

**Working Paper on Social-Ecological Resilience Series
No. 2009-007**

**Rural Livelihood Security Assessment for Smallholders
Undergoing Economic Changes and Agro-Climatic Events in
Central Kenya**

By

Matheaus Kioko KAUTI

Graduate School of Environmental Studies, Tohoku University

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Vulnerability and Resilience of Social-Ecological Systems

RIHN Research Project E-04

Research Institute for Humanity and Nature (RIHN)

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Abstract

The implementation of World Bank- and IMF-funded structural adjustment programs of the economy by Government of Kenya negatively affected smallholder farmers' production due to cost of agricultural inputs rising faster than the prices of agricultural produce. Concurrently, effects of the variability of precipitation patterns intrinsically link in shaping local-level households' vulnerability.

Drawing from field study data informed by longitudinal methodology of approach on crop variety selection and crisis-coping experiences, the overriding issue addressed in this paper is how smallholder farmers in Central Kenya cope and adapt with the changes. The study provides both place-based and household-based understanding of the livelihood security strategies available to and undertaken by the farmers.

Annual net income levels of 40 sample households are estimated and the production aspect of the household economy classified into five sectors: agricultural, livestock, non-farm, off-farm, and forest product extraction. An operationalization of the notion of livelihood strategies reveals the strategy in which households choose and combine options across the five sectors on the basis of crisis experiences. Examination of smallholders' crop variety selection identifies a multiplicity of criteria upon which decisions are based. These are grouped into five explanatory factors: geographic, economic, administrative, socio-cultural and agronomic.

The paper argues that an effective understanding of smallholders' coping and adaptive capabilities has important implications for adaptation policy. It can provide a basis for designing policies aimed at rural livelihood security improvement and also help to facilitate outside planners who engage in food security programs which can be built on existing livelihood strategies.

Key Words: Rural livelihood; Coping strategies; Economic liberalization; Drought; Kenya.

要旨

ケニア政府による経済の構造調整計画の実施は、農産物価格を凌駕する農業投入財価格の上昇をもたらし、小農民の生産に負の影響を与えた。同時に、降雨パターンの変動もまた地方レベルの世帯の脆弱性の状態に関わりを持っている。

本稿では、作物品種選択と危機対処の経験に関する長期間データの事例分析を通して、ケニア中央部の小農民がこれらの変化にいかに対処・適応しているのかという問題に取り組んだ。本研究は、彼らの取り得るあるいは実際に行っている生計安全保障戦略が、地域的あるいは世帯レベルでどのように理解できるかを示すものである。

調査対象とした 40 世帯の年間純所得を評価し、それを構成する経済活動部門を、農業、牧畜、非農業活動、農外活動、林業の 5 つに分類した。世帯の生計戦略を操作可能な概念とすることで、世帯が危機の経験を生かしこれら 5 部門の活動をどのように選択し組み合わせているかという、世帯の戦略を明らかにすることができる。

また、作物品種選択を検討することで、意志決定の基礎的な要因が複数あることが明らかになった。すなわち、地理的、経済的、政治的、社会・文化的、作物学的という 5 つの要因グループである。

本稿は、小農民の対処・適応能力の効果的な理解が政策にとって重要な意味を持つことを示している。それは農村部の生計の安全保障を改善することを目標とする政策立案のための基礎を提供するものであり、また既存の生計戦略の上に構築される食糧安全保障計画を推進する外部の計画者たちにも参考となると考える。

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1. Introduction

It is increasingly evident that the world is facing significant climate change, a process that has generated considerable environmental change research, specifically on the vulnerability and sensitivity of African dry land environment, the variability of its climate and resultant failure of its production systems (Eriksen, *et al.*, 2005). On the other hand, since the Second World War the global economic order has changed rapidly. In particular, the pattern of financial relationships between the industrialized and developing countries has altered following decolonization. Globally prices are fluctuating for the agricultural and mineral exports on which developing countries have traditionally had to depend (Weisner, B *et al.*, 2004). As a result, a large and growing body of literature has emerged on the developing countries, which have been forced to introduce neo-liberal structural adjustment policies (including International Monetary Fund (IMF) ‘stabilization’ and World Bank ‘restructuring’ policies) to address the economic crisis.

Economic changes and environmental (agro-ecologic) events are global macro-level processes intrinsically and fundamentally linked in shaping local level vulnerability and are manifested particularly in rural agricultural areas of developing countries such as in sub-Saharan Africa. Despite this realization, the two processes have seldom been studied in conjunction¹. The current study sets out to bridge the macro-level variability of the two processes with local-level impacts by drawing from a detailed case study material of crop variety and livestock breed selection. The overriding issue being addressed is coping and adaptive capacity among smallholder farmers in Kenya.

This paper reports preliminary findings of a study being conducted in Central Kenya and is structured in four parts. Part I, framed against a review of literature, explores the issue of rural livelihood dynamism by introducing and contextualizing the study theme within broader conceptual notions of livelihood diversification, vulnerability and resilience. In so doing, it exploits the relevant and/or existing literature and points out the emerging issues that lead to the articulation and formulation of the conceptual framework and research interest.

Part 2, provides the contextual setting for the detailed case study and sets the scene of inquiry. First it provides an understanding of livelihood dynamism of smallholder farmers in Kenya in the context of broader mediating forces of recent economic changes and environmental (agro-ecological) events. Secondly, it introduces the broad study area, Central province and from a historical perspective sets the stage for understanding livelihood system dynamism of smallholders in Central Kenya and justifies the choice of the study area and selection of specific case study sites. Part 3 on methodology deals with the fundamental question of how the research investigation proceeded. At the outset, it discusses the character of the case study sites and goes further to detail the study set-up,

¹ See e.g. O’Brien and Leichenko (2000), Leichenko and O’Brien (2002), and Eakin (2003) among the few studies which show how the interaction of environmental and economic changes contributes to dynamic nature of vulnerability and coping strategies among smallholder farmers within the framework of so-called ‘double-exposure’.

design, data collection and analyses (methodology).

As the core of the paper, Part 4 presents preliminary findings of the study. It is organized in four sections. Section one of Part 4 deals with an assessment of household average livelihood components and strategies through an estimation of annual net total income. In addition to elucidating socio-economic characteristics of the selected households and study sites, the section deals with the issue of operationalizing the concept of livelihood strategies with quantitative household-level data. Section two is devoted to an examination of household vulnerability in terms of crisis-coping experiences and acts as a prelude of the next section which zooms in the case of crop and livestock selection. Section three employs a chronological and/or historical approach in an attempt to identify smallholder farmers' crop variety and livestock breed selection criteria. In addition, the section takes a longitudinal time series perspective in identifying patterns of crop variety and livestock breed selection and de-selection into farmers' farm fields. These patterns are examined in relation to a variety of factors affecting decision-making, including geographical influence, economic situation, individual preference, and social context. Section four involves disaggregation of the data into constituent households and then matching of discernible livelihood strategies with crisis-coping experiences. Finally, a conclusion is drawn and future direction of the research noted.

1.1) Literature review

The central theme of the study is largely informed by the broader conceptual notions of livelihood diversification, vulnerability and resilience. The way in which livelihoods are composed under conditions of crisis, risk and uncertainty has received attention in the wider literature under the sustainable livelihoods approach. The approach provides a suitable framework² for linking macro-level economic changes and ecologic events to specific effects on the household's livelihoods at the local level. There exists a large and growing body of the literature on livelihood approaches³. The current study makes use of the guiding concepts and general framework in basic livelihood models⁴ as a platform in organizing its argument. The most widely cited definition of livelihood in the development literature is that provided by Chambers and Conway (1992:7) '*A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living*'. Minor modification of the definition have been attempted by other scholars such as Scoones' (1998) sustainability view that a livelihood is sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets both now and in the future. Ellis's contribution (2000) is on the issue of claims and access and the impact of social relations and institutions that mediate an individual or family's capacity to secure a means of living.

2. The DFID sustainable livelihood framework by Scoones (1998:4), Carney (1998:5) as well as Ellis' (2000) work are adopted as a referral point by this study.

3. See e.g. De Haan Leo and A. Zoomers (2005), Carney (1999), Chambers (1995), Blaikie *et al.* (1994), and Chambers & Conway (1992).

4. The basic livelihoods models can be traced back to influential works of Sen (1981, 1985), Chambers (1988), Scoones (1998), and Carney (1998). Other ideas such as Ellis' (2000) amongst others have been helpful in deepening understanding of the relationship between assets (also capitals, factors), activities (also strategies, production, exchange) and outcomes (also entitlement, consumption bundles, well-being, utility, income) within a mediating environment).

Morris *et al.*, (2000) observe that most livelihood models focus on the household as the most appropriate social group for the investigation of livelihoods, albeit external measures to manage risk may be social or public in nature. In household livelihood studies, increased attention has been paid to survival strategies of poor people in coping with and surviving different types of crises, such as falls in prices, droughts and famine (De Haan and Zoomers, 2005). An economic analysis of livelihood coping mechanisms explains crisis effects in terms of factors such as wealth, mobility, education, life cycle, gender among others. The framework developed in this paper follows a similar argument in considering the household as the basic unit of social analysis. Further more, a household is considered a more practical and convenient unit for the collection of empirical data.

The following section disaggregates the sustainable livelihoods framework into its constituent components and illuminates the points of leverage with the present study. In livelihood approach, five eminent categories (human, financial, physical, natural and social) variously referred to as assets, capital, or resource by some researchers are distinguishable. A sustainable livelihood is achieved when these assets combine both the tangible productive assets associated with economic analyses (e.g. land, labour, capital, and stocks) and the intangible assets more familiar to sociological and anthropological enquiry (e.g. social capital, health and educational status).

1.1.1) Coping in Context of Mediating Environment: Resilience and Vulnerability of Livelihoods

Scoones' (1998) view of sustainable livelihoods embodies resilience, i.e. the ability to cope with and recover from stresses and shocks by mobilizing assets to exploit opportunities and resist or recover from negative effects of the changing environment. Livelihood models acknowledge the role and importance of the mediating environment – the 'modifying and contextual forces' in translating individual or household assets into livelihood strategies and outcomes (Morris *et al.*, 2000). The DFID model divides these external forces into 'transforming structures and processes' – or 'policies, institutions and processes' - (e.g. levels of government, private sector, laws, policies, culture, institutions), and the 'vulnerability context', described in terms of shocks (e.g. civil and climatic), trends (e.g. resource stocks, population, technology, politics and economics) and seasonality (Carney, 1998:5, as cited in Morris *et al.*, 2000⁵). Ellis (2000: 37) similarly distinguishes between the modifying influence of 'social relations, institutions and organizations', and the contextual 'trends and shocks'.

This paper argues that understanding local-level decisions in adoption of different livelihood strategies in the face of changing economic conditions and agro-ecologic events requires a multifaceted and flexible approach that moves between analyses of macro-economic, political and historical contexts and local-level processes. Drawing on a case study of farming livelihoods in a Southern African setting, Scoones underscores the significance of analysis of people's livelihood

⁵ Much of the illustrations that follow borrows from the clearly exposed systematization in Morris *et al.*, 2000 and can be found there.

strategies focusing attention on the wider context of rural livelihoods (Scoones, 1996). This research takes up such an approach in pursuing its central theme.

Coping strategies are not fixed or generic across households, but rather vary according to the particular exogenous and endogenous context of the household concerned (Adams, *et al.*, 2001). The interaction between internal household livelihood components and the external influences typically reveals a pattern of vulnerability. According to Chambers 1989:1 as cited in Morris *et al.*, 2000:7 ‘Vulnerability refers to exposure to contingencies and stress, and difficulty in coping with them. Vulnerability thus has two sides: an external side of risks, shocks and stress to which an individual is subject; and an internal side which is defenselessness, meaning a lack of means to cope without damaging loss.’ The external side of vulnerability has dimensions of shock, trend or cycle (e.g. seasonality) whereby shocks are associated with the ability of livelihoods to cope while trends are associated with the adaptability of livelihoods.

The internal side of vulnerability is linked with net assets, and the rates at which these can be converted into consumption outcomes through activities. As Moser 1998 also cited in Morris *et al.*, 2000:8 notes: ‘Vulnerability is therefore closely linked to asset ownership...The means of resistance are the assets and entitlements that individuals, households, or communities can mobilize and manage in the face of hardship...The more assets people have, the less vulnerable they are, and the greater the erosion of people’s assets, the greater their insecurity’.

Households and individuals will have different and varying degrees of access to and thus different portfolios of assets. However not only do fewer assets equate to greater vulnerability, but also lower potential for substitution between assets and activities makes livelihoods more vulnerable, especially to shocks. Assets that can readily be liquidated and used to purchase more appropriate assets provide for greater livelihood flexibility (Ellis, 2000: 42). Substitution within asset categories can also occur. One notable example relates to the re-allocation of labour between domestic and outside earning opportunities in response to changing circumstance. With access to different portfolios of diverse assets, individuals and households will consequently respond in different ways to given livelihood shocks or trends.

