OPTIONS IN CLIMATE CHANGE ADAPTATION, RESILIENCE AND MITIGATION: EVIDENCE FROM ZAMBIA'S RURAL-RURAL MIGRATION

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Declaration

I declare that this thesis is entirely my own work, and except where otherwise stated, describes my own research.



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ABSTRACT

Least understood in human migration theory is the extent to which gradual and long-term environmental changes interact with other factors to trigger rural-rural movements. Research has tended to focus on rural-urban and cross-border movements based either on sudden environmental change drivers or economic differentials. Based on multi-disciplinary methods, and using climate, land cover, soil and/or land degradation as indicators of gradual and long-term environmental change, this research examines the extent to which these factors interact with other drivers of migration to trigger rural-rural movements in Zambia. Socio-economic attributes at household level including ways by which people recognise and respond to changes and/or variabilities are examined to measure vulnerability to environmental change and adaptive capacity potential. Results from social survey data suggest high vulnerability with low adaptive potential. However, vulnerability varies according to gender, migration status and area. Similarly, evidence from secondary environmental data for the 36-year period 1980 to 2016 shows that there are changes in all the environmental factors examined, although the magnitude of change varies between areas studied. Anthropogenic factors which appear to be the main cause of the observed changes also vary between areas. Findings show that gradual and long-term changes in environmental conditions can trigger rural-rural migration as these conditions were ranked highest in people's perception of risk. It is thus concluded that gradual and long-term environmental factors contribute to rural-rural migration to a larger extent than economic or social factors. Furthermore, environmental factors also contribute to the spatial scales of rural-rural migration. However, while this type of migration is shown to be a working strategy as an adaptive response to environmental change, it is arguably a maladaptive response. With climatic patterns currently dynamic, there is little or no certainty in the economic benefits that may materialise from these movements. With a lack of evidence-based policy responses in governance, compounded by slow but long-term changes in ecological systems, multidimensional poverty is likely to jeopardize further the livelihood prospects of the rural poor, regardless of migration status, gender and location.

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LIST OF ABBREVIATIONS

7NDP	Seventh National Development Plan
AEZ	Agro-ecological Zone, same as Agro-ecological Region
AIFS	African Improved Farmer Scheme
BSA	British South African Company of Cecil Rhodes
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CF	Commercial Farms
CIDA	Swedish International Development Agency
CIF	Climate Investment Fund
CL	Crown land
CMIP3	Coupled Model Inter-comparison Project III (World Climate Research Programme)
CMIP5	Coupled Model Inter-comparison Project V (World Climate Research Programme)
COMACO	Community Markets for Conservation
COP	Conference of Parties
CRLM	Climate Resilient Livestock Management
CSA	Climate Smart Agriculture
CSOs	Civil Society Organisations
CSO	Central Statistical Office (National Bureau of Statistics-Zambia)
CSPR	Civil Society for Poverty Reduction
DFID	Department for International Development (UK)
DoF	Department of Forestry
DPSIR	Driving forces, State change, Impacts and Responses
ENSO	El Nino/Southern Oscillation
EPICSA	Economics and Policy Innovations for Climate-Smart Agriculture Programme
ERB	Energy Regulations Board (Zambia)
GCMs	General Circulation Models (Climate Models)
GIZ	Gesellschaft für Internationale Zusammenarbeit (Germany)
GMB	Grain Marketing Board
HDI	Human Development Index
HIPC	Highly Indebted Poor Countries
IMF	International Monetary Fund
IOM	International Organisation for Migration
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
LATS	Land Access and Tenure Security
LDCF	Least Developed Country Fund
LECBP	Low Emission Capacity Building Programme
LHP	Lusemfwa Hydropower Company
LVI	Livelihood Vulnerability Index (same as Household Vulnerability Index)
MDPI	Multi-dimensional poverty index
MEB	Multiple-evidence Base
MMD	Movement for Multi-party Democracy
MoF	Ministry of Finance
NAMA	Nationally Appropriate Mitigation Action
NAMBOARD	National Marketing Board
NAPA	National Adaptation Programme of Action
NCCRS	National Climate Change Response Strategy
NCCS	National Climate Change Secretariat
NEAP	National Environmental Action Plan
NPCC	National Climate Change Policy
NR	Native Reserve
NTL	Native Trust Land
PPCR	Pilot Programme for Climate Resilience
PPP	Public Private Partnership
RL	Native Reserve
SAP	Structural Adjustment Programme
SES	Social-ecological System
SF	State-owned Farms
SHF	Smallholder Farms
SLA	Sustainable Livelihood Approach (same as SLF)
SLF	Sustainable Livelihood Framework (same as SLA)
TLHC	Traditional Land Holding Certificate
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Problems
UNFCCC	United Nations Framework for Climate Change
UNHCR	United Nations High Commission for Refugees
UNIP	United Nations Independence Party
VAGs	Village Action Groups
ZESCO	Zambia Electricity Supply Corporation

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CHAPTER 1: THE HUMAN-ENVIRONMENT NEXUS: AN INTRODUCTION

1.1 Introduction

Within the broader philosophical framework of political ecology, this study presents research that combines the degradation and margination, with political objects and actors theses proposed by Robbins (2012) to investigate the relationships between rural-rural migration and environmental change. In order to contribute conceptually and philosophically to climate change and adaptation debates that relate to rural livelihoods, a political ecology lens is utilised to focus explicitly on power relations, inequality, marginalisation and land degradation including how intervention policies are framed.

Rural-rural migration is relatively less analysed than rural-urban movements yet is a potentially important part of the wider human-environment nexus in the developing world. Focussed on Zambia, the research examines the extent to which environmental change among other attributes, drives rural-rural movements of people between agro-ecological zones. The main objective is to understand how environmental change interacts with other drivers of migration, and how in turn migration might impact on the environment. The spatial dimension of environmental change and variability in the recent past is identified and characterised. Data availability allows a focus on the 36 years from 1980-2016. To examine environmental change and adaptive potential of households, socio-economic attributes are assessed through both qualitative and quantitative techniques. This includes the ways in which climatic variabilities are recognised and responded to in natural resource use and agriculture-based livelihoods. This chapter however lays the ground for the thesis. It first outlines the study area, after which it introduces the background aspects of the human-environment interaction under which issues of environmental change and variability, and rural development are synthesised with the migration concept as adaptation.

1.2 Background: environmental change and migration

Throughout geological time, environmental change has threatened the survival of various species (Bowring et al., 1999). However, of the changing environmental conditions, anthropogenically induced climate change is unprecedented (Steffen et al., 2007). As Bowring et al (1999) argues, humans are the only species noteworthy for greater ability to forge into new environments and drastically alter natural systems. Natural systems are altered in ways that affect both the livelihoods and means with which to respond and mitigate the devastating impacts (IPCC, 2014b). However, over the centuries, climate change and variability has invoked response strategies from the human spirit of resilience (Salick and Byg, 2007) as the relationship between human social systems, climate and ecosystem is structured in inseparable ways (Berkes, 2012). Thus, sustaining the social system has almost always required thoughtful management of ecosystems through a series of constraining adaptive practices (Naess, 2013). Yet, while the concepts of environment, land, natural resources conservation and climate change play a structural role in adaptive practices, the context of how these concepts are integrated, at what scales, for whom, and to what end varies widely. Furthermore, within the human-environment nexus scholarship, consideration of social–ecological systems theory, resilience, and adaptive capacity remain largely unexplored (Grenade et al., 2016). While the available scholarship has provided a robust framework for interdisciplinary study, the inquiry tends to focus more on synergies and trade-offs in resource 'security', and less on the environment. This focus, somewhat fails to adequately acknowledge the environmental component as a set of both natural and human induced processes that underpin the nexus, especially among water, food production, land use and energy interactions (Al-Zu'bi, 2017). In this vain, resource security in the face of environmental change tends to be a reductionist approach that fails not only to address the limitations and potential of natural processes, but also the dynamic nature of human-induced processes (Sharmina et al., 2016). As Grenade et al (2016) argues, a more holistic approach is required to redefine the nexus framework to integrate adaptive capacity and

resilience within the theory and practice. A future line of inquiry must integrate the feasible ways of assessing the nexus in the context of dynamic social-ecological systems, including the implications that adaptive actions have on natural resource use across sectors, livelihoods and the environment (Berkes et al., 2014).

Within the broader concept of adaptation, literature evidence suggests that when people's livelihoods are threatened by environmental change and they sense risk, adaptation occurs to avoid or minimise the associated risks. One of the ways people do this is through migration. This type of human displacement broadly takes four temporal forms: seasonal, annual, temporary and permanent (Hugo, 1996; Adger, 2006; Renaud et al., 2007; Raleigh et al., 2008). Yet this role migration plays as an adaptive strategy to minimising risk has been cast with a negative perception; and is thus still amongst the least understood areas in migration and environmental change nexus enquiries (Adger et al., 2015). Research, and political discourse, has commonly focussed on international migration (Hugo, 2011; Geddes et al., 2012; Fussell, 2012; Milan et al., 2015). When focussed on within-country or more local scales, enquiries are usually either concerned with rural-urban movements, or involuntary resettlements; both of which may be caused by labour or income differentials on the former, and by extreme environmental disasters on the latter (Carr and Kenyon, 2015).

In developing nations, studies of movements of people from urban to rural contexts sometimes referred to as "turn-around migration" (Wardwell, 1980; UNEP, 2011), and rural-rural including gradual and long-term environmental risk are relatively few and limited in scope (Piguet, 2010b; Anon, 2011). The evidence base in Africa for instance is both varied and patchy, dominated by "business-as-usual generalization" (Tiffen et al., 1994). Nonetheless, available evidence suggests that migration in Africa related to environmental change is largely a strategy; not a reaction (UNEP, 2011; Tacoli, 2009). However, in these cases, the specifics of the strategies and response sets are connected to the socio-economic and environmental contexts of specific communities (Tacoli, 2009). Environmental change does not always result in

environmental degradation, degradation must be viewed in the context of the land use in which it occurs (Scoones, 1998).

From this context, I argue that a better understanding of the likely impacts of environmental change on migration, and the impacts of migration on the environment in natural resource-based rural economies, requires a shift in the migration research agenda towards a stronger focus on internal migration, particularly rural-to-rural movements. Similarly, the need to extend a greater focus on gradual or slow-onset events of environmental change is urgent. Although abrupt and extreme environmental events receive greater media and policy attention (Piguet, 2010b; Geddes et al., 2012), gradual and long term environmental change can have much greater impacts on the movement of people (Hunter et al., 2015; Neumann and Hilderink, 2015; Adger et al., 2015). I further contend that to improve understanding of the potential benefits of mobility, a new approach is needed. For instance, to stimulate a new set of responsive evidence-based-policies to environmental change and migration in least developed nations, current and future research agendas must explore, in much more detail, the dichotomy of the human-environment nexus. Research foci could include how migration is a form of adaptation to environmental change, and how migration is potentially a source of environmental change where people move within borders (UK-GOS, 2010; Naude, 2010; UNEP 2011; Piguet, 2010a; Hunter et al., 2015).

Long-term environmental factors singularly forcing migration can be hard to ascertain (Piguet, 2010b) as people migrate based on a combination of factors (Piguet, 2012). Black et al (2011) also posit that the binary decision to "migrate" or "stay" is complicated by the influences of other interacting factors. Among these are spatial and temporal environmental variabilities (sudden or gradual), and the economic prospect differentials between places. In addition, the associated interpretation of real or perceived risks on these variabilities and differentials also plays a role on the eventual decision outcome. This issue is developed further in Chapter 3. In natural resource dependent livelihoods however, environmental conditions may act either as

"pull" or "push" factors since they directly impact on the availability and accessibility of natural resources (Kniveton et al., 2012). Nonetheless, other than sudden environmental events (e.g., floods and hurricanes triggering temporary or circular migration patterns as people often go back after a certain time-lag) it is not clear at what point or threshold gradual environmental factors drive migration (Gemenne, 2011).

1.3 Study area selection

Zambia, like many countries in Africa, is facing dilemmas and changes afforced by the drivers of development and socio-economic change as well as those linked to environmental and climate change. Multi-dimensional poverty is pegged at 54 percent, and climate change could have more devastating impacts on the population. More than five percent of the population is already living on environmentally degraded land as Zambia records some of the highest annual averages of people affected by natural disasters in the southern African region, standing at about 26,183 per every million people (UNDP, 2016b). As Simatele and Simatele (2015) observes, rural-rural migration from one agro-ecological zones (AEZ) to another is evident. Furthermore, based on a CO_2 doubling scenario under changed climatic conditions, estimates predict a crop yield reduction of approximately 66 percent under rain-fed conditions (Niang et al., 2014). Given that more than 70 percent of Zambia's population relies on family land for food-crop production under rain-fed condition (UNDP and GRZ, 2010), Zambia is an appropriate country in which to investigate the relationships and consequences of the interactions between rural-rural migration and environmental change. To carry this investigation, two AEZs are selected based on the following:

a) A review of 2010 census records revealed a rapid population increase in AEZ II, with Kabwe and Chibombo districts' rural areas being the main targets for migrants. Kabwe particularly has one of the highest rural population densities in Zambia and population growth rates between 1990 and 2000 (CSO, 2010). Furthermore, based on past works of

United Nations World Food Programme (UNWFP) on food security in AEZ I and IIa, later published by Makondo et al (2014), a migration pattern was revealed between the zones. There was a presence of immigrants from other provinces among rural farmers in AEZ IIa, mainly in Kabwe District's Chibwe Village, and Chibombo District's Chikonkomene villages that forms part of the Mukonchi Farm Block. This created further interests for a detailed investigation. The study by Makondo et al (2014) also observed a peculiar deforestation pattern in the area and its surroundings as large portions of land were being cleared for settlements and agriculture, under what appeared to be 'clearing-to-claim' approach observed by Unruh et al (2005) in Southern Province of Zambia;

b) AEZ IIa presents a good case for investigating environmental degradation and migration as some immigrants moved long distances from other provinces among them, Southern Province (Simatele and Simatele, 2015). Southern Province which largely falls under AEZ I (Figure 1.1), is probably the most environmentally degraded and driest zone in Zambia (ZARI, 2008).

Given the limited time and budget, accessibility considerations to rural settlements and farmlands was important. AEZ IIa was found ideal since it has one of the largest rural settlements that fall within 50km radius from the main transport network while EAZ I was selected as the main migration source area (Simatele and Simatele, 2015); also for being the driest (ZARI, 2008) and most environmentally degraded zone (Chevo, 2014). Figure 1.1 shows the location of study areas in the agro-ecological zones while Figure 1.2 shows the location of migration destination area villages.

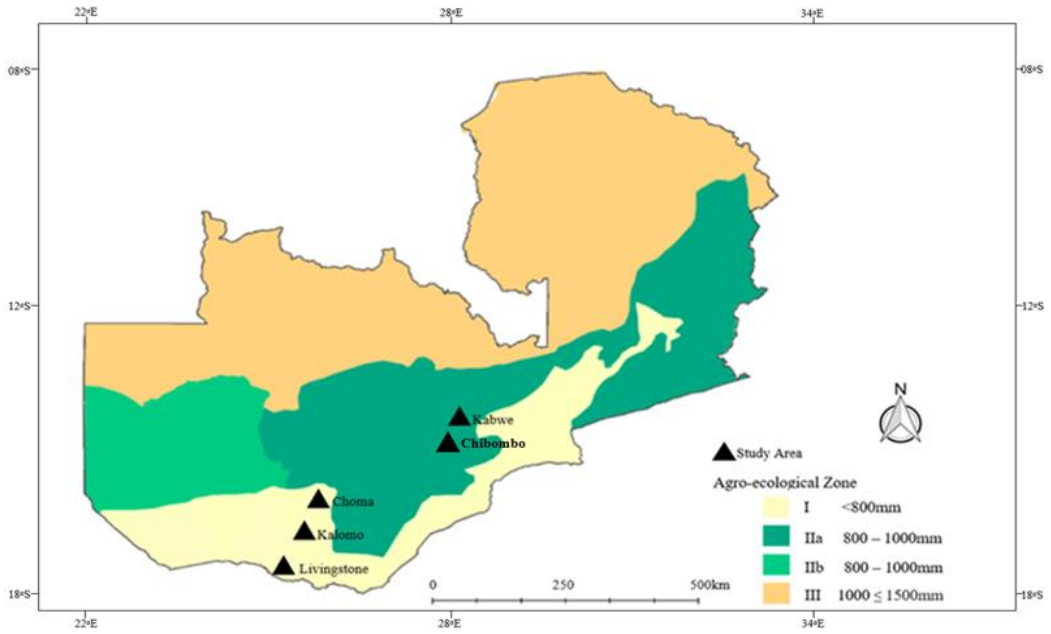


Figure 1.1: Study areas location and agro-ecological zones based on precipitation (Base map, ZARI, 2008)

Like most rural areas in Zambia, the livelihoods of people in the two Agro-ecological Zones (AEZ) selected as study areas are dependent on rainfed crop production with maize as the main staple food-crop.

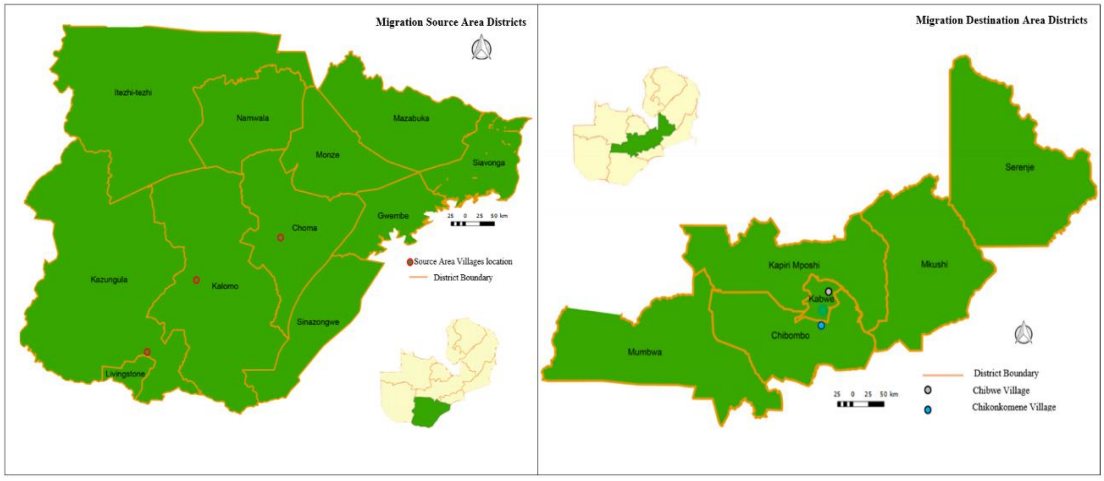


Figure 1.2: Location of study area (migration source and destination areas)

Agro-ecological I (AEZ I) which was once considered the maize belt and provided the nation with staple food now experiences low, unpredictable and poorly distributed rainfall with the shortest crop growing season ranging from 80 to 120 days (UNDP and GRZ, 2010). In addition, the region is largely deforested (Chevo, 2014), and soils degraded with relatively low potential for crop production (Sichingabula 1998; Unruh et al., 2005). However, despite poor soils, local

people in study area communities (Choma, Kalomo and Livingstone) engage in agriculture as the main livelihood activity. They grow maize, bulrush millet, sorghum and rear livestock. Commercial agriculture relies on rainfall as well as irrigation. This region, especially from Kalomo to Choma, is also facing a rapid influx of commercial farming driven by the Chinese. The Chinese farmers occupy the medium to large scale farms, producing all sorts of produce for local markets. The zone also hosts some of the major game management areas in Zambia around the Luangwa Valley, Lochinvar and Musi-o-Tunya national parks where coexistence of farming households and wildlife is increasingly becoming problematic. Chinese farmers have also been frequently violating conservation principles as some with farming licences have been found poaching and shipping different wildlife animal parts. This zone constitutes about 12 percent of Zambia's land area and subsistence agriculture continues to be the main livelihood activity (CGIAR, 2017).

Because agro-ecological zone IIa (AEZ IIa) has relatively more productive soils, with a growing season of 100 -140 days. Like AEZ I, the most dominant activity is agriculture. Households in study area communities of Chibwe in Kabwe and Chikonkomene in Chibombo cultivate a wide range of food crops e.g., sorghum, rice, maize, groundnuts, and cow peas including tobacco, sunflowers, wheat, sun-hemp (*crotalaria juncea*) and soybeans (UNDP and GRZ, 2010). Like in AEZ I, medium and large-scale mechanised farming including horticulture predominates agricultural activities in this zone with Chinese agricultural investments driving what some would term 'new neo-colonialism'. However, like AEZ I, subsistence agriculture is the main livelihood activity in rural areas. However, the western plateau zone, sub-categorised as AEZ IIb is characterized by infertile coarse sands emanating from the Kalahari and Namib Desert influences. Nonetheless, even in this region, subsistence agriculture dominates with maize, sorghum. cassava, bulrush millet, Bambara nuts (*Voandzeia*) grown on the upper land. Rice and sorghum are grown in the flood plain or dambos with rich alluvial deposits of the Zambezi River. This zone constitutes about 42 percent of Zambia's land area (ZARI, 2008).

1.4 Thesis structure

The overarching aim of this project is to investigate the linkages between rural-rural migration, land degradation and adaptation in both migration source and destination areas. The relationships between migration and environmental change, and the role of migration in adaptation and livelihood resilience, are investigated.

To address this aim, the project has five specific objectives, which are to:

- Enhance understanding of the connections between migration, environmental change and adaptation in rural-to-rural movement of people;
- Gain an insight of how adaptation, vulnerability and resilience in the face of climate change is influenced by migration in both source and destination areas;
- Gain an understanding of how migration might impact on the environment in destination areas;
- Enhance understanding of the spatial scales of rural-rural migration;
- Gain insight about people's perception of risk and severity of environmental change.

The theoretical framing and methodology required to meet these objectives cut across disciplines in the social sciences on the one hand, and physical sciences on the other. Thus, an approach informed by critical political ecology (Forsyth, 2003; Robbins, 2012; Death, 2014) is adopted because from a critical realist's perspective, reality is socially constructed and thus science, or the production of knowledge is entirely a social practice (Easton, 2010). In this regard, vulnerability to environmental change impacts, and an ability to adapt to environmental change impacts or avoid exposure are determined by social structural entities. Social entities, such as institutions and their actions are not only concept dependent, they have causal powers and liabilities, and therefore, warrant a critical analysis. Critical political ecology is no single perspective and it is neither a method nor theory. It is a systematically social and an environmentally urgent argument that examines winners and losers which can begin with and/or

end in a contradiction (Robbins, 2012). Embedded within the broader discipline of geography, this approach guides the investigation of environmental change, adaptive potential and vulnerability assessment of households in the study area through eight main activities:

1. An assessment of processes that may have influenced the environmental conditions is done using both satellite data, photography and respondent perception. This includes an identification of the causes and likely impacts of observed changes in environment, and how these changes impact on livelihoods;
2. Mapping the observed environmental change and environmental degradation;
3. Climate change and variability assessment in the context of rainfed agriculture is done using daily rainfall data;
4. Establishing migration years among migrants for association assessment and collation between environmental change and/or variability and migration;
5. Vulnerability and adaptive capacity assessment at household level through household capital assets profiling using semi-structured interviews;
6. Identification and placement of indigenous or local adaptation knowledge in relation to western science through focus group interviews;
7. Spatial mapping of the scales of migration;
8. A review of the Zambia climate change policies and projects aimed at rural development and resilience building on rural livelihoods.

The combined outcome of these activities constitutes a five-fold contribution to the existing body of knowledge. First, it contextualises environmental change at a local level, allowing a nested, multiscale analysis at household, community and national level. Second, by drawing tools from multiple discliplines in both the natural and social sciences to focus on shocks and trends in the context of the Sustainable Livelihood Framework (SLF), this thesis contributes a methodological and philosophical approach to environmental change and political ecology perspective. Such a multidisciplinary approach to research allows a more broad, thorough

assessment and evaluation of various factors than a single-handed discipline. Third, by focussing on rural-rural movements of people, this thesis potentially improves the understanding of the extent to which migration drivers interact in the binary 'stay' or 'migrate' decision process. Fourth, it untangles and establishes the extent to which the least studied long-term environmental drivers can trigger migration in the least understood rural-rural movement of people. This potentially improves understanding within the broader concept of migration theory. Lastly, by assessing indigenous knowledge of adaptation to environmental change, the thesis potentially provokes an approach that mainstreams indigenous knowledge in climate change policy debates and programmes of action.

1.5 Thesis outline

This thesis comprises nine chapters. Chapter 1 (this chapter) presents a generic introduction of the broad concept of human-environment nexus in the context of natural resource dependant livelihoods and the environmental-related migration question. From a political ecology lens, Chapter 2 delves into how inequality has been historically crafted, reinforced and propagated by different political regimes. The chapter provides a holistic and broader context about how certain social, economic and environmental problems emerge and/or propagate along livelihood options in Zambia. It casts light on the aspects of political and socio-economic transformation from the colonial period through post-independence to modern-day era. This also covers policies and strategies in environmental change resilience, and how these as external factors, may have, or continue to shape the livelihood choices rural people make. Understanding the source of environmental problems, inequality, social injustice e.g., access and utilisation of economic opportunities or resources among different social groups is important. It provides useful information for designing and implementing responsive policies for an equal, just and sustainable society where opportunities are equal regardless of gender, age and class (Osborn et al., 2015).

The most influential theories are discussed in Chapter 3 and applied in Chapter 4 for data collection, with an assumption that they are substantively connected in sequential ways and therefore materialise from similar logic. Thus, while Chapter 3 presents the theories and concepts utilised in this research, the merits and drawbacks associated with each research method adopted are also discussed with justification for their use in guiding the research process. Chapter 4 grounds these theories and operationalises the concepts into methods and tools to guide data acquisition, analysis and presentation. The overall research process which combines numerous methods drawn from various of social and physical science, integrating qualitative and quantitative techniques in a transdisciplinary fashion are described. Also considered, are the challenges incurred and aspects of positionality, reflexivity and power relations within the broader context of the research process and the interactions between the researcher and the researched.

Within the philosophical framework of political ecology, Chapter 5 examines how some of the indigenous or local peoples of the African continent have historically been adapting to changes and variabilities in environmental conditions. This is important given that climate is not static at multiple timescales, although usually at rates slower than those currently being experienced (IPCC, 2014b). Understanding indigenous knowledge-based adaptation is essential to ensuring that modern science-based programmes designed to minimize negative impacts on various human, natural, and socio-economic systems are sustainable and effective. Climate change is assessed in Chapter 6. However, due to challenges in climate record keeping facing many least-developed nations, data availability allows an assessment of a 36-year-period from 1980-2016. The importance of this assessment is that it ascertains and highlights local climate change risk to rural livelihoods in the study area, with potential to influence interventions. Based on rainfed agriculture and similar land uses in Zambia, the duration of the rainy season, total amount of annual rainfall, number of rain days, dry spells and distribution have been analysed. Statistical tests have also been performed and several comparisons have been made between and among parameters in the dataset.

Focussed on human-environment interaction within the marginalisation and degradation thesis of political ecology, Chapter 7 ascertains key types of livelihood activities, how these may be impacting on the environment, and how in turn, the environment may be impacting on these livelihoods. The chapter also narrows down from the broad vulnerability and adaptive capacity assessment at regional level in Chapter 6, to household level. This approach allows a much more detailed assessment of adaptive capacity potential through a deeper evaluation of livelihood capital assets composition at household level. The methodological tools are drawn from the SLF. Conceptualized as a holistic capital-asset-based approach (Ellis, 2000; Adger, 2003; Osbahr et al., 2010; Nielsen et al., 2014; Hua et al., 2017), SLF is widely used in international development praxis for poverty alleviation and intervention projects targeting the economically disadvantaged (Scoones, 1998; Morse and McNamara, 2013; USAID, 2014). In assessing environmental change however, the DPSIR (Driving factors, Pressures, State change, Impacts and Response) approach within the boarder framework of Social-ecological Systems (SES) theory is drawn upon.

Anchored on environmental change and migration theory, Chapter 8 assesses possible linkages between the environmental changes uncovered in Chapter 6 and 7, and migration; including factors that determine the spatial scales of human movement. By taking cognisance of the dominant environmental-migration thesis which posits that slow onset and long-term environmental change does not singularly drive migration (Piguet, 2010b; Kniveton et al., 2012; Adger et al., 2015), Chapter 8 focusses on teasing-out other drivers of migration from the environmental factors. The research approach utilises long-term environmental data over a 36-year period as well as interviews using a two-way approach. First, it investigates the extent to which long-term environmental threats among social, economic, demographic and political divers trigger migration in rural-rural movements. Second, social perception and interpretation of environmental risk, threat and/or shock is investigated at household level using methods of Pellizzoni (2014); Warner and Afifi (2014). The chapter also examines how external factors of

socio-economic policies and power relations shape decisions of rural households. A general discussion is given in Chapter 9, and conclusions drawn based on the findings.

