

The study showed that variables had differing levels of influence in exacerbating food insecurity depending on the livelihood group. Some of the variables were also discriminatory as they were not important determinants of food insecurity. Proximity to markets and rainfall seemed to have an impact on food insecurity in the pastoral, agro-pastoral and marginal agricultural livelihood groups. Conflict greatly influenced food insecurity in the pastoral and agro-pastoral livelihood groups. The HIV/AIDS determinant was most influential in the marginal agricultural and agro-pastoral livelihood groups. Diversity of food sources moderately influenced food insecurity in the pastoral, agro-pastoral and marginal agricultural livelihood groups. The number of income sources variable was influential in the pastoral and agro-pastoral livelihood groups with similarly lowered significance. Flooding was not an important determinant of food insecurity in this study - a rather unexpected finding because sudden onset disasters tend to have immediate devastating impacts on household food security.

The study provided a basis for the identification of important indicators for monitoring in each of the three livelihood groups namely agro-climatic, trade and market processes; migration

dynamics, stability of income and food sources; settlement patterns; and key livelihood and coping strategies. The study also demonstrated that there were important inter-relationships between the variables. The outcomes of the interaction variables showed important inter-relationships between rainfall and food consumption sources, income contribution and food consumption sources, market proximity and food consumption sources, rainfall and income contribution sources, market proximity and income contribution sources, and HIV/AIDS and income contribution sources. The strong inter-relationships illustrate that multiple variables need to be monitored concurrently to address livelihood food insecurity in Kenya.

8.2 Recommendations from study outcomes

It is also recommended that the government of Kenya (GoK) adopts livelihood approaches to monitor and respond to food insecurity in Kenya. The current use of administrative units such as districts tends to mask considerable variabilities that exist in the structures of different livelihood groups within the same district.

The study findings show that market proximity has highly significant influence on food insecurity across the three most food insecure livelihood groups, namely the pastoral, agro-pastoral and marginal agricultural. In addition, the GoK in collaboration with development partners needs to formulate interventions, projects, and programmes that seek to increase access to markets. The trade infrastructure is rudimentary and cannot address food insecurity unless markets become more accessible to food insecure groups. The GoK needs to improve roads to reduce transaction costs, provide market information regarding prices and availability of commodities in markets, facilitate the formation of groups to enhance bargaining capacities, and mitigate conflict to avoid disruption of market functions.

The importance of conflict in the pastoral and agro-pastoral livelihoods as well as HIV/AIDS in the marginal agricultural and agro-pastoral livelihood groups in determining food insecurity suggests that interventions which mitigate and prevent conflict and HIV/AIDS need to be central to strategies formulated to alleviate food insecurity. The formulation of plans that seek to reduce food insecurity in a sustainable way need to integrate all identified determinants in a coherent manner, rather than address each sector individually.

Mitigating drought seems to be at the forefront of most strategies intended to reverse growing food insecurity in Kenya. Yet, the study demonstrates that mitigating drought alone is unlikely to significantly lessen growing food insecurity. The formulation of interventions directed toward moderating the impacts of a single variable such as poor rainfall are unlikely to meaningfully address food insecurity in any one livelihood group. The inter-relationships cut across several sectors, calling for a strong leadership role from the GoK to ensure that the different sectors and multiple institutions work collaboratively. Well co-ordinated responses can be expected to ensure that livelihood-based interventions are balanced and holistic and address the multiple facets of food insecurity.

The study outcomes suggest that key food security practitioners including agencies and researchers need to model food insecurity from the perspective of livelihoods and beyond the lenses of rainfall, crop production, and prices. The inclusion of socio-economic characteristics at the core of livelihood frameworks provides a sounder basis for reflecting the realities that livelihoods face. Interventions developed on the basis of holistic livelihood approaches are more likely to achieve sustainable food security for disparate livelihoods.

8.3 Recommendations for improvements of the study

There are limitations inherent in the study. Firstly, the use of cross-sectional data limited the study to the extent that key variables such as seasonal fluctuation of food prices, transitory shocks and other variables with a time dimension could not be captured explicitly in the analysis. Secondly, the study does not rank the relative importance of explanatory variables due to the use of different units of measurements. Thirdly, empirical results show that flooding was not a good indicator for capturing adverse effects of rainfall, as it was statistically insignificant in all the models. With regard to the second sub-problem, the scope and model limitations constrained unambiguous analysis of interaction terms in identification of linkages and significant relationships across livelihood groups, and may not have adequately explored dynamics and impact of interaction variables.