1.1.2) Sequencing within and between Coping and Adaptive Livelihood Strategies

Livelihood strategies are composed of the portfolio of assets and various activities undertaken to generate a living which in turn determines the pattern of vulnerability of individuals or households. Sustainable livelihoods literature categorizes the main livelihood strategies into three broad types according to the nature of activities undertaken: agricultural intensification and extensification, livelihood diversification, and migration (See Scoones 1998, McDowell and de Hann 1997, and Swift 1998 for detailed analysis). Ellis (2000) classifies household-level diversification livelihood strategies into natural resource based activities and non-natural resource based activities. For the majority of

rural households in sub-Saharan Africa he observes farming alone does not provide a sufficient means of survival.

Devereaux (1993) and Davies (1996) amongst others have made the distinction between survival, coping, adaptive and accumulative strategies. Accumulative strategies are those which increase consumption outcomes and stocks of assets in response to opportunity. Adaptive strategies are those that seek to spread risk of consumption failure in response to anticipated adverse trends. This may be through the intensification of existing livelihood strategies or by diversification into new activities. Coping strategies are those that absorb the impact of an adverse shock by drawing down assets and reducing consumption. When there is no respite coping may lead to survival strategies. With survival strategies not only is consumption drastically reduced, but household assets are extensively, most often irreversibly eroded, in an attempt to ward off destitution and death (Morris *et al.*, 2000).

Coping strategies have a discernible sequence which corresponds to increasing levels of distress. Households and their members neither passively succumb nor instinctively react to crises. Rather, they are involved in purposively evaluating the costs and consequences associated with different coping strategies and pursue a variety of objectives by deliberately managing resources (Adams *et al.*, 1998). These are expressed in the myriads of decisions that are taken by individuals and by households from time to time. According to Mortimore and Adams (2001), it is difficult to generalize about such behaviour. However, the current study attempts to overcome this problem by taking a longitudinal methodology in detecting and discussing any (general) tendencies in the sequence of livelihood strategies using the case of crop and livestock selection and de-selection.

While an empirically based operational distinction of different strategies is valuable, it is outside the scope of current study to do so. However, the differences noted are kept in mind while investigating how smallholders cope and adapt with changing economic conditions and agro-ecologic events. The distinction of coping and adaptation strategies offered by Thomas, *et al.*, (2005) that adaptive strategies are differentiated from coping strategies on the basis of the duration of the response and the type and level of risk or vulnerability of households is relevant within the scope of the current study, and is adopted in the argument of its central thesis. According to Thomas, *et al.*, (2005: 7) 'Adaptation can be best seen as a process that involves changes in a system to increase its coping range, rather than temporary adaptation of historically familiar measures to cope with a transient threat. This is in contrast to coping, which is a temporary response to either a familiar disturbance or a transient threat'. Adaptive capacity is, therefore, used to refer to the ability of countries, communities, households and individuals to adjust in order to reduce vulnerability to variation, moderate potential damage, cope with, and recover from the consequences, including ecosystem responses to climate forces.

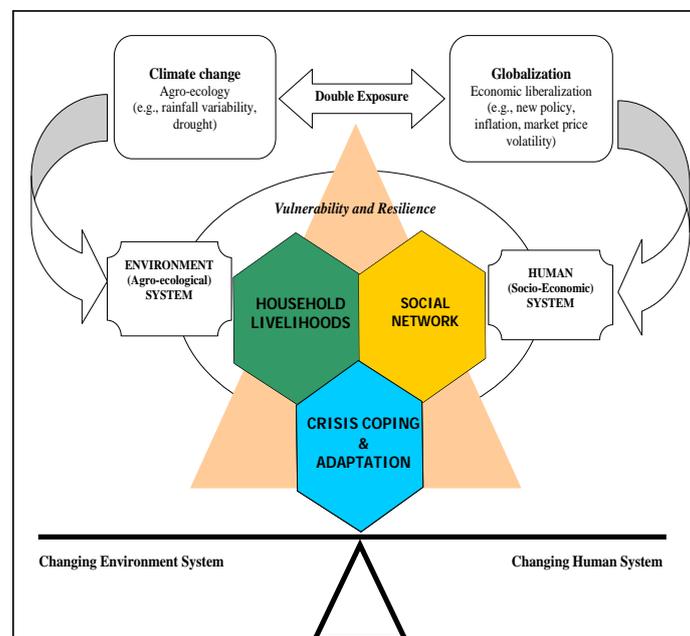
From the foregoing, it can safely be said that while livelihood approaches invite consideration of both macro and micro influences at the household or individual level, they have however little to

say about the effects of macro-level variability on livelihood dynamism of smallholders. Most studies on livelihood approaches in Africa are cross-sectional and lack time series perspective. Monitoring changes in livelihoods is deemed innovative and relevant theme in East African smallholder farming hence this study seeks to provide an understanding of livelihood dynamism of smallholder farmers in Kenya in the context of recent economic changes and environmental (agro-ecological) events.

1.2) *The research issue*

The study is about coping and adaptation processes by smallholder farmers in Kenya in the context of economic changes and environmental (agro-ecologic) events. The conceptual and analytical framework of analysis advanced for understanding the problem under investigation and thus the innovative aspect of the research is premised on the triad of Livelihood-Crisis-Network nexus approach (figure 1) i.e. the detection of dynamic changes in the sequence of livelihood strategies through understanding the ways in which households and communities cope and adapt under conditions of crisis, risk and uncertainty. The conceptual approach of the research design is rooted in the poverty-environment relationship to serve for the integrated analysis of classical socio-ecological systems research. Such an approach recognizes the dynamism and variability in both environment and socio-economic subsystems.

Figure 1: The Triad of Livelihood – Crisis – Network Nexus



While the individual is the prevailing unit of analysis, the research takes households as analytical frame of reference in investigating the themes embodied in the three legs of its triad approach. Theme 1: livelihoods, concerns an assessment of household livelihood components and strategies through annual net total income estimation. Theme 2: crisis, focuses on household vulnerability in terms of crisis-coping experiences and goes further to examine crisis events

objectively and longitudinally using the case of crop variety and livestock breed selection. Theme 3: social network is devoted to the mediating role of social network and community associational life in exchange and sharing of information and knowledge on seed varieties and agricultural production technologies by the smallholder farmers. Finally, the study deals with the issue of operationalizing the concept of livelihood strategies with quantitative household-level data and how then to use the identified strategies to test the livelihood-crisis-network nexus, i.e., the matching of discernible sequence of livelihood strategies with the sequence of crisis-coping experiences and social network.

1.2.1) Livelihood strategies

Realization that the world is facing significant climate change necessitates immediacy to further our understanding of dynamism in adaptation strategies in order to unravel both the processes by which adaptation takes place and the limitations of the various agents of change - states, markets, civil society, and households - in these processes (Adger, 2003).

Several types of livelihood studies have attempted to offer various reasons of livelihood diversification. Ellis (2000:15), (an influential agricultural economist and author on developing countries) defines rural livelihood diversification as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and improve their standards of living. Similarly, households may wish to diversify as a strategy for coping with an unexpected shock, or to minimize risk *ex ante* by participating in activities that generate imperfectly correlated returns (Brown, *et al.*, 2006).

The ability to diversify livelihoods as a coping strategy is critical to local welfare particularly in risk mitigation, uncertainty and contingencies (Scoones *et al.*, 1996; Ellis, 1998). Eriksen, *et al.*, (2005:288) quoting Cutter *et al.*, (2000) and Bohle (2001) observes that ‘the importance of people’s capacity to cope with and adapt to the negative effects of economic and ecological change is becoming increasingly clear’. It is by no means contestable the fact that this subject has received attention in the broad literature; however, as Eriksen, *et al.*, (2005:288) say: ‘the dearth of information with regard to how, in practice, effective adaptation measures can build on existing coping actions exists’ particularly for smallholders in Kenya. This forms the entry point of my study.

The work by Eriksen, *et al.*, (2005) is useful in examining the relationship between coping and vulnerability and is informative on how smallholders cope with climate stress and how constraints and opportunities shape variations in coping strategies between households and over time during a drought. The point of departure of this study and hence its justification hinges on two realizations.

First, unlike the previous studies which have viewed livelihood strategies against an unspecified, generally shorter period, the coping strategies looked at in this paper relate to both immediate activities undertaken in response to shocks and/or crisis facing the rural households and long term adaptive measures. While the approach adopted in Eriksen *et al.*, (2005) was based on ways

in which people ranked and selected different coping strategies and activities in the face of short-term seasonal drought and the relationships between selected groups of activities, this paper explores longitudinally the actual crisis-coping experiences by smallholder farmers using the case of crop variety and livestock breed selection.

According to Wisner, *et al.* (2004:79-80) and Ellis (2000), it is becoming increasingly clear that sustainable livelihoods cannot be supported only by natural resource-based activities (primarily agriculture) particularly in sub-Saharan Africa leading to a reduction in the farming component of livelihoods. This has affected vulnerability of smallholder farmers with some of the driving forces being: population growth and resultant reduction in per capita availability of land and food insecurity; adverse environmental change, including drought and unreliable rainfall; a decline in agricultural markets relative to non-farm wage levels, rises in agricultural input costs as result of structural adjustment policies; and a general decline in access to rural public services due to economic mismanagement, civil war and cost recovery programs under structural adjustment programs.

It is, therefore, safe to posit that smallholder farmers' vulnerability is inextricably linked to climate variability, natural resource such as land availability and soil fertility, socio-economic trends and policy framework. Thus, the overriding question to the farmers is how to maintain or increase production under these changing and adverse conditions. According to Scoones *et al.* (1996), responses necessarily involve continuous adaptive change in farming practice. The current study sets to fill in the gap in knowledge base on how in practice effective adaptation measures can build on existing coping action by focusing on crop variety and livestock breed selection as a case within the crisis element of the nexus.

Previous research has distinguished between coping and adaptation (Adger, 1996; Eriksen *et al.*, 2005; Smithers and Smit, 1997; and Thomas, *et al.*, 2005). The distinction offered by Adger (1996) is relevant and hence adapted within the framework of the current study, whereby coping refers to the actions and activities that take place within existing structures, such as production systems, whereas adaptation frequently involves changing the framework within which coping takes place.

1.2.1) Crop variety and livestock breed selection

The issue of crop and livestock selection defines a context that brings out the distinction between coping and adaptation clearly and can be operationalized using solid empirical data. In dry land farming systems in sub-Saharan Africa, farmers make decisions about crop choices at the beginning of every planting season which in most cases is a temporary response to either a familiar disturbance or transient threat such as a major drought or market prices. From a longitudinal perspective, these short timescale responses of crop selection within an existing agricultural production system gradually build into longer timescale adaptation measures and adjustment of the system into forms of agriculture that moderate the negative impacts thus reducing the need for coping. The initial crop choices at the beginning of a planting season consequently lead to broader cropping

patterns over time.

Crop production may be improved by increasing cultivated area and/or increasing crop yields (Njie *et al.*, 2006) but, increasing cropped area is checked by population growth and consequent diminishing of per capita availability of land a situation which puts the smallholder farmers in a dilemma of increasing crop yields in a shrinking acreage of cropped area per capita. Through a screening and integration process of previously proposed adaptation options by Jallow (1995) among others, Njie and others identify crop breeding/selection, crop fertilization, and irrigation, as the most comprehensive, no-regrets, flexible agricultural intensification strategies to improve crop yields (Njie *et al.*, 2006:7). The main argument in favor of crop breeding/selection is that of probable decline in rainfall and increased variability. The success or failure of agriculture in a household economy hinges on initial planting which is determined by farmers' ability to select crop varieties suitable to their own agro-ecological and broader socio-economic conditions. On the other hand, promotion of crop fertilization as an adaptation strategy is influenced by continuous decrease in available prime land and concurrent degradation of arable land.

Several studies have identified various important criteria of crop variety selection. Crop choice is frequently mentioned in the adaptation literature as a potential adaptation strategy to climate change. For example, Kurukulasuriya and Mendelsohn, (2007) estimate the climate sensitivity of specific crop choices made by farmers in Africa by examining the crop choices those farmers make across different agro-ecological zones, the analysis centers on how farmers in different climate zones have adapted to current climate. Barkley and Porter (1996) found that choosing a variety in Wheat in Kansas, U.S.A is strongly responsive to past production decisions and relative yield, as well as significantly related to variety in age and yield stability. In Holland, Rost and Walther (1997) elucidate the importance of variety selection according to market situation and site conditions. They demonstrated economic rationality in crop selection through grower's consideration of higher production output free of direct costs. These studies amongst others (see for example Scoones, *et al.*, 1996) indicate farmers make crop selections based on several criteria, including available inputs such as labour (both hired and household), experience, availability of seed, prices, government policy and a host of environmental factors such as climatic and soil conditions and available surface flow.