Finally, I must confess that by far, the biggest challenge in writing this thesis has been keeping things connected, linking all aspects critical to the central theme with clarity and conciseness. For quite naturally, any idea is only as valuable as how well it is put forward. To borrow George Bernard Shaw's words, "the single biggest problem in communication is the illusion that it has taken place" (Galsworth, 2017, p.1). In this regard, I would like to point out that while an effort has been made to weed out unnecessary repetitions, but due to certain aspects existing in one breath and multiple contexts, there are still some unavoidable ones. Given the complexity, nuanced and nested relationships within the human-environmental nexus, I believe that it does not hurt to regularly remind the reader of critical themes. As controversial as this statement may sound, the kind of thinking required in this thesis is systematic - taking a holistic, as opposed to a reductionist or linear approach. Hopefully, what I mean by this will become clear as the reader moves forward. To bypass anticipated incompleteness, chapters deliberately cross-reference one another, weaving in and out for coherence and clarity. As regarding detail, an attempt to keep explanations simple, succinct and 'accessible' has been made. However, needless to state that while all possible efforts have been made to avoid unnecessary complexity and tedious explanations, there is only so far one can go before such efforts become self-defeating. In this regard, complexity is retained where necessary.

CHAPTER 2: THE ZAMBIAN CONTEXT: FROM COLONIAL TIMES TO THE MODERN DAY

"We are never completely contemporaneous with our present. History advances in disguise; it appears on stage wearing a mask of the preceding scene, and we tend to lose the meaning of the play." Régis Debray (1967, p. 37).

2.1 Introduction

This chapter presents the overall national context of Zambia by casting light on the aspects of political ecology and socio-economic transformation from the colonial period through post-independence to modern-day era. The chapter combines two theses of political ecology as conceptualised by Robins (2012), namely; degradation and margination, and political objects and actors. With the aim of contributing conceptually to debates around climate change and adaptation in rural livelihoods, a political ecology lens is drawn upon extensively to lay the foundation of the thesis focussing explicitly on power relations, inequality, marginalisation and land degradation among farming communities in rural Zambia. It also highlights, with examples on key determinants of vulnerability, processes and factors that operate discursively at micro and structural levels in shaping the rural livelihood landscape. With a post-structuralist approach of political ecology, this chapter highlights the underlying causes of inequality stemming from historical, political, economic, demographic, and environmental contexts. Analysis of inequality leading to persistent marginalization needs to pay attention to changes in regimes of governance, colonial norms of land administration, agrarian reforms and green transformations (Scoones et al., 2015; Taylor, 2014). Critiques have also related the CSA discourse to corporate deception, suggesting the approach could repeat the injustices that resulted from earlier green revolution agricultural policies (CIDSE, 2015). When left unaddressed by current development interventions, the underlying causes of inequality and injustice push the vulnerable deeper into poverty, accelerate ecological degradation and co-produce disproportionate vulnerability to climate change (IPCC, 2014b).

2.1.1 Relative location

Zambia is a landlocked country located in Southern Africa between the latitudes 8° and 18°S and longitudes 22° to 34°E. It has a total area of about 752 618 km^2 (FAO, 2005). Figure 2.1 shows the geopolitical location in relation to eight neighbouring counties including the ten provinces that make-up the country.

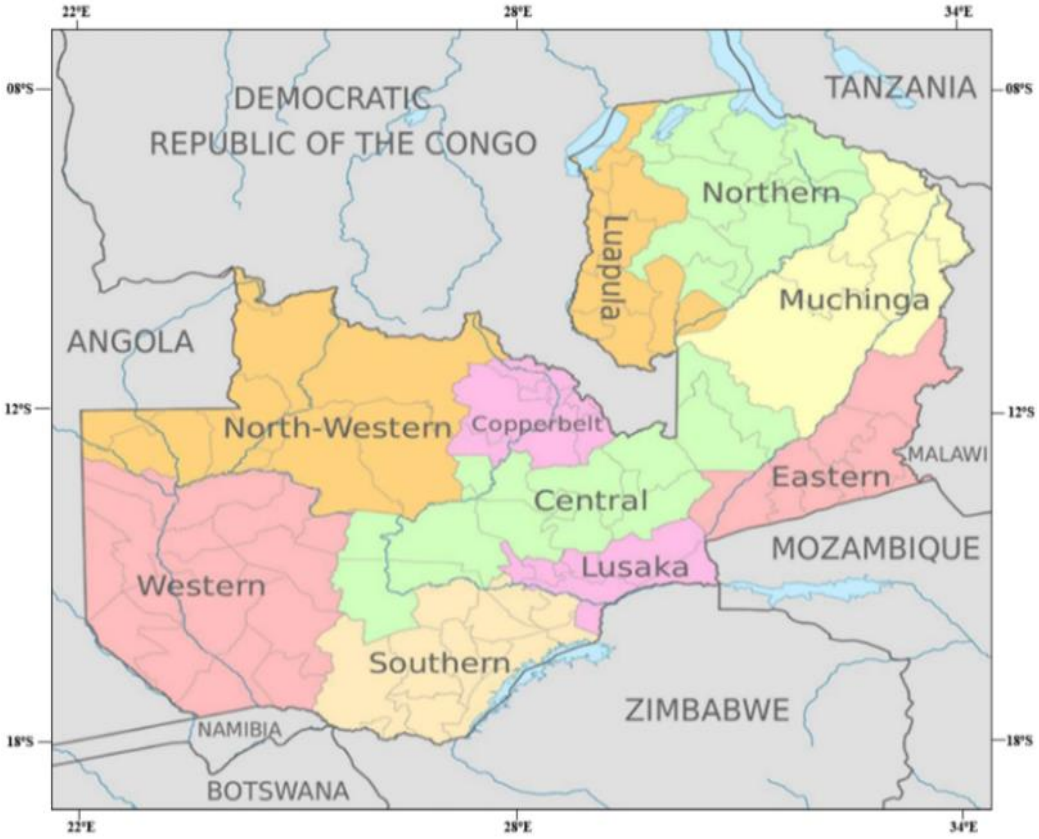


Figure 2.1: Geopolitical location of Zambia and its 10 provinces

2.1.2 Vegetation, forest cover and energy deficit

Recent estimates put forest cover at 65 percent of Zambia's total land area (FAO, 2015; UNDP, 2016a). Brachystegia, Julbernardia, Isoberlinia and other deciduous flora dominate the woodlands which contain shrubs and grassland underneath. Referred to as the Zambezian Regional Centre of Endemism, the miombo eco-region as shown in Figure 2.2 consists of a relatively high biomass.

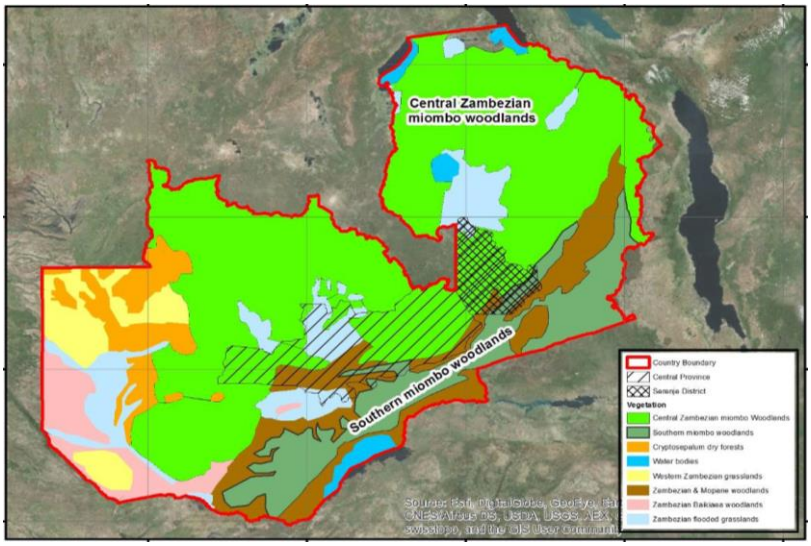


Figure 2.2: Vegetation types in Zambia (UNDP et al., 2015)

However, in most parts of Zambia, the miombo woodland cover has being shrinking due to agricultural expansion, settlement, wood fuel extraction and frequent fires (UNDP et al., 2015). In 2010, the total forest area depleted due to both charcoal production and agriculture was estimated at 300,000 hectares per annum (Vinya et al., 2011). However, with the 34 percent energy deficit that hit the country in 2014-2017 resulting in eight hours per day of load shading for domestic users (Sladoje, 2016), the forest depletion rate may have doubled. 2016 estimates put deforestation rates at 7.9 percent (UNDP, 2016a). Left without electricity and no access to gas coupled with unaffordable fossil fuel-based power generators, most people resorted to charcoal for both heating and cooking (Sladoje, 2016). Currently, 88 percent of the total population has no access to electricity (UNDP, 2016a).

2.1.3 Study area people

There are 73 ethnic groups of indigenous people found in Zambia speaking slightly similar but different linguistic dialects. European settlers called the indigenous as “bantu” speaking people (Brelsford, 1965). Figure 2.3 shows their location relative to other ethnic groups in Zambia. Southern Province is home to five ethnic groups: the Tonga; Ila; We; Lumbu and Toka-leya. However, although these are categorised as distinct ethnic groups, linguistically, they have the same dialect (Hachintu, 2013). Among all ethnic groups in Zambia, the Tonga are considered to

be the first to have settled in Zambia (Saha, 1994) although historical inquiries into their origin have not provided clear answers to questions about when they arrived, or from which part of Africa. Today, the Tonga sub-groups are found in Zimbabwe, Mozambique, and Malawi where they lead very similar lifestyles to that of those in Zambia, dominated by farming and pastoralism (Vickery, 1986). Throughout their history, land has been demarcated at 4-5 km between households to provide enough space for cattle grazing. With needs for more land and as population expanded, a propensity for clearing larger portions of land to claim ownership has characterised their lifestyle (Unruh et al., 2005).

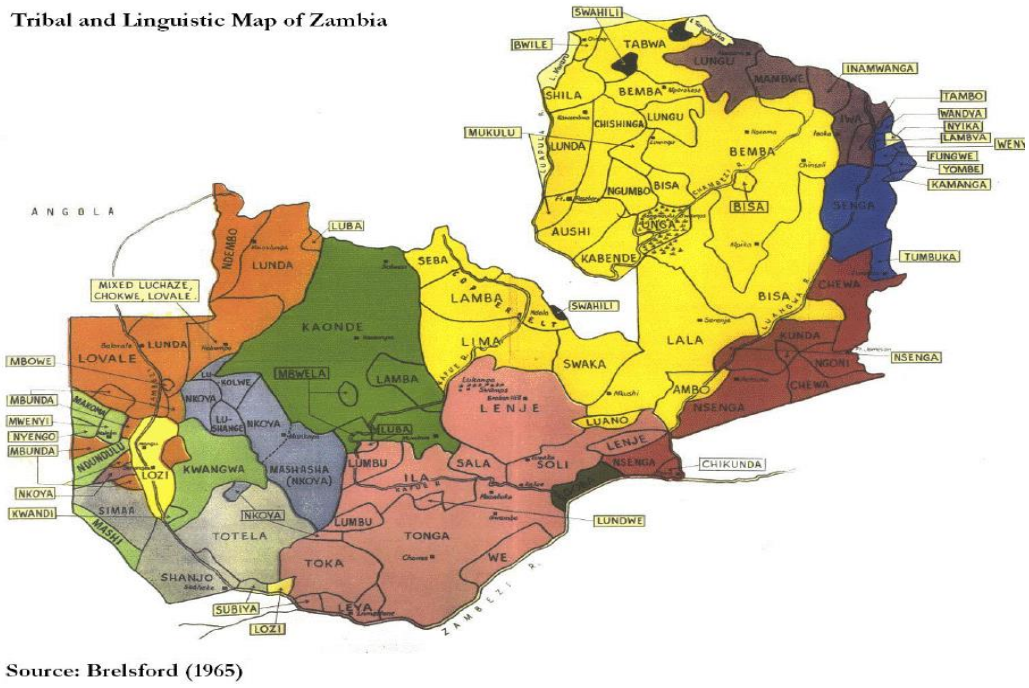


Figure 2.3: Ethnic groups of Zambia and relative location

Central Province has been home to the Lenje, Soli, Lala and Swaka speaking peoples before the ethnic group integration policy of the Kaunda regime. The ethnic integration policy is discussed later in the chapter. Linguistically, these ethnic groups except the Lala and Swaka are related to the Tonga of southern Zambia (Kaira, 2006). They were split during historical migration (Hachintu, 2013). The Swaka, Lala and Lenje later integrated in Central Province with generations speaking a Lala-Swaka-Lenje creole, which is heavily influenced by the Bisa and Bemba early contacts (Kaira, 2006; Hachintu, 2013). The Bisa and Bemba were fishermen who

migrated from the north in search of game and booty after conquering other ethnic groups. They also practiced swidden agriculture known as *Chitemene* (see Chapter 5). Chitemene was largely adopted by many other tribes in Zambia such as the Bisa, Lima, Luano and Lamba (Thrupp et al., 1997; Hachintu, 2013).

2.1.4 Population dynamics, migration and socio-economic indicators

The population system in Zambia is characterised by urban nodes, such as the provincial capitals of Lusaka, Ndola, Kabwe and Livingstone, that attract youths and young adults through rural to urban migration. The Copperbelt region, in AEZ III, is the most urbanised area in Zambia and urban centres in this region such as Kitwe and Ndola are significant attractors of those seeking employment. Rural areas, and the smaller settlements consequently have populations that become dominated by retired employees, the jobless middle-aged and the elderly. Table 2.1 shows however that the relative proportions of the total population that is rural or urban has fluctuated through the last twenty years. For example, linked to industrial and economic down turns, the urban percentage of the population declined from 39 percent in 1990 to 35 percent in 2000. This was the most difficult economic time of the structural adjustment programmes (SAP) that aimed to dismantle the government debt contracted by the former regime under Kenneth Kaunda. SAP was a severe social spending cut that further paralysed productive sectors of the economy, such as manufacturing, mining, health, education and agriculture during this period.

Table 2.1:Urban net population dynamics from 1990-2010

Description	**National Level Estimates**			**Study area: 3Districts Estimates Southern (AEZ I)**			**Study area: 2 Districts Estimates Central (AEZ II)**			**All 10 Districts Estimates Copperbelt (AEZ III)**		
Year	1990	2000	2010	1990	2000	2010	1990	2000	2010	1990	2000	2010
Urban population	3,081,740	3,510,720	5,233,140	75,605	101,222	153702	82,649	101,455	162,378	1,226,829	1,236,570	1,595,407
Rural population	4,792,870	6,450,450	7,986,590	333,071	376,467	486,723	212,525	316,915	345,052	199,716	290,724	376,910
Total	7,874,610	9,961,170	13,219,730	408,676	477,689	640,425	295,174	418,370	507,430	1,426,545	1,527,294	1,972,317
Urban Population % age	39	35	40	19	21	24	28	24	32	86	81	81
Urban population % age change	*	-4	5	*	3	3	*	-4	8	*	-5	0

* not applicable

Source: Author's analysis of population census microdata files of Central Statistical Office-Zambia (1990-2010)

The period also saw the plummeting copper prices on the international market. Most of the mines closed with a view to privatise them and at this point, Zambia was among the Highly Indebted Poor Countries (HIPC). Initiated in 1996 by the World bank and IMF, HIPC comprised a group of 39 developing nations with high poverty levels and debt overhang who would later get their debts cancelled following extensive lobbying by Civil Society Organisations (World bank, 2012). Owing to this government debt overhang, most people who lost jobs in Zambia may have turned their back to the city to embark on farming in rural areas until about 2003 to 2010 when the reversal of urban-rural movements appears to take place, bringing the urban population increase to 40 percent. However, for southern Zambia, the percentage of people in urban areas consistently rose. This has been due to employee mobility for the agriculture sector that did not suffer as much economic depression as mining in the far north (Nchito, 2010). With international debt cancellation in 2003 and HIPC completion point attained in 2004, Zambia's economy began a recovery path (Larmer, 2011). This was caused by the urban economic growth after debt cancellation and the completion of HIPC programmes in 2003. The manufacturing and mining industries resurfaced with potential to pay higher wages than rural agricultural sector (Crankshaw et al., 2018). This wage-differential was therefore the cause of rural-urban drift, linked to the economic theory of migration.

However, both migration and natural population growth can contribute to population increase in urban and rural areas: there is no necessity for either one of these processes to be the dominant cause of rural-urban movements or the reverse. The reason for this is that these two different processes are caused by different mechanisms that operate under different conditions. Under conditions of rural-urban migration, urban employment increase may be the larger driving force. However, loss of jobs and higher mortality rates in urban areas compared with rural areas could counteract this tendency, thereby triggering urban-rural migration. However, needless to suggest that if mortality rates are lower in urban areas than in rural areas, and fertility rates are higher in urban areas than in rural areas, natural increase of urban population results. In the data presented

in Table 2.1 natural growth of the urban population was roughly the same as that of the rural population, and the extent of natural population growth did not contribute substantially to the increase. Instead, as argued by Crankshaw et al (2018) relatively small changes in the extent and direction of net migration contributed to the changes. Table 2.1 results suggest that the direction of net migration corresponds to changes in the urban labour market that are consistent with the argument that rural-born urban migrants respond to high unemployment in the city by migrating to rural areas and vice versa.

With an estimated population of 16.4 million and an annual growth rate of about 3 percent, Zambia's life expectancy has risen from 35 to 66 in the last 30 years (UNDP, 2016a). As shown in Figure 2.4, approximately 42 percent of the population is concentrated in urban areas (CSO, 2015). However, population distribution differs per province with urban areas having high densities. Among the 10 provinces shown in Figure 2.1, central and southern provinces are of interest to this research due to rural-rural movements of people between these provinces (Simatele and Simatele, 2015). Central Province falls under AEZ II and comprises six districts (See Figures 1.1 and 1.2 in Chapter 1). To the contrary, central Zambia - the main study area in this project comprises six districts. Of these, Kabwe and Chibombo are relevant as destination areas in the observed rural-rural migration patterns from southern Zambia. With a total area of 1,572 km^2, Kabwe comprises 14 percent of the 1.9 million people in Central Province while Chibombo comprises 15.5 percent. However, Kabwe has the highest population density at 169 persons km^{-2} with about 66 percent located in the rural areas. Unlike Kabwe, Chibombo District's population density is about 22 persons km^{-2} (CSO, 2015). With a total area of about 13,423 km^2 , Chibombo district is also largely rural (CSO, 2010). As shown in Table 2.2, the MDPI for the province is the second lowest after Lusaka (CSO, 2015). In the study area communities – Chikonkomene and Chibwe, people rely on family or customary for farming as a main source of livelihood. Land size is limited hectarage, average of 10 hectares. Fishing is also common in local streams as source of income and protein (USAID, 2014).

To the contrary, Southern Province falls under AEZ I and comprises eleven districts (see Figure 1.2 in Chapter 1). Of the districts, Livingstone, Choma and Kalomo are of interest to this research as migration source areas. As shown in Table 2.2, the province has the third largest population at just under 2 million and the highest life expectancy in the country. However, multi-dimensional poverty index (MDPI) for the province is among the highest and above the national mean. 36 percent of the population in the province is found in Livingstone, Kalomo and Choma districts with 62 percent located in the rural areas of these districts. Of the rural population, 40 percent is in Kalomo; 38 percent in Choma; and 22 percent in Livingstone. Livingstone is the most urbanised district in the province and has the highest population density at 220 persons/km^2 (CSO, 2010). People rely on family land for farming and rearing cattle as the main source of livelihoods in study area communities in Kalomo, Choma and Livingstone (USAID, 2014).

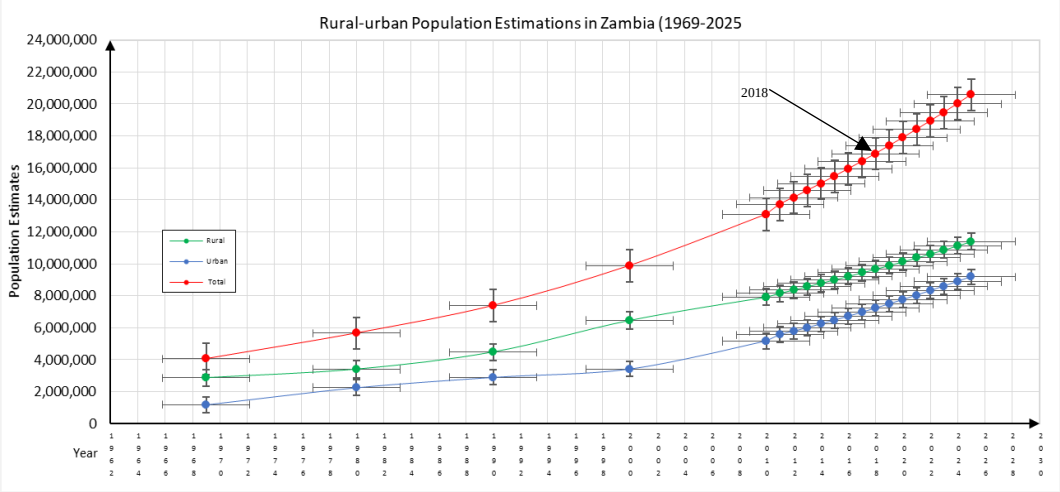


Figure 2.4: Rural and urban population projections based on current average rates of increase

Table 2.2: Comparative demographics and some socio-economic indicators by province (CSO, 2015)

Province	Population	**Population Growth Rate (%)	Percentage Share of Total Population	*Provincial Population Density/km^2	Life Expectancy (Years)	Mortality Rates (Deaths/100,000 live Births)	Gender Development Index (GDI)	Gender Inequality Index (GII)	Human Development Index (HDI)	*Multi-Demensional Poverty (MDPI)
Lusaka	2,994,079	3.9	17.9	100.4	53.9	357	0.95	0.49	0.60	0.12
Central	2,466,144	2.2	15.3	13.8	51.4	474	0.89	0.53	0.60	0.15
Southern	1,960,965	2.9	12.0	18.8	58.5	343	0.95	0.57	0.58	0.23
Eastern	1,911,371	2.7	11.7	24.6	51.3	442	0.90	0.59	0.40	0.32
Copperbelt	1,596,901	2.7	9.8	62.5	52.8	N/A	0.89	0.61	0.50	0.20
Luapula	1,385,310	3.1	8.4	11.9	56.3	475	0.87	0.62	0.35	0.28
North Western	1,186,081	2.6	7.3	19	48.6	573	0.94	0.63	0.45	0.32
Western	1,025,211	1.7	6.4	7.1	49.0	786	0.90	0.60	0.35	0.22
Muchinga	968,453	4.1	5.8	N/A	56.6	330	0.86	0.59	0.38	N/A
Northern	877,177	2.6	5.4	5.6	56.6	423	0.93	0.57	0.60	0.20
Total/Mean	16,371,691	3	100.0	17.4	53.2	483	0.93	0.59	0.55	0.22

Source: Processed from UNDP-Zambia 2016 Report & Central Statistical Office (* 2010 data **2015 Data)

The UNDP's 2014/2015 Human Development Index (HDI) Report ranks Zambia at 139 out of 188 countries. Of the 16.4 million people, only about 21 percent have access to electricity - 15 percent in urban areas, and 6 percent in rural areas. About 74 percent of total population live on less than US$1.50 a day. Low levels of education and health conditions contribute about 18 percent and 30 percent respectively to the dimension of overall poverty (CSO, 2015; UNDP, 2016a).

Like many African countries, Zambia has not been a debt free country from Kaunda regime to date with contradicting policies every regime. For example, between 1991-2001, Frederick Chiluba regime reversed all the Kaunda policies in a bid to liberalise and create a free market economy. All government owned companies and business ventures were sold very cheaply to private owners, a process that saw massive job losses. On top of the already accrued debt contracted in the Kaunda government, the Chiluba regime went back to IMF to stimulate economic recovery through SAP. Arguably, the Chiluba regime had the worst agricultural policies in living memory (Scott, 1995; Sardanis, 2014). All subsidies on agriculture were withdrawn, cooperatives and agricultural marketing unions were disbanded without viable alternatives for farmers to cope with the shocks. Conmen occupied the void of the marketing unions to buy maize from the farmers at extremely low prices, shrinking farmers' productive assets to illusive promissory notes. By sheer coincidence, a national outbreak of foot and mouth disease nearly decimated the cattle populations in southern, central and eastern provinces. Cash strapped, the government responded with lacklustre indifference. Instead of a robust veterinary response, roadblock checks to prevent stock movements were mounted - a move that saw many rural livelihoods financially crippled (Sardanis, 2014). Given, frequent droughts in the 1990s especially in the southern half of the country (Sichingabula, 1998), famine eroded key livelihoods assets (Scott, 1995). With the corruption that characterised the Chiluba regime, Zambia joined the most highly indebted poor countries (HIPC) by 1996. Emotional depression

among the working class was evident as wage freeze, job losses resulted in more than 83 percent of the population to live below US$1 per day by 1998 (Fraser, 2010).

However, with international debt cancellation in 2003 and HIPC completion point attained in 2004, Zambia's economy began a recovery path (Larmer, 2011). Unfortunately, a new government in 2011 began an ambitious road infrastructure development agenda, a move that led Zambia to head back to IMF for financial bailout by the end of 2013. While an external debt has been reported by government to be around US$ 9.4 billion, financial intelligence reports show that it is currently standing at US$16.4 billion – about 69 percent of the country's Gross Domestic Product (GDP). Some critics argue that this figure is even an underestimation (Africa-Confidential, 2018). By May 2018, amidst lack of transparency and accountability, Zambia was denied IMF bailout due to lack of clear plans on managing the increasing debt crises. Directions on rural development, agriculture, and general economic recovery remain neither clear nor easy to guess as government turns to China in its quest for bailout. What is clear however is that reckless borrowing is likely to continue amidst corruption allegations as rural livelihoods, agriculture, and rural infrastructure remain underdeveloped in the face of climate change and variability.

Without alternatives, rainfed food-crop production and animal rearing remain the main livelihood activities in rural parts of Zambia (Scott, 1995, Makondo et al, 2014). As shown in Figure 2.5, agriculture is the largest employer for both poor and non-poor population in Zambia (UNDP, 2016b).

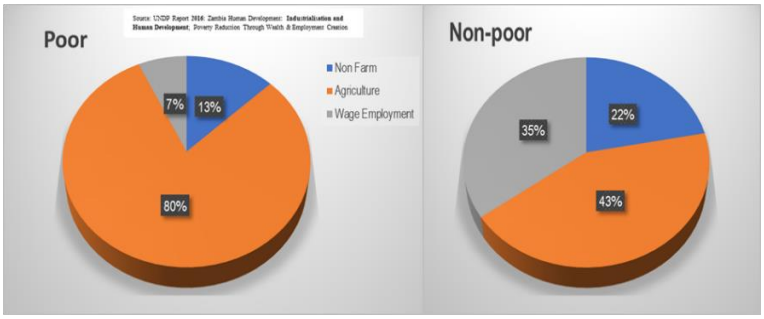


Figure 2.5: Distribution of working poor and non-poor by working category

Table 2.3: Livestock and poultry population estimates per province

Province	Catle Population	*Goat Population	*Sheep Population	*Pigs Population	*Poultry Population	Total Livestock Poultry	Percentage of Total Catle Population	Percentage of Total Goat Population	Percentage of Total Poultry Population	Percentage of Total Livestock & Poultry Population
Southern	2,105,891	1,040,731	46,411	224,186	25,747,107	29,164,326	42.2	49.3	22	21.8
Eastern	844,839	216,010	3,145	496,726	20,352,475	21,913,195	16.9	10.2	16	16.4
Central	576,169	348,788	20,264	60,442	20,352,475	21,358,138	11.6	16.5	16	16.0
Northern	79,044	76,894	10,000	120,885	12,873,554	13,160,377	1.6	3.6	10	9.9
Muchinga	175,801	86,537	457	10,990	10,544,053	10,817,838	3.5	4.1	8	8.1
Copperbelt	69,616	56,209	7,311	60,442	7,846,737	8,040,315	1.4	2.7	6	6.0
Lusaka	128,190	108,623	35,205	36,265	7,724,132	8,032,415	2.6	5.1	6	6.0
Luapula	21,564	51,139	35,205	36,265	7,724,132	7,868,305	0.4	2.4	6	5.9
Western	890,288	73,858	548	26,375	5,762,448	6,753,517	17.9	3.5	5	5.1
North Wester	93,508	51,380	558	32,969	6,252,869	6,431,284	1.9	2.4	5	4.8
Total/Mean	4,984,910	2,110,169	159,104.0	1,105,545	125,179,982	133,539,710	100	100	100	100.00

Source: Musika Development Initaitives, 2017 * 2013 Data

Table 2.3 shows the livestock and poultry population numbers in Zambia. As shown, southern, eastern and central are the top three provinces in animal and poultry rearing.

2.2 Land tenure regimes

Given a historical colonial encounter, most African countries have complex land tenure systems (Platteau, 1996). I posit that land appropriation is likely to continue to be an emotional and sensitive issue in much of Africa. The following sub-sections discusses the land tenure systems before, during and after colonial encounter.