Therefore, such limitations emphasise the need for governments and food security analysts to prioritise collection of panel data. Given the dynamics and complexity of potential food security determinants, panel data would provide rich and powerful information, because it facilitates analysis of cross-sectional elements across time. This study also recommends standardization of important explanatory variables. Standardization of data would not only facilitate measurement of relative importance of explanatory variables but may also increase efficiency in measuring abstract data. Future studies that would use a similar approach may consider using quadratic terms for rainfall, to better capture adverse effect for extreme levels of rainfall. In addition, future research may carry out exhaustive studies on the characteristics of interactions and linkages of the different food security constructs, as this would be fundamental in informing and formulating policy.

The data requirements for livelihood-based studies are extensive. It is important that the adoption of livelihood approaches includes deliberate investment in a national database that includes all the livelihood indicators used in this study. For example, the data on HIV/AIDS prevalence were obtained from a national household survey done by the Kenya National Bureau of Statistics. Although the data could be normalised for any level of disaggregation, livelihood data would have been preferable and livelihood-specific sampling would have improved consistency with the rest of the data.

Certain indicators would have been more useful in the study if they had been sufficiently disaggregated. For example, the number of sources of income would have been more useful if the contribution of each of the income sources for each livelihood was specified. Similarly, the number of livestock alone may not be sufficient, but the type of livestock species and their productivities may have provided more useful insights in the analysis. Better disaggregation of the flooding variable is warranted. The study results show that the impacts of flooding in accentuating food insecurity were statistically insignificant which seems implausible, unless the impacts are moderated by general food security in flood-prone areas.

While some policies affect livelihood food security, they may or may not be directly quantifiable. Yet, it is important to expand the analysis and data collection to capture such policy

decisions. The government may implement different disarmament policies or pricing regimes for one livelihood group and not another. Impacts of such decisions need to be understood.

8.4 Recommendations for further research

Research that incorporates impacts of seasonality is recommended. It is likely that important indicators of food security in distinct livelihoods groups could provide dissimilar outcomes during different times of the year. It is important that additional research which identifies the appropriate indicators and the timing of relevant interventions is carried out.

It is recommended that the same research is expanded to cover all the different livelihoods in the country to get a sense of the comparability of outcomes across the whole country. In addition, it would be useful to conduct the same livelihoods-based analysis in neighbouring countries that share the similar livelihood structures, notably Ethiopia, southern Sudan and Somalia. A comparative cross-border analysis would provide a basis for the formulation of a regional strategy to address growing food insecurity in a manner that transcends borders.

One of the indicators that seemed to be highly significant in determining food security in the key livelihood groups of concern was proximity of markets. It would be very useful for research institutions, both governmental and non-governmental, to conduct a detailed analysis of markets. Further research could be aimed at identifying which additional dimensions including their proximity cause markets to have such an overwhelming impact on food insecurity in Kenya.

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APPENDIX A: KENYA FOOD SECURITY STEERING GROUP (KFSSG) LIVELIHOOD ZONING DATA COLLECTION INSTRUMENT

About the Format

The livelihood zoning exercise will serve national and district planning in these ways:

1. Help to identify key livelihood-based information that should be collected for early warning.
2. Improve our ability to analyse and assess the impact of droughts and other hazards.
3. Allow more meaningful analysis of price, agricultural and socio-economic data.

Instructions

Please read these instructions before filling in the form. The form should be filled in black ink, and be as legibly as possible. Do not leave any cells blank. Either put in a zero or write 'not applicable' where appropriate.

District Level Information: Basic Details

District		Date of Submission (mm/dd/yy)	___/___/___
Names and Positions of People Completing Format			
Name	Position	Name	Position

Livelihood Zone Definition

List the main livelihood zones in the district according to the main source of income for households living in that zone. A single livelihood zone is one in which the majority of people have a similar way of life, including economic opportunities, economic activities, and cultural and social practices. Ensure that the classification that you use includes all parts of the zone.

ID No	Type	Description of Basic Characteristics of Livelihood zone
1		
2		
3		
4		
5		

Here are some examples of types of livelihood zone for use as a reference.

Pastoral	Poultry Production	Mixed Farming	Hunting & Gathering
Agro-pastoral	Rainfed Cropping	Casual Waged Labour	Fisheries
Ranching	Irrigated Cropping	Firewood/Charcoal	Petty trade
Formal Employment	Non-farm produce	Retailing	

Location and Population

Refer to the attached census list of sub-locations for the district, and assign a zone ID to each sub-location. The zone ID should be from the table at the beginning of this form (i.e. 1 – 6). So, if the second livelihood zone is agro-pastoral, put a 2 against all sub-locations in the list that you would classify as agro-pastoral. Also indicate the number of the zone against the sub-location on the map that you have been provided. Make sure that you have indicated the livelihood zone type for each sub-location in the district. There are 6,322 sub-locations in the country.