Detlefsen and Jensen's contribution (2004) of a stochastic model for crop variety selection that finds the optimal variety with respect to several characteristics is valuable in elucidating the issue of crop choice from the farmer's perspective and its emphasis on the dynamics in the decision process even though its scope is limited to consideration of future uncertain observations and decisions by farmers. But, Scoones *et al.*, (1996) working from a different geographical setting in sub-Saharan Africa arrives at opposite conclusion, that due to the immense range of influences on crop choice, simple decision models that try to describe such detail will almost inevitably fail due to specification problems since so many factors are influential, thus there can neither be optimal crop choice or combination nor standard prescriptions for an area characterized by variability of environment and

economic conditions such as Africa's dry lands. It is worth noting that Detlefsen and Jensen (2004) are aware of this fact as noted in their model assumptions and limitations with regard to variations brought about by seasons and locality. The current study seeks to contribute to this body of knowledge and enhances our understanding of crop and livestock selection in the context of variability and fluctuation of economic and environmental conditions by employing a dynamic approach which crucially hinges on a historical perspective. To the best of my knowledge there are no studies that examine determinants of farmers' decision-making process under changing economic conditions and agro-ecologic events in a longitudinal manner i.e. the chronological ordering of decision-making process as sequences of crop and livestock selection episodes over time.

Second novelty of this paper deals with the issue of operationalizing the concept of livelihood strategies in quantitative household-level data and how then to use the identified strategies to test the livelihood-crisis nexus, i.e., the matching of discernible livelihood strategies with crisis-coping experiences. The literature on livelihoods provides various approaches of classifying household livelihood strategies based on realized incomes (Barrett *et al.*, 2005; Dercon and Krishnan, 1996; and Reardon *et al.*, 1992). Annual production estimates data is mostly used in calculation and characterization of household livelihood strategies. The major concern with this approach is on mismatch of time since crisis/shock may be experienced over a period of time not coinciding with the annual income estimation period. This realization makes it prudent to employ conceptually related approach of asset endowment. In the words of Brown *et al.*, (2006: 23), 'An alternative method of analyzing livelihood strategies involves direct examination of the individual household's asset endowment'. The amount of income earned and even the type of activity undertaken by a household is a stochastic function of the assets it controls (Brown *et al.*, *ibid*: 23). Morris *et al.*, (2000) note that the pattern of vulnerability and/or opportunity of individuals or households are reflected in the portfolio of assets and the activities which are undertaken to derive a livelihood. As an intrinsic part of the assets-activities-outcomes cycle, livelihood strategies are generally adaptive over time, responding to both opportunities and changing constraints.

Thus, in this paper, both realized income and asset-based approaches are used in the livelihood-crisis-network nexus analysis to test whether vulnerability in terms of crisis-coping experiences is determined by status of socio-economic well-being. In order to achieve these objectives, the study takes a longitudinal approach of data collection and analysis so as to fully understand the nature of livelihood dynamism for the smallholders when faced by crisis. The longitudinal methodology is applied on the crop and livestock selection sequence as well as crisis-coping experiences, but not on livelihood strategies. However, this study employs household asset endowment in order to overcome the mismatch as noted earlier. As Chambers *et al.*, (1989) recommends the study employs a methodological pluralism that includes qualitative and quantitative methods in increasing understanding of complex, diverse and risk-prone smallholder livelihood systems.

2. Context of Research

This part succinctly provides the contextual setting for the detailed case study and sets the scene of inquiry. First it contextualizes the theme under investigation within the broader mediating forces of economic change and agro-ecologic events in Kenya, and secondly, introduces the case study area.

2.1) *Coping with Double Exposure to Economic Changes and Agro-Ecologic Events*

2.1.1) *Economic structural adjustment programs and rural livelihoods in Kenya*

Over the last two decades, economic crisis and resultant economic structural adjustment programs (ESAPs) together with environmental changes have had profound effects on the rural livelihoods and survival strategies of smallholders in Kenya majority of whom live in Arid and Semi Arid Lands (ASALs) characterized by ecological and economic hardships. Through the 1980s and 1990s, the Government of Kenya, with assistance from the World Bank and IMF, instituted the ESAPs to address and stimulate the declining trend in economic growth resulting from the oil-price shocks of 1973-74, rapid increases in international interest rates between 1979 and 1981 and the effects of two coffee booms (Karigi and Siriwardana, 2001).

At the macro-level, the measures taken included devaluation of domestic currency, removal of exchange rate controls, deregulation of interest rate, trade and investment, deep cuts in domestic budgets, including in health and education, massive layoffs of public sector employees, privatization of government-owned enterprises, curtailment of subsidies, and a general re-orientation to exports as opposed to support for domestic industry and self-sufficiency (Karanja, A.M, *et al.*, 2003, Karigi and Siriwardana, 2001, and Van Wijk and Makokha, 2000). At the micro-level, the reforms were sector-specific evidenced by the liberalization of commodity markets in the agricultural sector. Specifically, commodity prices were decontrolled, trade restrictions such as licensing controls and commodity movement restrictions were reduced or removed altogether and the role of government in commodity marketing was reduced (Van Wijk and Makokha, 2000).

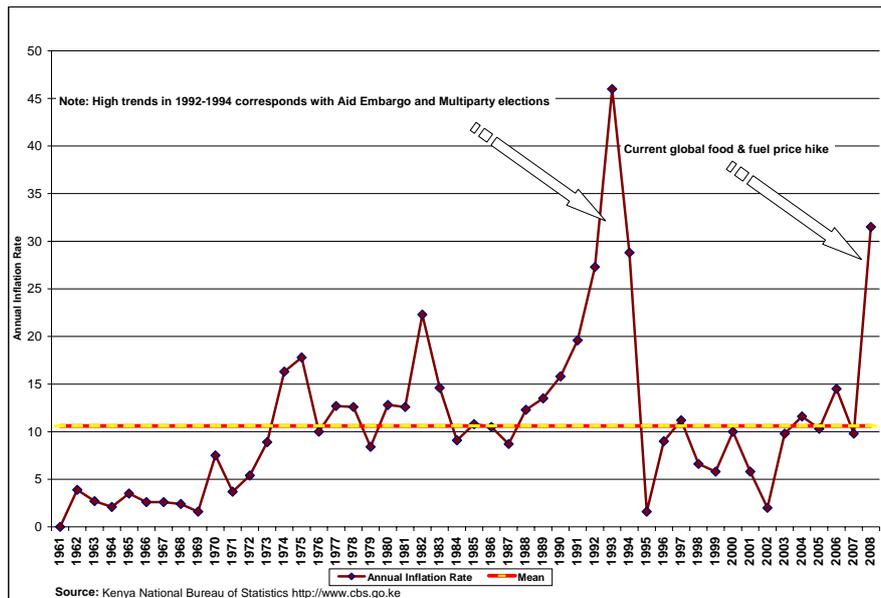
These economic policy reforms have been blamed for the current crisis in rural agriculture as small farmers' production is negatively affected by the cost of agricultural inputs and consumer goods rising faster than the prices of agricultural produce (Mahmould Bah, *et al.*, 2003). According to Tacoli 2003; increases in food prices and service charges, cuts in public expenditure especially on health, education and infrastructure expenditure have been felt particularly by low-income groups in ASALs.

There is empirical ambiguity, however, on the extent and actual effect of market reform policies on the general direction and magnitude of real price changes (Barrett, 1997; Karanja A.M, *et al.*, 2003). Nevertheless, a look at the national consumer price index⁶ (CPI) and inflation trends from 1961

⁶ Consumer Price Index is defined as a measure of the weighted aggregate change in retail prices paid by consumers for a given basket of goods and services. Price changes are measured by re-pricing the same basket of goods and services at regular intervals, and comparing aggregate costs with the costs of the same

to 2008 indicates an exponential increment (Figure 2) during a period which is in tandem with the implementation of the reforms. Karanja, *et al.*, (2003:271-296) describes the effects of market reforms on the evolution and volatility of producer prices in Kenya during the periods 1985-91 and 1992-99 which represent the pre-reform and reform periods respectively. Results from the study indicate that market reforms were generally associated with higher volatility of commodity prices, although there are inter-commodity differences.

Figure 2: Kenya Annual Inflation Trends 1961 – 2008



2.1.2) Climatic and/or Agro-ecologic events in Kenya

Concurrent with the economic policy shocks are agro-ecologic events and inherent crisis. According to Kabubo-Mariara and Karanja, (2006: 320), ‘global circulation models predict that global warming will lead to increased temperatures of about 4 °C and cause variability of rainfall by up to 20% in Kenya by the year 2100’. Climate variability and change can have serious impacts on the hydrology of semi-arid areas, and consequently on agricultural production. In semi-arid tropical regions, inter- and intra-annual variability of rainfall is considered key climatic elements that determine the success of agriculture. Figure 3 illustrates the high level of variability in annual precipitation levels 1970-1999 at Ark Gate of the Aberdare National Park rainfall station, the nearest station from the research area. The observed rainfall patterns are characterized by unpredictable variability both within and between years with drought episodes being frequent. Further, the seasonal precipitation differences between months in a year make agriculture to be highly risky and uncertain activity.

basket in a selected base period. Price data for constructing the indices are collected by Central Bureau of Statistics through a survey of retail prices for consumption goods and services. The percentage change of the CPI over a one-year period is what is usually referred to as inflation. Source: Kenya National Bureau of Statistics, (2006): Inflation Trends 1961-2006. <http://www.cbs.go.ke> (2007-12-10).

The current research area (see part 2.2) is within Arid and Semi Arid Lands (ASALs). The ASALs of Kenya make up more than 80% of Kenya's landmass; support nearly half of the livestock population of the country and over 30% of the total human population (Republic of Kenya, 2004). Agriculture is the leading sector in the Kenyan economy contributing about 24% to real GDP. The sector is the largest contributor to employment (with more than 70% of the labor force based in rural areas) and accounts for about 50% of principal export earnings (Republic of Kenya, 2006).

Figure 3: Rainfall Variation 1970 - 1999, for Ark Gate Aberdare Park Station, Nyeri

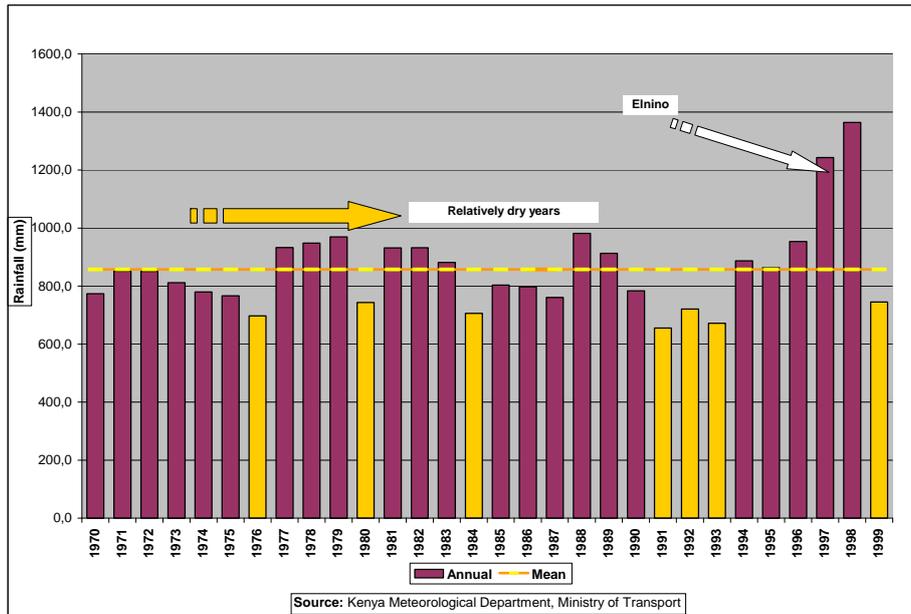
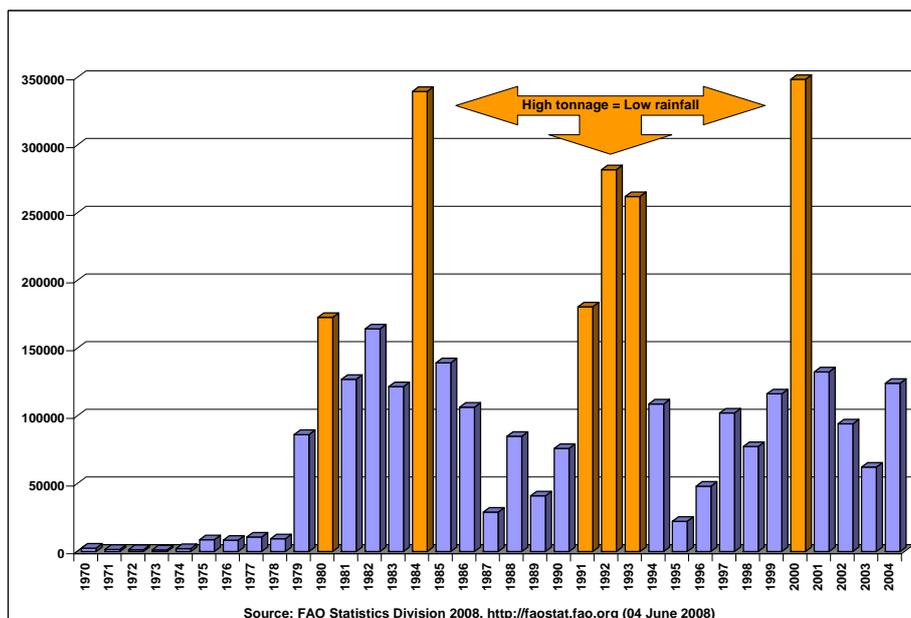