2.2.1 Precolonial era

In this system, land was collectively owned through family, clan or community cooperatives in which the chief or headman was the main distributor (Vickery, 1986). Land was not traded as it was considered sacred, a gift from the creator together with other resources on it (Colson, 2006). Recognised as a basic human need, all natural resources such as trees, game, and fruit were open access to community members (Colson, 1971; Vickery, 1986). Disputes over land was rare. As two controversial scholars have argued, this cultural idea of collective ownership guided the proliferation of the traditional norms that were core and important to social cohesion. They created a sense of collective ownership and belonging (Rodney, 1972; Mazrui, 1986). This was an integral governance approach to land-use planning and distribution among ordinary community members and their traditional leadership before the arrival of European colonialists.

Even at arrival however, colonialists were first voluntarily given pieces of land as gifts, probably as a symbol of good will in cultural exchange. However, this may not have been recognised by the recipients as indigenous people's displacement and confinement characterised the colonial period. Additional land was obtained either through unjust concessions or by force where necessary (Colson, 1971).

2.2.2 Colonial era

As Northern Rhodesia, Zambia was administered under Cecil Rhodes' British South African (BSA) Company from about 1891. With the arrival of early Christian missionaries and explorers e.g., David Livingstone and François Coillard, the preaching of the gospel paved way for more European entry into Zambia. With the economic promise of base metals in southern and central Africa, Cecil Rhodes had been expanding British influence into Zambia, securing mineral rights from local chiefs and encouraging European settlers in the process. This strategy expanded both BSA's political and economic influence in Northern Rhodesia from 1891 until 1923 when Britain took over political power through the Federal Government. Mining and exporting base mineral resources continued under the BSA banner (Larmer, 2010).

With expanded mineral prospecting, indigenous or local landowners were simply displaced when found on mineral-rich land. The traditional view of land was altered as decision-making on access, use and occupation shifted to colonial powers, allowing a highly centralised system of land governance (Mvunga, 1978). As the result, three categories of land tenure systems based on racial categorisation emerged: Crown land (CL), Native Reserve (NR), and Native Trust Land (NTL) (Mvunga, 1978).

Earmarked for European settlement and business parks to power economic development, CL was surveyed and titled for both freehold and leasehold. In the NR and NTL categories, land was neither surveyed nor put on title (Ng'ombe and Keivani, 2013). This made developing NR and NTL difficult since titles were key to loan access (Colson, 1971; Vickery, 1986).

Administered under the English Law, holding of CL tenure by any indigenous person was illegal. The indigenous were only permitted on NR and NTL where land tax applied (Mvunga, 1978; Mushinge, 2016).

With more mineral discoveries, large scale mining around 1926 triggered migration to meet labour demands. This rural-rural migration, given all mines were initially not yet urban areas, led to the gloom of agriculture not only where mining claimed farmlands, but also in areas that supplied labour (Larmer, 2010).

With more influx of Europeans due to the booming mining industry, the demand for cheap local labour and a means for feeding mine workers soon became problematic. To manage the problem, the colonial administration applied a combination of taxation on the indigenous people and an incentive for commercial European farmers. 'Indigenous taxation' as it was known, took various forms such as hut tax, crop tax, poll tax and animal tax. These were paid in cash, thereby requiring a cash income. With the increasing tax burden coupled with low income from agricultural produce, job search in the mines inevitably sparked more rural-urban migration (Fraser, 2010). However, to ensure that indigenous tax remittance continued from the rural-urban migrants, at the same time ensuring access to cheap food, the colonial administration introduced further restrictions. For example, mine-labourers were not allowed to move into urban areas with their families and were also paid very low salaries. This left the labourers with limited options, other than to continue as cheap labourers, at the same time engaging in farming to diversify income sources. Rural areas continued as suppliers of both labour and cheap farm produce (Gewald and Soeters, 2010).

2.2.3 Post-colonial era

At independence, the newly formed indigenous government under Kenneth Kaunda embarked on a radical reversal of all 'divisive' colonial legislation in a bid to rearrange the land ownership system. Using socialism along customary laws, land was simply categorised either as State Land

(formally CL), or Customary (formally TL and NTL), but still anchored on English Law (Mvunga, 1978). However, the rearrangement became problematic for the newly independent Zambia as it suspended property holding rights. Kaunda made several decrees about land rights and consolidated the decrees by a land mark legislation of 1975 which vested all powers to the presidency (Mvunga, 1978). Under this legislation, land was a gift from the creator and selling it, as in a capitalist world was viewed as evil. The presidency held all land in perpetuity on behalf of the Zambian people (Mushinge, 2016). This inadvertently undermined the traditional customary land tenure system just like in the colonial period as it stripped traditional leaders of powers in decision making process on matters of land governance (Mushinge, 2016). Freeholds were abolished and replaced with a renewable statuary leasehold tenure of 99 years. Even then, the 99 years' leasehold tenure prohibited the holder from selling the land. It could also be repossessed by government if no tangible development occurred within the agreed fixed term. According to Mvunga (1978), ownership by non-Zambians was illegal and attracted serious penalties except through the 'alienation of land' Act of 1985 under strict conditions as follows:

- proven ability to be an investor in Zambia;
- the president has given under his hand, in writing;
- rights of ownership being inherited under other operational law;
- proof of being a non-profit or a charity organisation and right arose out of a lease.

Nevertheless, even under these circumstances, the holder was not permitted to sell or lease to third party (Mushinge, 2016). In 1991 however, at the fall of Kaunda regime, the successive government under Frederick Chiluba re-established the colonial worldview with a capitalist lens. Within three years following the Lands Act of 1995, ownership, from mining plants to government owned housing, and businesses went into private hands. Aimed at both attracting investment for national development, this legislation allowed acquisition and trading of land to individuals and organisations but maintained the two distinct land tenure systems created by Kaunda (GRZ, 1995).

Today, under statutory tenure system, which applies mostly in urban and peri-urban areas, land is administered by local councils. Local authorities demarcate and assign land for different uses such as residential, business and industrial. However, holder permits, or land title issuance remains the sole responsibility of the Ministry of Lands. In practice, acquiring land through statutory system requires a non-refundable fee determined by the local authority as a measure of 'the ability-to-develop-the-land' (Mushinge, 2016). Given the influx of Chinese investors offering financial inducements to local chiefs and corrupt government officials, this approach has been problematic for poor and vulnerable communities (Fahmida, 2017).

To the contrary, customary land tenure continues to be under traditional leadership - chiefs and village headmen give land in rural areas. While it is the most easily accessible as it is also acquired through inheritance along family lineage or kinship, customary land is not well documented. Traditional leadership demarcate and apportion land by verbal 'permits' (Ng'ombe and Keivani, 2013). Boundaries between chiefdoms and individual verbal permit-holders are arbitrary and unclear - a potential for land conflicts. In this regard, customary land tenure system continues to be regarded as the most insecure as it lacks any form of accountability and transparency (Mushinge, 2016).

Within the post-colonial era China has emerged as a new external force seeking raw materials for its growing economy (Kragelund and Hampwaye, 2012). And as climate change threatens global food prices and energy security (CIDSE, 2015), China-driven large-scale land acquisitions target Zambia along with other African nations (Yan snd Sautman, 2010). Through this land acquisition process, which some could argue, is agro-imperialism, a new form of neo-colonialism appears. Traditional/customary land considered by government as 'underutilized' but occupied by smallholder farmers is slowly being taken over by China under the concept of redemptive development and development by dispossession (Carmody et al., 2012; Chatelard, 2014; Makki, 2014) . This land grabbing is largely for large-scale crop production and in some cases, mining - both driven by capital accumulation that is principally interested in geographies

and settings where profit can be generated easily, regardless of institutional, structural conditions, location, boundaries, or nationalities (Vhumbunu, 2016). For this reason, the land gab exercise by the Chinese in Zambia highlights a clear political ecology around land resource access and control, as well as state relations.

Although some argue that China's agricultural engagement in Zambia is an influx of ideologically driven agro-socialist mode of cooperation and investment in the context of the Cold War (Hofman and Ho, 2012; Yan and Sautman, 2010), it is evident that this 'investment and cooperation' has shifted into a fully-fledged profit-driven agro-capitalist mode since the 2000s (Sojková, 2018). Though there is a lack of data on migration numbers, the Chinese population appears to have been increasing to the level that locals became weary and somewhat xenophobic by 2010 - a condition that provided an opportunity for the popularist opposition leader Michael Sata, to ascend to presidency in 2011. Sata rode on the local people's frustration and popularised the 'Chinese deportation' rhetoric (Postel, 2017). However, as soon as he ascended into presidency, the rhetoric was reframed, and the deportation slogan abandoned. Instead, more Chinese people arrived with various investment options in the extractive sector; and because of their financial capital strength, major road infrastructure development projects were tendered to them by government (Vhumbunu, 2016). The impact of these investments, infrastructure development and their significance on land use dynamics, Chinese and local population flows, and the distribution of the economic benefits require a separate investigation as highlighted in Chapter 9.

2.3 Agriculture and rural development

About 32 percent of Zambia's total area is agricultural land but only about five percent is arable (CGIAR, 2017). Figure 2.6 shows the major soil types. Acrisols are common with luvisol-phaeozem in few places. Luvisol-phaeozem and cambisol-luvisols are commonly found in low lying areas of interfluves such as the Kariba and Kafue basin. Soils are generally of moderate

fertility status with salinity or acidity problems in some over cultivated land parcels and tend to be sandy, leached and underlain with hardpan (Scott, 1995; Rashid et al., 2013). Under good management however, crops can be produced with high yields and quality. Commercial farmers regularly produce more than six tonnes per hectare of maize (Xu et al., 2009). With frequent droughts, semi-wetlands normally referred to as dambos are utilised for food-crop production (see Chapter 5). Dambos are seasonally waterlogged, grassy depressions found in river basins surrounding most southern and central African rivers into which fluvial materials from runoff and seepage collect (Scoones, 1991).

2.3.1 Colonial period

Agriculture largely remained underdeveloped in the colonial period since Northern Rhodesia was regarded as an annex to Southern Rhodesia, now Zimbabwe - a colony that attracted more European settlement between the two 'Rhodesias'. Thus, although European settler-agriculture and mining industries developed in Northern Rhodesia, Southern Rhodesia provided much more attraction and "investor" confidence. In spite of the mines which generated relative bigger revenues, the north remained underdeveloped and largely rural as much of the capital was injected into developing Southern Rhodesian infrastructure, farms, factories and service industries (Gewald and Soeters, 2010; Sardanis, 2014). The colonial interest merely reinforced the tendency of economic activity, other than mining, to concentrate in Zimbabwe (Scott, 1995).

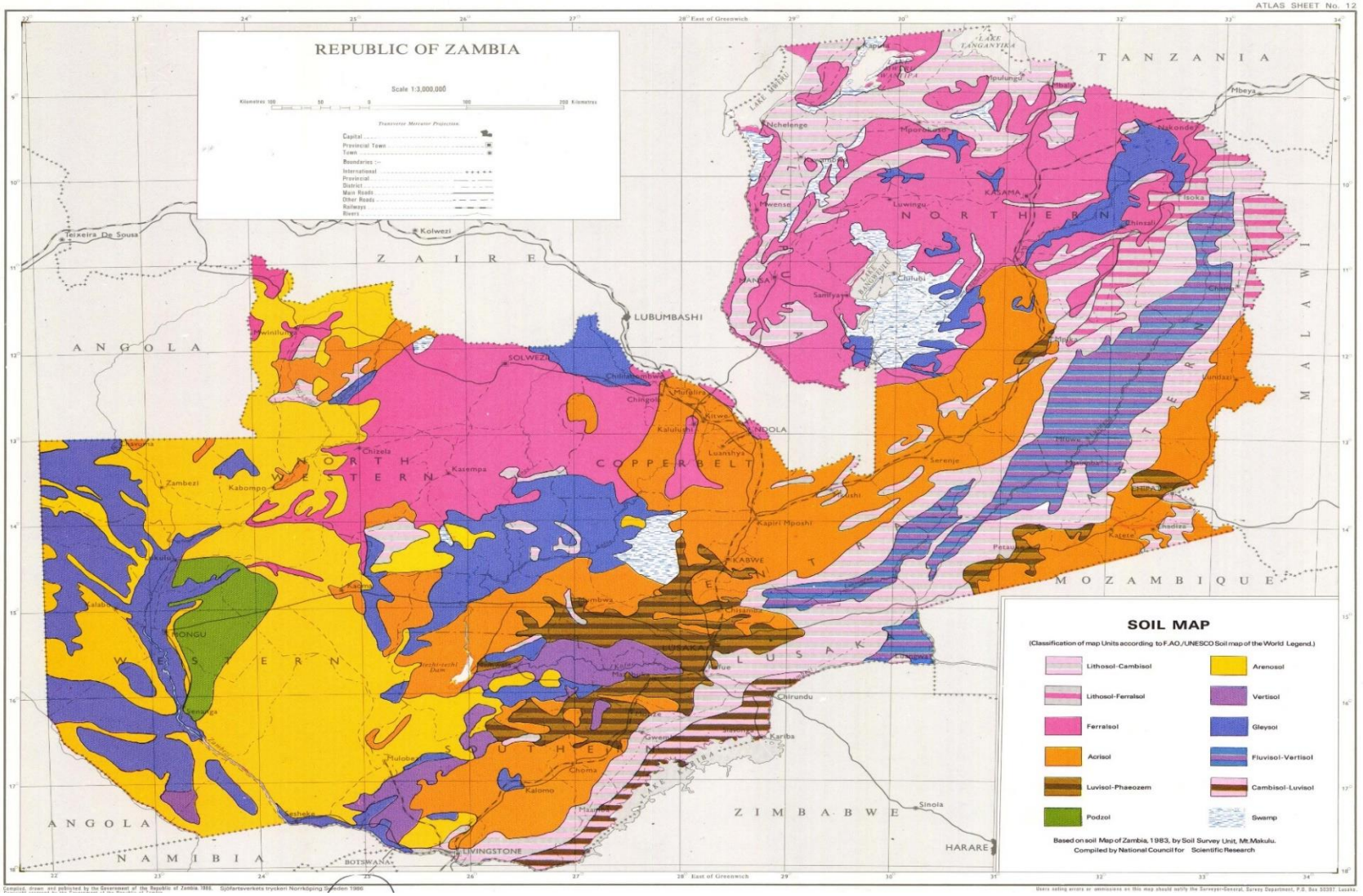


Figure 2.6: Soil map of Zambia 1986 (ESDAC, 2018).

2.3.2 Post-colonial period

After gaining political independence 1964, Northern Rhodesia, now Zambia introduced a new governance system which would last till 1973. Referred to as the First Republic in mainstream narratives; see e.g., Larmer (2011); or Sardanis (2014), the governance system embraced multi-partisan politics, but heavily dominated by Kenneth Kaunda's United Nation Independence Party (UNIP). With an indigenous taking over power as republican president, Zambia was a shining model of self-political rule on the African continent and by 1969, based on copper expert earnings, it was categorised as a medium income country. It had one of the highest per capita incomes: higher than that of South Korea, Turkey, and Egypt (Fraser, 2010).

Within 5 years of self-rule however, mines, private businesses, farms and factories were nationalised after Kaunda accused foreign mine owners and businesses of externalising profits, leaving the Zambian exchequer with none for development projects (Fraser, 2010; Gewald and Soeters, 2010). Parastatal companies quickly formed and took over the management of businesses under the famous maxim "on behalf of the people, for the people and by its people". However, agriculture and rural areas remained underdeveloped as mining still provided the biggest revenue for the government and its urban population. As Fraser puts it:

> *...the wealth generated from mining in the early years of nationalized industry had an important impact on the people…supported the self-confident, cosmopolitan identity…Zambians saw themselves as active participants in the production of global wealth and political trends…Life featured an unusually high concentration of motor cars, fashionable hairstyles and European style night clubs. Football teams sponsored by the mines appeared as worthy opponents for leading international sides on tour, and Zambians paid close attention to their teams' fortunes in the domestic league* (Fraser, 2010 p.8).

However, this success was short lived as the economic trade model inherited from the colonialists involved selling all minerals through London Metal Stock Exchange (LMSE), exposing the income to global price fluctuations. With the failing mining sector, government turned to agriculture as an alternative.

2.4 Soil erosion and degraded farmlands

2.4.1 Colonial era

With rapid increase in copper production, the demand for electricity increased and a dam construction was proposed by the colonial government in 1954 in the lower Zambezi River valley. To pave way for the construction of one of the largest man-made lakes, indigenous people along the Zambezi River valley were displaced. The displacement was a major turning point in fishing and local agricultural livelihoods. More than 35,000 indigenous farmers benefiting from the alluvial soils and indigenous acacia (*faidherbia albida*) woodlands along the valley were relocated to the plateau zones along Kalomo, Choma, Monze, and Mumbwa (Colson, 1971). In the relocated areas however, soils were not as good: environmental degradation and soil erosion problems emerged within five years of resettlement on most indigenous farmlands (Makings, 1964). This negatively impacted on food-crop production, increasing commodity prices. In response, the Federal government introduced agricultural and soil erosion management strategy through the comprehensive African Improved Farmer Scheme (AIFS). The scheme focussed on training indigenous farmers on land management. For this purpose, the Kanchomba Agricultural Research and Training Institute (KART) established in 1936 in east Choma rural was revamped.

According to Makings (1964), KART - specialised in practical training of farming techniques became known as 'Kanchomba' formula. The techniques included ridging, tillage, ripping, animal manure, composting and crop-rotation. Later focus went on chemical fertilizer use to manage soil exhaustion and degradation. From the formulation of the maize control policy in 1930s by colonialists, maize-mono culture was the mainstay for indigenous farming albeit lower selling prices below that of colonial farmers (Makings, 1964). To increase earnings, indigenous farmers extended farmlands for more crop land, but continued the maize mono-cropping, resulting in widespread soil exhaustion and land degradation problem. However, with the

adoption of the Kanchomba formula, farmers who were found complying were awarded a certificate of satisfactory performance (Bowman, 2011). The certificate entitled them to receive a maize selling price increase at 22 percent higher than the available price for their category as indigenous farmers. The higher price was, of course, only available for clearly improved farmland. 18 percent was deducted as a contribution to the AIFS. To receive the remaining 4 percent, an indigenous farmer needed to demonstrate exceptional conservation standards of cultivation and weed control (Makings, 1964). Fertilizer application increased crop-yields three-fold, while ridging and ripping contained soil erosion between maize fields and between lines of maize plants (Vickery, 1986; Colson, 2006; Bowman, 2011).

Following this early success of AIFS in the Southern Province, a second scheme was initiated in Central Province in 1952 (Blaikie, 1985). However, various indigenous struggles against colonial powers were already gaining ground as disenchantment and distrust spread. For instance, along low maize price coupled with the difficulty in obtaining the 22 percent increase for certified farmland performance, most indigenous farmers did not take farmland management seriously. There was fear based on past experiences that improving farmland would ultimately result in 'grabbing' by European famers (Makings, 1964). This resulted in some sort of 'underground resistance movement' through which the roll-out of soil erosion, land degradation and conservation farming programmes by the colonial government failed. Political struggle acted as a major stumbling block on soil erosion and environmental degradation interventions (Bowman, 2011).

2.4.2 Post-colonial era

The land degradation problem in post-colonial period was complex, but not any different from the colonial era. Given the historical inequalities in which agriculture and food supply was almost entirely dominated by colonial famers, Kaunda faced challenges as European famers' relocation to Southern Rhodesia at independence greatly impacted food security north of the Zambezi (Sardanis, 2014). However, from 1961 until 1991, numerous agricultural

transformation policies and extension programmes were pursued. Most notable policies are 'green revolution' and 'go-back-to-the land' which resulted in numerous socio-economic and environmental problems.

2.5 Green revolution and land degradation in post-colonial era

Specifically, for agriculture development, Lima Bank Facility was created to focus on two components within the agriculture sector, namely; smallholder farming (SHF) and state-owned farming (SF). As commercial agriculture was the preserve of the Europeans, indigenous 'commercial' agriculture, other than subsistence farming was non-existent except among a few Tonga farmers in southern Zambia who encountered the Kanchomba formula. These continued to work the land and rear animals but were unable to meet the feeding needs of the nation. Thus, Kaunda targeted and incentivized them to produce-for-sale (Sardanis, 2014). However, although farmers were given incentives, given the land degradation history on the plateau, crop yields were low (Bowman, 2011). Furthermore, people of Southern Province generally measured wealth using the number of cattle as indicator and so the meat shortage problem could not be solved (Sardanis, 2014).

However, using Lima Bank - a government agriculture bank, highly subsidised agricultural in-puts and simple loan programmes targeted small-holder farmers countrywide with Southern Province as pilot project area. With green revolution and agricultural extension becoming a government agenda between 1973 and 1985, Southern Province became the *Maize Belt* as maize production increased five-fold despite re-emerging land quality problems (Scott, 1995). In-put subsidies - chemical fertilizers and hybrid maize seed varieties from the newly established agricultural research centre at Mount Makalu led to this increase in yields (Simtowe and Muange, 2013; Rashid et al., 2013). The demand for agricultural land also increased as large portions of forest were cleared in the province (Unruh et al., 2005). New agricultural small-holding schemes were established by government in Monze, Choma and Mazabuka (Scott,

1995; Snyder and Cullen, 2014). Maize production as the only crop spread across the country, heavily supported by subsidies. In southern Zambia however, this led to more environmental problems - soil nutrients depletion, hard-pan, salinity and acidity. While these problems called for sustainable soil management strategies, continued reliance on more chemical fertilizers became the immediate option (Chevo, 2014). This marked the beginning of the second phase of environmental degradation, having first appeared under colonial rule in 1940s as leached and over-cultivated soils resulted. Crop production became costly under which farmers sought more virgin land and/or relied heavily on chemical fertilizers (Blaikie, 1985; Simtowe and Muange, 2013).

However, the Kaunda regime was determined to empower and strengthen the traditional economic role of rural dwellers while at the same time obtaining cheap supplies for the urban dwellers and political bureaucrats. Agriculture colleges and research centres were opened in all provinces as agriculture science became compulsory in the secondary school curriculum. Figure 2.7 shows the distribution of research stations and major agricultural projects. School leavers also underwent a compulsory one-year national service technical training combining agriculture and military skills (FAO, 1991).

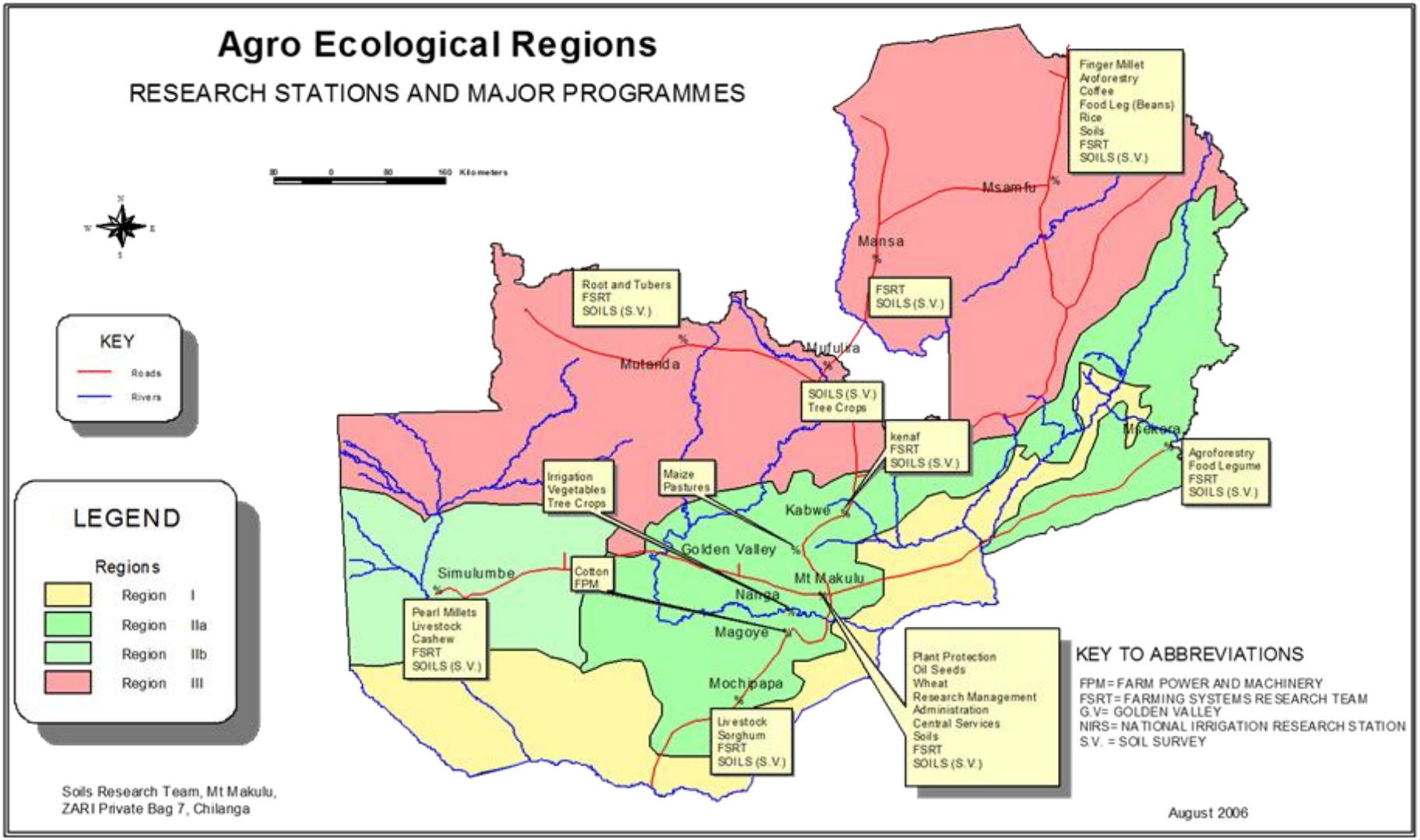


Figure 2.7: National agricultural research stations(ZARI, 2008).

To cushion trained youth unemployment, state-owned farms (SF) took over commercial farms (CF) initially ran by European farmers. Managed through a quasi-military programme by some youths under ZNS programme, SF ventures spread throughout the country. With Chinese technical assistance, SF brought agricultural schemes that had never been seen before. Forest clearance, irrigation canals, water pipes looping round, down and uphill to power centre-pivot equipment, as truckloads of fresh produce brought into urban greenmarkets became the symbol of "success". However, this success was not market driven. Spearheaded by government owned marketing system that replaced the Grain Market Board of the colonial government, the agricultural sector was among the first to experience drastic changes and price-fixing. As the umbrella body for all parastatal agri-business NAMBOARD (comprising of provincial and district marketing unions) bought and sold agricultural produce. Exchange and interest rates were set at levels grossly not backed by economic activity as currency value plummeted. Government fixed selling prices on all agricultural transactions to provide market access and reduce unemployment (Scott, 1995). With poor thrifty, NAMBOARD eventually 'bought' maize using promissory notes. Promissory notes were vouchers that allowed NAMBOARD to obtain produce from farmers on debt to be settled later. Eventually, the debt became too huge to pay and most farmers were left stranded, vulnerable and unable to buy inputs each farming season that followed (Sardanis, 2014).

However, following a mandatory national service training, most of the young people from rural areas migrated permanently into urban areas (Sardanis, 2014). The infirm, aged, and the obstinately rustic remained behind, subsisted largely on occasional remittances from the young in the city (Scott, 1995). This led to some chaotic policy interventions in agriculture which is nowhere more evident than in the 'go-back-to-the-land' national policy.

2.6 Go-back-to-the-land national policy

The ‘go-back-to-the-land’ policy was no more than an anti-urban rhetoric, like that of the agronomist Rene Dumont. The policy aimed at reversing the rural-urban migration pattern created earlier by the compulsory national service training programme for school-leavers. As unemployment figures steadily rose among the trained youths, the anti-urban messages were crafted to discourage people from staying in the city and preventing those rural dwellers from migrating to the city. Through this anti-urban campaign, rural-urban migration was ‘no good and a waste of time’ while urban-rural migration was ‘good’ as genuine development was right there in the countryside. The employed in urban areas were also continuously reminded to think seriously about returning to their villages and engage in agriculture at retirement.

To ‘walk-the-talk’, government degazetted many large forested lands along the line of rail as small-holder farm blocks specifically for retired personnel. In addition to their pension, retirees were provided free transport to facilitate their permanently reversed migration. The small holdings as they famously became known, had better access to urban markets having located along the main transport links. Arguably, they also must have had some of the most knowledgeable cultivators in form of retirees. Meanwhile, Kaunda continued subsidising urban consumption with coupons, a system that was never fool proof. As shown in Figure 2.8, coupons allowed civil service employees to obtain free maize-meal for the whole month. The coupon system was among one of the most abused facility as many other people somehow accessed it without even working for civil service. It also attracted more people to remain in urban areas than the-back-to the-land policy ever repelled. While maize crop production increased, and food security achieved albeit long-term environmental impacts, the go-back-to-the-land policy failed to yield tangible results. It was indirectly undermined by the urban subsidies policy. Most retirees were also either too old to engage in such a labour-intensive livelihood, or were simply unable to risk their pensions in the farming business (Scott, 1995).