Livelihood Zone Details

ENTER Name & Number of Livelihood:	

Repeat this questionnaire for each livelihood zone in your district.

Main Sources of Income and Food

In the table below, estimate the percentage of average cash income per family in the livelihood zone from each of the income contribution sources listed.

INCOME CONTRIBUTION SOURCE	**Percent**
Livestock Production (including meat, milk, hides, skins, and by products)	
Poultry Production (including meat and egg production)	
Cash Crop Production	
Food Crop Production	
Casual Waged-labour Income	
Formal Waged Labour (including public and private sector employees)	
Fishing (marine or inland)	
Hunting and Gathering	
Small Businesses/Own Business (including crafts, non farm production, etc.)	
Firewood collection/Charcoal Burning	
Petty Trading	
Remittance and Gifts	
Other (specify)	
TOTAL INCOME	**100**

In the table below, for each broad type of food, estimate the food percentage that comes from each of the four sources for an average for family in a normal year.

	Percent of total food consumption from each source				
TYPE OF FOOD	**Own Farm Products %**	**Market Food Purchase %**	**Hunting, Gathering, Fishing %**	**Gifts & Food Aid %**	**Total**
Maize and posho			0		100
Wheat, barley, rye and bread			0		100
Sorghum, millets, etc.			0		100
Rice and products			0		100
Beans			0		100
Other pulses and nuts					100
Vegetables (including wild)					100
Fruits and berries, etc.					100
Roots and tubers					100
Meat (including wild animals)					100
Milk and dairy products			0		100
Fish	0				100
Cooking fats and oils					100

Crop Production

In the space provided, rank the ten most important crops in the LZ in terms of their contribution to annual cash income (from sales) from 1 (most important) to 10 (least important) and provide the rough proportion of cash income from each crop. Repeat the exercise considering the contribution to food consumption. The analysis should be for a 'normal' year (not unusually good or unusually bad)

	Contribution to Cash Income		**Contribution to Food Consumption**	
Name of Crop	**Rank**	**Percent**	**Rank**	**Percent**
TOTAL		**100**		**100**

In the table below, include all crops, both cash crops and food crops that are grown in the area. Provide a breakdown of crop cultivation in the area, by giving the approximate percentage of the

cultivated area in the LZ that is covered by each crop and by fallow and fodder crops. Also estimate the average yield in kilograms per hectare and provide an estimate of the percentage.
Use specific crop names (like 'haricot bean" or "wheat") instead of general categories (like "pulses" or "cereals"). Include all crops that are grown in significant quantities. Consider your answers for a 'normal' year, in which growing conditions are neither exceptionally good, nor exceptionally bad.

	Long Rains Season				**Short Rains Season**			
	Rainfed Crops		**Irrigated Crops**		**Rainfed Crops**		**Irrigated Crops**	
Name of Crop	**% of Cultivated area**	**Ave. Yield in Kg Per Ha**	**% of Cultivated area**	**Ave. Yield in Kg Per Ha**	**% of Cultivated area**	**Ave. Yield in Kg Per Ha**	**% of Cultivated area**	**Ave. Yield in Kg Per Ha**
Fodder Crops								
FALLOW								
TOTAL AREA	**100**		**100**		**100**		**100**	

Livestock and Poultry Ownership

In the table below, enter the approximate number of animals of each type held on average by households in the livelihood zone. For the contribution to cash income and food consumption, provide the ranks (1 = most important) and the approximate shares for a 'normal' year (not unusually good or unusually bad).

TYPE OF ANIMAL	**Ave. Number of Animals per Household**	**Contribution to Cash Income from animal sales**		**Contribution to Food Consumption**	
		Rank: 1=most important	**Approx percent of cash income**	**Rank: 1=most important**	**Approx percent of consumption**
Cattle					
Goats					
Sheep					
Equines					
Camels					
Pigs					
Chickens					
Ducks			100		100

Labour Patterns

For roughly what percentage of the working day (assume 16 hours) does the adult working age population of the area engage in the activities listed below as their main activity, during weekdays? Answer for men and women.

ACTIVITY	Women	Men
Labour on own farms (crop production)		
Livestock husbandry		
Travel to place of work		
Waged labour on other farms		
Low-skilled non farm labour (including paid manual and domestic labour)		
Skilled labour		
Managing own business		
Hunting and gathering		
Fishing		
Trading		
Domestic (unpaid work including childcare)		
Begging		
Commercial sex work		
Leisure, inactivity, socialising and entertainment		
TOTAL	**100**	**100**

Expenditure Patterns

Consider three households with three income profiles – low, medium and high. Specify each of their income levels. Specify also what percentage of the LZ population falls into each category. In this LZ, how, approximately, would the money be divided up? Express in percentages and make sure the totals add up to 100 percent.