Figure 4: World Food Programme: Food Aid Shipment of Cereals (in Tonnes) to Kenya



However, the sector is adversely affected by two extreme climate events namely drought and

flooding in both the ASALs and the high potential areas. It is now a common place observation that drought and flooding in Kenya have, in the recent past, become virtually permanent state of affairs. A relatively unsystematic reading of the evidence suggests the occurrence of major droughts and shortfalls in food security in Kenya recorded in 1889, 1894, 1898, 1914-19, 1928, 1931-34, 1939-40, 1943-44, 1947-48, 1951, 1952-55, 1957-58, 1960-61, 1964-65, 1970-71, 1973-74, 1979-80, 1983-84 and 1999-2000 could be associated with rainfall deficits experienced in the respective years (Migdal, 1974; Ongwae and Karanja, 2005). The droughts of 1983-84 and most recent 1999-2000 had wide spread social and economic impacts, with the 1999-2000 drought being the longest and severest on record in Kenya (Ongwae and Karanja, 2005). According to Food and Agricultural Organization (FAO) statistics division, Kenya has continued to receive food aid in the form of cereals since 1979 with highest shipment recorded in 1984, early 1990's and 2000, same years when drought and low rainfall was experienced (Figure 4). This shows existence of a relationship between food insecurity, rainfall deficit and drought occurrence. However, as Scoones *et al.*, (1996:165) cautions, 'defining agricultural drought solely by rainfall deficit (meteorological drought) is clearly inadequate'. Thus, Stephen Sandfords' (1979) economic definition of drought as 'rainfall induced shortage of an economic good' as adopted by Scoones is acceptable and will be used in this study for it not only depends on rainfall levels, but also takes into account changes induced by demand and supply factors influenced by prices, markets conditions, levels of infrastructure, politics etc.

From the foregoing discussion, it is apparent that the livelihoods of smallholders in Kenya are 'double-exposed' to effects of both climatic and economic changes which are in turn intrinsically and fundamentally linked in shaping local level vulnerability. So the question that needs to be asked is how these two global processes shape local vulnerability among smallholder farmers in Kenya and how do the farmers cope and adapt with the changes. The emerging issue taken by the current study to investigate is about how smallholder farmers in Kenya are coping and adapting in the context of these global changes. It is premised on the detection of dynamic changes in livelihood strategies through understanding the ways in which households and communities cope and adapt under these conditions.

2.2) The setting of study area and research site selection

2.2.1) Introduction

Historical process of migration and settlement pattern is very decisive of livelihood strategies of a locality. From a historical perspective, this section sets the stage for understanding livelihood system dynamism of smallholders in Central Kenya, the subject matter of the study. It therefore examines historical processes of change in reference to the local agrarian structure with emphasis on various forms of land use, subdivision, transition and tenure dynamics over time as well as migration history and settlement patterns. These range from land alienation during the colonial era on the White Highlands to the historical development after independence of Kenya. The paper argues that these

events have in turn shaped the contemporary local-level livelihood system. In so doing, the choice of the broad study area, Central Kenya (Map 1), becomes implicit.

The exceptional nature of Central Kenya, a largely Kikuyu-speaking part of Kenya has been amply described by Bates (1989) among others. Nationally, the richer regions of Kenya lie at higher elevations, with greater and more reliable rainfall while the poorer regions lie at lower elevations with less and less certain rain. This has led to emergence of a pattern of substantial inequality with high growth concentrated in the high potential areas with plenty of rain, particularly in the central portion of Kenya. In an environmental sense, Central Kenya possesses attributes which distinguish it from the rest of Kenya regions, explaining the attention it attracted for early settlement by the European colonialists. It is by nature the best province of Kenya with characteristic young volcanic soils on rain-harvesting slopes in suitable table altitudes (Jaetzold *et al.*, 2006); consequently, it has the most developed infrastructure passed on from the colonial government and its accessibility and proximity to markets around the capital City of Nairobi.

Having said that, it is worth noting that this is a generalized statement, the reality in Central Province is that there are pockets of extreme underdevelopment comparable to any other part of the country. Land scarcity fueled by high population density in the humid areas of Central Province triggered out-migration of the land poor into less humid and precarious semi arid zones. However, these areas remain largely un-researched because of the same general view of the Province as the most developed in Kenya.

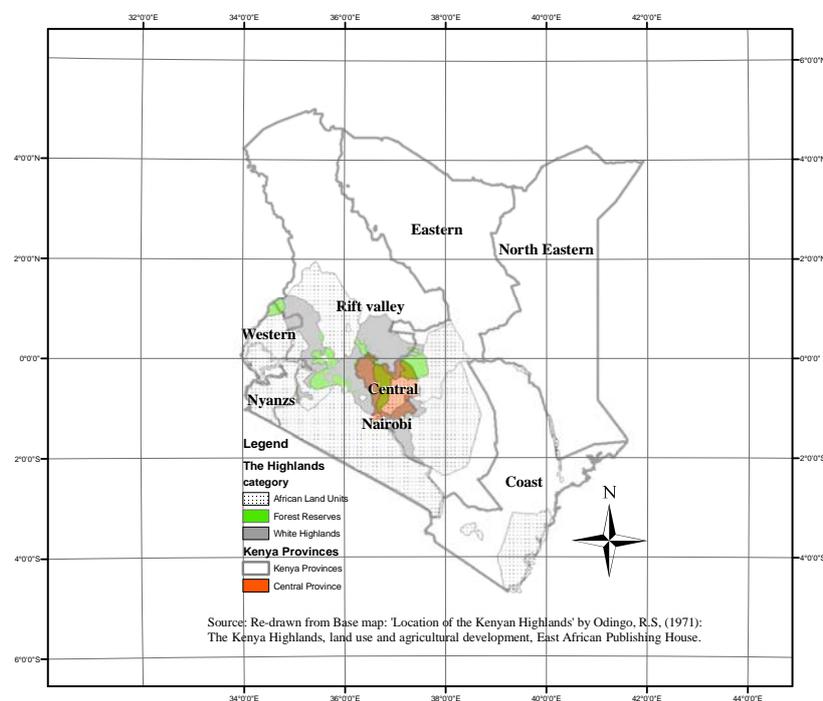
2.2.2) A Historical Overview of Central Kenya

The introduction of British rule, followed by European colonization of the highlands of Kenya (then known as the East Africa Protectorate) in the early years of the twentieth century was to have impact on the Kenyan land (Sorrenson, 1967). The major impact on the traditional agrarian society was the introduction of a settler economy. The events that followed of land ownership transition and inherent migration and settlement patterns characterizing Central Kenya can be considered in two distinctive periods: Colonial and post colonial.

In the colonial period, the process of colonization saw the balkanization of Kenyan land into the 'White Highlands' or the 'Scheduled Areas' and the 'Native Reserves'. This led to the alienation of land from the native tenure of Africans who were confined to 'reserves' and not allowed to own land in the European area. The adoption of a policy of exclusion mandated the extinction of African property rights; as a result, land and land shortage remained at the centre of Kenyan history throughout the colonial period and beyond. The subject of land alienation, mounting land shortage and resultant land revolution in Central Kenya area during and after the colonial rule has received wide attention by scholars (see for example Sorrenson, 1967; Leys, 1975; Overton, 1988 among others). This is indicative of the magnitude of growing uneasiness over the whole Kenya land problem, not least the situation in and around Central Kenya.

While exploring the economic and political impact of colonial occupation in rural Kenya, Bates (1989: 17) notes: ‘in the early twentieth century the tribal system of Kikuyu landownership was subjected to a major exogenous shock. The British alienated the lands to the north – Nyeri, Nanyuki, and Laikipia becoming part of the White Highlands – and the lands to the south – Thika, Nairobi, and parts of Kiambu (Map 1). Establishing ranches, plantations, and mixed farms, the colonists alienated lands over which Kikuyu settlers had established rights; at least as important, they also extinguished the possibility of acquiring new land rights. As laborers and tenants, Kikuyu gained access to these lands; but they were forbidden ownership of them’.

Map 1: Location of the White Highlands within broad study area, Central Province, Kenya



Land alienation created a sense of loss among the Africans (Overton, 1988) resulting to a rebellion. The situation was exacerbated by increased unequal landholding in African reserves as a result of population pressure and land transactions, whereby the educated (*athomi*) accumulated land through off-farm incomes including clerical and educational work, and commerce (Ueda, 1999 citing Kitching, 1980 and Chege, 1987). The origins of and demand for rebellion in the rural areas of colonial Kenya can be traced back to an armed conflict known as Mau Mau⁷ which engulfed the city of Nairobi and major portions of two agricultural provinces: Rift Valley and Central finally culminating in Kenya’s independence. According to Spencer, 1985 (quoted in Bates, 1989:12), ‘the Mau Mau rebellion spread geographically in a “V” shape. The apex lay in Nairobi. The left arm extended northward into the White Settler farming areas of the Rift Valley Province; the right arm into

7. According to Bates, Mau Mau has generated an enormous literature; one bibliography by Clough and Jackson, Jr., *Mau Mau Syllabus* notes over two hundred secondary sources.

Kiambu, Fort Hall, and Nyeri Districts – the districts that together formed the Kikuyu reserves. Dividing the two arms were the Aberdare (or more properly the Nyandarua) mountains, in which the armed forces of Mau Mau took refuge and from which they launched many of their attacks on the settlements below’.

In the early twentieth century, then, there came to exist virtually side by side two farming systems; that of the new European settlers and that of the indigenous community. One consequence of the vesting of land rights in the Highlands was the formation of a market for labour. The settlers possessed abundant land and little labor; the Africans possessed abundant labor but lacked land. The European settlers used taxation to compel Africans into a wage labour system in which the settlers bid for labor and promoted the movement of Africans into the White Highlands where they became ‘squatters’. During the colonial period, the Kikuyu gained access to land on the Highlands, but in the capacity of workers, not landowners. This labour-land demand and supply relationship created by the colonial system can be said to be the initial trigger of the migration and settlement mosaic evident in Central Kenya to date.

In the post-colonial period after Kenya became independent in 1963, some of the White Settlers decided to withdraw from the White Highlands and the areas became an open frontier for African immigration and settlement. The land was acquired by the Government, the Land Buying Companies and Co-operatives, or individuals. The ensuing partitioning and resettlement of Africans from the crowded reserves to less densely populated areas of the former White Highlands encountered rival land claims. With different groups competing for the fruits of independence, the land issue became a major source of political controversy at the time of transition to African rule (Bates, 1989). As Kiteme *et al.*, (1998) notes, the wave of land subdivision that started immediately after independence has continued unabated to the present time.

A critical look at the events surrounding land subdivision that took place after independence reveals two distinct key players and consequent features of their motivation: the first was government settlement schemes operating under the noble objective of settling the people who had been rendered landless by the colonial events. The government initiated a series of settlement programs, the first and most widely known of which was the ‘One Million Acre Scheme’, in the course of which more than one million acres of land, mainly in the White Highlands, were bought and subdivided into small scale farming plots. According to Okoth-Ogendo (1981:332), the total area purchased accounted for approximately 20 percent of the former Scheduled Areas. The program, which was a legacy of the colonial era, was funded with British and Germany money and received further financial assistance from the Common Wealth Development Bank (Kohler, 1987). Besides backing the official settlement policy, and providing a way-out for those European settlers who wished to leave the country, one of the motives of the creditors’ support seems to have been to prevent land market and agricultural production from collapsing (Kohler, 1975 citing Leys, 1975:95). According to Kiteme *et al.*, (1998), this explains why land for subdivision was acquired following strict assessment of the ecological

capability of the given areas to support certain agricultural activities. As a result, land sub-divided under the government settlement schemes was limited to the wetter, high-potential areas.

The second player was private land-buying companies that sprang up after independence. It became apparent that the government settlement schemes were overwhelmed by the large number of those in need of land. Taking advantage of the landless poor people from the high-potential areas of Central Kenya with relatively cheap means of acquiring their own land, directors of many land-buying companies bought land on speculative basis and recruited members in order to maximize profits and build political bases for their future political advancement. Motivated by political and economic desire, the subdivision did not take into account the need to assess the ecological capacity of these areas to support the resulting land use activities. Land subdivision was based exclusively on absolute numbers of shareholders and not on the carrying capacities of the areas affected. Based on these considerations, many of the subdivided farms averaged 10 acres (Kiteme *et al.*, 1998). It was estimated that by 1970, land-buying companies and cooperatives had already acquired about 20 percent of the White Highlands (Leys, 1975:84), or as much as the government settlement programmes.

Following the initial land subdivision, a secondary subdivision fuelled by socio-cultural and socio-economic factors has continued to be experienced. Over time, as the families of the first generation settlements matured, more land was required to fulfill inheritance⁸ and other important familial obligations such as education costs, subjecting the already subdivided land to further subdivision. As a result, the original acreage dropped, sometimes to extremely small parcels (as small as 1 acre) depending on the size of the family, with the initial effects of population pressure manifesting themselves clearly in the affected areas. This trend has continued to trigger further out-migration into more drier and semi arid areas further North such as Laikipia district.