Figure 2.8 : Coupons used to obtain free food by civil servants and loyal UNIP political party supporters

2.7 Climate change as a cross-cutting issue in national development

While concerns are global, the impacts of climate change differ between nations, e.g., developed and the least-developed nations, the rich and the poor communities. It also depends where specific countries lie in respect to different climatic systems (IPCC, 2014a). The least-developed nations and the poor are among the most vulnerable (IPCC, 2014b). Among the poor, rainfed agriculture and natural resource-dependent livelihoods, women and child-headed households are the most vulnerable (Madzwamuse, 2010).

In the Zambian context, climate change is viewed by government both as an environmental and development issue that compounds vulnerability of both biodiversity and human population. Given multi-dimensional poverty pegged at 54 percent, more than five percent of the population is already living on environmentally degraded land. Zambia records some of the highest annual averages of people affected by natural disasters in the southern African region, standing at about 26,183 per every million people (UNDP, 2016b). Climate projection reports in the National Adaptation Programme of Action (NAPA, 2007), and the National Communications Reports of 2002 and 2004 to the UNFCCC all highlight an increase in both temperature and rainfall variability and impact. In general, more anomalies are expected in rainfall in rainy season from October to May with peak concentrations between December to February (CGIAR, 2017). Foreseeable impacts are prolonged droughts, localised floods and shortened growing seasons by 2050 (IPCC, 2014a). However, these impacts are already being felt on food security (UNDP and

GRZ, 2010); water availability (Sichingabula, 1998), and energy (Sladoje, 2016). Widespread crop failure and water scarcity remain some of the major problems facing the agricultural sector, particularly the small-scale rainfed dependent farmers. Within the last 20 years, prolonged dry spells and shorter rainfall seasons have reduced maize yields by about 40 percent of the long-term average (UNDP and GRZ, 2010). Most farmers lack the capacity and financial resources to cope with climate change and variability. In addition, due to poor road infrastructure, rural farmers experience multiple problems e.g., difficulties in accessing farming in-puts and markets (Makondo et al., 2014).

However, the Zambia NAPA has been mainstreamed into national development policies starting with Vision 2030 formulated in 2006 and the Seventh National Development Plan (7NDP). Vision 2030 aims to make Zambia a middle-income country by increasing annual economic growth rates from 6 to 10 percent (Reddesk, 2009). It also aims at significantly reducing poverty levels, achieving education and access to health care for all by 2030. The Vision promotes a decentralised governance system and sets out specific targets for different sectors, e.g. for the energy sector, the share of fire-wood fuel must reduce to 40 percent by 2030 from the current 88 percent (GRZ, 2009). This vision is operationalised by the 7NDP which is aligned to the Sustainable Development Goals (SDGs). 7NDP also mainstreams and operationalises the 2010 National Climate Change Response Strategy (NCCRS) for a prosperous climate change resilient economy. Alongside NCCRS is the Zambian Forestry Action Programme (ZFAP 2000-2020) which was adopted under the 1994 National Environmental Action Plan (NEAP). Now overridden by the Forestry legislation of 2015 NEAP recognises the importance of integrating traditional leaders and local knowledge in the sustainable use and management of forest resources.

2.7.1 Framework for mainstreaming climate change agenda

Several legislations have been passed from 2003 by the Zambian government to mainstream climate change into the main development agenda within the institutional framework. Figure 2.9

provides a schematic overview for action. The office of the Vice-President, with the permanent secretary in the Ministry of National Planning, Lands, Natural Resources and Environmental Planning forms the chairing committee. The committee does the policy planning and provides guidelines on coordination, implementation monitoring and evaluation processes through the disaster management unit established by Disaster Management legislation of 2010.

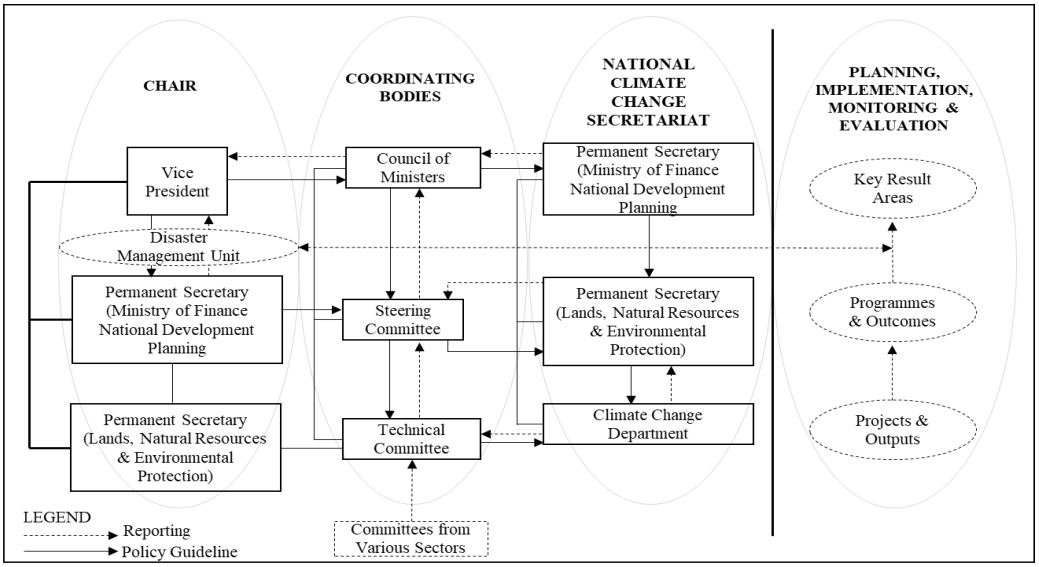


Figure 2.9: Zambia's institutional framework for the coordination of climate change action

The coordinating bodies comprises committees from various sectors, such as agriculture, energy, water, gender, education which report to the technical committee. The technical committee reports to the steering committee which reports to council of ministers. The council of ministers provides policy guidance to the climate change secretariat which sits between two ministries that form part of the chairing committee.

2.7.2 Climate change policy

The National Climate Change Policy (NPCC) was launched on 3rd of March 2017. Following the launch, the Climate Change Department was established under the Ministry of Environment and Natural Resources to facilitate effective implementation of NPCC. For purposes of coordination, overall oversight and mainstreaming of climate change in national development planning processes, this department closely collaborates with the ministry responsible for

national development planning. The policy is aimed at stemming the impact of climate change and subsequent reduction of the country's annual economic growth due to crop failure and the impact of climate change on energy production. Driven by the Ministry of National Development Planning, it includes a special consideration of vulnerable groups such as poor rural women, children and the youth (CIF, 2017).

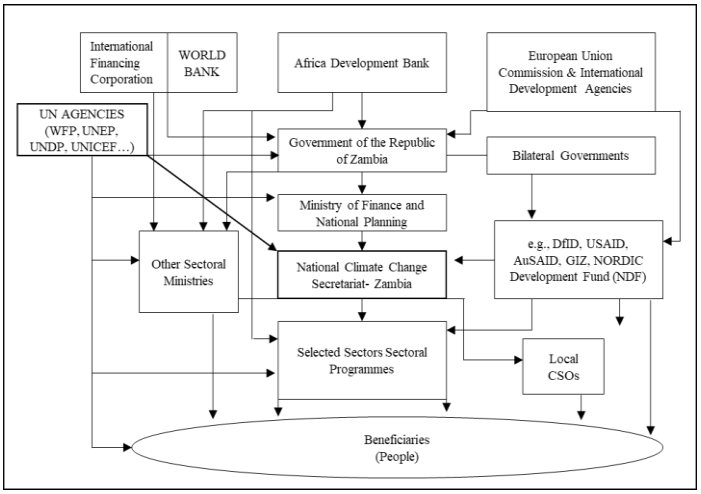


Figure 2.10: Governance in Zambia's climate adaptation support programmes

2.8 Projects: climate change mitigation and adaptation responses

There are numerous programmes and projects running under the umbrella of multiple stakeholders other than the UNFCC. They range from piloting on resilience in specific sectors to human capital training and institutional capacity building. From the global level to local beneficiaries, the institutional framework and linkages for technical support and financial flow for mainstreaming climate change in the global sustainable development agenda is shown in Figure 2.10. The National Climate Change Secretariat (NCCS) under the Ministry of Finance (MoF) provides overall responsibility for coordination and execution of projects.

2.8.1 Pilot programme for climate resilience

Established under the multi-donor Climate Investment Fund (CIF) the Pilot Programme for Climate Resilience (PPCR) is aimed at assisting countries shift from 'business as usual' to climate resilient development path. It is consistent with poverty reduction and sustainable

development goals. Financed by global climate funds, PPCR supports climate resilience and adaptation policies and projects on a sector-by-sector and project-by-project basis (CCSZ, 2017b). Targeted sectors are agriculture, natural resources, transport, health, water, energy, and disaster risk management. The lower Zambezi-basin's Strengthening Climate Resilience (SCRP) 2013-2019 Phase II project is a classic example. Under this project, 8 districts and 24 wards - a total of about 25,000 households have been targeted. Priority is given to female-headed, most vulnerable households, and innovating 'champions.' Innovating champion's award focuses on locally designed and/or locally-led initiatives such as flood management, tree planting and conservation of local forests. This is based on the idea that since climate change affects many aspects of vulnerable community lives, resilience and adaptation must be led by such communities themselves (CCSZ, 2017b). Within PPCR, another notable project is the Kafue sub-basin SCRP. Funded by the African Development Bank from 2014 to 2019, the project envisages to foster sustained economic growth, reduce poverty and enhance food security through strengthening the adaptive capacity of 800,000 targeted farmers. Focussed primarily on community-driven transformation, both projects closely consult local beneficiaries, collate and share information with a view to replicate and scale-up to other areas. Total cost of the PPCR is approximately US$79m (i.e., US$36m from the World bank, US$5 from Zambian Government and US$38m from the African Development Bank (CIF, 2018).

2.8.2 Climate Smart Agriculture (CSA): conservation farming and agro-forestry

From Zambia's total annual emissions estimated at 364 $MtCO_2$ equivalent in 2012, agricultural greenhouse gas emissions contribute about 7 percent (CGIAR, 2017). Like PPCR, CSA is aimed at reducing effects of droughts and climate change in AEZ I and II among small-scale famers though synergies between climate-resilient agricultural development, and sustainable water resource management. Implemented by the Conservation Farming Unit (CFU) under the UNFAO's Economics and Policy Innovations for Climate-Smart Agriculture Programme (EPICSA), the first phase ended in 2017 having started in 2013. However, extension is expected

with financial support from UK's Department for International Development (DfID), European Union and Swedish International Development Agency (SIDA) (CGIAR, 2017). Similarly, Climate Resilient Livestock Management project (CRLM) funded by Least Developed Country Fund (LDCF) targets and train farmers in manufacturing livestock-related products as a way of diversifying income sources. It also ensures that alternative livelihood options being explored are consistent within agro-forestry and natural forest regeneration project being promoted by partner organisations.

2.8.3 Community-based climate resilient: Indigenous forest regeneration pilot project

Costing about U$20m under LDCF, this project covers part of the study area in Central Province as shown in Figure 2.11. Focussing on securing natural resources that underpin rural livelihoods, the project is aimed at promoting community-driven regeneration of indigenous or local forests at community grassroots level. For this purpose, Village Action Groups (VAGs have been formed (UNDP et al., 2015).

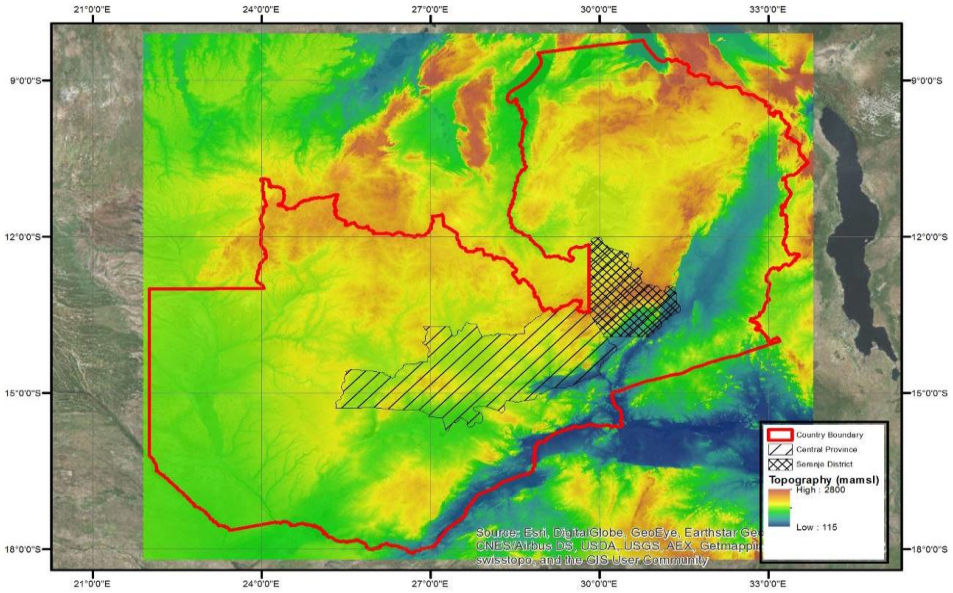


Figure 2.11: Location of pilot project on community-based indigenous forest regeneration in AEZ IIa (UNDP et al., 2015)

VAGS will decide the distribution of benefits according to community priorities. Using their indigenous knowledge integrated with scientific conservation practices, local communities are expected to plan and implement measures for maximum environmental benefits. The project

also hopes to collaborate with Community Markets for Conservation (COMACO), which links access to local and overseas produce market-linkages for valued local trees such as rosewood timber (UNDP et al., 2015). This will be the first project to integrate indigenous and scientific knowledge system in Zambia. Traditional knowledge-based forest conservation has largely been overshadowed by laboratory research. However, laboratory research tends to focus on a few timber species of high value for external markets, rather than on collective biomes. Due to such limitations, ingenious knowledge on managing forest ecosystems in Zambia has not been effectively collated with scientific knowledge. Where it is collated, it is seldom ready for immediate application (Kapungwe 2000; UNDP et al., 2015).

2.8.4 Capacity building: Energy and low emissions capacity building

As a global initiative for supporting national climate change mitigation efforts, Low Emission Capacity Building Programme (LECBP) focusses on developing strategies and enhancing the measuring, reporting and verification systems in the energy sector. Launched in 2011, LECBP is part of the joint multilateral collaboration between the European Union Commission, UNDP, UNEP, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (CCSZ, 2017a). In Zambia, LECBP has focussed on enhancing appropriate tools through training to support Nationally Appropriate Mitigation Actions (NAMAs) and shift towards a green and energy-efficient economy (MacEachern, 2014).

2.9 Chapter summary

The chapter has laid the foundation for a holistic and broader understanding about how certain social, economic and environmental problems emerge and/or propagate along livelihood options. As demonstrated in this chapter, a political ecology lens offers an understanding about the source of environmental problems, inequality, social injustice (e.g., access and utilisation of economic opportunities and resources) among different social groups. It is an important aspect of policy design to offer a different, equal, just and sustainable future. As shown, the

environmental degradation and marginalization of rural livelihoods have been propagated by monopolistic, elite-centric political representations, hegemonic and discriminatory policies, vis-à-vis inequitable allocation of resources. The political ecology in colonial and post-colonial government towards rural development did not differ in many aspects. They both indirectly exposed rural subjects to multidimensional poverty with long-term social mobility foreclosure. In both regimes, livelihoods vulnerability and environmental degradation exacerbated by capitalism confronted the poorest in different guises, more so in rural areas. Poverty disproportionately jeopardized the livelihood prospects of the poor. Under colonial regime, indigenous taxation and extraction of minerals using cheap labour reveals a carefully designed process of subjugation through which profit maximisation is achieved, but with long-term environmental implications. Similarly, after independence, post-colonial politicians adopted the same model, obtaining cheap rural food supplies for the urban population, at the same time discounting the importance of rural development. This had some profound effects on environmental degradation, soil quality, erosion, and deforestation in which the farmers themselves and not policy makers became the long-term casualties. Mitigation measures were top-down and thus faced community resentment. Similarly, climate change adaptation and mitigation measures are top-down as communities continue to be dictated to on what measures to follow. Within the mainstreaming of climate change into multi-sectoral development agenda, policy chaos manifests in different sectors. Even following the launch of NPCC in 2017, lack of harmonisation characterises the implementation of NAMAs and LECBP.

Climate change and food security are moral, ethical and social justice issues in which the concept of power relation, access and control are important. Yet, climate change and agriculture literature have only narrowly considered power analysis. The concept of power relations has been understood from the position of authorities, i.e. social groups make decisions and control resources of another (Eriksen et ala., 2015). For example, to appreciate the role of power relations and structures in green revolution or current CSA policies, a more nuanced

understanding of power encompassing the influence of historical social justice issues, decisions of transnational political networks and social groups is needed. Furthermore, the popularisation of scalar arrangements and governance that structure mitigation and adaptation responses is a relevant concept for evaluating climate change programs of action. The distribution of institutional power relations and scalar arrangements beyond agrarian communities have a profound influence on how scientific knowledge on CSA is formulated. How global politics around climate change is influenced, shaped and administered and how local realities on vulnerability are represented or mispresented, included or excluded by northern institutions can only be understood through a critical political ecology lens (Hulme, 2010).

CHAPTER 3: THEORETICAL FRAMEWORK

3.1 Introduction

This chapter lays the methodological foundation applied in the next chapter. It introduces and explains the key theories and concepts utilised in this research. This is done at three levels: 1) by tracing their origin and development; 2) by conceptualising and discussing their strengths and weaknesses; and 3) by justifying their associated methods in guiding this research. As stated in Chapter 1, the main objective of this research is to understand linkages between environmental change and human displacement or migration - how changes in climate, environmental degradation, droughts or floods affect people in rural livelihoods; and how rural livelihoods impact on the environment in turn. The theoretical framing and methodology required to investigate this dichotomy cuts across disciplines within the social science on the one hand, and across physical sciences on the other. Under the broader framing of political ecology, the three most influential theories are discussed in the subsections that follow, with an assumption that they are substantively connected in sequential ways and therefore materialise from similar logic. These are: migration theory, social-ecological systems theory and sustainable livelihoods.

3.2 Migration theory conceptualisation

Migration is the movement of people from one place to another due to various reasons such as demographic, social, economic, political, and environmental factors (Black et al., 2011). In broader terms, migration takes four temporal forms as shown in Table 3.1 after Hugo (1996); Adger (2006); Renaud et al (2007); Raleigh et al (2008).

Table 3.1: Temporal and spatial scales of environment and migration processes conceptualisation

ENVIRONMENTAL CHANGE PROCESS		**MIGRATION (Forced or Voluntary) RESPONSE**	
TIME	SPACE	TIME	SPACE
1. Sudden 2. Gradual	1. Local 2. National 3. Global	1. Temporary 2. Seasonal 3. Annual 4. Permanent	1. Local (within boundaries) a) Rural-rural b) Rural-urban c) Urban-rural 2. International/transboundary a) National, continental, and Inter-continental

Throughout this thesis, environmental displacement is understood, after Lunstrum et al's (2016) definition, as a process by which individuals, households or communities find their main livelihood asset altered in ways that manifest foreclosure to basic wellbeing, impeding continued habitation. Poor soils unable to support food-crop production and lack of water or access to natural capital within the confinements of the environmental spaces and landscapes are classic examples. However, migration is better viewed as a continuum between forced and voluntary movements (Hugo, 1996; Raleigh et al., 2008; Kniveton et al., 2008). In this thesis, it is conceptualised after Hugo (1996), as population mobility arranged along a continuum from totally voluntary to totally forced, with most cases lying somewhere in between. This conceptualization is necessitated by the intensity or impact of a factor, and/or combination of factors driving a movement but differs between individuals, such as on gender, age and income (Neumann et al., 2015; Mutabazi et al., 2015). For example, an individual who has lost key livelihood assets from a combination of factors is likely to be more willing to leave, than one who has not. Similarly, a widowed woman in a rural setting with strong cultural and traditional norms where ownership of key livelihood assets is controlled by men is more likely to suffer multiple impacts than their female counterpart who is married. As such, she is more likely to remain in an area of high risk than men or indeed other women, due to differentials on access to land, technology and loan facilities. Similarly, like the poor who may be unable to migrate due to lack of resources, the older generation is more likely to remain dormant in areas of risk due to cultural attachment to land. These may be greatly impacted by disasters than young people or their old counterparts who are relatively rich. Thus, an environmental impact triggers different responses among different people of the same location (UK-GOS, 2010).

3.3 Migration drivers

While mainstream debates on environment-migration and adaptation have tended to focus almost entirely on displacements and have cast migration as a problem, the influence of environmental change can be variable and is still largely poorly represented in standard theories of migration (Hartmann, 2010; Black et al., 2011; Tacoli, 2011; Geddes et al., 2012a; Joseph and Wodon, 2013). With an increased volume of literature on migration studies, five main drivers of migration (regardless of space as conceptualised in Table 3.1) can be distinguished as shown in Figure 3.1.

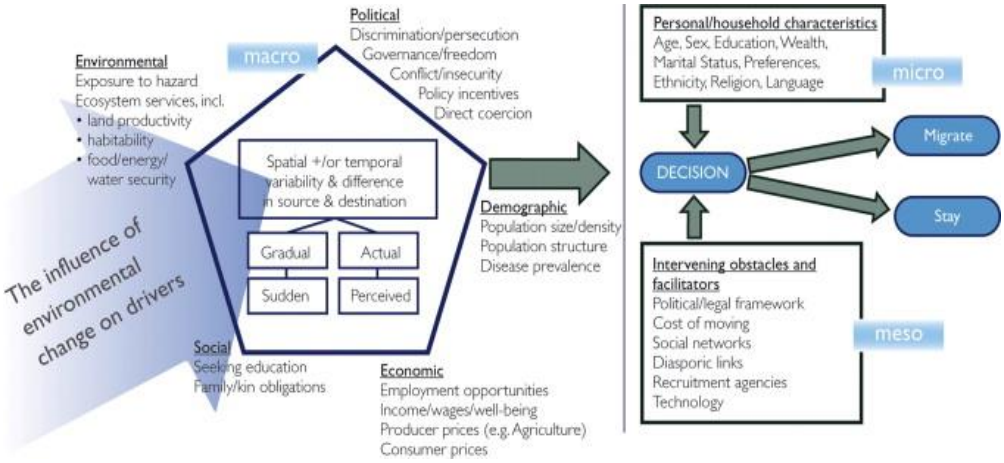


Figure 3.1: Conceptualising migration drivers (Black et al., 2011 p.55).

These are: political, social, economic, environmental, and demographic drivers. They are discussed at length below.

i. **Political drivers**

Governance breakdown, e.g., a failed state resulting in social conflict, insurgency, political persecution or violence may force people to leave. Similarly, government policy to relocate people for an infrastructural project may impact directly on a certain portion of the population and force migration either as a push or pull factor. However, as Black et al (2011) argues, the conflict-based form of migration is usually just to get to the next conveniently safe place. There is no clear threshold beyond which this type

of migration is triggered, given logistical limitations and other factors. Studies have shown that even in the absence of actual violence, political uncertainty has driven people out of their homeland. Similarly, in the presence of violence, the opposite has been observed (Cavendish, 2000; Potts, 2010; Makina, 2012).

ii. **Social drivers**

Social drivers are closely linked to economic drivers. Family, community and cultural expectations are some of the social drivers as people (especially young adults) search for better education opportunities (Black et al., 2011). These movements can be rural-urban, cross-border and across continents. International or continental is regarded as cultural in some cultures such as China and Mexico (Cohen, 2004; Adger et al., 2013). Associations between places and historical connectedness usually trigger initial pull factors (Black et al., 2011). The greatest impact of social drivers of migration is on the destination areas and host communities (Anon, 2011). Migration patterns can become consolidated once established through social networks, an initial movement may lead to another and several others as 'cumulative causation.'

iii. **Economic drivers**

By and large, it is economic factors that have been studied more and documented as the main determinant of migration decisions (Geddes et al., 2012b; Gill, 2010; Adger et al., 2015; Kniveton et al., 2012). People's movements looking for better life opportunities, be it through education or dream-jobs, have all been linked to the quest for economic wellbeing. Net income differentials have been cited as the main cause of migration related to economic factors in both rural-urban migration (Bryceson et al., 2008; Bryceson, 2009), and in least-to-developed countries migration (Lilleør and Broeck, 2011). However, economic drivers are more nuanced than simply being explainable by income and wage differentials (Anon, 2011). Migration is not always unidirectional from poor to rich places (Hirvonen and Lilleør, 2015; Oladele, 2017). The scale and direction of movement will be more likely determined by the interplay of other factors

on an individual migrant. Factors such as religious beliefs, age, ethnicity, social class, level of education including active links in destination areas influence the scale and direction of migration (Geddes et al., 2012b; Kniveton et al., 2012). Of great importance under economic factors are remittances (Anon, 2011). Remittances play an important role in resilience and vulnerability reduction in migration sending areas as it acts as a means for spreading and reducing risks on livelihoods (Hoddinott, 1994; Adger et al., 2002; Adams and Cuecuecha, 2013; Ratha et al., 2011; Clemens et al., 2015; Naiditch et al., 2015).

iv. **Environmental drivers**

Environmental conditions may act to either pull or push migration (Kniveton et al., 2012). If livelihoods are severely affected by the environmental factor, migration may take place. However, other than sudden events e.g., floods, typhoons, tsunamis, hurricanes, tornadoes, mudslides and earthquakes, it is not clear at what point non-sudden, slow onset or gradual environmental change factors trigger migration. However, what is clear is that slow onset environmental factors do not singularly drive migration, but do so in interaction with other drivers (UNEP, 2011; Black et al., 2012; Adger et al., 2015). Nonetheless, it is still unclear about the extent to which this interaction eventually results in movements, and whether these movements will be permanent or temporal as resilience to exposure differs across gender, age, cultural practices, economic status and government policy (Geddes et al., 2012b).

As shown in Figure 3.1, the actual drivers of migration as a means of adaptation are numerous, and it is quite difficult to isolate and ascertain the environmental component as a direct cause of movements (Piguet, 2010b). And as consensus holds, there is no-one called “climate” or “environmental migrant” (in the narrow sense of the word, exclusively moving for environmental reasons) except for sudden environmental shocks (Piguet, 2010a; UK-GOS, 2010).

v. **Demographic drivers**

> Demographic dynamics are complex and as research has demonstrated, it is not population density in a given area that triggers migration, but rather, poor living conditions, squalor and lack of access to sanitary facilities (Plane, 1993; Sambisa and Stokes, 2006; Potts, 2016). Young people are most likely to move leaving an aging population behind. However, as studies have shown, aging population areas can also be a pull factor of migration for young people to take up jobs, especially in developed economies which may include care jobs (Black et al., 2011).

As a large volume of migration literature has shown, while these drivers have been separately and distinctly discussed, it is important to note that these factors interactively influence the binary 'stay' or 'migrate' decision process in a complex fashion (White, 2011; Verhoeven, 2011; Black et al., 2011).

3.3.1 Migration as a component of livelihood security

In this study, the focus is on the least-understood form of population mobility in climate change resilience and adaptation enquiries: rural-rural migration. In general, the adaptation and resilience roles that migration can play in the nature-society nexus has not been given much scholarly attention. Many contemporary narratives on this subject often depict migration as the result of failure to adapt to the changing environmental conditions, rather than as a possible way of enhancing adaptation (Adger et al., 2002; Lilleør and Broeck 2011; Black et al., 2011; Kniveton et al., 2012; Craven and Gartaula, 2015). It was not until the early 1990s that this was given attention after alarmists like Norman Myers hypothesised environmental migration with a sensational vocabulary. Myers (1993) projected alarming migration figures showing how the 'environmental refugee' problem would rank as one of the foremost human crises of all time (Piguet, 2013). Although this work received tremendous media attention (Piguet et al., 2011), the term 'environmental refuge' can be traced back to Lester Brown of World Watch Institute who popularised its usage in 1970s and furthered by El-Hinnawi, invoking an image that garnered public attention (Piguet et al., 2011). However, studies on migration as a strategy for

livelihood security; or migration as a means of adaptation to changing environmental conditions remain somewhat empirically and theoretically constrained (UK-GOS, 2010; Adger et al., 2015; Bylander, 2015).