EXPENDITURE ITEM	Income Level Low	Income Level Mid	Income Level High
Food Commodities			
Healthcare			
Education			
Transport			
Leisure			
Gifts			
Other			
Other			
Others – please specify			

Markets Serving the Livelihood Zone

Enter the names of the main markets used by people living in the livelihood zone, and the name of the nearest town or village and district/division where the market is located. Indicate which types of product are traded, by circling 'yes' or 'no'. Include markets in other districts, if these are used.

Name of Market	Name of nearest village or town	Name of District and Division	Type of Transaction Conducted in Market											
			Trade of Livestock		Trade of Poultry		Trade of Farm Produce		Food Produce Retail		Retail Farm Inputs		Labour Exchange	
			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
			Y	N	Y	N	Y	N	Y	N	Y	N	Y	N

Settlement and Migration Patterns of the Inhabitants of the Livelihood Zone

In the table below, give the approximate proportions of households falling into each category in the livelihood zone.

MIGRATION PATTERN	Percent
Fully nomadic (no fixed abode, don't settle)	
Semi-nomadic (nomadic for part of year but have fixed abode)	
Occasional nomadic	
Out-migrant labour (live in LZ but work elsewhere seasonally)	
In-migrant labour (live elsewhere but come to work in the LZ)	
Fully settled	
Internally displaced (settled in temporary accommodation, cannot return to their usual homes)	
TOTAL	100

Society and Ethnicity

In the table below, provide a rough breakdown of the population by ethnic group, i.e., what percentage of the population of the LZ belongs to each ethnic group. Check the totals add up to 100.

Name of Ethnic Group	Percent

Patterns of Hunger

Season	Number of Years of Widespread Hunger (Out of Ten)

Long Rains Season	
Between Long and Short Rains Season	
Short Rains Season	
Between the end of short rains and beginning of long rains	

In the space provided, in how many years in the last 10 years have the majority of people experienced hunger, or required food aid to avert widespread hunger?

Hazards

In the table below, provide information on the main hazards in the LZ, i.e., the factors that have created the most human suffering in terms of mortality, hunger, morbidity and economic hardship. Rank them in importance from 1 (most important, highest risk) to 20 (least important, lowest impact) and estimate how many times they have occurred in the last 10 years.