The attempt to trace the system of land ownership transition over time has revealed a tendency toward individualization and fragmentation of land with changing land uses and land holdings becoming smaller and smaller from one tenure system and generation to the other. Having established the historical roots upon which the current study anchors, the next section turns to more specific issue of local-level choice of study area.

2.2.3) The Choice of Study Area: Northeastern slopes of Aberdare Ranges, Nyeri North District

At the outset, a key issue of consideration was the choice of the area in which to undertake the study. This was based on several considerations emanating from the subject under investigation. A broad goal of the study project is to provide an understanding of livelihood dynamism of smallholder farmers in Kenya in the context of recent economic changes and environmental (agro-ecological) events. Understanding local-level decisions in adoption of different livelihood strategies in the face of

⁸ The system of land ownership and inheritance according to Kikuyu customs is patrilineal and patrilocal i.e. from father to son.

changing economic conditions and agro-ecologic events requires a multifaceted and flexible approach that moves between analyses of macro-economic, political and historical contexts and local-level processes (Scoones, *et al.*, 1996). This research takes up such an approach in pursuing its theme and choice of the study area.

The study area is located in the former Nyeri District⁹, Central Province, which comprises the most western part of the moist windward side of Mt. Kenya (5199m), the drier western leeward side of this extinct volcano, the borders of the semi-arid Laikipia Plateau (in the rain shadow area), and the moist windward eastern slope of the Aberdare range (4000m). The inhabited areas in the District consist of two distinct blocks conforming to the newly created Districts, the traditionally Kikuyu south (Mathira, Mukurweini, Othaya, Tetu Divisions, and Nyeri Municipality) and the north formerly in the scheduled areas (Kieni East and Kieni West Divisions). The southern half is former African reserves, densely populated and fertile, with homesteads of Kikuyu, while the northern half is part of the former scheduled areas for white settlers which have been subdivided to African smallholders under settlement schemes¹⁰ in the 19960s (Ueda, 1999). The new frontier areas attracted the migrating land poor Kikuyus from the traditional birthplaces in the south. In these new frontier areas, Sottas (1992) researching under the auspices of Laikipia Research Programme, observes that unfavorable ecological and economic conditions create contradictions and many households undergo a considerable risk to fall into marginality. Yet, as noted earlier, these areas remain largely un-researched.

Within Nyeri North District, Northeastern slopes of Aberdare Ranges qualified and was chosen as study area on several accounts. Based on the historical mosaic bequeathed from the colonial and post colonial period as already discussed, the area was an open frontier for African settlement with both government settlement scheme known as Watuka and private land-buying company, Gatarakwa, being key players in land subdivision and allocation. Consequently, the area witnessed an influx of migrants from the densely populated high-potential areas of Central Kenya.

In order to understand the influence of local agro-ecological settings on household livelihood strategies, it was deemed necessary to undertake a comparative case study approach. An ingredient of such an approach is local level areal differences arising from ecological gradients, such as found on mountain slopes, which provide examples of a variety of farming and economic systems in a small area, and often are characterized by interactions between the slope zones (Ueda, 2007; Kiteme *et al.*, 1998 and Majule *et al.*, 2004). Northeastern slope of Aberdare Ranges constituting forest adjacent communities of smallholder households encompass such diversity and was thus chosen as the study area. The differences range from the upper/higher elevations being cool and very humid yielding greater and more reliable rains and more moderate temperatures to the hot, semi-arid savannah at the lower slopes. These local-level elevation differences give rise to household livelihood differences with

⁹ The study site lies under the newly-created Nyeri North District which was hived off the larger former Nyeri District in 2007.

¹⁰ For example, Gatarakwa, Mugunda, Watuka, and Ng'ari Ng'iro settlement schemes among others in Central Province.

high elevations supporting agricultural-based economy. On the other hand, households might struggle at lower elevations, eking out a bare subsistence straddling different livelihood activities. The comparative case study approach used in this research allows these general postulations to be substantiated and confirmed at both household and local (geography) levels. Pilot survey ensued during which several key sites within the study area were visited to obtain more insights and general view of the area as well as test if the general questionnaire was suitable with the settlements' conditions. These were sites thought to yield and/or provide suitable conditions for the research theme. The help of local village and government leaders who are familiar with and know the history of the settlements was sought to introduce the research and seek participation by the locals. Within Northeastern Slopes of Aberdare Ranges, the study focused on two contrasting research sites in the micro study area, Kamariki Sub-location¹¹ (Table 1 and Map 2). The area is broadly a mix representative of the conditions found in the wetter and drier parts of Nyeri North District. The case study sites are representative of the diverse range of ecological conditions, topographical settings, vegetation associations and soil types prevalent in the district. The two sites are: Kabendera located at lower to intermediate zones of Northeastern slopes of Aberdare Ranges adjacent to South Laikipia Forest Reserve and the wetter Kiambogo on the higher elevations of Aberdare Ranges next to Aberdare Forest Reserve. Located in a continuous slope, the two sites were chosen for detailed survey to facilitate comparative case study approach owing to their location in different agro-ecological zones within the study area as well as different settlement history. Such an approach is deemed necessary to enhance understanding of the functioning of the regional system within which the two sites are located.

Table 1: Households and Household Size, Area in Sq Kms and Density by Administrative Levels

Country	Province	District	Division	Location	Sub-Location and Village	Households	Population	Area (Sq.Kms)	Density
Republic of Kenya						6 371 370	28 686 607	581 677	49
8 Provinces of which	Central Province					924 545	3 724 159	13 220	282
	7 Districts of which	Nyeri District				168 786	661 156	3 356	197
		7 Divisions of which	Kieni West Division			16 699	68 461	626	109
			5 Locations of which	Gataragwa Location		3 809	16 310	213	77
Central				4 Sublocations of which	Kamariki Sub-Location	1 647	6 740	89	59
Nairobi	Nyeri	Kieni West			Githura A	121	510	Information not available	
					Kandigiri	61	261		
					Githura B	109	481		
Coast	Kiambu	Kieni East			Kiambogo	166	734		
					Kiboya	89	344		
Eastern	Kirinyaga	Mathira	Gataragwa		Bellevue B	217	780		
					Bellevue A	175	528		
North Eastern	Murang'a	Mukurwe-ini	Mwiyogo	Kamariki	Kabendera	32	101		
					Kaheho A	114	450		
Nyanza	Nyandarua	Othaya	Mweiga	Watuka	Kaheho B	116	506		
					Gacuma	118	519		
Rift Valley	Thika	Tetu	Endarasha	Lamuria	Birisha	90	377		
					Secondary Line	157	830		
Western	Maragua	Municipality	Mugunda	Embaringo	Wamucuni	82	319		

Source: Kenya, Republic of, (2001): The 1999 Population & Housing Census, Volume 1, Nairobi: Central Bureau of Statistics.

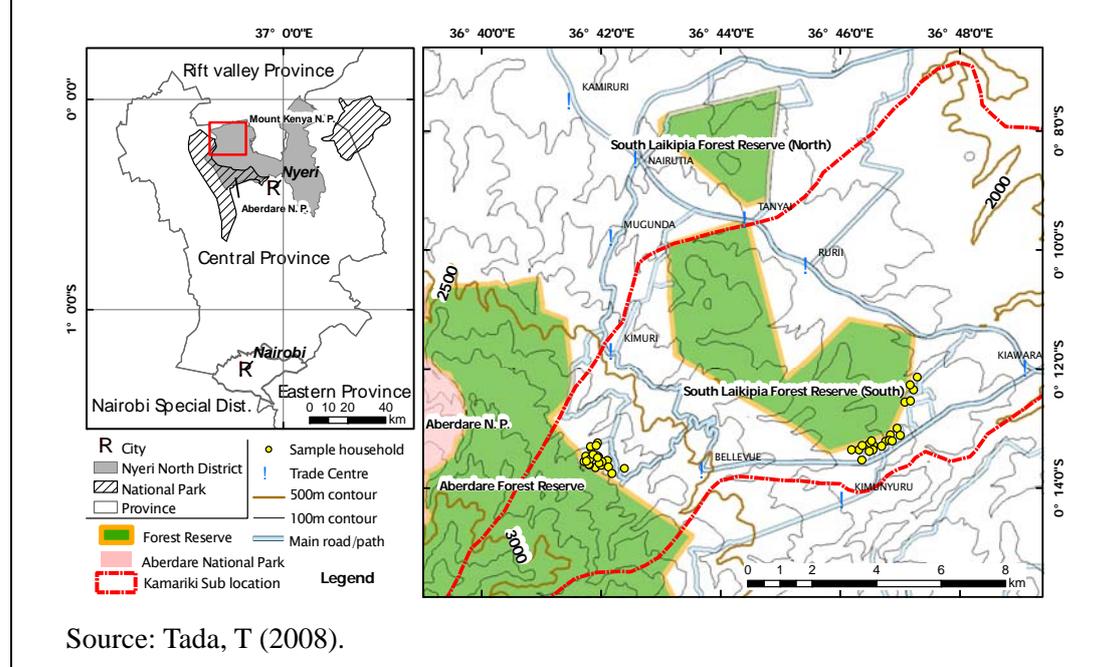
Notes:

- There has been changes in boundaries due to creation of new districts and divisions since 1999, for instance, Nyeri District has been sub-divided into Nyeri North and Nyeri South. Therefore, Kieni West Division, the broad study area lies in Nyeri North District
- A Village is the lowest administrative level and corresponds with CBS Enumerated Area - a statistical unit of enumeration which according to 1999 Census was expected to contain 100 households. The boundary of an EA was delineated using identifiable features like roads, rivers, footpaths etc
- From the above definition of a Village and/or Enumerated Area, the boundaries of the two case study sites are not clear and can be said to lie in Kiambogo, Kabendera and Wamucuni villages.

¹¹ The area is located in Gataragwa Location, Kieni West Division, Nyeri North District. It is worthy noting that Kenya is divided into five hierarchical tiers of administration; Province, District, Division, Location and Sub-location.

In order to fully understand the socio-economic trends responsible for the maintenance of livelihood security of the study sites, a brief synopsis of the underlying historical and agro-ecological conditions that influenced the choice of the two sites is imperative. This is highlighted under methodology section which also answers the fundamental question of how the research was conducted.

Map 2: Location of Study Area: Kamariki Sub-location, Northeastern slopes of Aberdare



3. Research Methodology

3.1) The case study sites

The impression that emerges out of a (candid) observation of the study sites ranges from that of a semi-arid savannah at the low land zones of Northeastern slopes of Aberdare including Northern part of South Laikipia Forest from the Nyeri-Nyahururu tarmac road with the area rising gently to the highland zones of Aberdare. Kabendera lies at the intermediate zone (about 2100-2200 m asl) of Northeastern slopes of Aberdare Ranges in dry lands characterized by climatic variability (semi-humid), where smallholder mixed farming is a dominant economic activity. It is a newly opened settlement with initial settlers having bought the land through land purchasing society known as the Gatarakwa Land Buying Company in the late 1970s. On the other hand, Kiambogo, which is located in the upper zone at a higher altitude of 2500-2800 m asl has a relatively older settlement history. It is a sub-humid climate zone that receives adequate rainfall year round and is more sufficient in agricultural production. As part of the White Highlands, both areas were largely initiated through the government operation of reallocation of formerly European-occupied White Highlands through government settlement scheme such as Watuka in the 1960s.

From a historical perspective, the study area has witnessed various forms of land management

and transition over time. The historical events described earlier of land alienation during the colonial era which resulted in the White Highlands to the historical development after independence of Kenya were witnessed at the research sites. The initial settlement of Africans in the area started immediately after independence in 1963. The period was followed by considerably more immigrations from original birth places (high potential areas of Tetu and Othaya in the former Nyeri District) by initial settlers' families from 1970's to early 1980's. This reflects a state after a recent migration where families are spatially extended. One or two family members migrate with the aim of developing the plot and/or wait for better times before calling their children and others. This period also witnessed further land subdivision from father to his sons. In the recent past (the late 1980's to date), the study area has experienced a new form of land transition. This is a stage whereby the land has been further subdivided into smaller plots. When the given portion of land is not enough, some of the household members may emigrate thereby extending the households spatially.

From the foregoing, the justification of the study sites as suitable test bed for examining dynamism of smallholder livelihoods under changing economic conditions and agro-ecologic events becomes increasingly explicit.