While there have been limited investigations into how environmental change interacts with other factors to force migration (Kniveton et al., 2012; Adger et al., 2013; Whitfield, 2015) it is important to note that there have also been few studies on migration impacts on the environment (UK-GOS, 2010; White, 2012; Piguet, 2013; Obokata et al., 2014; Hunter et al., 2015; Adger et al., 2015; Neumann et al., 2015). The migration-environmental change nexus is a complex one and recent studies, for example Geddes et al (2012b); Black et al (2012); Bylander, (2015); Adger et al (2015) have shown with some robust evidence that environmental impacts on migration are far more complex than simply being a response to singular event or income loss. Some context specific environmental shocks do not spur migration; or do so only selectively, suggesting that migration as adaptation vary by context. Moreover, the links between heightened vulnerability, risk, and migration remain unclear. New economic theories and the perspectives of environmentally motivated migration assume that migration is a response to increased vulnerability. This discourse suggests that despite environmental distress, local livelihoods and investments are still relatively profitable and valued (Bryceson and Howe 1997; Osbahr et al., 2008; 2011). However, in some rural economies, it remains unclear whether migrants are diversifying risk through migration; or whether they are coping with highly risky environments through shifting the bulk of resources to the least risky alternative location (Bryceson, 2002; Osbahr et al., 2010). What is certain however, is that everyone is potentially a migrant, as people have been moving for millennia and centuries, with ancestral humans having left Africa about 120,000 years ago, and that migration itself is one of the several adaptative strategies for avoiding loss of income or livelihood (Piguet, 2013; Adger et al., 2015; Neumann et al., 2015; Connolly-Boutin and Smit 2016). As evidenced in the Sahel and other drylands, in times of drought and other stressful environmental conditions e.g., lack of good pasture,

affected people have regularly migrated away from such harsh conditions as a response to avoid loss of livelihoods (Kniveton et al., 2012; Neumann et al., 2015; Richmond et al., 2015; Mutabazi et al., 2015; Connolly-Boutin and Smit 2016). For pastoralists and nomads, such movements are an integral part of livelihoods, safeguarding against the loss of animals which they perceive as great wealth and status symbol (UNEP, 2011). As exhibited by the 40 years of Harry Cook's depiction of the African Odyssey, people in Africa (among them the Fulani of Nigeria, the Maasai of Kenya, the Mundari of Southern Sudan and the Berbers of Morocco) have used migration as a livelihood adaptation strategy for centuries (Styles, 2015).

In the Kalahari of southern Africa, Sporton et al (1999) and Thomas et al (2008) have also demonstrated how rural people - the Khoisan and Xhosa ethnic groups adapted to droughts through temporary circular movements, either as individuals or as collective. Through circular movements, community association formation and sometimes focussing their investment away from crop production to livestock stocking, they spread and reduced risk on their livelihoods. In this case, migration or changes in investment became an adaptation strategy to the changes and variations in environmental conditions. This role migration plays and the transformation of livelihoods in the social-ecological system interactions remain largely neglected. For example, it was not until 2014 that the Intergovernmental Panel on Climate Change (IPCC) acknowledged for the first time, through its Fifth Assessment Report, the broader connections and implications a changing climate has on human mobility. But these implications have been demonstrated in earlier works within the dominant literature on migration, notably Hugo (2011); White (2012); Piguet (2013); Obokata et al (2014); and Adger et al (2015). However, in its Fifth Assessment Report, the IPCC acknowledges and gives a thoughtful cognisance of migration and assesses it both as an impact and as an adaptation response to climate change. Notable sections of the Report include livelihoods and poverty- Olsson et al (2014); food production systems - Porter et al (2014); Africa -Niang et al (2014); rural areas - Dasgupta et al (2014); urban areas - Revi et al (2014); human security - Adger et al (2014); emergent risks and key vulnerabilities -

Oppenheimer et al (2014). Nonetheless, the IPCC report is devoid of an explanation and a projection on how climate related migration may impact on environmental conditions in the future.

3.3.2 Rural-urban migration

Rural-urban migration is on the rise in Africa and the reasons for this are two-fold: the increase in the population with the majority being youths below 30 years looking for better lives away from rural livelihoods (Bryceson, 1996; Bryceson and Howe 1997; UNEP, 2011); and the loss of livelihoods in rural areas emanating from degraded agricultural land. With climate change, unproductive land is exacerbating the challenges faced in rural communities whose livelihoods are predominantly ecosystems and natural resource dependent (Drechsel et al., 2001; Whitfield, 2015). As observed by the United Nations Environment Programme on the Sahel's changing environmental conditions:

> *Increasingly, the Tuareg and the Fulani pastoralists in northern Niger cannot find enough available pasture, water or land to sustain their traditional livelihood. Though some have tried adaptation mechanisms, such as planting fields in the marginal land of the pastoral zone or buying supplemental fodder to sustain their animals, many have lost their herds and migrated to urban areas in search of alternative livelihood options* (UNEP 2011, p.55).

In this vain, rural-urban migration (like international migration) is potentially a strategy to avoid environmental change by seeking alternatives (adaptation) for economic reasons (Abramitzky et al., 2013). With social networks, remittances have grown rapidly over the past decade and are undoubtedly an important aspect of resilience in both rural-urban and international migration (Naiditch et al., 2015). Unlike in rural-rural migration where remittances may perhaps be in the form of crop or fertilizer, remittances in rural-urban or international migration are predominantly monetary. For instance, remittances from diaspora to Africa is now a multi-billion-dollar transaction. It surpassed international aid in 2010, and falling just below it in 2013 (Ratha et al., 2011; Abramitzky et al., 2013; Naiditch et al., 2015). Within Africa, and within specific countries, movements of the young and the semi-skilled people is largely labour driven.

In Nigeria for example, the men leave for months, sometimes years, hoping to return with savings earned in cities – highlighting the difficulty of living purely on a fishing-related livelihood (UNEP, 2011). Remittances can be a major source of income for poor rural families and an important element in adaptation and resilience building to economic and environmental shocks. In Zambia, a similar scenario emerged in a study on socioeconomic impacts of floods and droughts among households located in the middle Zambezi valley. Households devised several coping and adaptive strategies where coping included; disposal of assets, reliance on remittances and piecework at neighbouring farms; while adaptive strategies included streambank and floodplain cultivation, and long-term relocation or labour migration (Bosongo et al., 2014). However, as noted by Bosongo et al (2014), such response mechanisms are short-term and some conflict with Zambia's environmental laws.

3.3.3 Rural-rural migration

There is substantial evidence on seasonal or circular migration within rural areas over the African continent which has been largely linked to the quest for economic survival (UNEP, 2011). However, although they are still strongly associated with diversification within natural resource dependent livelihoods, these movements have been restricted in some countries like Botswana, South Africa and Zimbabwe due to the nature of government policies (Thomas and Twyman, 2005; Osbahr et al., 2010). Nonetheless, despite significant seasonal fluctuations in rainfall; erratic crop yields, poor soils, and depleted fish stocks; farming, herding and fishing remain the dominant livelihoods in communities where rural-rural movements have been observed in Africa, e.g., Niger, Burkina-Faso, Mauritania, Chad, Mali Senegal, Ghana, Cote d'Ivoire, Nigeria, UNEP (2011) and in Botswana and South Africa Sporton et al., (1999); Thomas and Twyman (2005). The actual environmental impacts of these movements largely remain poorly understood other than the general desertification explanation. In East Africa for example; the Maasai circularly shift from one plain to another on the savannah open grasslands, grazing their cattle around South-West Kenya and North-East Tanzania in the game

management areas of the Serengeti. The Mundari do the same in the Kidepo game management area in southern Sudan dependent entirely on pasture and similar natural resources for their livestock rearing. These movements have spurred wildlife-human conflicts. The Maasai tribal warriors and pastoralists have been condemned by conservationists for the systematic killings of lions and other wildcats to protect their livestock. Similarly, the Mundari pastoralists dependent on their cattle in south Sudan have largely lost their animals on both fronts – protracted civil wars which have also restricted their circular migrations on the one hand, and degraded pastoral land on the other (Mujak, 1997). In Zambia, although there is no nomadism, circular migration has been documented in many parts of the country, where it has involved household and even entire community movements. The Lozi people of Western Zambia whose livelihoods are based on fishing and rain-fed crop farming move away from the Zambezi Lower Plain during the flood times to the higher ground. This practice has gone on for centuries, with people depending on natural resources for more than 500 years (Mwanangombe, 2010). Today the Lozi have continued their lifestyle with a western twist, by planting crops at destination on arrival, which would be ready for harvest just before departure (Mwanangombe, 2010).

In Southern Zambia however, a recent study revealed a new pattern of migration where evidence suggests that people from the low rainfall agro-ecological zone I or Southern Province of Zambia were moving northwards into Agro-ecological zone IIa and III in the Central and Copperbelt provinces respectively (Simatele and Simatele, 2015). Although it is not clear whether these people make movements together as communities, families or individuals, there is a spread in environmental degradation in the migration destination areas that has been observed with a probable link to these movements (Makondo et al., 2014).

3.4 Perception of risk

The perception of risk has been considered by many schools of thought, including in personality, economic, political and culture theories (Wildavsky and Dake, 1990). However,

other than viewing individuals as active organisers of their own perception, the intricacies of these theories are beyond this thesis. In brief, cultural theory posits that people choose what to fear, and arbitrarily assign a scale by how much to fear it (Holdren, 1983), while political theory, which links to the theoretical foundation of this this thesis in form of political ecology provides the access and control explanation on resources. This includes an explanation on how and why disparities result in socio-economic characteristics along social demographics, e.g., gender, age and class (Wildavsky and Dake 1990). Politics leads to governance through social institutions, an overarching determinant of socio-economic conditions that give rise to the 'haves' and the 'have-nots', access or the lack of, as such conditions are inherently political (Castree, 2015). The active agent emerges from political and economic theories: a participant's personality which posits that individuals are constituted to take or reject risk in an enduring manner (Maccrimmon et al., 1988). Thus, personal, culture, economic and political factors shape perception of risk, which is essentially a subjective judgement about the characteristics and severity of risk (Wildavsky and Dake 1990).

3.5 Environmental components of migration theory

Reports in the 1980s from the Worldwatch Institute (WI), Intergovernmental Panel on Climate Change (IPCC), and United Nations Environmental Programme (UNEP) rekindled interest in the environmental-migration nexus, with environmental determinism. Sensational terminologies, e.g. *environmental refugee*, *ecological migration*, and *road-to-survive* became common in research papers and media narratives describing the consequences of desertification, droughts, floods, climate change, global warming and sea level rise (Piguet, 2013; Stern, 2007; Myers, 1993). However, some of these terminologies have been heavily criticised, but the rekindled environmental explanation in migration theory may be attributed to five main reasons:

i. The emergence of environmental movement raised public interest and rekindled concerns on the roles the environment plays in human existence. New terms such as

environmental risk, *tolerance thresholds* and *global risk society* occupied centre stage in academic and policy debates. Migration was theorised publicly as an inevitable consequence or a means to get out of environmental risk zones (Colby, 1991; Beck, 2009);

ii. The increased number of documented environmental hazards put into focus the possibilities of human migration to hazard free areas. While different types of environmental-related calamities were perceived with unequal strapping, emotionally and politically, migration began to be viewed with the same 'page-turning power', a consequence of environmental degradation, and a catastrophe in itself (Gill, 2010; Tacoli, 2011; Rob, 2013);

iii. Growing global anxiety about the impacts of environmental change. Unlike physical indicators of change such as temperature, floods or droughts in the climate change context, the migration issue became a powerful tool for engaging policy makers. The rising environmental movements on the problem of environmental change took over this responsibility of policy market engagement (Urry, 2011; Li, 2002);

iv. Environmental politics. The political ecology of environmental change and climate science may have also inevitably made migration an obvious consideration. Terms such as *climate refugees* and *climate security* re-entered the mainstream vocabulary with security framing of the linkages between environment and migration on the one hand, and migration and geopolitical security on the other (Westing, 1992; Gill, 2010; White, 2011; White, 2012);

v. The narrowing gap between refugee studies and mainstream migration enquiries. This revived academic interest on the environmental variable (Chimni, 1998; Anon, 2011; Adger et al., 2015; Tacoli, 2011).

Despite the environmental variable re-surfacing in migration research, scholarly narratives generally fail to systematically account for the role of people moving from one place to another as either a cause or consequence of emerging environmental risks (Adger et al., 2015). Yet,

these movements can impact greatly on environmental change itself in destination areas especially in the most neglected studies of rural-rural movements. A bulk of research has dedicated much efforts to international movements. When focussed on local level or within borders of specific nations, these enquiries tend to leave out rural-rural migration to focus on rural-urban movements and involuntary resettlement. Rural-urban and involuntary movements are largely driven by labour or income differentials and sudden and extreme environmental disasters respectively. Within environmental explanations, these narratives tend to neglect consideration of long-term events and tend to be highly skewed towards abrupt and short-term events e.g., tsunamis, typhoons, tornadoes and floods (Carr and Kenyon, 2015). Studies on gradual or long-term environmental change events such as desertification, coastal or soil erosion and droughts are few and limited in scope (Hugo, 2011; Piguet, 2013; Adger et al., 2013a; 2015). This is not surprising. Much of the time, slow but long-term changes in environmental conditions fail to arouse policy responses because they are underrepresented in human memory, falling beyond the immediate, or the easily perceivable. They are cataclysms scientifically convoluted in which casualties are discounted or postponed for generations (Rob, 2013). In arguing for the need to rethink the impacts such as slow but long-term environmental changes have on human society and ecological constitunts, Rob (2013) coins the term 'slow violence' to refer to slow changes as deforestation, bio-accumulation, increased greenhouse gases concentrations, diminishing natural resource stocks and climate change.

Similarly, there has been little attention on the potential impacts *of* migration *on* environmental change. The agency of people moving from one area to settle in another remains among the least understood and is simply ignored at best. Given this standpoint, I argue that a better understanding of potential impacts of environmental change on migration, and the impacts of migration on the environment in nature-based-rural economies will require a shift in the migration research agenda. The shift must be towards a stronger focus on internal migration, particularly rural-rural movements. Similarly, the need to include a greater focus on gradual or slow-onset is urgent because although abrupt and extreme environmental events receive greater

media and policy attention, slow onset long term environmental change can have much greater impacts on the movement of people (Hunter et al., 2015; Neumann et al., 2015; Adger et al., 2015). I further argue that to better understand the potential benefits of mobility and to stimulate responsive evidence-based-policies to environmental change and migration in least developed nations, future migration research agendas must explore in much more detail the dichotomy of the nature-society nexus. Namely, analysis is needed of how migration is a form of adaptation to environmental change, and how migration is potentially a source of environmental change in rural economies. As argued from a policy perspective (UK-GOS, 2010; Hugo, 2011; Adger et al., 2013), there is an urgent need to recognise that most migrants move within boundaries, especially in least developed countries. It is in these countries where population distribution is largely rural with livelihoods highly dependent on natural resources that climate change will have far reaching impacts (Hugo, 2011; Adger et al., 2013; Obokata et al., 2014; Hunter et al., 2015).

3.6 Political ecology

Defining political ecology is a difficult task as its meaning is constantly changing from the time it was coined by Wolf in 1972 (Blaikie, 1985; Bryant, 1992; Robbins, 2012; Flachs, 2016). As such, it is probably more inviting to construe political ecology with a more recent interpretation. It is as an eclectic and transdisciplinary body of research focussed on understanding the complex nexus between society and nature and how both internal and external influences tend to modify this relationship. This focus, may only be achieved through a detailed and carefully executed analysis of access and control over natural resources (in the face of knowledge, power relations, governance practices and social justice) and how these have an implication for environmental equity and sustainable livelihoods (Blaikie, 1985; Ian Scoones, 1998). Understanding what roles external factors and political governmentality play to the livelihood circumstances and how these roles force people into certain livelihood activities in the absence of alternatives, is the hallmark of modern-day political ecology. It is a chain of explanations

(Scoones et al., 2013; Buscher, 2014; Flachs, 2016; Popke et al., 2016). Figure 3.2 shows the 'chain of explanations' conceptualisation, while Table 3.2 shows the five dominant theses, their target and focus of explanation.

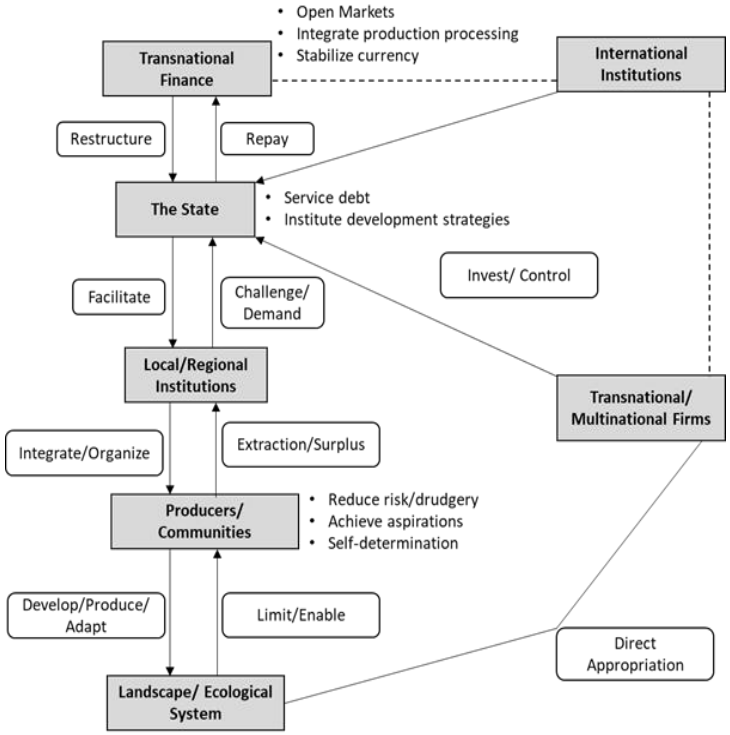


Figure 3.2: The chain of explanations in political ecology (Robbins 2012, p.89).

Political ecology is at the centre of ecologically rooted social science and the principles of political economy to explicitly represent an alternative to apolitical ecology that addresses the central questions about the relations between human society and its bio-cultural-political complexity (Robbins, 2012). Political ecology has focused on analysing forms of social and/or human organisation in the human-environment interaction phenomena affecting the developing world (Death, 2014). In this research, I use critical political ecology for three main reasons: First, highlight to policy makers and organisations of the complex nature surrounding environment and development by thorough questioning of the relationship between economics, politics, and nature to advocate for fundamental changes in the management of environmental resources and the rights of people dependent on them. This is with a normative understanding

that there are sustainable ways of doing things, far better, less exploitative and coercive. Second, understand the decisions that communities make about the natural environment in the context of their economic pressure, political environment, and societal regulations. Third, examine how unequal relations in communities and/or among societies affect the natural environment in the face of governance and policy.

Political ecology is a useful philosophical framework for encompassing issues of individual interests and the potential for clash and collusion that often lie at the centre of economies and ecologies. As is a holistic analytical approach, it connects with the social and power-centred fields of research in natural resource access and control politics, including environmental issues and the socio-economic cleavages that emerge along social demographics. In this regard, the broad scope and interdisciplinary nature of political ecology is used not only to critique, but also provide alternatives in the interplay of politics, socio-economic and environment issues. This is because concepts in the nature-human nexus are inherently political (Death, 2014). As such, it is only necessary to maintain awareness of how roles played by political institutions at different levels impact on livelihood choices the governed make.

Often, the rich and powerful treat poor communities as a people without knowledge or concerns of their own (Rob, 2013). If there is anywhere this becomes clearly normalised, it is in policy making and implementation. In this regard, the political ecology lens becomes handy as it uncovers issues that are subliminal and receive inattention, such as slow but long-lasting catastrophes impacting lives of the masses yet continue to elude the naked eye (Death, 2014). Keeping in mind that there are always 'gate-keepers' seeking to 'police' theoretical approaches and establish clear-cut boundaries, care has been taken to tread these boundaries using a critical approach within the broader base of political ecology. 'Critical' political ecology is adopted not as a card-carrying member of a research tradition, as doing so would not be a particularly critical attitude (Death, 2014); but 'critical' in the sense of reflexivity, care, rigour, thorough questioning and testing of answers from multiple perspectives and disciplines (Forsyth, 2003;

Walker, 2005). The complexity and nested relationships associated with the human-environmental interaction being examined in this research requires such an approach because from a critical realist's perspective from which I draw the stance, reality is socially constructed. Therefore, it naturally follows that the very foundation of science and its processes of knowledge production, is entirely a social practice (Easton, 2010). Thus, aspects of social vulnerability to environmental change, and the ability of society to adapt or avoid exposure to impacts of environmental change are determined by structural entities, shaped by social practice. These entities, such as institutions and their actions are not only shaped by concepts, they are concepts dependent, and thus, have causal powers and liabilities that warrant a critical analysis from multiple perspectives (Robbins, 2012).

Table 3.2: The five-dominant theses in political ecology and their narrative focus (Robbins 2012, p.21–22).

THESIS	FOCUS OF EXPLANATION	TARGET OF EXPLANATION	RELEVANCE
Degradation & Marginalization	Environmentally innocuous production systems undergo transition to over-exploitation of natural resources on which they depend as response to state development intervention and or increasing integration in regional and global markets. Sustainable community management is hypothesized to be unsustainable due to efforts by state authorities or outside authorities to enclose traditional collective property or impose new foreign institutions. Similar assertions posit that modernist development efforts to improve production systems of local people have led (in contrast) to decreased sustainability of local practice and linked decrease in the equity of resource distribution.	Why environmental systems change: (because of wealth and capital accumulation)	Environmental conditions e.g., degradation, long blamed on marginal people, is shown in its larger political and economic context
Conservation & Control	Control of resources and landscapes has been wrested from a producer or producer groups (associated by gender, class and ethnicity) through the implementation of efforts to preserve "sustainability" "Community" and "nature". In the process, local livelihood systems, production, and socio-political organizations have been disabled by officials and regional and or global interests seeking to preserve nature and the "environment". Related works have shown that where local production practices have previously been productive and relatively benign, they have been categorised as unstainable by state officials or other players in the process to control resources.	Why external interventions fail : (disregarded local knowledge)	Mostly viewed as benign and efforts at environmental conservations are shown to have pernicious effects, and sometimes fail as result conservation outcomes (especially failures)
Environmental conflicts & Exclusion	Increased scarcity created through resource enclosure or appropriation by state authorities, private firms or social elites accelerate conflict between groups (gender, class or ethnicity).Similarly, environmental problems become "socialised" when groups secure control of collective resources at the expense of others by leveraging management interventions by development authorities, state agents or private firms. Similarly, existing and long term conflicts within and between communities are "ecologised" by changes in conservation or resources development policy.	Why natural resources based conflicts arise (external powers and influence)	Access to environment resources and conflicts over exclusion from it, especially natural resources. Thus, environmental conflicts are shown to be part of gendered, classed and raced struggles and vice-versa
Environmental subjects & identity	Institutionalised and power-laden environmental management regimes have led to the emergence of new kinds of people, with their emerging self dentitions, understanding of the world, ecological ideologies and behaviours. People's beliefs and attitudes do not lead to new environmental actions, behaviours or rules systems; instead, new environmental actions, behaviours and rules systems lead to new kinds of people. Correlatively, new environmental regimes and conditions have created opportunities and imperatives for local groups to secure and represent themselves politically, often representing a new political action, since their ecological strands can connect disparate groups across gender, class or ethnicity.	Why social identities change (because of transformed environmental institutions, which in turn affect livelihoods of societies dependent on environmental activity)	Identities of people and socio groups (new or emerging ones) and their struggle are shown to be linked to basic issues of livelihood and environmental activity
Political object & Actors	Material characteristics (abiotic .e.g. climate, forests, soils etc.) and its (biotic, e.g. animals, bacteria etc.) components impinge upon the world of human struggles and are entwined within them, and so are inevitably political. Yet as these characteristics and agents assume new roles, they are transformed by these interactions. Thus, people, institutions, communities and nations assemble and participate in a network that emerge, leveraging power and influence, just as non-human organisms and communities do. In recent history, hegemonic institutions and individuals (environmental ministries, multinational corporations, corrupt foresters have gained influence by controlling and directing new connections and transformations, leading to unintended consequences and often pernicious results. In the process, the resistance emerges from traditional, alternative or progressive human/non-human alliances marginalised by such efforts (especially along class, ethnicity and gender lines)	Why changes in environmental conditions affect economic conditions and vice versa (because of the social ecological system connections)	Deeply structured socio-economic conditions. The political and economic systems are shown to be underpinned and affected by non-human actors with which they are intertwined

3.7 : Assembling the conceptual frameworks

The next sub-sections assemble the two main conceptual frameworks utilised within the broader approach of political ecology, namely; Sustainable Livelihoods Approach, and Social-ecological Systems approach.

3.7.1 Sustainable Livelihoods Approach

The Sustainable Livelihood Framework (SLF) is derived from development economics as an evidence-based approach centred on household capital assets analysis to understand the complex nature of poverty vulnerability (Osbahr et al., 2010; Ellis, 2000; Adger, 2003; Nielsen et al., 2014; Hua et al., 2017). From the 1990s, international development praxis (as an emancipatory and hermeneutic action) continue to draw much of its drive from the SLF for implementing development aid and poverty intervention projects in economically disadvantaged countries (Scoones, 1998; Morse and McNamara, 2013). Centred on household livelihood, the original thought of SLF dates back to the works of Robert Chambers in the mid-1980s, and further developed by Conway and others in the early 1990s (DFID, 1998).

In this thesis, "household" is conceptualised as a domestic unit; a smallest social unit with decision-making autonomy about production and consumption (Guyer, 1981). In rural Zambia, it is the basic social unit of survival comprising members of the same family, and/or extended family relations living together. "Livelihood", is understood as a means of making a living, comprising people's assets, capabilities, income and activities required to secure the necessities of a living (Scoones, 1998; Ansoms and McKay, 2010). A livelihood is considered sustainable when it enables members to cope with and recover from shocks and stresses, and enhances their well-being and that of future generations without undermining the natural environment or resource base (DFID, 1998). Thus, in this thesis, SLF is conceptualised as a holistic capital-asset-based framework for analysing the complexity of rural people's livelihoods. As tool, SLF is useful in understanding the various dimensions of household vulnerability, resilience strategies being

pursued and associated opportunities or constraints of rural people (Ansoms and McKay 2010). SLF has been considered by many development experts as the 'vehicle' for development with potential for broadening vulnerable people's choices and widening their capital base (Morse and McNamara, 2013; Scoones, 1998). According to Morse and McNamara (2013) SLF operates on two main ideas for development which can take place in parallel:

i. Immanent: denoting a broad range of human development advancement processes at any given level, local, national or global in various areas such as science and technology, medicine, arts including governance. Immanent development can take place regardless of deliberate interventions, but can essentially be influenced by cultural exchange or integration and globalisation;
ii. Intentional: resource and time-bound development as determined by interventionists such as CSOs and governments. It is a directed and focussed process of implementing a designed intervention programme on a target group to achieve a particularly desired positive outcome. Unlike immanent, intentional development cannot take place without intervention. Intentional praxis adds complementarities to enhancing immanent development using SLF as a formal analytical framework to help understand what 'is currently obtaining' and what can be done (Morse and McNamara, 2013).

The SLF framework (Figure 3.3) is a useful lens for looking at the complexity of people's livelihoods, how they respond and cope from various shocks and trends. It recognises the necessity to understand the livelihood capital asset composition, resilience strategies and how these help in reducing vulnerability from environmental trends and associated shocks. In this regard the framework makes it possible to investigate and enhance understanding of the relationships among different household activities that constitute livelihoods. With its strength of analysis, the SLF unveils specific details about capital structure which may be shaped by types of assets, intra-household, community or social relationships and networks, and how these are affected by external forces such as various levels of governance and policies.

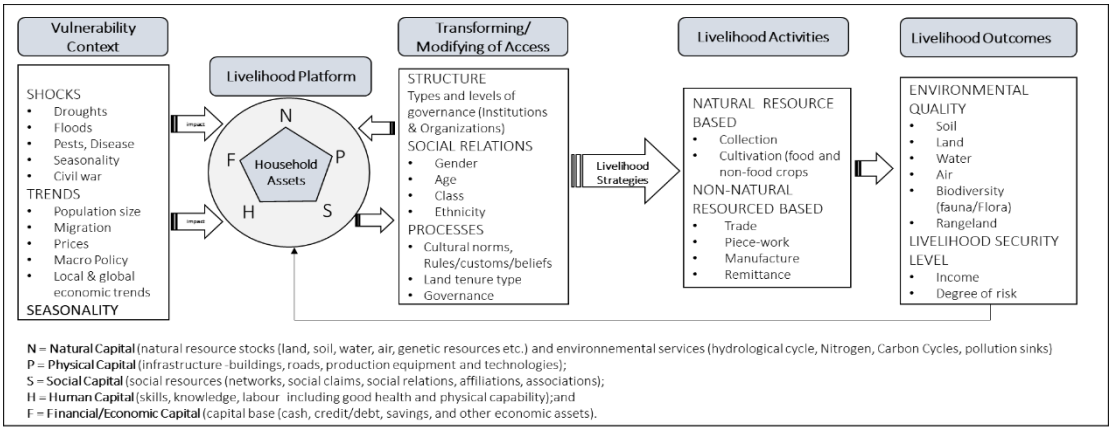


Figure 3.3: SLF Conceptualization (DFID, 1998; Ellis, 2000; Ian Scoones, 1998).