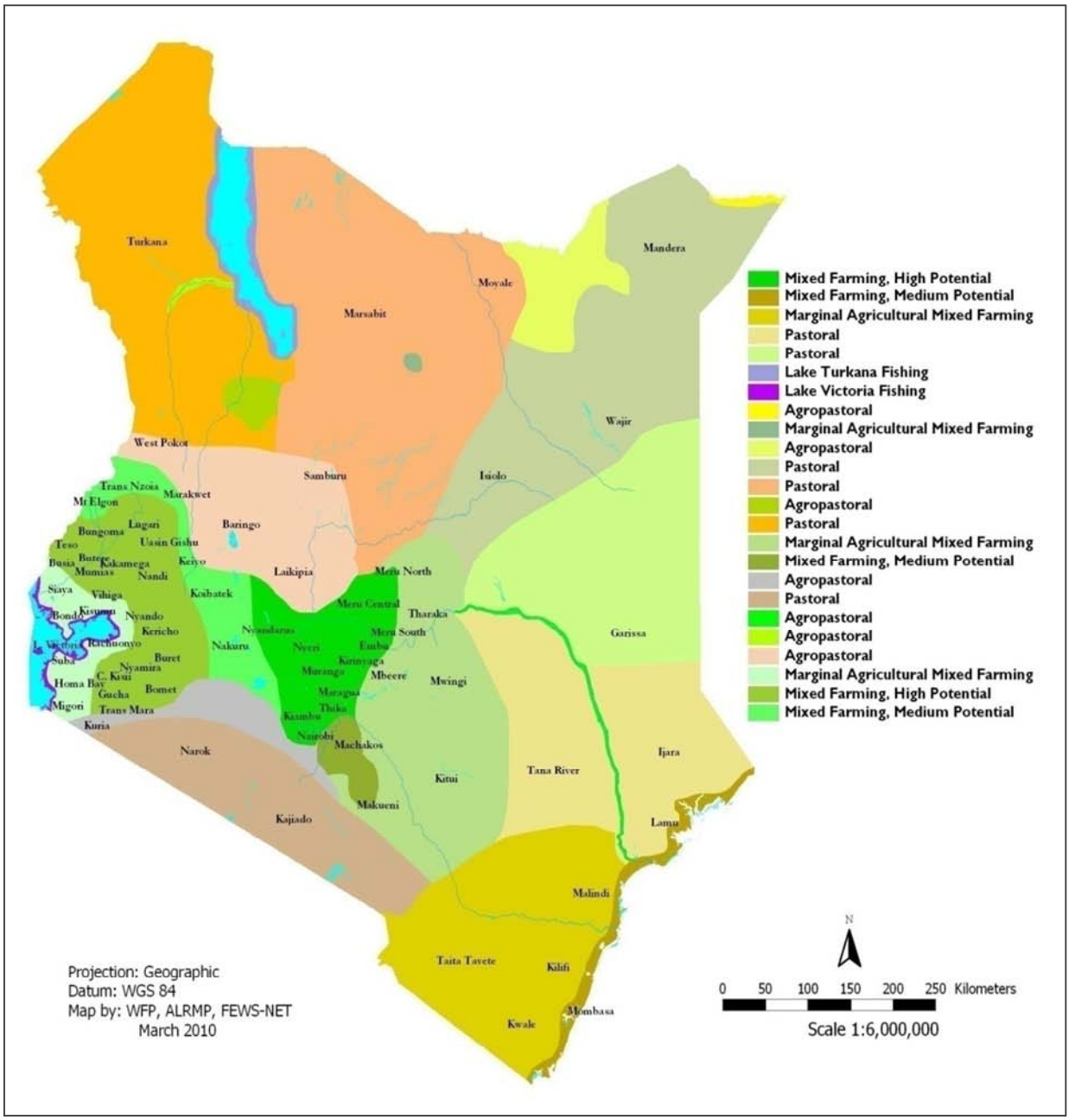
NAME OF HAZARD		**Rank of Importance (1 – 21)**	**No of Years Experienced in last 10 Years**
1	Animal Rustling		
2	Banditry		
3	Ethnic Conflict		
4	Political Conflict/violence		
5	Drought		
6	Livestock Pests and Diseases		
7	Hailstorms or Frost		
8	Flooding		
9	Landslides		
10	High Winds/Cyclones		
11	Bush Fires		
12	Crop Pests		
13	Crop Diseases		
14	HIV/AIDS		
15	Significant Malaria Outbreak		
16	Water Borne Disease Epidemics (cholera, D&V, dysentery etc)		
17	Crop Damage from Wild Animals		
18	High/Variable Food Prices		
19	Shortages of Food on the Market		
20	Drinking Water Shortages		

Source of Income	Constraint	Rank
Income from Waged Labour - Rank from 1 (most pressing	Low educational attainment/low skills	
	Poor health, frequent illness	

constraint) to 5 (least important constraint)	Too few jobs, lack of demand for labour	
	Too much time spent on farm	
	Low average wage rates	
Income/Consumption from Crop Production - Rank from 1 (most pressing constraint) to 9 (least important constraint)	Small land holdings	
	Lack of credit	
	High input costs	
	Low land fertility	
	Lack of reliable water, unfavourable climate	
	Low technical skills, knowledge	
	Low quality seed stock and planting materials	
	Lack of access to markets, low producer prices	
	Endemic crop pests or diseases	
Livestock Production.- Rank from 1 (most pressing constraint) to 7 (least important constraint)	Lack of pasture and browse	
	Lack of animal drinking water	
	Poor/low yielding animal genetic stock	
	High costs/restricted supplies of veterinary drugs	
	Endemic livestock pests and diseases	
	Lack of market, low prices for animals	
	Insecurity/raid risk of holding animal stock	
Fishing (coastal or inland)- Rank from 1 to 6	Low fish stocks	
	Poor market/low prices for fish	
	Lack of equipment, high cost of equipment	
	Too much competition	
	Lack of expertise	
	Restrictions on fishing rights	
Natural resource based activities (charcoal, firewood, forest products, hunting and gathering) - Rank from 1 to 4	Low/declining natural resources	
	Too much population pressure on natural resource	
	Restrictions on rights to exploit natural resources	
	Low value of natural resource-based products	
Small enterprises and non-farm production (including retail, trading, petty commodity production) - Rank from 1 to 5	Lack of capital, weak financial services	
	Too much red tape	
	Too many taxes, tax rates too high	
	Lack of access to markets	
	Lack of expertise	