3.2) Data collection: Household and Field Surveys

Judicious mix of a qualitative component addressing the social and institutional context of people's lives and a quantitative component addressing assets, activities, incomes as well as vulnerability aspects at household level was used during the research. Case studies were fielded out at four stages February – March and August – September in 2007 and 2008. A census survey for the two sites was not possible and, therefore, a selection of 20 households¹² from each study site was done and questionnaire surveys administered (N=40). The selection of the households to be interviewed was based on land register map¹³ of the area with the assistance of local village leaders. The map indicates original subdivision of land and size of land holdings by households. Purposive judgement was employed in determining which households to interview. From each site a section was selected having households with both large and small landholdings in order to facilitate comparative analysis approach and socio-economic stratification of the households. These were a cluster of mutually neighbouring households adjacent to the forest reserves (those within the third line of households from the forest reserve boundary). The rationale behind the choice of households to interview stems from the research focus on crisis-coping sub-theme. It is hypothesized that, faced with collapse of production system especially during drought, poor people will tend to rely more heavily on forest resources such as indigenous fruits or collection of firewood and charcoal burning for commercial

12. A household is defined as spatially distinct residence unit consisting of a person or a group of persons who live, farm, and eat their meals together in the same compound/homestead but not necessarily in the same dwelling unit, have common housekeeping arrangements and are answerable to the same household head whom they all acknowledge as their head, includes both present and absent members such as school attending, remitting and/or self-supporting children excluding those married away or with their own households.

13 From government records at Nyeri District Department of Survey.

purposes than in ordinary times. Further, the approach used allowed to gather more time-series in-depth information. The non-probabilistic sampling procedure meant that statistical inferences could not be made to some predetermined population. Data collection was done using a range of techniques to generate a wide variety of information on each of the three themes in the triad of Livelihood-Crisis-Network nexus. The household-level questionnaire was designed to provide information on the socio-economic aspects of the households in order to assess average livelihood components and strategies through an estimation of annual net total income. Data on the crisis-coping element was acquired through information gathering on crisis events objectively and longitudinally using the case of crop variety and livestock breed selection. Finally, collection of information on the mediating role of social network and community associational life in exchange and sharing of information and knowledge on seed varieties and agricultural production technologies by the smallholder farmers as well as history and migration process of the households was carried out. A variety of key informant interviews were conducted with village leaders, older people and Government staff as part of information gathering on general issues such as migration and settlement history and process, agro-ecological events among others.

3.3) Data sources

Data for this study were derived from two main sources, primary and secondary. The main techniques which were used to collect primary data include; (a) observation by the researcher recorded by use of a camera, field notebook, among others, (b) personal or informal interviews with various key personalities in the study area on matters related to the study, and (c) recording schedules or questionnaires. As in the second, these were in form of discussion of topics related to the study whereby short notes were taken when necessary. The relevant secondary data sources for this study entailed: published and unpublished works on studies previously done on the topic; government statistics and publications such as Population Census Reports, Statistical Abstracts, Development Plans, Economic Surveys, Maps, Districts Socio-Cultural Profile Reports, among others.

4. Preliminary findings

4.1) Highlights of socio-economic characteristics of the selected households

The most salient average socio-economic characteristics of the research sites referring to all members and heads of the selected households are presented in Table 2. These are in form of frequencies, mean values and percentages. On average, the mean values of age of the household head, household size and adult equivalent units (AEU) indicate that Kabendera households are older, have larger family size and active labour force. Similarly, they are more endowed with assets (land and livestock) in per capita terms. The adoption of livelihood strategies changes over time and is determined by the family life-cycle stage of the household which is related to the age of the household

head (Owuor, 2005). The household heads in both sites are within the active age cohort of 40 – 59 years with Kabendera having a mean of 52.5 while Kiambogo has 48.3. Official retirement age from the civil service in Kenya is 50 years. Further examination of the mean values of age and estimate value of the main house shows that houses in Kabendera are older (11.5 years) and of higher value (215.6 per 000 Kshs) compared to Kiambogo (9.4 years and 178.2 per 000 Kshs) respectively. This finding concurs with that of age of household heads but contrasts the settlements' history. It is expected that, Kiambogo being historically older than Kabendera should constitute older households which is not the case. This anomaly can be explained by the different system of land management, transition, and inheritance over time whereby most household heads in Kiambogo are heirs (sons) of the initial settlers unlike Kabendera household heads who bought their land.

Located in a semi-arid area, Kabendera households have more livestock value per capita, (Kshs 15,170.9) than those in Kiambogo (Kshs 11,104.5). This can be attributed to the drier condition of Kabendera - a part of the people's strategy to cope with the climatic hardships. On the other hand, Kiambogo farms more area per capita (0.8 acres) and its agricultural sector contribution to annual net income is considerably greater than that of Kabendera (0.5 acres) as a result of reliable rainfall throughout the year owing to its ecological setting.

In terms of housing conditions and amenities for both of the sites, the dominant roofing, wall, and floor materials are corrugated iron sheets, wooden, and earth respectively. Use of firewood, charcoal, and paraffin as cooking, heating and lighting fuel is prevalent in that order. Kabendera residents rely more on river/stream (50%) as source of water while their counterparts in Kiambogo depend on borehole (45%).

4.2) Household livelihood components

In this study, both realized annual net total income estimate and asset-based approaches are used in analyzing household livelihood strategies. I define annual net total income as gross production less all total variable costs including hired labour, farm implements, fertilizer, seeds, pesticides etc. Thus, the total annual net income (covering one year period prior to the survey i.e. August and September, 2007) is calculated by subtracting monetary costs (household labour excluded due to difficulties of accurate measurement) from the value of total production, which is evaluated on average market prices of the relevant products for each site (see Ueda, 2007 for similar approach).

The production aspect of the household economy is classified into 5 sectors (Table 3). The agricultural sector comprise of all crops cultivated in the two sites. The livestock component includes rearing of cattle (cow, sheep and goat) and poultry. Non-farm activities comprise of self-employment in small-scale commerce (shop, posho¹⁴ mill, transport services, alcohol brewing), remittances, and formal salaried employment. Off-farm activities include income from temporary and casual

¹⁴ Maize flour used as an ingredient to make a popular meal referred to as 'Ugali' in East Africa.

agricultural work on others' land as well as income from *exsitu* (remote land owned by the household). Lastly is the forest products extraction sector which refers to income derived from firewood and timber poles used by the household.

The percentage composition of annual net income by sector indicates Kiambogo leading in agricultural, forest products extraction as well as non-farm activities while Kabendera is highly depended on non-farm activities, agricultural, and forest products extraction in that order. The observable differences are explained as follows. First, ecological and/or altitude differences have strong explanatory power of the variation in agricultural production aspect of the two sites. Second, the accessibility and/or nearness to the tarmac road and market-trading and shopping centers expose Kabendera to more opportunities for non-farm activities. In addition, as a newly opened settlement Kabendera comprises of new migrants from high potential areas of Central Kenya who have not cut their close ties with their relatives and the household heads engagement in formal employment are relatively higher than in Kiambogo. Third, fencing of adjacent Aberdare forest in Kiambogo can safely be associated with better reporting of its products extraction by the informants compared to the free access (no fence) of South Laikipia forest adjacent to Kabendera. These factors are expected to impinge on crisis-coping experiences and responses both at the settlement and household levels.

Daily net income per capita reveals Kiambogo to be more productive. The mean per capita daily income distribution for interviewed households in Kabendera is lower (Kshs 59.6) than in Kiambogo (Kshs 75.0) and Kenya's absolute poverty line¹⁵. But, Brown *et al.*, (2006) cautions against strict geographic determinism when making inferences about income differentials. It is obvious, that there exists a significant dispersion of household income within and between the two sites. A geographical breakdown of the data is deemed necessary when examining areal differentiation of smallholder livelihoods and this article supports Ueda, 2007 view that such differentiation should be substantiated and confirmed at household level. Thus, this study seeks to identify distinct livelihood strategies pursued by the smallholders and disaggregates the household level data among such livelihoods.

¹⁵ The absolute poverty line is the minimum amount of money necessary to afford an adult equivalent their basic minimum food and non-food requirements (Less than 1 US \$ a day). The exchange rate was Kshs. 66 per 1 US \$ in August and September 2007.

Table 2: Selected Household Characteristics, August and September 2007 (Mean Values)

Village	Kabendera	Kiambogo	Total
Number of the selected households	20	20	40
Age of the household head (years)	52.5	48.3	50.4
Number of years in education: household head	8.1	7.8	7.9
Household size	8.1	6.2	7.1
AEU (adult equivalent units)*	6.2	4.5	5.3
Land			
Land owned (acre)	9.6	7.3	8.4
Area farmed (acre)	3.3	3.9	3.6
Land owned per capita (acre)	1.5	1.4	1.4
Area farmed per capita (acre)	0.5	0.8	0.7
Livestock			
Livestock value (Kshs)	94,665.0	62,691.5	78,678.3
Livestock value per capita (Kshs)	15,170.9	11,104.5	13,137.7
Housing Amenities			
Age of the house	11.5	9.4	10.5
Estimated value of house	215,625.0	178,230.8	198,862.1
Number of dwelling units	2.2	1.7	1.9
Habitable rooms in main house	3.4	3.1	3.3
Wooden wall %	85	95	90
Corrugated iron sheet roof %	100	100	100
Earth floor %	75	75	75
Energy/fuel			
Firewood as cooking fuel %	100	100	100
Charcoal as heating fuel %	65	70	67.5
Paraffin as lighting fuel %	75	60	67.5
Source of Water %	River/stream-50%	Borehole-45%	NA
Source: August and September, 2007 Survey			
*AEU: Youth (aged between 12 and 16) counted as 2/3 of adult. Those aged below 12 are excluded. Adopted from Ueda, (2007).			

Table 3: Annual Net Income Estimation 2006/2007 (Mean Values for the Selected Household)

Village	Kabendera	Kiambogo	Total
Number of selected households	20	20	40
[Kshs]¹			
Agricultural	26,596.7	56,547.1	41,571.9
Livestock	35,805.4	26,299.7	31,052.5
Non-farm activities	66,510.0	14,250.0	40,380.0
Off-farm activities	6,175.0	16,545.0	11,360.0
Forest products extraction	14,934.0	31,316.4	23,125.2
Total	150,021.1	144,958.2	147,489.6
Net income per capita ²	21,769.5	27,359.1	24,564.3
Net income per capita/day	59.6	75.0	67.3
Share of subsistence consumption to net total income	23.4%	20.1%	21.8%
Source: August and September, 2007 Survey			
¹ The exchange rate was Kshs: 66=US\$ 1.00 in August 2007			
² Includes both present and absent members such as school attending, remitting, and self-supporting children excluding those married away or with their own households.			

4.3) Household crisis-coping experiences and responses

An attempt was made to empirically operationalize the notion of smallholders' vulnerability to shocks at household level by investigating crisis-coping experiences longitudinally (Table 4 and Figure 5). A characterization of the two research sites in terms of crises and resultant responses typology is summarized in Table 4. Generalized crises, i.e. climatically triggered shocks (drought and severe water shortage) rank higher in both sites, with altitude differences contributing to Kabendera vulnerability compared to Kiambogo. Structural adjustment and price related shocks are reported

more in Kiambogo. This is expected owing to the more market-oriented production system of Kiambogo (mainly horticulture) which makes it prone to effects of price shocks. The finding buttresses variation observed in percentage share of subsistence consumption to net total income (Table 3). For household specific shocks, illness and/or death of household member and family disputes rank higher in Kabendera and Kiambogo respectively. In terms of crisis-coping responses, use of savings (livestock and food reserves) was reported more in both sites. A glance at site differences reinforces the claim that Kiambogo is self-sufficient and hence its use of savings and/or reserves ranks higher than that of Kabendera households. On the other hand, Kabendera households' reliance on social networks and market mechanism more than their Kiambogo counterparts is attributed to its young history and hence tendency to maintain close ties with original birth places and close proximity to market-trading centers and main tarmac road. Further, the number of opportunities available as a coping strategy is more for Kiambogo than Kabendera where institutional support was sought for by Kabendera than Kiambogo households.