Despite its popularity among academics and development experts, SLF is not without criticisms. Though not particularly unique to SLF, critics advance the following reasons:

i. People and culture: while SLF is a people-centred approach, it pays lip service to people among other capital assets and focuses instead on individual human capital, making it a laborious quantitative cataloguing exercise which post-modernists label 'a cluster of task-oriented activity on household economics.' It has also been criticised for paying little or no value for culture, a very important aspect of communities (Dongfeng and Zhou, 2010). However, to those who use SLF, quantitative cataloguing turns into a strength as it sits in well with the current vogue for proof-with-numbers and statistics in social development policy, making it useful in evidence-influenced social policy responses for maximum positive impacts (Morse and McNamara, 2013);

ii. Capital asset substitution concern: in typical economic theory, capital assets are considered 'production factors' where one asset can be replaced by another. In this regard, critics argue that costing natural assets sustainably is a nightmare for SLF as this is impossible. It is also argued that assets can be such a sensitive subject where withholding information by households cannot be ruled out. Even in the event of high level accorded to the investigator, a household can still withhold valuable information as it holds the ultimate discretion to giving out such information. It is also unclear on how to determine which other assets within the main five capital-frame are important

for inclusion. This raises the concerns on the SLF lack of specificity (Morse and McNamara, 2013);

iii. Prediction of shocks: unpredictability concerns arise from the complex nature of assessing vulnerability at macro-scale. This is evidenced in the global credit crunch, and 'nun-away' inflation in politically unstable countries such as Venezuela, Zimbabwe or Greece where prediction was clearly impossible. Such shocks have a profound effect on households and may include land abandonment and migration as evidenced the countries highlighted above. Although a historical analysis can help, this does not allow precision into the future when that can occur (Hammar, 2010; Makina, 2012; Morse and McNamara, 2013).

However, to make SLF more useful, Clark and Carney (2008) suggests building on the achievements based on lessons drawn from best practice, while developing simple narratives for livelihood approaches. Others include improving its power of analysis on policy processes, such as in ecological sustainability with focus on gender and power relations (Morse and McNamara, 2013). These suggestions resonate with both political ecology, and social ecological systems theory which are discussed later in the subsections that follow.

In this research however, the strengths of the SLF is drawn upon given its holistic approach to understanding vulnerability of households and how their livelihoods are shaped and affected by capital structure and external factors (Antwi-Agyei et al., 2012; 2014; Hua et al., 2017). Given its limited extent in integrating sensitivity to climate exposure and the handicapcy in evaluating household adaptation capacity comprehensively, SLF has been applied in combination with other approaches. The Intergovernmental Panel on Climate Change Assessment Report approach is drawn upon to supplement SLF. Within the IPCC Reports approach, three established assessment methods exist, namely; risk, impact and venerability. These are shown in Table 3.3. However, given the focus of the research and data challenges associated with the

other two approaches, the vulnerability method is utilised in the context of the 4th Assessment Report Framework.

Table 3.3:IPCC impact, vulnerability, and risk assessment methods and their differences: adopted from (Connelly et al., 2018, p.5).

Focus	Vulnerability Assessment	Risk Assessment	Impact Assessment
Issues	Adaptation responses can be developed to reduce vulnerability. However, without details of the probability of, and potential spatial exposure to, hazards, the effectiveness of responses to moderate vulnerability is reduced.	Risk assessments provide a picture of priority risks, in terms of their probability and consequence, enabling available response capacity and resources to be targeted more effectively.	Impact assessments generally provide no indication of the probability of impacts occurrence. Impact severity, which relates factors including hazard intensity and the vulnerability of the system to the event, is not commonly considered.
Input	Sensitivity and adaptive capacity data are needed to undertake a vulnerability assessment, based on the IPCC's AR4-5 approach.	The IPCC's AR5 risk approach focuses on the interaction between hazard, exposure and vulnerability. Data are required on these themes to complete an assessment.	Impact assessments require details of weather and climate hazards and the natural and human systems with the potential to be affected.
Output	Details of the vulnerability of 'receptors' to climate hazards. Data permitting, vulnerability can be mapped spatially.	Identification of weather and climate risks. Data permitting, risk assessment outputs can be mapped spatially.	Potential weather and climate impacts to natural and human systems. Cascading impacts, within and between systems, are significant yet can be difficult to establish due limited data and modelling capacity.

3.7.2 Livelihood Vulnerability Index (LVI-IPCC-AR4 Framework)

Based on the Intergovernmental Panel on Climate Change's 4th Assessment Report (AR4), LVI-IPCC approach uses primary data from household surveys to construct an indicator system using livelihood sub-components. This methodological approach presents a framework for grouping and aggregating indicators at different spatial and/or temporal scales, such as district, regional or national level over a given period (Hahn et al., 2009). By using primary data obtainable through household surveys, this method does not suffer the handicapcy associated with secondary data utilisation for development and adaptation planning which usually have missing entries as data are collected at different temporal or spatial scales, and for different purposes. With the LVI approach, measurement errors are limited to self-reported data. By focussing on the local level, such as district or zone, LVI also reduces the dependence on climate models such CIMP5, which although useful, are spatially too large to provide detailed local level information useful enough for socio-economic and environmental planning (Patz et al., 2005). In view of this, LVI serves as a flexible and practical tool to local level policy makers across sectors for development practitioners and disaster risk managers. The overall composite index and sectoral vulnerability scores can be segregated to identify potential areas for

intervention (Hahn et al., 2009; Adu et al., 2018). For instance, a gender empowerment intervention project whose objective is to reduce socio-economic disparity between genders can incorporate female-male dependence ratio in the overall LVI baseline to climate change vulnerability. This can be recalculated as required for monitoring and evaluation purposes and/or for overall outcome of the intervention project for important future lessons.

However, LVI is not without limitations in that the sub-components used to construct the overall index may not reflect other populations within an area. Human societies are a compendium category subject to infinite local differentials and fractures along gender, ethnicity, age, class and religion. These variations of complex reality are oversimplified in form of composite indices as sub-components are averaged into one major component score, without incorporating variance between study populations or categories. Similarly, the selection of sub-components involves normative judgment (Vincent, 2007). Other shortcomings are that primary data used is based on how accurately the other sub-components could be used to quantify the major components and weightings used to reflect local priorities (Hahn et al., 2009). Since, LVI is done at local level, it cannot be merged with climate projection approaches such as general circulation models (GCMs) which have potential to extend from 'the now' livelihood assessment further into the future than the LVI allows (Hahn et al., 2009; Vincent and Cull, 2010).

3.7.3 Social-ecological Systems Approach

Old dominant perspectives in human-environment nexus notably, frontiers economics; have implicitly assumed a stable and infinitely resilient environment where resource flows could be controlled while nature repaired itself into equilibrium as an infinite source of resources, and as an infinite sink of waste by-products (Colby, 1991). In the face of climate change and other environmentally related perturbations, resilience is an important concept in understanding how systems cope. Underpinning the resilience paradigm is the social-ecological systems (SESs) theory. Different definitions of what is meant by resilience have been advanced from different

perspectives, the majority of which focus on the capacity of SES to absorb shocks and maintain function (Holling, 2001; Folke, 2006; Berkes and Ross, 2016). As argued by Walker et al (2004) resilience cannot be considered as a 'stand-alone' attribute of a system: it must be considered in relation to other attributes that govern the system's dynamics as the stability of all linked systems of society and nature emerge from three complementary attributes, namely; resilience, adaptability, and transformability. These attributes determine the future trajectories of any SES (Walker et al., 2004).

Thus, in this thesis, resilience of SES is conceptualized as the capacity of a system to absorb shocks and reorganise itself while undergoing transformation that allows it to retain its normal function, structure, identity, and feedbacks within space and across time (Levin et al., 2013; Berkes and Ross, 2016). As a conceptual framework, the SES paradigm has a long intellectual history conceived from generic systems theory in the quest for enhanced quality explanations in human-environment nexus. Its roots can be traced back to 19th century evolution biology involving naturalistic observations of biomes and analysis of organism-environment relationships (Stokols et al., 2013). Over the years, SES has developed a multidisciplinary methodological approach that cut across biology, ecology, economics, sociology, anthropology, psychology, governance and policy (Emery and Trist, 1972) Embraced by both the behavioural and environmental researchers, SES has been utilised in answering resilience and sustainability questions across multiple-scale interactions of the human-environment systems (Stokols et al., 2013). However, the SES paradigm is still not without criticisms. The main critics of this paradigm are the Frankfurt scholars and anti-naturalists. As critical realists, Frankfurt scholars contend that the SES paradigm depoliticizes situations being represented (Welsh, 2014). They argue that sustainable futures almost always involve questions of politics and power relations. Foreclosure occurs to people's livelihoods because of the role politics and power relations play. They further argue that SES frames the available governance choices in the feedback mechanisms as though they are neutral and natural (Stojanovic et al., 2016). For the anti-

naturalist, SES is a determinist's methodology where a naturalistic concept is propagated into the social science domain. The contention is that SES is not only centred on determinism, but also fails to address the normative and power relations question; hence the inadequately conceptualized social-ecological complexes that result in the biases in explanations (Crane, 2010; Stojanovic et al., 2016). Table 3.4 gives a synopsis of the SES conceptualisation.

Table 3.4: Social-Ecological System Conceptualization

CONCEPTS	CHARACTERISTICS	FOCUS	CONTEXT REFERENCE
Resilience a) Engineering	Return time, efficiency, linear/non-linear or proportionality	Recovery time, constancy/ maintenance.	Vicinity of a stable equilibrium (Walker et al 2004; Gunderson and Holling 2002).
b) Ecosystem Ecological	Buffer capacity, withstand shock and maintain function.	Persistence, robustness.	Multiple equilibria, stability landscapes (Olsson and Folke 2001; Folke 2006; Berkes 2012).
c) Social–Ecological	Interplay disturbance and reorganization, sustaining and Developing.	Adaptive capacity, transformability, learning, innovation.	Integrated system feedback, Cross-scale dynamic interactions (Berkes et al. 2012; Folke 2006).
Adaptation	Blind, complex, dynamic and contingent process based on Darwinian biological organisation, "transposed" on culture organization. Meaning changes dependent on perspective of communities, social institutions, and policies	Dynamism, continuously evolving ideas, practices, including learning. Cognisance of diversity in the fundamental building blocks of a system. Adjustment in human or natural systems as a response to actual or expected impacts stimuli. Practices and results are sustained through planning, oriented towards longer-term livelihood security.	Linked to environmental extensity and diversity (e.g. seeking new or better environments when the currently occupied are no longer useful (Thornton and Manasfi, 2010; IPCC, 2014)
Adaptability	Continued development within the current stability domain.	Part of resilience; capacity of actors in a system to influence resilience (mainly humans).	Capacity to adjust responses to changing external drivers and internal processes (Gunderson and Holling, 2002; Allen et al., 2014; Berkes and Ross, 2016).
Adaptive capacity	Feature of structure, function, or behaviour. The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC pre-AR5 Definition).	Response to at least maintain; transformability of system; sustainable adjustments, ability to cope, and/or adjust to maintain structure, function or behaviour after perturbation. The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term (IPCC AR5 Definition).	Restructuring or maintaining the nested components (panarchy) of a system (Gunderson and Holling 2002; Allen et al., 2014; Berkes and Ross, 2016).
Transformability	System alteration; defining and creating new stability, regime shift.	System organization, new components, changed state variables, and often the scale, that define the system.	Capacity to create a fundamentally new system when ecological, economic, or social (governance) when conditions make the existing system untenable (Walker et al 2004; Folke et al 2005; Ostrom 2009).
Sensitivity	Transformation to Perturbation ratio. Reactivity to a given perturbation.	Amount of transformation of the system per unit of change in the perturbation. The degree to which a system or species is affected either adversely or beneficially, by climate variability or change (IPCC pre AR5 and IPCC AR5 focus)	degree to which the system is modified/affected by an internal or external perturbation(s)(Gallopín, 2006; IPCC, 2014b).
Vulnerability	Susceptibility to harm. A combination of defencelessness, insecurity, and exposure to risk, shocks	Sensitivity to perturbation, and capacity of response. Dynamic concept, unlike poverty which is measured with static indicators like	Function of the system's sensitivity and capacity of response (Berkes 2007; Warner and Afifi, 2014; Shah et al 2013; Connelly et al 2018).

	or stress. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC pre AR5)	income. The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC AR5 focus)	When those working within the pre-IPCC AR5 concepts refer to vulnerability, IPCC AR5 and disaster risk management understands this as risk. Similarly, vulnerability in IPCC AR5 equates to sensitivity and adaptive capacity within climate change studies.
Exposure	One of the elements constituting vulnerability (Extrinsic outlook). The nature and degree to which a system is exposed to significant climatic variations (IPCC pre AR5 focus)	External side of vulnerability of a system; Degree, duration, and/or extent to which the system is in contact with, or subject to the perturbations (Nelson et al., 2007; Adger, 2006). The presence of people, livelihoods, species, ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected (IPCC AR5 focus)	Relationship between the system and the external forces of a perturbation (Watts and Bohle, 1993); Beneficial or detrimental to a system (Cardona et al., 2012; Shah et al., 2013; IPCC, 2014a).
Coping	One of the elements constituting vulnerability and capacity to adapt (Intrinsic outlook).	Internal side of vulnerability of a system. Short-term, or reactive response motivated by crisis. Because it is prompted by a lack of alternatives, it often depletes resource base.	the internal capacity of system to handle external forces of a perturbation (Ito, 2010; Rademacher-Schulz et al., 2014; Bylander, 2015).
Risk	Probability or chance of suffering an adverse consequence, or of encountering some loss. Risk = Probability x Consequences	Component of Exposure to hazard or an endangerment. Viewed as vulnerability in IPCC AR5 context. Risk = f (Probability of a Hazard x Exposure, x Vulnerability). The potential for consequences where something of value is at stake or outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.	Undesirable event and its consequences arising from spontaneous natural origin or from a human action (Pellizzoni, 2014; Connelly et al., 2018).
Mitigation	The external component of Resilience to protect system function.	Addressing physically (e.g. through policy and engineering technologies) the root causes of the undesirable changes to a system.	Deliberate human action to reduce vulnerability while increasing resilience (IPCC, 2014a).
Livelihoods	Means of making a living.	People's assets, capabilities, income and activities required to secure the necessities of a living.	Scoones (1998); Ansoms and McKay (2010); DFID (1998).
Migration	Movements of people between places	Different levels (see Table 3.1)	Hugo (1996); Adger et al (2002; Renaud et al (2007); Raleigh et al (2008).
Environmental change	Deviation from normal	Land degradation, soil erosion, climate change, deforestation	Piguet (2010b) Morrissey (2013); Blaikie (1985) ; Tiffen et al (1994).

SES utilises numerous research methods. It combines the new non-equilibrium ecology which has been popular during the post-structural turn in political ecology as it debunked the long-standing models of equilibrium of communities, which were understood to be illustrative of the 'social framing' of science (Forsyth, 2003). This has provided greater opportunities for addressing concerns on social equity and justice, by viewing communities as contributors to

ecological sustainability, rather than as contributors to environmental threats themselves (Leach and Mearns, 1996).

Table 3.5 below shows some of the popular methods used. As a methodological approach, there is no panacea to its utility (Ostrom, 2009; Rissman and Gillon, 2016).

Table 3.5: Characterisation of the multi-dimensional methods applied is assessing the human–nature nexus, and the component of migration

TYPE OF MIGRATION	Displacement Strategy ⟶			Adaptation
ASSESSMENT TYPE	Impact	Vulnerability	Adaptation	Integrated
SCIENTIFIC OBJECTIVES	Impacts on migration under future climate	Processes affecting vulnerabilities to changes in the climate that are likely to lead to migration	Processes affecting the uptake of migration as an adaptation strategy	Interactions and feedbacks between multiple drivers of, and impacts on, migration
PRACTICAL AIMS	Actions to reduce risks	Actions to reduce vulnerability	Actions to improve adaptation	Evidence based national, regional and global policy options and costs.
RESEARCH METHODS IN SESs	• Standard approach • Drivers, Activities; Pressure, State change; Impacts on Welfare, Response (DPSIR) • Hazard driven risk assessment • GIS/RS	• Vulnerability indicators and profiles • Past and present climate risks • Sustainable Livelihood Approach (SLF) analysis • Agent-based methods • Narrative methods • Risk perception, including critical thresholds • Field observation/Surveys • Development/sustainability policy performance • Relationship of adaptive capacity to sustainable development • Panarchy (Heuristic metaphor)		• Integrated assessment modelling • Cross-sectoral interactions • Integration of environment with other drivers • Stakeholder discussions/interviews • Linking models across types and scales • Combining assessment approaches/ methods
SPATIAL DOMAINS	Top-down global -› local	Bottom-up, local, regional (macro-economic approaches are top-down)		Across scales: global/ regional/ national/local
TYPES OF DIRECT ENVIRONMENTAL DRIVERS	Sea-level rise	Flooding, water stress/Droughts		Changes in patterns and distribution of rainfall
TYPES OF INDIRECT ENVIRONMENTAL DRIVERS	Government policy, programmes, resettlement; land use demand, drought, soil erosion, desertification	Changes in food security /livelihoods		Changes in employment and livelihood opportunities
EXAMPLES	Svarstad et al (2008); Bernard and Elliott (2015)	Scoones (1998); McLeman et al (2008); Gunderson and Holling (2002); Berkes et al (2007); Folke (2006); Bernard and Elliott (2015); Berkes and Ross (2016).		Black et al (2011); (2012); Adger (2006); Adger, et al (2013); Kniveton, et al (2012).

In this research, the SES framework has been drawn upon based on the following:

i. Its comprehensive explanatory power in resilience studies. If applied correctly, the SES paradigm could be the most useful methodological framework there is in conceptualising and understanding how complex livelihood systems (at various levels in space and time) cope to climate change and other similar environmental shocks and hazards (Folke, 2006; Miller et al., 2010; Levin et al., 2013; Berkes and Ross, 2016).

ii. To complement other frameworks and strengthen the methodological approach. SES has been drawn upon as complementary tool to strengthen the SLF methodological framework, given the relationship that exists between resilience, adaptation and vulnerability. In vulnerable systems, even small disturbances may cause dramatic consequences (Folke, 2006). It is argued that managing for resilience through increasing adaptive capacity lowers vulnerability and enhances the likelihood of sustaining desirable pathways for development in changing environments where the future is unpredictable and surprise is likely (Walker et al., 2004; Adger, 2006; Thornton and Manasfi, 2010; Perez et al., 2015; Chaudhury et al., 2017).

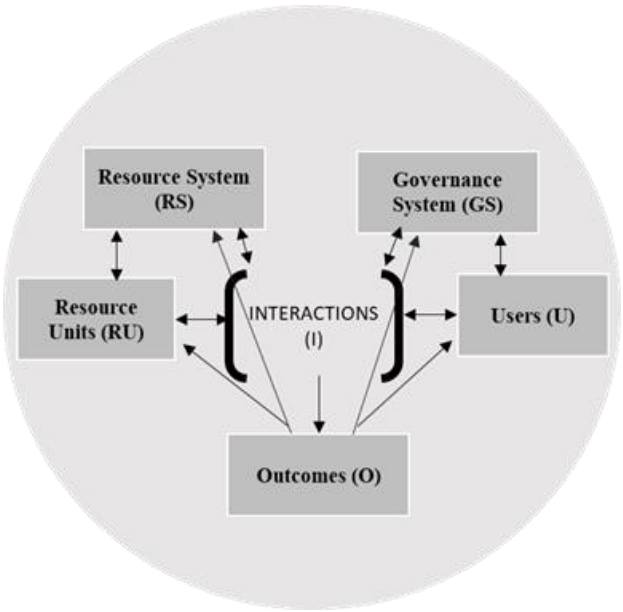


Figure 3.4: SES Framework with first-order core subsystems

Of the SES methods, one of the most notable is the DPSIR approach (Figure 3.4). With its powerful diagnostic and analytical components, the DPSIR approach is arguably a strong problem-structuring-method in casual-effects linkages identification (Bell, 2012).

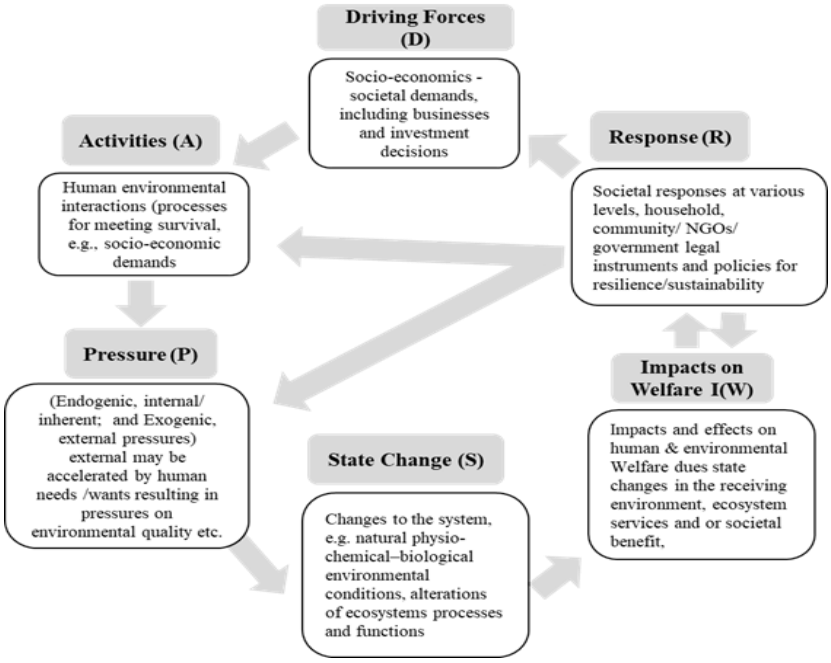


Figure 3.5: The DPSIR Approach: Reconceptualised after (Barnard and Elliott 2015)

As a systems analysis tool, the DPSIR approach focuses explanations on how *driving* forces and *pressures* (i.e., social and economic needs and wants) trigger specific *activities* that exert *pressure* on the environment. The *activities* may result in the environmental *state change*, which manifests in form of indicators or *impacts* on both the welfare of humans and the environment itself. For example, a depletion of soil nutrients on farmland or nutrients loading in streams, has consequential outcomes on both humans and the environment itself. These outcomes or *impacts* if identified (accurately with their specific indicators) may then elicit societal *responses* that feedback to address the *driving forces* or *activities*, *state change* or *impacts* directly through adaptation mechanisms or curative actions (Smeets and Weterings 1999). However, the DPSIR approach has been criticised. Critics largely view the DPSIR approach as a narrowly formulated engineering device that is incompatible with the multiple perspectives of human-nature interactions. Other than having overwhelming data demands, it also treats people as passive objects by assuming a single decision maker, depoliticising and scientising the issues that require stakeholder consensus (Rosenhead and Mingers, 2001). It is viewed as an ineffective tool beyond the means to introduce the indicator approach in problem analysis of society-environmental systems (Bell, 2012).

Nevertheless, the DPSIR approach can be flexible in practice as it deeply engages people as active objects. For instance, in strategic social-environmental assessment processes that need consensus decision making, the approach has facilitated planning from bottom-up, engaging stakeholders with simplicity and transparency aimed at clarifying areas of possible conflict, and how these can be resolved (Rosenhead and Mingers, 2001; Smeets and Weterings, 1999). As Svarstad et al (2008) argues, that although the framework has discursive biases, it cannot be denied that as an approach, it is relevant to problems identification and their causes. When applied as an assessment tool within a multi-methodological framework, the DPSIR framework has clear chains of explanations. It acts as a powerful tool for providing useful information on the causal-effects linkages including severity of environmental problems. By highlighting indicators of environmental change, it has potential to invoke priority setting and stimulate responsive evidence-based policy development. By identifying key drivers, activities and pressures that cause environmental change, the systemic multi-methodology strength of DPSIR approach indirectly helps create responses that can be measured as indicators. This is useful in e.g., monitoring policy outcomes and adjusting accordingly to meet desired outcomes (Bell, 2012; Barnard and Elliott, 2015). However, it should go beyond this and explore the potential for expanding its applicability to incorporate in much more detail, the social and economic issues including the agendas driving them. This implies that adequate attention not only need to be applied to the state of the environment, but also to the state of social and economic issues to broaden the understanding of socio-economic and cultural drivers of the issues in focus (Svarstad et al., 2008).

3.8 Chapter summary

As demonstrated in this chapter, understanding the environmental change and migration question and how the latter could essentially be an adaptation response to minimising risk of the changing environmental conditions in natural-resource-dependent livelihoods is a complex one. For this reason, it has been argued and justified why an avenue of trans-disciplinary approach is

useful and must be explored and utilized. Thus, by drawing upon tools of SLF and SES grounded in the analytical framing of 'critical' political ecology, an emphasis on the importance of understanding how migration is shaped by various factors in the human-environmental interaction has been made. This approach recognizes the active role that social entities play in shaping human-environment relations, and the importance of understanding how environmental change itself may be as the result of both social action and ecological dynamics. In this regard, it has been contended that it is not only necessary to maintain awareness of the concepts in nature-human nexus due to their inherently political nature, but rather, it is also necessary to be 'critical' owing to how social institutions shift the meaning of these concepts. Given the complex nature of human-environmental interaction, there is no doubt that an approach informed by critical political ecology (Forsyth, 2003; Robbins, 2012; Death, 2014) is necessary because social entities, or institutions and their actions are not only concept laden, they have causal powers and liabilities (Easton, 2010). For example, the costs and benefits associated with environmental change are unequally distributed and changes in the environmental conditions do not affect individuals and communities in a homogenous way. The political, social, and economic differences account through which political power plays an important role Similarly, the distribution of costs and benefits reinforces or reduces existing social and economic inequalities as changes in environmental conditions affect the political and economic status quo (Forsyth, 2003). Essentially, unequal distribution of costs and benefits, and the reinforcement or reduction of pre-existing inequalities has political implications owing to the altered power relations that emerge. Therefore, they warrant a critical analysis from a multi-lens perspective to provide a valid social and environmentally urgent explanation on winners and losers (Robbins, 2012).

CHAPTER 4: METHODOLOGY

4.1 Introduction

This chapter outlines and describes the research processes applied, justifying the various methods utilised and linking these with the aspects of theory described in Chapter 3. To answer fundamental questions, this study used a research approach informed by critical political ecology (Forsyth, 2003; Robbins, 2012; Death, 2014). The methodological embodiment was drawn from the broader geographical and social-ecological system framework, combining statistical analysis of climatic data and the application of sustainable livelihood framework (Thomas et al., 2007; Motsholapheko et al., 2011; Hua et al., 2017). The research process combined numerous methods drawn from both the natural and social sciences, integrating qualitative and quantitative techniques in a transdisciplinary fashion.

Also considered in this chapter are the challenges incurred and aspects of positionality, reflexivity and power relations. The merits and drawbacks associated with each research method used are discussed in the text. As indicated in Chapter 1, the aim of this research was to investigate the interactions of rural-rural human migration and environmental change - that is, whether environmental change attributes (e.g., drought and environmental degradation) were factor among others driving rural-rural movements of people in Zambia. To examine this, first, the identification and characterisation of spatial dimensions of environmental change and variations in the recent past was done. For climatic data, this related to the past 36 years (Antwi-Agyei et al., 2012; Dunning et al., 2016). Second, socio-economic attributes through qualitative and quantitative techniques were examined at household level (Hua et al., 2017) in both migration source and destination areas. This included the ways in which climate change and variabilities were recognised and responded to in terms of adaptation in natural resource use and agricultural based livelihoods (Cobbinah and Anane, 2016; Pauw, 2013). This was achieved through climatic data analysis and respondents' responses to questions about how migration

may be linked to environmental change in source areas and how migration may be enhancing adaptation in destination areas. The specific objectives of the study were to:

- enhance understanding on the connections between migration, environmental change and adaptation in rural-to-rural movement of people;
- gain an insight of how adaptation, vulnerability and resilience in the face of climate change may have been influenced by migration;
- enhance understanding on how migration may have impacted on environment change itself in destination areas;
- gain insight about people's perception of environmental risk and its severity.

4.2 Social and physical science methods integration

Understanding how the relationship of the nature-human nexus is shaped by prevailing environmental conditions and predominant socio-economic factors is methodologically challenging (Gallopín, 2006). It calls for methods that break-down the silos in both the social dimensions of livelihoods, and the physical attributes of nature (Gunderson and Holling, 2002; Gallopín, 2006). Breaking down these silos is methodologically demanding given the complex nature of ecological, and cultural dynamics, compounded by diverse socio-economic underpinnings (Bryceson, 1999; Rissman and Gillon, 2016). In the context of environmental change, a scientifically credible understanding of social behaviour calls for an integrated multidisciplinary approach (Hodbod and Adger, 2014). For example, behaviour related to resource extraction and responses to environmental hazards and extremes and how responses are influenced by governance cannot be adequately addressed by one disciplinary approach (Robbins, 2012). It requires careful examination of the natural environmental interactions and social dimensions of resource use (Hodbod and Adger, 2014). Methods to do this are grounded in economics, political science, sociology, anthropology, and environmental geography among other disciplines (Death, 2014). Multidisciplinary methods of this sort have an advantage of

assembling different timeframes into a single research project. For instance, in investigating the environmental aspect of deforestation and land-use, change in land-use and forest cover ; e.g., over the past four decades, time series aerial-photography and satellite images can be used to show these changes (Enenkel et al., 2015; Sheffield et al., 2014). This information can then be supplemented by oral histories which go back even further in time, while questionnaires scope perceptions, opinions and understanding of respondents on most recent and current environmental change aspects (Stringer, 2004; Stratford and Bradshaw, 2014).