Constraints to Main Economic Activities

APPENDIX B: Map of national livelihood groups in Kenya, 2008



APPENDIX C: Sample photos of livelihood groups in Kenya, 2011

Figure 1. Pastoralists migrating to dry-season grazing areas in Wajir District

Source: ALRMP

Figure 2. High potential livelihoods in Kirinyaga Distrct

Source: WFP/VAM

Figure 3. Agropastoralists watering goats in Kajiado District

Source: ALRMP

Figure 4. Crop weeding in the marginal agricultural livelihood in Kitui District

Source: MoA

APPENDIX D: Outputs from the ordered general logit and heterogeneous ordered logit models for security determinants in Kenya, 2008

	Ordered logit		Heterogeneous ordered logit	
Diagnostics tests	**Coefficients**		**Coefficients**	**P value**
Specification test (Linktest): hat	1.1345	0.000***	0.8375	0.000***
Hatsq	-0.0072	0.113	0.000095	0.976
LR test: Chi(df)	3701.76	(df=11)	3845.38	(df=20)
Prob> chi2	0		0	
Log likelihood	1607.4		-1535.59	
Pseudo R square	0.5352		0.5560	
Archaic information criterion	3242.8		3117.18	
Bayesian information criterion	3325.4		3252.96	
Parallel odd assumption test				
Chi2(25)	933.41			
Prob>chi2	0.000			
	Coefficients		**Coefficients**	**P value**
Food insecurity				
Conflict	-1.556705	0.000***	-1.381673	0.000***
HIV/AIDS 1	2.433304	0.000***	3.306754	0.000***
HIV/AIDS _2	3.209697	0.000***	3.860761	0.000***
Flooding	.2159562	0.09	.0560543	0.734
Migration pattern 2	3.994146	0.000***	4.829929	0.000***
Migration pattern 3	3.136447	0.000***	3.942471	0.000***
Market proximity	-4.283181	0.000***	-6.569274	0.000***
Rainfall	.0045543	0.000***	.0056412	0.000***
Own farm production	.0094102	0.000***	.0079564	0.002***
Food consumption source	.0411166	0.000***	.0372392	0.002***
Income contribution source	.0383507	0.000***	.040895	0.000***
Variance equation ln(sigma)				
Conflict			-.5085509	0.000***
HIV/AIDS 1			-.0390798	0.009**
HIV/AIDS 2			.34433	0.000***
Flooding			.3260131	0.725
Own farm production			.0013485	0.144
Market proximity			.9537234	0.002***
Income contribution source			.0099997	0.000***
Food consumption source			-.0112511	0.005**
Rainfall			-.0001112	0.302

APPENDIX E: Heterogeneous ordered logit model estimated coefficients for interactions between food security determinants in Kenya, 2008

i) Interaction between rainfall and food consumption source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	0.843	0.000***
Hatsq	0.0126	0.027
LR test: Chi(df)	3879.1	(df=21)
Prob> chi2	0	
Log likelihood	-1518.73	
Pseudo R square	0.5608	
	Coefficients	**P value**
Food insecurity		
Conflict	-0.8655	0.000***
HIV/AIDS 1	2.4838	0.000***
HIV/AIDS 2	2.6834	0.000***
Flooding	0.0048	0.965
Migration pattern 2	3.4703	0.000***
Migration pattern 3	2.9121	0.000***
Market proximity	-7.2799	0.000***
Rainfall	0.0043	0.000***
Own farm production	0.0052	0.005***
Food consumption source	0.0043	0.002***
Income contribution source	0.676	0.000***
Rainfall and food consumption source	**-0.00005**	**0.000*** **
Variance equation ln(sigma)		
Conflict	-0.776	0.000***
HIV/AIDS 1	-1458	0.185
HIV/AIDS 2	0.2031	0.132
Flooding	0.3435	0.000***
Own farm production	0.0006	0.557
Market proximity	1.3719	0.002**
Income contribution source	0.0094	0.000***
Food consumption source	-0.0183	0.000**
Rainfall	-0.0003	0.008*
Marginal effect and significant test values		
Pastoral livelihood	0.000002	0.000***
Agro pastoral livelihood	0.000023	0.000***
Marginal agricultural livelihood	0.000016	0.004***
High potential livelihood	-0.0000059	0.000***