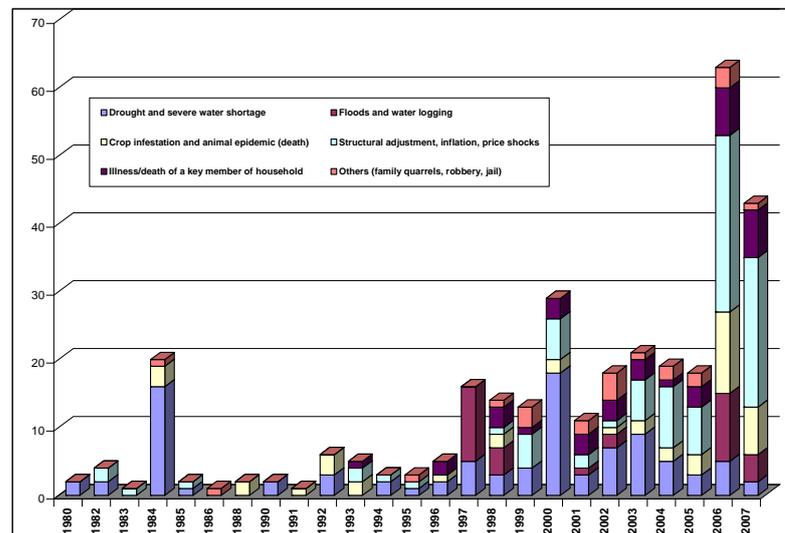
Table 4: Typology of shocks and responses experienced in Kabendera and Kiambogo 1980-2007

Village	Kabendera	Kiambogo	Total
Number of selected households	20	20	40
Covariate shocks			
1. Drought and severe water shortage	51 (46.4%)	44 (30.1%)	95 (36.1%)
2. Floods and water logging	11 (10.0%)	21 (14.4%)	32 (12.2%)
3. Crop infestation and animal epidemic (death)	24 (21.8%)	19 (13.0%)	43 (16.3%)
4. Structural adjustment, inflation, price shocks 1	24 (21.8%)	62 (42.5%)	93 (35.4%)
Total	110 (100%)	146 (100%)	263(100%)
Household-specific shocks			
Illness/death of a key member of household	27 (62.8%)	10 (40%)	37 (60.6%)
Others (family quarrels, robbery, jail)	14 (32.6%)	15 (60%)	22 (36.1%)
Missing (Non-response)	2 (4.6%)	0 (0%)	2 (3.3%)
Total	43 (100%)	25 (100%)	61(100%)
Responses (Coping Mechanism)			
1. Use of savings, livestock and food reserves 2	81 (29.4%)	113 (36.8%)	194 (33.3%)
2. Engage in diverse opportunities 3	53 (19.3%)	77 (25.1%)	130 (22.3%)
3. Social networks 4	59 (21.4%)	34 (11.1%)	93 (16%)
4. Institutional support 5	30 (10.9%)	11 (3.6%)	41 (7%)
5. Change of eating habits 6	30 (10.9%)	62 (20.2%)	92 (15.8%)
6. Reliance on market mechanism 7	19 (6.9%)	5 (1.6%)	24 (4.1%)
7. Did nothing	1 (0.4%)	5 (1.6%)	6 (1%)
8. Missing (No response)	2 (0.7%)	0 (0%)	2 (0.3%)
Total response	275 (100%)	307 (100%)	582 (99.8%)
Share of subsistence consumption to net total income	23,4%	20,1%	21,8%
Source: August and September, 2007 Survey			
1. Large fall in sale prices of crops, large rise in prices of food and agricultural inputs prices			
2. Spent cash savings, sold farmland, animals, or crops			
3. Worked for long hours, more household members went to work, charcoal burning, income generating activity			
4. Received help from family/relatives or neighbour			
5. Received help from government, non governmental organisation, welfare association, religious group			
6. Reduced food consumption, consumed lower cost but less preferred food			
7. Purchased food from the market/shops			
† The term crisis and/or shock is used to mean a turning point, a critical moment, or an impending change for the worse in an indecisive state, whereas 'coping mechanisms' are seen as resultant responses rather than as part of a broader strategy for diversifying incomes (see Mortimore, et al., 2001: 50)			
NB: Respondents were asked about crisis experiences and responses in an open-ended question, which permitted them to provide multiple answers			

In order to detect trends and patterns in households' exposure to crises over time, the data are disaggregated annually (Figure 5). The household level data on crisis experiences validate Kenya's national statistics (Figures 2, 3 and 4) that a severe drought was experienced in the research sites in the year 2000 and more recently (starting 2007) witnessed local expressions of global price hike in

food and crude oil, inflation trends and resultant price related crisis. These two events have had negative local-level impacts in the study area and will be used here to illustrate coping and adaptive capacity of smallholder farmers using the case of crop and livestock selection/de-selection.

Figure 5: Household Chronology of Vulnerability: Crisis and Shock Experiences



4.4) Identification of smallholder farmers' crop variety and livestock breed selection

The 40-household survey identified seven crops, two types of livestock, and seventy three crop varieties and livestock breeds having being introduced into farmers field plots since settling in the area. Table 5 shows the number of crop and livestock selection and de-selection episodes with percentage in brackets. The observable site differences can be attributed to local agro-ecological condition of the two sites whereby Kabendera's variable semi-arid dryland to semi-humid climatic condition is suitable for growing beans, maize, onion, and wheat while the sub-humid condition in Kiambogo with adequate year round is favorable for horticultural crops such as cabbage and carrot. A higher frequency of selection and de-selection can be an evidence of a greater degree of being affected by climatic changes.

There is a multiplicity of selection and de-selection criteria upon which smallholders base their decisions. An agglomeration of these factors for the 40-households is shown in figure 6. Economic rationality is the most influential consideration in decision-making as evidenced by factors such as high yield, fast maturity, size (of grains or tubers) and market opportunity. This is followed by geographical consideration of factors such as micro-climate adaptation and drought tolerance. Socio-cultural influence of taste, nutrition and preference in addition to inheritance is also highly regarded. Of less importance in decision-making are agronomic factors of crop and livestock characteristics, perishability and durability, pests and disease resistant and fat content of milk for instance.

On the other hand figure 7 shows determinants of smallholders' crop de-selection criteria. Similarly it is revealed that crop de-selection criteria are economically justified. The number of

economic factors influencing crop de-selection is not only more but also their frequency. These are followed by geographical and agronomical factors of consideration in that order.

Table 5: Crop and Livestock Selection and de-Selection Episodes in Percent (Brackets)

Selection	Kabendera	Kiambogo	Total
Maize	61 (59.2)	42 (40.8)	103 (100)
Potato	54 (50.5)	53 (49.5)	107 (100)
Beans	64 (71.1)	26 (28.9)	90 (100)
Cabbage	1 (16.7)	5 (83.3)	6 (100)
Carrot	1 (20.0)	4 (80.0)	5 (100)
Onion	35 (61.4)	22 (38.6)	57 (100)
Wheat	17 (100)	0 (0)	17 (100)
Cow	26 (51.0)	25 (49.0)	51 (100)
Sheep	5 (41.7)	7 (58.3)	12 (100)
Grand Total	264 (58.9)	184 (41.1)	448 (100)
De-Selection			
Maize	27 (75.0)	9 (25.0)	36 (100)
Potato	15 (36.6)	26 (63.4)	41 (100)
Beans	18 (90.0)	2 (10.0)	20 (100)
Cabbage	1 (100)	0 (0)	1 (100)
Carrot	0	0	0
Onion	12 (75.0)	4 (25)	16 (100)
Wheat	2 (100)	0	2 (100)
Cow	9 (75.0)	3 (25.0)	12 (100)
Sheep	1 (50.0)	1 (50.0)	2 (100)
Grand Total	85 (65.4)	45 (34.6)	130 (100)

Source: Fieldwork Survey 2007 and 2008

Figure 6: Determinants of Farmers Crop Selection

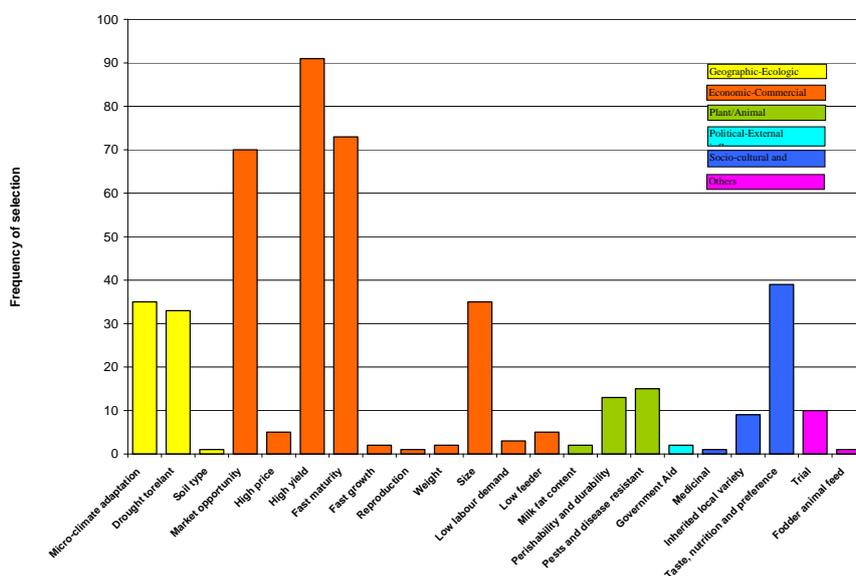
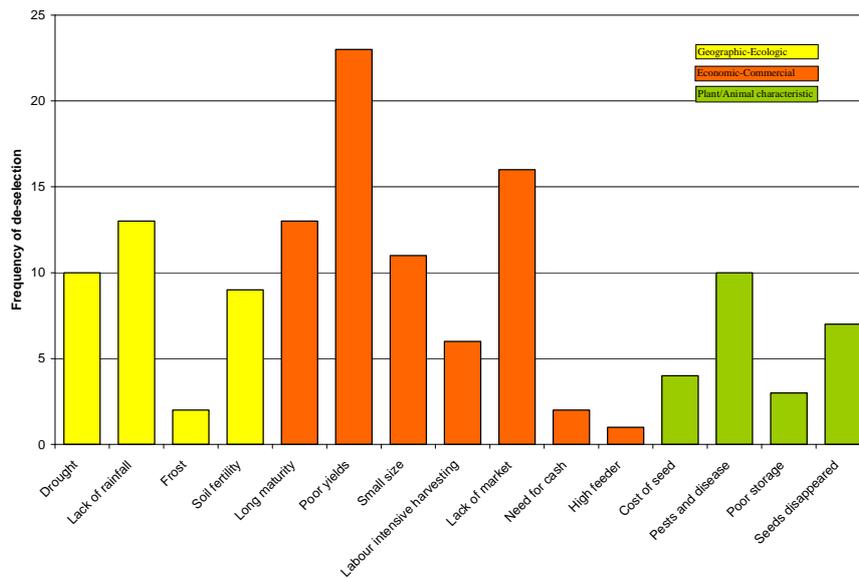


Figure 7: Determinants of Farmers Crop De-selection



The originality and innovative aspect of this study emanates from its historical depth of data collection by taking a longitudinal time series perspective in identifying patterns of crop variety and livestock breed selection and de-selection into farmer's land. It is therefore, prudent, to examine and interpret the smallholder farmers decision-making in crop selection criteria within the context of the two external driving forces of economic changes and environmental (agro-ecologic) events.

To achieve this aim, reference is made of Kenya's neo-liberal structural adjustment policies, recent annual inflation trends and (resultant) price hike in food and crude oil (Figure 2), precipitation data (Figure 3) as well as food aid shipment to Kenya (Figure 4) in order to situate farmers' decision-making within these changing situations. In addition, the risk exposure (Figure 5) is examined vis a vis the general trends on economic changes and environmental events to interpret decision-making in crop and livestock selection/de-selection. Table 6 shows that the 2000 drought was responded to positively by selection of more crops and livestock than de-selection. Inspection of within crop differences shows that selection of food crops such as maize, potato and beans depends on vagaries of climate as well as taste, nutrition and preference. In contrast, selection of market-oriented crops such as onion and cow for milk produce is determined by economic factors e.g. market opportunity, high yield, and fast maturity.

Similarly, the more recent price related crisis period 2006 to 2008 was responded to positively (Table 7). The period is outstanding in selection of market oriented crops such as onion, cabbage, carrot and to some extent maize and potato with economic rationality being influential factor in decision-making, including market opportunity and fast maturity and high yields for instance. Price and money related factors such as cost of seed, labour demand, lack of market, need for cash have been cited among other criteria used for crop de-selection.