To assemble this multidisciplinary toolkit of methods, a review of methodologies was conducted from October 2015 to October 2016. As an iterative process, it identified numerous potential methods, including their strengths and weaknesses. However, based on practical needs to meet specific research requirements, type of data, strengths and weaknesses; only specific methods were selected. Following the work plan, it was decided that fieldwork would occur in two phases. Phase one was conducted between 26 October and 20 December 2016 allowing preliminary data collection, and analysis to identify characteristics and outlier cases that would determine the direction for further investigation in phase two.

Phase two took place between 29 October and 23 December 2017. It comprised more open-ended in-depth interviews for outlier cases but also applied a semi-structured questionnaire interview approach for additional cases in migration source areas. These were identified through migrants in destination areas during phase one data collection (UN-DESA, 2005). At the beginning of phase two, feedback was also given to the available participants on the preliminary findings of the research in destination area. To some extent, this may have enhanced the sharing of more insightful information and expert opinions on the research by some respondents. Respondents were freer to speak and gave more information on the challenges they were facing and the lack of responsive government support.

4.3 Primary and secondary data acquisition: tools and procedures

Data acquisition had four components: household interviews, focus group (Dunn, 2014), field transects (Pauw, 2013), and imaging (Tiffen et al., 1994; Erener et al., 2012). Household interviews which utilised questions in the semi-structured questionnaire involved 100 respondents; 70 in two migration host study area communities (Chibwe and Chikonkomene) in AEZ IIa, and 30 in three migration sending study area communities (Kalomo, Choma and Livingstone) in AEZ I. Field transects used both visual observation, open-ended questions and photography. Imaging relied on open source satellite technology. Procedures and tools for data acquisition are described in the sub-sections below, with aide of flow-diagrams to illustrate the details of the research procedures and processes.

4.3.1 Sampling procedure: selecting households and institutions for interviews

Many approaches and organising frameworks have been used to structure investigations in the climate-environment-society nexus. Household level studies have proved more useful for the understanding of response nuances to environmental change in agrarian communities (Thomas et al., 2007; Deressa et al., 2009; Motsholapheko et al., 2011; Below et al., 2014; Van Damme et al., 2014; Dumenu and Obeng, 2016; Gerlitz et al., 2017). In this regard, the analysis and detailed understanding of household choices and response strategies; e.g., to climate variability, need to recognise that such choices and behaviour may be spiralling from a multi-scaler interaction nested within a broader political ecological framework (Ostrom, 2009; Berkes et al., 2014).

As a requirement, prior arrangement was made through the local government in study areas to seek clearance for village or local community entry for conducting research. In the first phase interview, using a village 'mental' register - through the assistance of the village headmen in two study area communities/villages in AEZ IIa, a total sample of 70 households were selected. 40 out of 120 households in the first study community (Chibwe Village) comprising 20 local or

indigenous-headed households, representing 50 percent of the sample; with the remining 20, drawn from immigrant-headed households to allow equal representation. In the second study community – Chikonkomene Village, a total of 30 out of 87 households were obtained using the same approach applied in the first study community where 50 percent of these were immigrant headed-households, and another 50 percent comprised of households of locals or indigenous. Socio-economic profiling to the 70 respondents was done using a semi-structured questionnaire in Appendix D. From the immigrant sample, social networks or linkages were also identified, most of which pointed to AEZ I. Using snowball sampling (Baxter, 2014), along social network or linkages along the migrants' source or sending areas a total of 125 households were identified in the network scattered across the country, the majority of which were in three district villages in AEZ I. From this network, dependent on access and availability, a total of 30 households (ten from each district in the villages identified were reached in the second phase of fieldwork. Using the same semi-structured questionnaire and methods for host area households in AEZ IIa, socio-economic profiling was done per household in the same way as in AEZ IIa for comparisons purposes. This brought a total number of households to 100; 70 percent in AEZ IIa sampled in phase one, and 30 percent in AEZ I sampled in phase two. The coded list of respondents showing basic demographics is attached as Appendix C 1; see also Figure 4.2 overall process in the approach to research. In AEZ IIa, the identification of respondents by migration status was done with the help of local leadership, using their local knowledge and village memory as no formal records exist. An equal number of migrant and indigenous households were included for comparison purposes. Each interview took 35 minutes at the most. Processing and analysis of the initial data for AEZ IIa revealed social linkages that led to AEZ I for the 30 percent cases through snowball sampling. In addition to the semi-structured questionnaire which was administered in local language, open-ended interview techniques were incorporated in the process, allowing an atmosphere of dialogue which was tailored towards the interviewee (Mullings, 1999; Dunn, 2014; McGuirk and O'neil, 2014). In combination, this interview process allowed collection of primary socio-economic and environmental data that

was processed into household capital and vulnerability information for each interviewed household (DFID, 1998; Scoones, 1998). Response rate was 100 percent.

4.3.2 Focus groups for indigenous or local knowledge

Often, studies of indigenous knowledge have taken limited account of the diversity of expertise that may exist within this "blanket" term (Chalmers and Fabricius, 2007). To explore this diversity and the factors that lie behind it, traditional knowledge holders were selected for focus group interviews as part of phase two activities. Focus group interviews were used in this regard given logistical, time constraints and as a mode for authenticity verification since individual member contributions can be subjected to immediate peer-review than participatory methods such as walk along interviews (Dunn, 2014). With the help of local leaders and relying on their 'mental registers' since no formal records exist, snowball sampling was used through recommendations from some of the 100 respondents to arrive at 18 respondents for indigenous knowledge information extraction. Regarded locally as experts or holders of legitimate traditional or indigenous knowledge, the 18 respondents are a separate sample from the 100 used in the socio-economic profiling. In terms of representation, they represented 16 ethnic groups in Zambia. 15 respondents are sub-Saharan descendants, and 3 are Sahel-linked descendants, comprising a near gender balance of 8 women and 10 men. Core questions to this group were four-fold:

- According to local experts, how were the indigenous people able to cope from and adapt to changes in environmental conditions and climate in the past?
- How do their adaptation strategies compare to modern-day (scientific) approaches?
- With specific examples, please share what you think was not working well with indigenous adaptation?
- What do you think has not worked well with the modern-day approach?

The responses to the above questions covered broad and diverse themes. However, after analysing the responses, 11 thematic areas emerged. With follow-ups for clarification that

formed part of phase two of fieldwork, and combining literature evidence, these were narrowed down to seven thematic areas since they were related. Chapter 5 presents the evidence gathered on the approaches, techniques and mechanisms indigenous people claim to have drawn upon for centuries in climate change adaptation efforts.

A GPS was used to record the location of each household. Other interviews involved key informants in institutions, i.e., Civil Society Organisations (CSOs) and government departments. These were identified as main stakeholders in climate change adaptation programmes targeted at rural livelihoods and small-scale farming. In this regard, five institutions were selected based on their appropriateness relevant to the core aims of the research. Three CSOs interviewed were Conservation Farming Unity (CFU), Civil Society for Poverty Reduction (CSPR) and Zambia Climate Change Secretariat (ZCCS). Government departments were Department of Agriculture and Livestock, and Department of Forestry. However, among the CSOs, ZCCS opted for written responses and could not be interviewed one-on-one. As opposed to household interviews which were conducted mainly in a local language most comfortable to the informant, these were conducted entirely in English. The choice of government and civil society organisations engagement allowed for the detailed contextual analysis of success and failure anecdotes of climate change programmes while maintaining the local context. It also provided a more nuanced picture, yielding insights that might otherwise be too subliminal in the broader context of the research. For instance, when talking about climate change, issues were narrowed down to four aspects; rainfall, water availability, agriculture and energy. However, when climate change was re-phrased to broadly mean environmental change, this widened the scope of discussion to include conservation farming and afforestation efforts meant to curb land degradation, deforestation and charcoal making. This established in context the connections between energy deficits and the booming business or high market demand for charcoal in urban areas, while deforestation and climate change became clearer with hydrological cycle implications.

These interviews uncovered different but specific institutional efforts on resilience and adaptation programmes administered in the past, and those that were being carried out. In discussing current resilience and adaptation programmes, informants from CSOs stressed on the lack of enough government resources, inconsistencies in and contradictory policies, including inaction in addressing energy deficits. According to all CSOs informants, energy deficit in the country in the last three years was arguably the main cause of deforestation through charcoal making. Similarly, while the informants from the government departments emphasised on the lack of resources to implement programmes, one of them was equivocal on the adequacy and consistency of policy. Nevertheless, he was quite straightforward on the issues around deforestation and its causes. Both CSOs and government acknowledged the high poverty levels in rural areas, and the energy deficit problem implying awareness on the connections between poverty and deforestation, energy deficit in urban areas and increased charcoal making in rural areas.

4.4 Socio-economic data acquisition

To obtain information about vulnerability of each selected household, socio-economic data were acquired through profiling interviews and surveys on capital assets and livelihoods (DFID, 1998; Scoones, 1998). The methods are drawn from the Sustainable Livelihood Approach (SLA) to assess vulnerability of households based on the five-asset-portfolio (i.e., natural, physical, financial, human, and social capital). This method is useful for understanding multi-dimensional poverty which can be displayed graphically in form of indicators using a capital-asset pentagon (Gerlitz et al., 2017). Figure 4.1 below shows the asset pentagon (see also Figure 3.3 of Chapter 3). The central point of the pentagon (i.e., the intersection of all lines) of the capital assets has available capital as zero, while the vertices indicate the available capital value of each type of capital from zero to one, with one being the maximum (Carney, 1998). The further away from zero, the stronger the capital (Derissen et al., 2011).

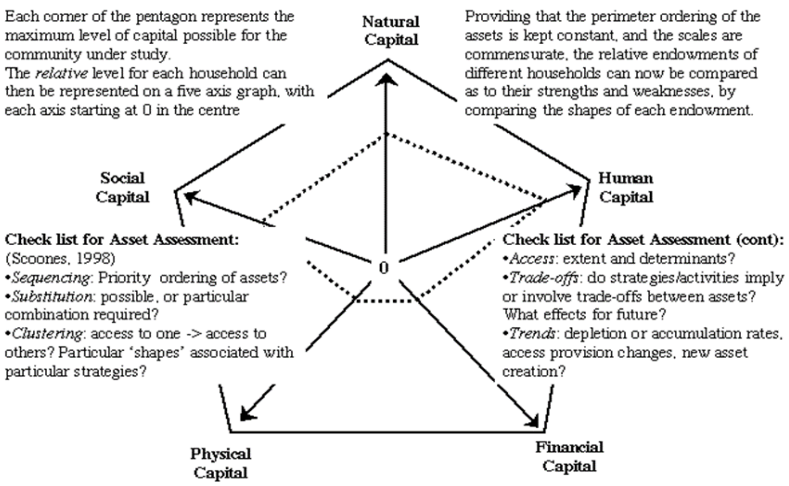


Figure 4.1: Household capital assets profile

The application of this method however requires an understanding of the specific elements of livelihoods in a particular region or community (Dong et al., 2016; Gerlitz et al., 2017; Hua et al., 2017). Based on the operational definition, local characteristics and data availability, a total of 22 sub-components constituting the five main livelihood capital assets were identified (Motsholapheko et al., 2011; Wu et al., 2017). This formed the basis for an indicator system of livelihood capital (Mutabazi et al., 2015; Dong et al., 2016). Data were collected through a one-on-one semi-structured household survey with each head of a household (i.e., a person responsible for making key livelihoods decisions such as spending, production and consumption in the home). The survey inquired among others, income size, largest expenses, land size, recent crop yield, education level, general sense of health, and social economic wellbeing (See Questionnaire in Appendix D). In each case, a head of household was also asked about the migration history of their members, relatives or friends. Part of the information collected was then used to identify links to source area respondents who were interviewed later in the second phase of fieldwork. Data were analysed using SPSS, XLSTAT and Excel. Figure 4.2 shows the overall process and approach to the research.

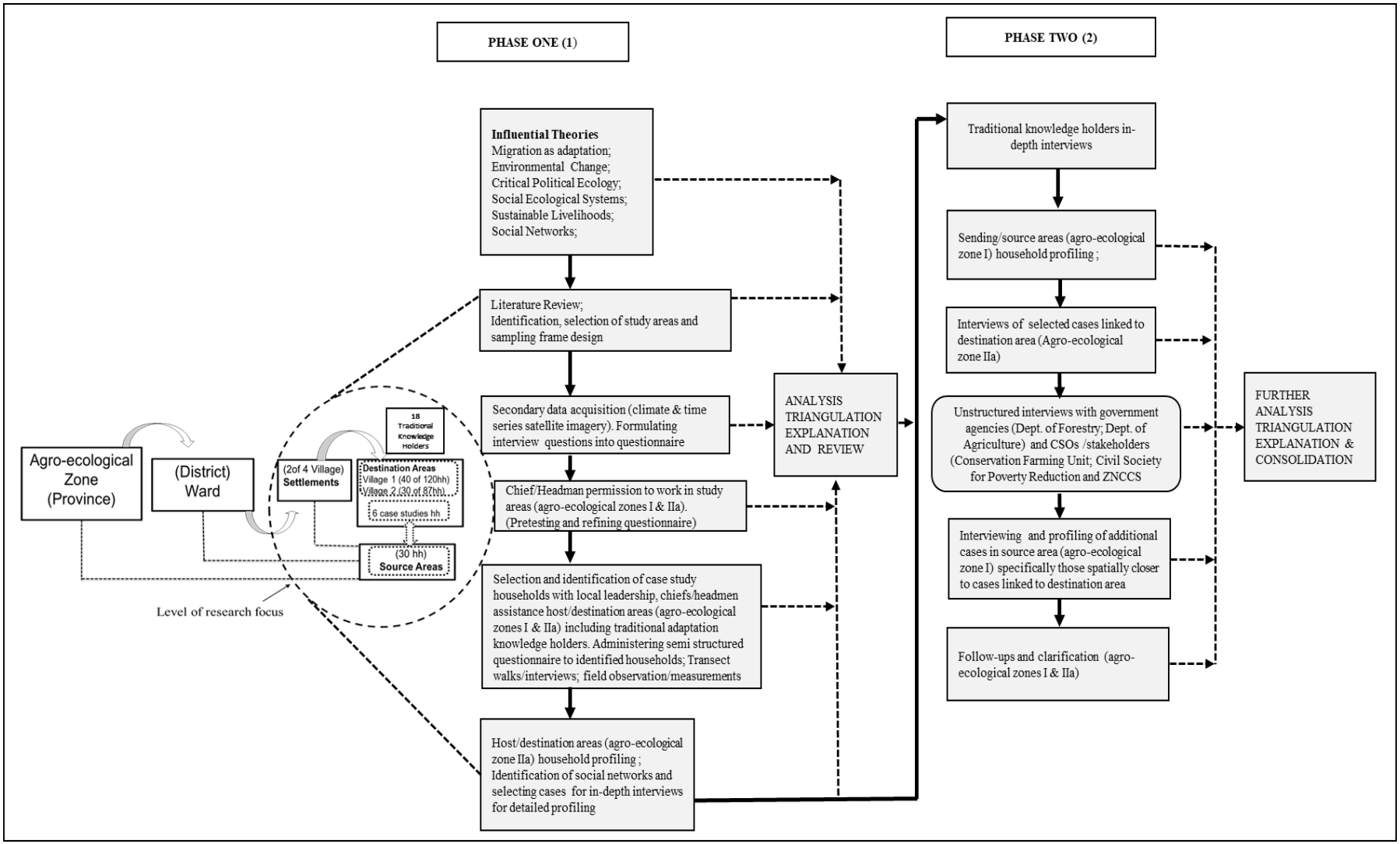


Figure 4.2: Flow-chart of overall process in the approach to research

4.4.1 Livelihood vulnerability and household capital asset indicator system

The application of LVI and household capital requires an understanding of specific elements of livelihoods (Dong et al., 2016; Gerlitz et al., 2017; Hua et al., 2017). In this study, two-phase LVI application was used. First, as composite index comprising major components and second, as composite aggregation into the IPCC conceptualisation of adaptive capacity and sensitivity to exposure. Livelihood capital base was also based on same principle. Based on operational definitions adopted from local understanding and literature, field survey, study area characteristics and data availability, a total of eight major components for LVI were identified with 35 sub-components. For livelihood capital, five major components were identified, with a total of 22 subcomponents. The identification process for both LVI and livelihood capital was based on the approach of Motsholapheko at al (2011); Mutabazi et al (2015) and Wu et al (2017). The LVI factor composition is shown in Table 4.1, while Table 4.2 shows the livelihood capital factors composition. These formed the basis for the indicator system development.

Once the calculations on 35 sub-components were completed for the eight major components, the eight major components were re-categorized and arranged in context of the IPCC-AR4 framework. Thus, socio-economic, migration, social networks and diversification were aggregated into the adaptive capacity category, while water, energy, market and health were aggregated into the sensitivity category. Climate change and/or variability, or natural disasters and environmental degradation comprised the exposure category. To measure Livelihood Vulnerability Index (LVI) values between AEZ I and AEZ IIa, equation (1) was used:

$$Index_V = (ex_v - ad_{cv}) * S \qquad \textit{Equation (1)}$$

Where $Index_V$ is LVI-IPCC for a district or zone V, ex_v and ad_{cv} are exposure and adaptive capacity respectively; and S is sensitivity or reactivity to a given perturbation. $Index_V$ is measured on the scale of -1 to 1, with -1 being the least vulnerable and 1, the most vulnerable. $Index_V$ values are interpreted as relative values compared in within the same study only.

Table 4.1: Livelihood Vulnerability Index components profiling

Major Components	Sub Components or Factors	Value Allocation Procedure from Survey Data (method ensures $0 < index \leq 1$)	Potential limitations
Socio-demographics	Household dependence ratio/HH_1 Household Gender/HH_2 Child-headed households/HH_3 Elderly headed households/HH_4 Household education/HH_5 Household capital structure/HH_6	-Percent of population under 18 and over 65 year of age to population between 19 and 64 years old -Percent of female-headed household. -Percent of child headed household (<18yrs). -Elderly headed household (>65yrs). -Percent of household where one or more members did attend formal education. -Percent of household with capital index below overall mean.	Lack of birth certificates Confusion on who is head of household in extended family, widowed or divorced households
Health	Health conditions/HC_1 Distance to medical care/HC_2 Healthcare/HC_3 Child-headed care/HC_4 Child-health/HH_5	-Percent of households with one or more members with terminal illness -Average time to reach nearest health facility (minutes). -Percent of households without medical care. -Percent of household with children as care-givers. -Percent of household where one or more members miss school due to ill health.	Subjectivity in time estimation: no timers or watches. Challenges in medical care definition
Market Access	Market access/MA_1 Farming input support/MA_2 Distance to market/MA_3 Support efficiency/MA_4	-Percent of households with access to market for produce. -Percent of households with access to timely farming input. -Time it takes to reach market place. -Percent of household who sell produce below market value.	Definitions of "market", "timely" and "market value" Subjectivity in time estimation: no timers or watches.
Livelihood strategies	Remittances/SLF_1 Migration/SLF_2 Social networks/SLF_3 Income diversification/SLF_4 Food sources/SLF_5 Crop diversification/SLF_6 Livestock diversification/SLF_7	-Average give: receive ratio. -Percent of household whose one or more members migrated. -Percent of household in co-operative or access to loan/technology. -Percent of household members diversifying income sources. -Percent of household dependent solely on family farm for food. -Mean crop diversity index. -Livestock animal rearing diversity index.	Confusion about who is family (immediate) and who is a relative (extended); Reliance on self-reported types of help/support.
Natural Disasters and Climate Change/ Variability	Drought or floods /ND_1 Disaster warning/ND_2 Damages/ND_3 Precipitation /ND_4	-Total number of floods and droughts in the past 5 yrs. -Percent of households that did not receive a warning about the pending natural disasters. -Percent of households with damaged property or crops due to disaster (2011-2016). -Mean standard deviation of monthly precipitation in rain season (2011-2016).	Subjective definition of ''warning.'' Recall bias (only severe droughts or floods are most likely to be remembered) Gaps in rainfall data.
Water	Access rights/WA_1 Distance to source/WA_2 Availability/WA_3	-Percent of households reporting water conflicts or restricted access. -Average time it takes to reach primary water source (minutes). -Percent of households without primary water availability during certain times of the year.	People are more likely to remember violent conflicts and severe water shortage times of year. Subjectivity in time estimation: no timers or watches.
Environmental Degradation	Soil quality/SQ_1 Fertilizer/Manure application/SQ_2 Vegetation Index of Farmland/SQ_3 Soil erosion/SQ_4	-Percent of households reporting poor soils on farmlands. -Average amount of soil conditioner used per hectare (Kilogram per hectare). -Average bare land estimate as percentage of total farmland for a household -Average percentage estimate of eroded part of bare land of farm for a household.	Subjectivity on definition of "poor" and individual perception. Lack of reliability due to field estimates without equipment.
Energy Sources and types/mix	Electricity/ES_1 Firewood or Charcoal/ES_2	-Percentage of households without access -Percentage of households relying on charcoal/firewood.	

Table 4.2: Capital asset components profiling

Type of Livelihood Capital Asset	Sub components of Livelihood Capital Asset	Value Allocation Procedure from Survey Data (method ensures $0 < \text{index} \leq 1$)	Potential limitations
Natural (N)	Land Title/N_1	-On title give score 1, No title but document assign 0.5, No title or document, assign 0.	Subjectivity in land size estimation, and bias definition of "adequacy", and what constitutes "soil quality".
	Size of Cropland/N_2	-Actual family agricultural acreage (Assign 0 for inadequate; and 1 for adequate).	
	Cropland Adequacy/N_3	-According to household self assessment: binary variable Yes =1, No =0.	
	Soil quality on Cropland/N_4	-Assign value according to household self-assessment of soil quality: 0 for Very poor; 0.25 for poor; 0.5 for fair; 0.75 for good; and 1 for very good.	
	Water Availability /Access/N_5	-Set to binary variable, where Yes=1, No=0.	
Physical (P)	Living Capital/P_1	-Set a dichotomous variable, assign 1 for enough/possession, otherwise 0.	No devaluation consideration, or condition of physical assets was taken into account.
	Production Capital/P_2	-Set a dichotomous variable, assign 1 for enough/possession, otherwise 0.	
	Housing Capital/P_3	-Assign the value according to the weighted integration of the building material, and housing structure (Concrete blocks and iron sheet scores 1, earth brick and iron scores 0.5; wood, earth brick scores 0)	
	Livestock/Poultry Capital/P_4	-Convert the number into prevailing market price, and set to binary variable (adequate=1, inadequate=0).	
Social (S)	Social Networks/S_1	-Opportunities to obtain any assistance (number and quality of social links including family): - Assign 0 for very weak; 0.25 for weak; 0.5 for fair ; assign 0.75 for a good contact relationship; assign 1 for very good contacts/relationship.	Recall subjectivity in self described relationship strength
	Neighbourhood or Social Clubs/S_2	-Type of clubs and support: Value according to social club support or the strength of household. community/ neighbourhood relationship. Assign 0 for very weak or no community/no neighbouring contacts; assign 0.25 for weak club; assign 0.5 for fair, 0.75 for strong and assign 1 for very strong.	Confusion about who is family (immediate) and who is a relative (extended); Reliance on self-reported types of help/support.
	Social Spending/S_3	-Social events e.g., assistance to family, relative or others, through e.g., seeds, fertilizers, healthcare and school fees: Find ratio of the number of types of help received by a household in the past 3-6 months to the of types of help given by a household to someone else in the last 3-6 months.	
	Time taken to reach facilities (health, school and market)/S_4	-Assign 1 for less than 1 hour, 0 for more than an hour.	Subjectivity in time estimation: no timers or watches.
Human (H)	Family Labour Force/H_1	-Sum each item according to the age assignment of members in a household. Assign 0 for infants to 12 years, the disabled and seniors outside the labour force; assign 0.5 for the teenagers between 13–19; assign 1 for the middle aged and elderly between 20 and 60.	
	Education Level H/H Head/H_2	-Assign 0 for the illiteracy; assign 0.25 for the primary school; assign 0.5 for the middle to high school; assign 0.75 for technical college and assign 1 for university.	
	Health Conditions/H_3	-According to household self assessment, include family medical expenses per capita and : Assign 0.2 for poor; assign 0.5 for fair; assign 0.8 for good; assign 1 for very good.	Subjective self-assessment of health condition.
Finance (F)	Annual Net Income/F_1	-Set as annual net household income, binary variable (adequate=1, inadequate=0).	Recall subjective bias as these are only estimates and upon subjective definition of "adequacy".
	Credit Condition/F_2	-Set it as a dichotomous binary variable, assign 1 for possess otherwise 0 and sum each item.	
	Main Food Crop Yield/F_3	-Convert to prevailing market value per unit as binary variable (adequate=1, inadequate=0).	
	Adequacy of Crop Yield/F_4	-Assign according to household self assessment: binary variable (Yes =1, No =0).	
	Dependence Ratio/F_5	-Assign 1 for 1.5 or less, 0 for more.	No specification regarding the seasonality of crops.
	Mean Crop Diversity Index/F_6	-The inverse of the number of crops grown by a household +1.	

4.4.2 Indicator system calculations

In developing a comprehensive quantitative indicator system from multiple entries of measurements on different scale or units, the first step was the standardisation of the scoring system. Each sub-component scale that makes up a component need to be harmonised to the rest of the components (Hahn aet al., 2009). The equation used for this standardisation was drawn from the Human Development Index concept as used to calculate life expectancy (Vincent and Cull, 2010; Motsholapheko et al., 2011; Opiyo et al., 2014). It is simply the ratio of the difference of the actual life expectancy and a pre-selected minimum, and the range of pre-determined maximum and minimum life expectancy. Thus, Equation (2) was derived for each of the 35 sub-components in value allocation for LVI. The same applied to the 22 sub-components of capital assets (Ansoms and McKay, 2010; Pritchard, 2013; Lei et al., 2016; Wu et al., 2017):

$$Index_x = \frac{x - x_{min}}{x_{max} - x_{min}} \qquad \textit{Equation (2)}$$

Where $index_x$ is the value of the indicator measured in any unit, x_{min} and x_{max} are its pre-determined minimum and maximum values. The process drew logic and adopted a mathematical definition of a non-empty set with non-negative weights where $index_x$ score was defined using domain $0 \leq x \leq 1$, i.e., $x \in [0, 1]$. For example, a respondent who had no title for land but had an adequate area of crop land; adequate crop yields; good soil quality of crop land; and adequate water source, scored 0, 1, 1, 0.75, and 1 respectively for natural (N) capital. Using Equation (2) the indices were calculated for all the five capital assets for each household.

In this regard, the scoring system for each capital asset or major component was standardised such that it summed up to 1. All the indices for each of the eight major component factors in Table 4.1, were averaged using Equation (3). The same applied to each type of the five-capital assets in table 4.2.

$$Y_x = \sum_{i=1}^{n} \frac{index_{yi}}{n} \qquad \textit{Equation (3)}$$

Where Y_x is type of capital or major component, $index_{yi}$ is the index of any of the indicators calculated using Equation (1) and n is the total number of indicators used to estimate Y_x. Households were also asked to state their livelihood capital standing and responses captured using the scoring system shown in Table 4.2. Similarly, to obtain the mean score for major components or capital assets for each study area or category for comparison purposes, a convex combination to account for the unequal number of contributing sub-components or unequal number of respondents e.g., between agro-ecological zones was applied (Strutz, 2010). Thus, the indices obtained using Equation (2) were weighted to obtain an arithmetic mean using Equation (3):

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}, \text{i.e.}, \bar{x} = \frac{w_1 x_1 + w_2 x_2\ w_3 x_3 + \cdots w_n x_n}{w_1 + w_2 + w_3 + \cdots w_n} \quad \textit{Equation (4)}$$

Where $\bar{x}$ represents the weighted index value of any given major component, w_i is the weight of each major component, n is the number of sub-components that make up a given major component, and x_i are the sub-component indexed by i. Using Equation (3), calculations were done for both agro-ecological zones for LVI, and across categorisations for capital assets that needed comparison based on capital structure, such as gender, migration status, household size, and age. After the tabulation process, data were analysed using SPSS and XLSTAT software packages.