ii) Interaction between rainfall and income contribution source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	0.9299	0.000***
Hatsq	0.0054	0.207
LR test: Chi(df)	3851.3	(df=21)
Prob> chi2	0	
Log likelihood	1532.63	
Pseudo R square	0.5568	
	Coefficients	**P value**
Food insecurity		
Conflict	-1.176575	0.000***
HIV/AIDS 1	2.779769	0.000***
HIV/AIDS 2	3.199173	0.000***
Flooding	0.0491386	0.72
Migration pattern 2	3.964268	0.000***
Migration pattern 3	3.227151	0.001***
Market proximity	-5.735897	0.000***
Rainfall	0.0049406	0.000***
Own farm production	0.006582	0.002***
Food consumption source	0.0275172	0.006***
Income contribution source	0.0563969	0
Rainfall and income contribution source	**-0.0000232**	**0.014***
Variance equation ln(sigma)		
Conflict	-0.4690927	0.000***
HIV/AIDS 1	-0.0469788	0.668
HIV/AIDS 2	0.3337979	0.012*
Flooding	0.3234139	0.000***
Own farm production	0.0010851	0.243
Market proximity	0.8723689	0.004**
Income contribution source	0.0090933	0.000***
Food consumption source	-0.0133002	0.001***
Rainfall	-0.00017	0.129
Marginal effects and significant test values		
Pastoral livelihood	0.0000009	0.009**
Agro-pastoral livelihood	0.0000001	0.018**
Marginal agricultural livelihood	0.00000013	0.283
High potential livelihood	-0.000002	0.018**

iii) Interaction between market proximity and income contribution source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	0.8755	0.000***
Hatsq	0.004	0.282
LR test: Chi(df)	3874.23	(df=21)
Prob> chi2	0	
Log likelihood	1521.16	
Pseudo R square	0.5570	
	Coefficients	**P value**
Food insecurity		
Conflict	-1.262946	0.000***
HIV/AIDS 1	2.991681	0.000***
HIV/AIDS 2	3.456446	0.000***
Flooding	0.0465273	0.754
Migration pattern 2	4.314681	0.000***
Migration pattern 3	3.510265	0.001***
Market proximity	-6.834279	0.000***
Rainfall	0.0050723	0.000***
Own farm production	0.0070813	0.002***
Food consumption source	0.0307143	0.004***
Income contribution source	0.0017228	0.899
Market proximity and income contribution source	**0.0733098**	**0.018****
Variance equation ln(sigma)		
Conflict	-0.4614731	0.001***
HIV/AIDS 1	-0.0489286	0.659
HIV/AIDS 2	0.3490697	0.009
Flooding	0.3356264	0.000***
Own farm production	0.0012545	0.176
Market proximity	0.009136	0.002***
Income contribution source	-0.0136688	0.000***
Food consumption source	-0.0001078	0.003***
Rainfall	0.9232409	0.318
Marginal effects and significant test values		
Pastoral livelihood	-0.0025	0.005**
Agro pastoral livelihood	-0.003	0.015**
Marginal agricultural livelihood	0.0058	0.011**
High potential livelihood	-0.0002	0.91

iv) Interaction between proximity to markets and food consumption source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	1.187	0.000***
Hatsq	0.0121	0.01
LR test: Chi(df)	3861.94	(df=21)
Prob> chi2	0	
Log likelihood	-1477.31	
Pseudo R square	0.5728	
	Coefficients	**P value**
Food insecurity		
Conflict	-0.9571343	0.000***
HIV/AIDS 1	2.626459	0.000***
HIV/AIDS 2	2.868881	0.000***
Flooding	-0.0070274	0.955
Migration pattern 2	2.185264	0.004***
Migration pattern 3	1.532895	0.014
Market proximity	-27.39858	0.000***
Rainfall	0.0040698	0.000***
Own farm production	0.0039912	0.009**
Food consumption source	-0.1961832	0.006***
Income contribution source	0.0236299	0
Food consumption source and market proximity	0.572127	**0.000*** **
Variance equation ln(sigma)		
Conflict	-0.4602485	0.000***
HIV/AIDS 1	-0.2304376	0.03
HIV/AIDS 2	0.2351432	0.067
Flooding	0.3695607	0.000***
Own farm production	0.0010754	0.24
Market proximity	1.106701	0.001**
Income contribution source	0.0079798	0.000***
Food consumption source	-0.0197932	0.003***
Rainfall	4.35E-06	0.967
Marginal effect and significant test values		
Pastoral livelihood	-0.0233	0.000***
Agro pastoral livelihood	-0.0217	0.000***
Marginal agricultural livelihood	0.059	0.000***
High potential livelihood	0.00013	0.234***