Table 6: Crop and Livestock Selection as a Response to 2000 Drought

Year	Selection	Beans	Cabbage	Carrot	Cow	Maize	Onion	Potato	Sheep	Wheat	Grand Total
2000	Climate adaptation	0	0	0	0	4	0	0	0	0	4
	Fast maturity	1	0	0	0	0	2	1	0	1	5
	High yield	0	0	0	3	2	0	1	0	0	6
	Market opportunity	0	0	0	0	1	2	1	0	0	4
	Pests and disease resistant	0	0	0	1	1	0	0	0	0	2
	Size	1	0	0	1	0	0	1	1	0	4
	Taste, nutrition and preference	2	0	0	0	0	0	2	0	0	4
Total		4	0	0	5	8	4	6	1	1	29
2000	De-selection										
	Lack of market	0	0	0	0	1	1	0	0	0	2
	Lack of rainfall	1	0	0	0	1	0	1	0	0	3
	Long maturity	0	0	0	0	1	1	0	0	0	2
	Pests and disease	0	0	0	0	0	1	0	0	0	1
	Poor yields	0	0	0	0	0	1	0	0	0	1
	Small size	0	0	0	0	0	0	1	0	0	1
Soil quality	0	0	0	0	0	0	1	0	0	1	
Total		1	0	0	0	3	4	3	0	0	11

Source: Fieldwork Survey 2007 and 2008

Table 7: Crop and Livestock Selection as a Response to 2006-2008 Price shocks

Year	Selection	Beans	Cabbage	Carrot	Cow	Maize	Onion	Potato	Sheep	Wheat	Grand Total
2006-08	Climate adaptation	2	0	0	1	3	0	0	0	0	6
	Drought torelant	0	0	0	1	1	0	0	0	0	2
	Fast maturity	2	0	0	0	7	0	6	0	0	15
	High price	0	0	0	0	0	2	0	0	0	2
	High yield	2	0	1	5	1	0	2	0	1	12
	Inherited local variety	0	0	0	0	0	0	1	0	0	1
	Market opportunity	0	3	1	0	1	17	1	0	0	23
	Size	0	0	0	0	2	1	1	1	0	5
	Taste, nutrition and preference	0	0	0	0	2	0	0	0	0	2
	Trial	1	0	0	0	0	0	0	0	0	1
Total		7	3	2	7	17	20	11	1	1	69
2006-08	De-selection										
	Cost of seed	0	0	0	0	2	0	0	0	0	2
	Labour intensive harvesting	1	0	0	0	0	0	0	0	0	1
	Lack of market	0	0	0	0	0	0	1	0	0	1
	Lack of rainfall	1	0	0	0	2	0	1	0	1	5
	Long maturity	1	0	0	0	0	0	0	0	0	1
	Need for cash	0	0	0	1	0	0	0	0	0	1
	Pests and disease	0	0	0	1	0	0	0	0	0	1
	Poor storage	0	0	0	0	0	0	2	0	0	2
	Poor yields	1	0	0	2	1	0	2	0	0	6
Seeds disappeared	0	0	0	0	0	0	1	0	0	1	
Small size	0	0	0	0	2	0	1	1	0	4	
Total		4	0	0	4	7	0	8	1	1	25

Source: Fieldwork Survey 2007 and 2008

4.5) Livelihood strategies, socio-economic stratification, and crisis-coping

Annual income estimation by sector and socio-economic stratification of the selected households is prudent in examining the relationship between livelihood strategies and crisis-coping experiences and responses in the research sites. A direct examination of the individual household's asset endowment complements annual income estimates especially in alleviating the problem of mismatch in time span since crisis/shock may be experienced over a period of time not coinciding with the annual income estimation period. Land ownership and livestock value are used to achieve this aim.

The 40 households are classified into distinct groups based on per capita values of three indicators of socio-economic status differentiation: annual net income flow, land size, and livestock

value (Table 8). In addition, average age of household head is calculated for the respective household cluster membership. An examination at the stratification of Table 8 reveals a clear relationship between annual net income flow and asset ownership in spite of different time frame. The mean land size for combined livestock and annual total net income cluster member households of the upper and upper lower strata is thrice (12.45 acres) that of lower and lower upper strata (4.4 acres). Interestingly, the average age of household head is higher (51.4 years) for the same cluster membership of higher strata compared to the lowly stratified households (48.6 years). This enhances the earlier postulation that the family life-cycle stage of a household related to the age of the household head determines adoption of a particular livelihood strategy.

A diagonal glance at the stratification presented in lower section of Table 8 shows equal distribution of household cluster membership. When the data are geographically disaggregated, it is realized that Kiambugo's household cluster membership in high strata exceeds that of Kabendera.

Table 8: Classification of annual net income and asset relationship in Kabendera and Kiambugo 2006/2007

Livestock strata** (Kshs)	Quartile					Total
	IV	III	II	I		
IV	5	3	2		10	15 hhds
III	4	3	1	2	10	
Annual net income strata* both sites (Kshs)						Vs
II	1	3	3	3	10	
I		1	4	5	10	15 hhds
Total	10	10	10	10	40	
Mean land size both sites (Acres)						12.45 acres
IV	16.1	16.3	7.3		14.4	
III	12.1	5.3	4.0	2.5	7.4	Vs
II	18.0	10.4	3.7	5.6	7.7	
I		4.5	3.6	4.7	4.2	4.4 acres
Total	14.7	10.1	4.4	4.5	8.4	
Average age of household head (Years)						51.4 years
IV	54.6	55.7	47.0		53.4	
III	50.3	45.0	51.0	41.5	47.0	Vs
II	54.0	53.3	49.7	42.3	49.0	
I		63.0	55.0	47.6	52.1	48.6 years
Total	52.8	52.5	51.4	44.8	50.4	
Kiambugo						
IV	3	2	1		6	
III	1	3		2	6	
II		2	1	2	5	
I			2	1	3	
Total	4	7	4	5	20	
Kabendera						
IV	2	1	1		4	
III	3		1		4	
II	1	1	2	1	5	
I		1	2	4	7	
Total	6	3	6	5	20	

Source: August and September, 2007 Survey

*Net income strata by quartiles (per capita): Kshs.
 IV: 34,012.75<income
 III: 18,356.03<income<=34,012.75
 II: 8,263.06<income<=18,356.03
 I: income <=8,263.06

**Livestock strata by quartiles (per capita): Kshs
 IV: 18,739.38<income
 III: 7,350.83 <income<=18,739.38
 II: 3,618.75<income<=7,350.83
 I: stock<=3,618.75

This paper employs cluster analysis techniques to operationalize the concept of livelihood strategies using household level data and shows how households choose and combine options across the five different sectors of activities identified in earlier section of this paper. In particular, the 40 households are partitioned into statistically distinct groups with reference to the sectoral composition

(in percentage) of their annual net total incomes¹⁶. Two considerations were made in choosing the number of clusters; first is the examination of fusion coefficient aimed at tolerating the information loss, and second is the distribution tendency of the 40 households in the resultant groups (clusters). Thus, four distinct livelihood strategy clusters were chosen. The sectoral composition in percentage of each activity constituting the annual net total income is presented in Table 9 (Part A). The mean values for each shock/crisis and response by households in each livelihood strategy cluster are summarized in Part B of Table 9, while part C contains a cross-tabulation of cluster membership by site and income. Other variables examined include average age of the household head, share of subsistence consumption to annual net total income, daily per capita income, land size per capita and livestock value (owned stock) per capita.

Interestingly, all the four livelihood strategy clusters comparatively employ one sector/activity with percentage contribution to annual net total income being above average except for Cluster 3. Cluster 1 is characterized by reliance on forest product extraction, while Cluster 2 employs non-farm activities as their dominant activity. Livestock contributes the most towards annual net total income for Cluster 3 while agriculture is the main activity for Cluster 4. Drought and severe water shortage has been experienced more by those households who have high dependence on non-farm activities (Cluster 2) followed by forest product extractors comprising Cluster 1. As expected, flooding and water logging has been reported as a major crisis by agriculturally based Cluster 4. Similarly, this group is most susceptible to price related shocks. The fact that crop infestation and animal epidemic is not a significant shock to forest depended households is understandable but, the reason why it is ranked highly by those relying on non-farm activities is not easy to decipher. There is no clear relationship between these dominant activities pursued by respective cluster members and the more household specific shocks such as illness/death of a family member or even family quarrels and disputes. When faced with the shocks, Table 9 part B shows that, the use of savings, livestock and food reserves is an immediate response by cluster 4 members who depend on agriculture as a dominant activity followed by non-farm activities of Cluster 2. The number of opportunities available as a coping strategy is likewise associated with the agricultural households. Social networks and institutional support is relied upon by Cluster 1 members who are forest dependent and the poorest in terms of daily per capita income. The clusters' share of subsistence consumption to net total income is the highest among the four clusters and is seemingly having the oldest family cycle.

Armed with this general view regarding the dominant activity employed, I now turn to the character of the constituent livelihood strategy clusters. The first strategy (Cluster 1) is employed by 9 (22.5%) of the households; 4 from Kabendera and 5 from Kiambogo. The Kabendera households belong to the lowest income strata and are responsible for the clusters' position as the poorest. Agriculture is the second contributing sector towards the annual net income which explains why the

¹⁶ The SPSS was used to perform the cluster analysis (standardized data, square Euclidean measure, and Ward's method).

livelihood of the cluster is affected by drought and severe water shortage. Cluster 2 is characterized by non-farm activities followed by agriculture. It is prone to drought, price shocks, and crop infestation. In response to these shocks, the cluster members depend on savings, have many opportunities to cope and depend on social networks. Overall, the cluster ranks top on its reliance to market mechanism.

Table 9: Classification of Livelihood Strategies in Kabendera and Kiambogo, 2006/2007

Part A: Clustering activities		Cluster average (%)				Total Average
		1	2	3	4	
Agriculture		21.7%	17.9%	20.9%	60.8%	31.5%
Livestock		9.6%	4.9%	36.2%	8.6%	17.1%
Non-farm activities		9.4%	69.2%	18.2%	9.2%	22.7%
Farm activities		8.9%	0.6%	13.6%	1.2%	6.8%
Forest product extraction		50.4%	7.5%	11.2%	20.2%	21.9%
Total		100.0%	100.0%	100.0%	100.0%	100.0%
Part B: Livelihood-Crisis-Coping Nexus						
Shock/Crisis Experience (mean values)						
Drought and severe water shortage		2.6	3.3	2.0	2.1	2.4
Floods and water logging		0.9	0.3	0.5	1.4	0.8
Crop infestation and animal epidemic (death)		0.7	1.3	1.2	1.2	1.1
Structural adjustment, inflation, price shocks		1.2	1.7	2.1	3.3	2.2
Illness/death of a key member of household		1.2	1.0	0.8	0.8	0.9
Others (family quarrels, robbery, jail)		0.8	0.7	0.6	0.8	0.7
Missing (No-response)		0.0	0.0	0.1	0.1	0.1
Total		7.3	8.3	7.2	9.6	8.1
Responses (mean values)						
Use of savings, livestock and food reserves		4.2	5.3	4.2	5.8	4.9
Engage in diverse opportunities		2.1	2.9	3.2	4.5	3.3
Social networks		2.9	2.6	1.5	2.6	2.3
Institutional support		1.4	1.4	0.7	0.8	1.0
Change of eating habits		1.6	1.4	2.8	2.9	2.3
Reliance on market mechanism		0.4	1.3	0.1	0.9	0.6
Did nothing		0.1	0.0	0.2	0.3	0.2
Missing (No-response)		0.0	0.0	0.1	0.1	0.1
Total		12.8	14.9	12.8	17.9	14.6
Part C: Cross-Tabulation						
[Number of households]						
Village	Income strata*	Cluster				Total
		1	2	3	4	
Kiambogo	IV	1		2	3	6
	III	2		2	2	6
	II		1	3	1	5
	I	1		1	1	3
Kabendera	IV	1	2	1		4
	III		2	2		4
	II		1	2	2	5
	I	4	1		2	7
Total number of households (% in brackets)		9 (22.5%)	7 (17.5%)	13 (32.5%)	11 (27.5%)	40 (100%)
Other variables						
Average Age of the household head (years)		54.8	45.7	52.6	47.1	50.4
Share of subsistence consumption to net total income (%)		29.2%	22.9%	20.8%	16.2%	21.8%
Daily per capita income (Kshs)		53.6	77.7	71.2	67.2	67.3
Land size per capita (acres)		1.7	0.8	2.0	0.9	1.4
Livestock value per capita (Kshs)		10,299.92	15,465.41	18,497.14	7,644.51	13,137.74
Source: August and September, 2007 Survey						
*Net income strata by quartiles (per capita): Kshs.						
IV: 34,012.75<income						
III: 18,356.03<income<=34,012.75						
II: 8,263.06<income<=18,356.03						
I: income <=8,263.06						

It is not surprising that it is the most affluent in terms of daily per capita income and comprises of younger households drawn from Kabendera (but not Kiambogo) and belonging to high income strata. However it is the least endowed with land resource. There is no wide variation in contribution of Cluster 3 sectors of activities to annual total net income. Its dominating activity i.e. livestock is

substantiated by large land size ownership and livestock value per capita figures. It comprises of the largest number of household membership 13 (32%) of which 8 are from Kiambogo and 5 from Kabendera. Distribution of these households along the income strata is even. Price related shocks and drought have affected these households who as a result respond by use of savings, diversity of coping opportunities as well as change of eating habits. It is rated second in terms of wealth and family-life cycle in both sites.

Finally is Cluster 4 with agriculture being its dominant contributor to annual total net income followed by forest product extraction. Price related shocks and climatically triggered shocks such as drought and flooding/water logging are major concerns for the households belonging to this cluster. Use of savings, availability of a wide range of coping opportunities and change of eating habits are among the responses employed in times of crisis by the households. The clusters' share of subsistence consumption to net total income as well as livestock per capita value is the lowest. The daily per capita income of this group is almost equal to the less than 1 US\$ a day poverty line as previously noted.

Conclusion and Future direction

The preliminary findings presented in this paper demonstrate that livelihood-crisis coping nexus is a function of factors and processes that interact at a given place and time to determine patterns of coping and risk exposure. The results from the 40 selected households in central Kenya suggest that areal differences evident in livelihood strategies and crisis-coping experiences and responses are attributable to settlement history, geographical/ecological gradient differences, different positions in regional system, and effects of economic liberalization. The study argues for place-based analysis at both household-level and regional-levels in enhancing understanding of location-specific context of the human-environment system interaction in which rural livelihoods of smallholders in Kenya take place. Even though the study is limited to local scope, the results presented in this paper should facilitate and inform targeting of interventions designed to improve household livelihoods double-exposed to effects of economic and ecologic changes. Further data analysis, interpretation and generalization are required in order to draw firm conclusion(s) of the research.

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