v) Interaction between income contribution source and food consumption source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	1.006	0.000***
Hatsq	0.0102	0.059
LR test: Chi(df)	3882.43	(df=21)
Prob> chi2	0	
Log likelihood	-1517.067	
Pseudo R square	0.5613	
Food insecurity	**Coefficients**	**P value**
Conflict	-1.0476	0.000***
HIV/AIDS 1	2.4487	0.000***
HIV/AIDS 2	2.7305	0.000***
Flooding	0.0469	0.693
Migration pattern 2	3.4314	0.000***
Migration pattern 3	2.7981	0.000***
Market proximity	-5.3076	0.000***
Rainfall	0.0041	0.000***
Own farm production	0.0054	0.002***
Food consumption source	0.0358	0.001***
Income contribution source	0.0863	0.000***
Food consumption source and income contribution source	**-0.0013**	**0.000***
Variance equation ln(sigma)		
Conflict	-0.5067	0.000***
HIV/AIDS 1	0.0072	0.947
HIV/AIDS 2	0.3554	0.007**
Flooding	0.3048	0.000***
Own farm production	0.0011	0.246
Market proximity	0.8687	0.003**
Income contribution source	0.0099	0.000***
Food consumption source	-0.0191	0.000**
Rainfall	-0.0002	0.156
Marginal effects and significant test values		
Pastoral livelihood	0.00053	0.000***
Agro pastoral livelihood	0.00006	0.000***
Marginal agricultural livelihood	0.000016	0.015**
High potential livelihood	-0.00013	0.000***

vi) Interaction between HIV/AIDS prevalence and income contribution source

Diagnostics tests	**Coefficients**	**P value**
Specification test (Linktest): Hat	0.8779	0.000***
Hatsq	0.0002	0.967
LR test: Chi(df)	3857.89	(df=21)
Prob> chi2	0	
Log likelihood	-1529.34	
Pseudo R square	0.5578	
	Coefficients	**P value**
Food insecurity		
Conflict	-1.30967	0.000***
HIV/AIDS 1	3.618726	0.000***
HIV/AIDS 2	3.850217	0.000***
Flooding	0.0434289	0.783
Migration pattern 2	4.52196	0.000***
Migration pattern 3	3.692021	0.001***
Market proximity	-6.54639	0.000***
Rainfall	0.0053637	0.000***
Own farm production	0.0073639	0.002***
Food consumption source	0.0352855	0.002
Income contribution source	0.0067911	0.515
HIV/AIDS and income contribution source	0.0262014	**0.006***
Variance equation ln(sigma)		
Conflict	-0.5179379	0.000***
HIV/AIDS 1	-0.0743714	0.494
HIV/AIDS 2	0.327725	0.010*
Flooding	0.308531	0.000***
Own farm production	0.0010592	0.25
Market proximity	0.9649789	0.001**
Income contribution source	0.0098409	0.000**
Food consumption source	-0.0114285	0.004***
Rainfall	-0.0001121	0.298
Marginal effect and significant test values		
Pastoral livelihood	-0.00001	0.144
Agro pastoral livelihood	-0.0017	0.000***
Marginal agricultural livelihood	0.0019	0.001***
High potential livelihood	-0.00008	0.337

APPENDIX F: Summary of indicators for monitoring food insecurity in Kenya, 2008

Determinant	Indicators for monitoring	Inter-relationships with other determinants
Conflict[a,b]	Agro-climatic outlook and pre-season forecasts. Season rainfall progress – length of season, spatial and temporal distribution. Migration dynamics. Inter-clan relationships. Peace processes.	
HIV/AIDS[,c]	Market structures and trade dynamics. Production patterns. Dietary diversity. Household access to food. Access to medicare.	Income contribution source.
Rainfall[a,b,c]	Pre-season forecasts. Season rainfall progress – length of season, number of rainfall days, spatial and temporal distribution. Vegetation indices. Rainfall progress in neighbouring countries. Run-off levels and extent of recharge of pans and dams.	Food consumption source, income contribution source.
Proximity to markets[a,b,c]	Population movements and new settlements. Profiling markets – structure, conduct and performance. Types of roads. Information processes. Value chain participation and length. Impediments to trade.	Food consumption source and income contribution source.
Food consumption source[a,b,c]	Proportions of food obtained from own farm production, market purchases, hunting and gathering and remittances. Trends in relief food. Dietary diversity and food consumption scores. Composition of the household food basket. Health and hygiene conditions. Rates of child malnutrition.	Rainfall, income contribution source, and proximity to markets.
Income contribution source[a,b]	Main household income sources. Proportion of income from each source. Stability of income from each source. Key livelihood strategies. Coping strategies, seasonality and contribution to income.	Rainfall, proximity to markets, food contribution source, and HIV/AIDS.
Migration patterns	Agro-climatic outlook and pre-season forecasts. Season rainfall progress – length of season, spatial and temporal distribution within and beyond the country's borders. Migration dynamics. Availability of grazing resources in key migration routes.	
Own farm production	Agro-climatic outlook and pre-season forecasts. Season rainfall progress – length of season, spatial and temporal distribution. Enterprise types and diversity. Stability of sources of food. Composition of the household food basket.	

a – pastoral livelihood.

b – agro-pastoral livelihood.

c – marginal agricultural livelihood.