> ***Example 2***: A head of a household (respondent) can either be male or female at Study Areas X and Y. If the number of male headed households equals that of females in each study area, that won't raise problems when comparing across gender within and across agro-ecological zones. However, a problem arises when the numbers are different in one or both cases. For instance, area X has 15 Males and 10 Female headed households whose livelihood scores are as follows:
>
> Male: [0.21, 0.3, 0.27, 0.2, 0.26, 0.31, 0.28, 0.28, 0.2, 0.28, 0.32, 0.23, 0.22, 0.33, 0.3]
> Female: [0.23, 0.25, 0.21, 0.24, 0.22, 0.31, 0.25, 0.26, 0.21, 0.22]

The straight average for male-headed households is 0.266; and 0.240 for females. The straight average for 0.266 and 0.240 is 0.253 i.e., the mean of the gender category means. However, this does not account for the differences in the number of households in each category (15 versus 10). Hence 0.253 does not reflect the average household score independent of class in area X. Equation (3) solves this problem: Thus, the correct mean of category means $\bar{x} = \frac{15(0.266)+10(0.253)}{15+10} = 0.256$

Or by convex combination of coefficients, summing to one: i.e., $\frac{15}{15+10} = 0.60$ and $\frac{10}{15+10} = 0.40$; Then by weights application $\bar{x} = [(0.60)(0.266)] + [(0.40)(0.240)] = 0.256$

The process is done for area Y as well for comparisons either within or with Area X.

4.5 Environmental change data acquisition

Since the dominant livelihood activities in rural Zambia's economy are underpinned by agricultural and food crop production (UNDP and GRZ, 2010), only selected environmental change indicators (climate change, environmental degradation/land cover change) were investigated. The methods used for data acquisition and analyses are discussed at length in the subsections below.

4.5.1 Climate change

As discussed in Chapter 3, long-term climate measurements are obtained from accumulated daily weather parameters of which precipitation and temperature are the main ones used in climate change assessment (IPCC, 2014a). In this study however, only rainfall data from daily records were utilised and analysed for change and variations. This was obtained in electronic format from the Zambian Meteorological Department Office.

The network of weather stations generating data varies in density in the landscape, ranging from 20-100km apart and 488 -1673 meters above sea level (Figures 4.3). Data in the source areas were sparse, with few recording stations. In such situations, data from the nearest weather

stations, were utilised e.g., Livingstone-Kazungula area and Choma. However, further challenges were faced in that records at some of the nearest alternative weather stations had many gaps. Only Livingstone and Kabwe data records were complete. In this regard, tabulation for Choma was only done up to 2011.

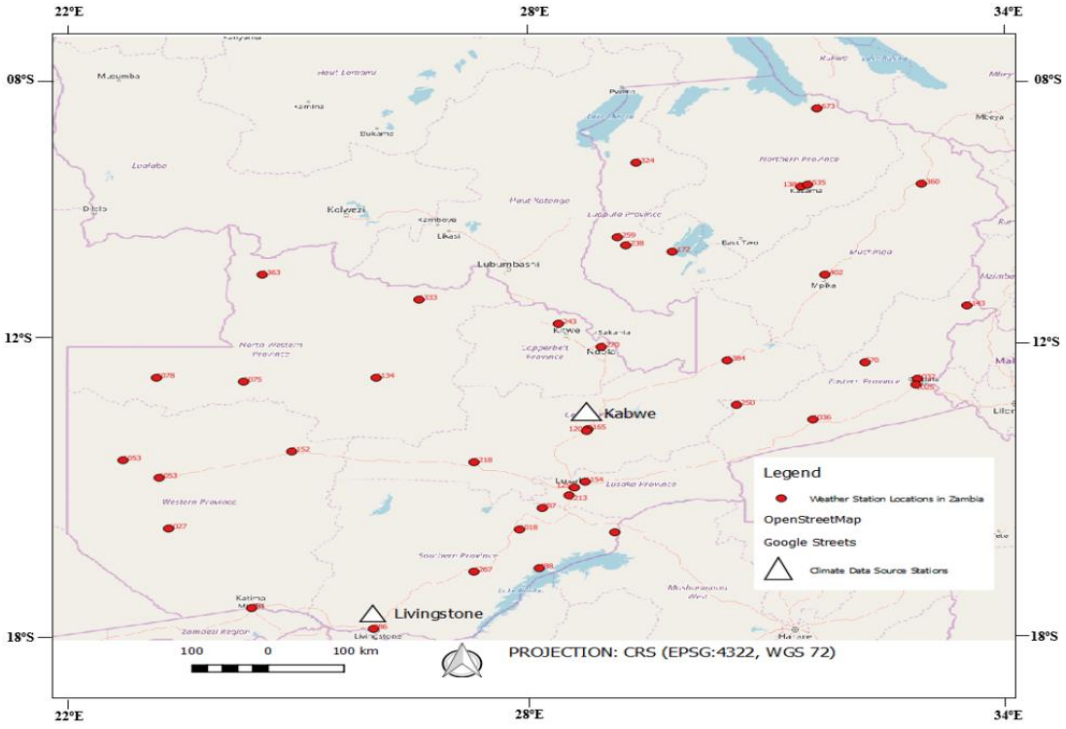


Figure 4.3: Location of ground weather stations in Zambia

For farmers and other similar land users, it may not be enough to consider changes over time in mean annual climate parameters alone (Thomas et al., 2007). Similarly, the concepts of extreme rainfall or drought may be too broad and not sufficient to fully capture the climate variability dynamics that farmers face in their critical decision-making processes (Deressa et al., 2009; Below et al., 2014; Lei et al., 2016). Within the broader concept of rainfall variability lies intra-seasonal factors such as timing of onset and cessation which determine the crop planting regime and growing period (Mugalavai et al., 2008). In between planting regime and growing period are intermitted rainfall disturbances such as dry-periods and floods which ultimately influence the effectiveness of the rainy season in a year (Dunning et al., 2016). All these factors determine the effectiveness of farming activities and ecosystems utilisation as they introduce an element of uncertainty, leading to certain changes in social behaviour (Thomas et al., 2007).

Thus, daily rainfall data were processed to generate annual mean totals, rain season duration and dry spells (Lázaro et al., 2001; Tilya and Mhita, 2007). Utilizing data processing techniques from mainstream literature *total rainfall* and *rain season duration* were conceptualised as the accruals from *onset* to *cessation* in the rainfall year, and the period between *onset* and *cessation* respectively (Tilya and Mhita, 2007). However, the definition of 'onset' and 'cessation' in tropical and subtropical climates has been problematic due to the intermittent nature and patchy distribution patterns of rainfall (Sawa and Adebayo, 2011). Thus, only the operationalised definitions of both terms were utilised in this study, drawn from Douguedroit (1987) and Sawa and Adebayo (2011). As a starting point, it was essential to first define 'dry-day' which is basically a period during which no amount of rainfall is experienced in 24 hours (Mathugama and Peiris, 2011). This definition takes the threshold value of zero. However, different authors have operationalised different threshold values dependent on scope and focus of study (Douguedroit, 1987; Lázaro et al., 2001; Tilya and Mhita, 2007; Mathugama and Peiris, 2011). In this study, a threshold value of < 1.0 mm in 24 hours was adopted (Douguedroit, 1987) on the assumption that due to intense incident solar radiation in the tropics, rainfall below this amount may not stimulate plant growth as it is lost almost immediately through evaporation (Tilya and Mhita, 2007; Masupha et al., 2016).

Building from the dry-day definition, 'onset' of rainy season was conceptualised as the beginning of a rainfall year during which dry-days (dry season) were terminated by amounts above a threshold (Ati et al., 2002; Masupha et al., 2016). In agricultural production, this threshold relates to plant growth and is dependent on crop type (Sawa and Adebayo, 2011). In this study a threshold value of ≥10mm in 24 hrs, or accrual of ≥25mm in ≥7 consecutive days was adopted (Mathugama and Peiris 2011). Accordingly, cessation was defined as the time of the rainy season during which no more 'effective' rains were received (Sawa and Adebayo 2011). For maize crop production, 'effectiveness' ceases between 1.35-2.2 mm day^{-1} range, dependent on soil-moisture-holding capacity and evapotranspiration rates (FAO, 2018). For

other crops such as sunflower and groundnuts, it is much higher averaging between 2.7-3.8mm per day^{-1} (FAO, 2018). Length of drought was processed from dry spell frequencies. Taking into account the requirements of maize as the main food-crop in the study area, 'dry spell' was defined as a period of ≥14 consecutive days during which no rainfall of ≥1mm was received from onset to cessation in a rainfall year (Ati et al., 2002; Sawa and Adebayo, 2011; Mathugama and Peiris, 2011; Fisher et al., 2015; Ng'ombe and Kalinda, 2015). For purposes of other crops grown in the study area which are sensitive to drought (e.g. sunflower and groundnuts), dry spell was further sub-categorised to short (5≤9 days) medium (9≤14 days) and long (>14 days) (Masupha et al., 2016).

4.5.2 Rainfall data standardisation and significance tests

Several techniques have been developed for the analysis of climatic data, which generally fall into variability analysis and trend detection categories. In this research, both variability analysis and trend detection were utilised. For example, the variability analysis approach largely utilised coefficient of variation (CV), or percentage departure from the mean (anomalies). CV is a measure of relative variability. It is the ratio of the standard deviation to the mean (average) (Strutz, 2010). This was applied at inter-annual (between years) and intra-seasonal (monthly within season) level to gain an insight of how much rainfall may have varied over the study period (Ayanlade et al., 2018). If CV of an area is less than 30 percent (CV<0.3), it implies lower variation and rainfall pattern is much more reliable than in an area where CV is above 30 percent (i.e., CV>0.3) (Pai et al., 2011; Kisaka et al., 2015). For trend detection, both the parametric and non-parametric test approach were used (Gebremedhin et al., 2016). Standardized anomalies of rainfall were calculated to examine the nature of the trends. These enabled the determination of the dry and wet episodes in the climatic records and to further analyse frequency and severity of droughts. Rainfall and drought characteristics as evidence of climate change were analysed based on annual rainfall fluctuations, variability, occurrence and

duration of dry episodes within rainy season (Ayanlade et al., 2018). Standardized Rainfall Anomalies (SRA) was calculated for each study area using equation (5):

$$SRA = \frac{R_t - R_m}{\delta} \quad \textit{Equation (5)}$$

Where SRA is a function of R_t (i.e., the annual rainfall value in year t); R_m is a long-term mean of annual rainfall over the period being studied (i.e., 1980–2016), while δ is the standard deviation of annual rainfall for the period under study. The higher the SRA, the wider the variability (Jaiswal, Lohani, and Tiwari, 2015). A positive SRA indicates excess rainfall while a negative SRA signifies deficit or drought. In this investigation, the drought severity classes were considered *extreme*; if SRA < -1.65), *severe*; if -1.28 > SRA> -1.65), and *moderate* of -0.84 > SRA > -1.28 with *zero* drought category where SRA > -0.84 (Agnew and Chappell, 1999).

However, because normality and homogeneity of variance in the series of climatic data may be adversely affected by outliers and missing records, a combination of parametric and non-parametric tests were used. Thus, a non-parametric test, Mann-Kendall (MK) and parametric Z-test were utilised in this analysis. MK is usually the most recommended non-parametric test and has been widely utilised in assessing trends in meteorological variables: see for example Yue et al (2002); Seleshi and Zanke (2004); Jaiswal et al (2015) ; Gebremedhin et al (2016); and Ayanlade et al (2018). However, MK test does not specify the trend in the data (i.e., weather linear or non-linear). Nevertheless, the relative advantage over the parametric test lies in its strength in the handling of any data series that have missing records, or non-normally distributed data with outliers, which are frequently encountered in most climatic data. Although it lacks trend specificity, MK was used in this research with Kendall's tau rank correlation coefficient and slope estimator (Sen's slope). Kendall's tau rank correlation coefficient assesses statistical associations based on the ranks of the data. Ranking data is carried out on the variables that are separately put in order and numbered. Correlation coefficients take the values between -1 and +1. The positive correlation signifies an increase in the ranked variables. Conversely, the negative correlation signifies a decrease (Jaiswal et al., 2015).

To the contrary, Sen's slope (β) estimation test computes the gradient (i.e. the linear rate of change). It is a linear regression test (a straight line fitted to the data series with the gradient of the line. The gradient or slope is a scalar function which can be significantly different from zero. For example, for a series of observations: x_i, where $_i$ =1, 2, 3, 4…n, a straight line in the form of $y= bx+a$ is fitted to the data series where; the change in y is defined by the gradient or slop b of x, at intercept a. A positive value of β indicates an 'upward trend' or increase, while a negative value indicates a 'downward trend' or decrease. β equals zero signifies no change (Ayanlade et al., 2018). To test for significance of variations on e.g., amount of annual rainfall, length of rainy season, number of actual rainy days and number of dry days, a Z-test statistic was performed. Rainfall data for both areas were approximately normally distributed at 95% confidence level. Largely, data analysis utilised XLSTAT software package and excel spreadsheet.

4.5.3 Nature-society interaction

The nature-society interaction is complex, and the utilisation of social-ecological systems (SESs) approach to understanding this complexity serves as common framework (Berkes et al., 2014).

However, the core challenge in applying the SESs lies in the identification and analysis of relationships that exist at different spatial and temporal scales (Ostrom, 2009; Wily, 2011). In an attempt to understand a natural resource system of rural land-use for agricultural production and its various resource units utilisation (e.g. forestry and water resources) this research attempted to apply the SES approach (Locke et al., 2014). The governance mechanisms - organizations and policies that govern land use, its subsystems, and resource units including how rules are made and by who, were also analysed (Rissman and Gillon, 2016). As part of the livelihood capital portfolio, the "social" system was the household, community and its immediate social networks and structures (Berkes et al., 2014). The analysis also included how available local knowledge and technologies were being used as a transformation response towards resilience in the face of

environmental change (Gallopín, 2006). The "natural" system was land for agricultural production and its various components such as soil quality, forestry, and water (Ostrom, 2009) and how these interacted both with the natural and anthropogenic influences to yield certain livelihood outcomes (Pandey et al., 2017).

Figure 4.4 (below) gives an overview of the SES framework adopted. See also Figure 3.4 in Chapter 3. Shown below are probable relationships from the core or first order system (S) (i.e., social, economic, and political) and how this connects to and interacts with the second-order subsystems [i.e., Resource System (RS), Resource Units (RU), Governance System (GS) and Users (U)]. In this interaction, the second order subsystems yield certain first order outcomes (O). In turn, these outcomes interact with both the first-order and the second order subsystems, and other related ecosystems to yield second order outcomes, e.g., sustainability, transformation or collapse (Walker et al., 2004; Ostrom, 2009; Berkes and Ross, 2016). Similarly, the first order systems, and second order subsystems interact within and across orders, and so do outcomes (Gunderson and Holling 2002; Allen et al., 2014; Berkes and Ross, 2016).

Essentially, multiple order variables were identified, e.g. under second order subsystem:

(i) resource systems (i.e., smallholder farmland; encompassing a specified territory and forestry resources, streams or rivers, and wildlife);

(ii) resource units (i.e., types of trees, shrubs, and plants contained in the rangeland or forest park, types of wildlife, access and/or availability of water);

(iii) governance systems (i.e., the government and other organizations (CSOs) that influence, directly or indirectly the resource system, through specific rules or intervention programmes related to the use of the resource system, and how these rules are made, and by who);

(iv) users (i.e., individuals who use the resource in diverse ways for livelihood sustenance, recreation, or commercial purposes).

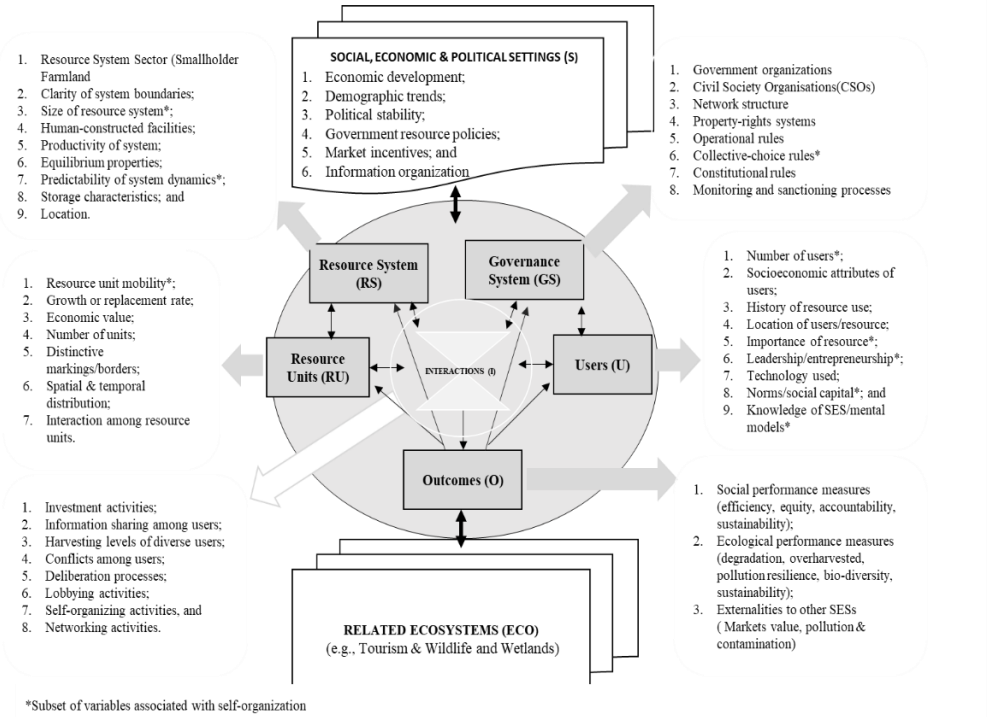


Figure 4.4: Variables identified and levels of nested relationships using SES approach

Thus, every resource system has a specific size, specific resource units, mobility of these units, level of governance, and users' knowledge of the resource system. The knowledge of the system are further comprised of third-order variables, (e.g. types of knowledge as exhibited in types of farming methods and tools) which result in livelihood outcomes (Ostrom, 2009; Locke et al., 2014; Rissman and Gillon, 2016).

In terms of social system attribute of governance, key influences for specific outcomes considered were the presence or lack of multi-level institutions; partnerships among state and non-state actors (Berkes et al., 2014). Along this consideration were investigations of social processes such as appreciation of and respect for diverse perspectives, knowledge, and shared learning that provided opportunities for adaptability and resilience (Berkes et al., 2014; Berkes and Ross, 2016). Also, an attempt to identify what constituted success or failure of the system was made through identification and analysis of driving factors, impacts, state change and responses (DPSIR) (Barnard and Elliott, 2015). This provided a nested framework within the SES and SLF approach for analysing causes of change in socio-economic and ecological

variables, and how the causes were responded to at different levels for desirable vulnerability and resilience outcomes (Ostrom, 2009; Berkes and Ross, 2016). As a generic data organising structure, the framework is useful in the identification of multi-tier hierarchies of variables, thereby enhancing the researcher's ability to effectively analyse nested relationships at different temporal and spatial scales (Locke et al., 2014).

4.5.4 Environmental degradation indicators

Data for environmental variables, e.g. soil productivity/fertility, water and land adequacy were captured qualitatively both by asking direct questions in the survey and through local level field transect walks. This simple technique involved walking with respondents through their crop fields or farmland, asking questions, listening, looking at the surrounding, observing and taking notes (Stringer, 2004; Stratford and Bradshaw, 2014; Dunn, 2014). This method has been used in many studies from longer to shorter-cycle movements in documenting environmental change and migration (UNEP, 2011; Bohra-Mishra and Massey, 2010; Piguet, 2010). It is useful in understanding levels of environmental degradation first hand, with or without laboratory equipment or GIS platform integration (Sakdapolrak et al., 2014). Thus, to ascertain levels of farmland conditions and farming practices or technologies used, the assessment of environmental indicators was based on integrated methods, combining qualitative environmental impact assessment through field observations and field-walk-along interviews (Sporton et al., 1999; Osbahr et al., 2010; Pauw, 2013).

In addition to the semi-structured questioning during field-walk-along, respondents were asked using the approach of Pauw (2013), to comment or grade the quality of their farmland e.g., soil quality, woodland, amount of fertilizer or manure required and water availability on the farmland (Pauw, 2013). The comments were jotted down in the field notebook and later used to compare and cross-check for consistence with corresponding questionnaire responses (Milan et al., 2015). Information obtained was based on respondents' perception and expert opinion (Dunn, 2014; Baxter, 2014).

4.5.5 Land cover change

Land cover change was assessed using open source Google Earth images (Erener et al., 2012). Where necessary, images were integrated on open-source QGIS platform to show environmental conditions on a much larger scale (Gudex-Cross et al., 2017). Location of households were also mapped using the same technique (Byrne et al., 1980). However, while satellite image utilisation is useful in investigating environmental conditions over large areas, it is not as useful for small areas given spatial resolution limitation. For this reason, environmental conditions such as soil erosion and land degradation were captured using photography (Tiffen et al., 1994). This also applied both as a satellite image verification exercise and as ground truthing (Ariti et al., 2015; Gudex-Cross et al., 2017).

4.6 Challenges and methodological limitations

Data collection challenges are not easily separable from methodological ones. They inherently impact upon the results collected. In social sciences, this is even more complex (Dowling, 2014). However, by combining techniques, some of the challenges encountered in real-time social situations can be solved (Stratford and Bradshaw, 2014). Specific challenges in this research are around perception and individual personal judgement, some of which have been covered in Tables 4.1-4.2. In addition, some environmental indicators such as soil quality were determined using respondent perception, which may not necessarily reflect the true condition of soils in question. Interviews have their own limitations. For example, focus group-based interviews tend to suppress views along such social stratification as age, gender and class. This makes it impossible to obtain views from every participant. There is also an additional challenge that emerges around social interaction and dialogue: influence. “It is impossible for an interviewer not to influence an interviewee, since observer and observed are placed in a highly reactive situation” (Harvey, 1969 p.321). As an interviewer, I recognized that the potential to influence answers does exist, and therefore worked actively to minimize this phenomenon. Leading, ambiguous and double-barrelled questions were avoided (McGuirk and O’neil, 2014)

both in the questionnaire and during in-depth interviews. However, during interviews with institution representatives, it was difficulty at times to be aware that the process was being conducted in English. English is a second language to both me and the informants. Under these circumstances, both language in which knowledge was being constructed, and the interviewee's proficiency in the language may have influenced and affected the ways in which opinions and meanings were being conveyed or interpreted (Dunn, 2014). Similarly, meaning may have been lost in the household questionnaire translation process by reduction or distortion, resulting in poor articulation of social context and traditional practices misrepresentation (Smith, 1996).

On another aspect, it was important to be aware that culturally, age and gender differences impose restrictions on the type of questions that can be asked. Questions about age and marital status cannot be asked anyhow as this can be regarded as 'disrespectful'. This was difficult to deal with at times but with the help of the local leadership, it was possible to ask such questions and answers obtained in confidence.

Alongside struggles for political control, power relation challenges were encountered given the volatile nature of the local politics. In Zambia, local politicians take advantage of any situation to gain political "mileage". Bringing external support to the community guarantees this support: it assures votes and continued stay in power if already in leadership position. Around this power control struggle, my request to enter the community through the local authority was immediately dismissed by the local ward councillor. He advised that it was not necessary to do so, given that the project was understood purely as academic, though with potential to future benefits. He referred me to the local village headmen in the two villages studied. However, the local headmen requested a clearance notice from the local authority. Similarly, given the historical baseline studies conducted by CSOs for their numerous household support programmes, local people may have been conditioned by such projects for economic benefits. For this reason, everyone would want to be interviewed.

Constantly mindful about this, precautions were made to ensure clarity from the outset about the goals of the project. For instance, both the local leadership and the respondents themselves were fully aware about the purpose of the interviews and the information being sought including what this information would be used for. Nonetheless, this may have created some suspicion among some of the community members. Close to 50 percent of the selected respondents reported having been either confronted by a non-respondent, or another fellow respondent; with the former seeking confirmation on the truth of non-benefits, and the latter doing cross-checks about the type of questions asked. This social behaviour meant to solicit aid from donors had potential to alter information provided in ways that might reflect untrue desperate socio-economic conditions. To ensure that information obtained was factual and reflected true conditions , other techniques were applied in combination (UN-DESA, 2005). These included house construction material checks, size of yield, granary size and content, number of animals and equipment.

A total of 70 households were interviewed in the destination area. Despite the challenges faced around logistical, resources, time and household accessibility, a total sample of 30 households was achieved in the source area, bringing the overall total sample size to 100. Another important challenge was that on my return for phase two data collection, I found that one of the respondents identified for in-depth interviews had died in the months before I revisited the village. This was challenging ethically, culturally and research wise. However, after consultations with both the headman and the bereaved family members themselves, the family found no reason to discontinue participation in the interview process.

While the SES lens is useful for understanding system resilience and sustainability in livelihoods and natural resources conservation, it has challenges. Understanding a system requires knowledge about specific variables and how these are related at different levels and scale (Ostrom, 2009). However, identifying the variables and their relationships is complex as practical problems emerge when deciding on what variables to include or leave out (Gallopín,

2006; Rissman and Gillon, 2016). In this research (drawing heavily from literature and informants), care was given in identifying and deciding on variables for inclusion in the analysis (Ostrom, 2009; Locke et al., 2014; Rissman and Gillon, 2016). For instance, pre-conditional attributes of SES application focussed fundamentally on natural, society and governance subsystems which were outlined based on literature and respondents involvement (Ostrom, 2009; Locke et al., 2014). In this regard, society and governance were viewed as sub-systems comprising communities and social institutions established through a self-organising process to guide (through policies) community livelihoods towards prevention, mitigation and adaptation from changing environment conditions (Folke et al., 2005; Berkes and Ross, 2016). The natural referred to the ecological system and its subsystems involved in the interaction with the social system resulting in certain livelihoods outcomes (Berkes et al., 2014).

4.7 Ethics, privacy and confidentiality

Ethics consideration is an important component of every research process involving people (Haggerty, 2004). From visiting respondents at their homesteads to asking them personal questions that force them to provide the type of information which may be considered private, requires ethics and confidentiality considerations (Dowling, 2014). This does not only involve invading people's private lives, but also creates household routine disruptions that take valuable and productive time away from them (Liamputtong, 2007). In this research, ethics and confidentiality considerations were incorporated from the semi-structured questionnaire content through to ensuring informed consent. Consent was not just a matter of "yes, you can interview me": it was making sure that respondents understood exactly what they were consenting to (Dunn, 2014). Confidentiality in the research process ensured that no third party could identify participants. By coding and withholding names throughout this thesis, anonymity is achieved (Dowling, 2014). Every respondent was specially valued and genuinely respected with their needs, traditional values and social systems surrounding their livelihood (Mullings, 1999).

While working closely with respondents to meet specific objectives of the research, honesty regarding the use of data was always maintained. All questions considered likely to cause psycho-social harm were avoided. By asking right questions and exhibiting genuine interest in listening to every respondent's responses, dignity and respect were maintained along total awareness and sensitivity to the socio-economic realities (Liamputtong, 2007). No respondents were paid for the information they provided. It was also stressed throughout the research process that findings may be accessed by government and CSOs, but without reference or guarantee to any direct impacts as a result.

4.8 Positionality, reflexivity and power relations

Adopting and using qualitative methods outlined in this chapter inevitably exposed me to various roles, responsibilities, power and social relations in the research process. However, being aware of how my social relation, role and responsibility could have inhibited or enhanced the information collected was not an easy task. It is not always possible to assess or anticipate precisely the ways in which one's personal traits, characteristics and mannerisms could affect the information being collected (Dowling, 2014).

Power relations in qualitative research is involved throughout the process. As researchers attempt to answer questions in a social setting, the process requires them to either participate in or create scenarios (Dowling, 2014). In this process, a researcher is differently positioned in relations, social structure and status through which power permeates in numerous ways (Liamputtong, 2007). Power intersects through narratives by researchers about the subject of research and the interpretation of these narratives may result in specifically powerful knowledge. Knowledge has great power to directly inform policy or indirectly change the way people (as subject of research) are perceived by the outside world (Liamputtong, 2007).

Along the spectrum of power relations, I recognised and considered my overall position as that of an insider, with a semi-asymmetrical relationship to those interviewed at institution level, and

somewhat a potentially exploitative relationship to household respondents (Hay and Muller, 2012). However, differentials in social status and background are hard to overcome (Moss, 1995). In a bid to effectively manage a potentially exploitative relationship, it is often useful to involve the participants in the design or in carrying out the research (Dowling, 2014). In this regard, participants were involved in the process, including identifying and deciding on what key features compromised household capital portfolios in the semi-structured questionnaire design and testing.

Overall, with my introduction to respondents as a Zambian research student based at the University of Oxford, the interview participants were willing to provide information throughout the interview process and generally aided the research process. However, the mention of both Zambian and University of Oxford may have triggered mixed feelings (Mullings, 1999) of insider, outsider, poshy or even an inferior but certainly a non-threatening position. Whatever the negative perceptions overall, they were overridden by the positive ones given the overwhelming acceptance and willingness to participate in the interviews. I was accepted and considered as an insider: one who was like them in many aspects (Mullings, 1999) as informants engaged freely in the discussions. The insider shares the informant's outlook of the world and the information collected and its interpretation is likely to be more valid than that of an outsider (Dowling, 2014). However, throughout the process cognisance and awareness were maintained that a social researcher was never simply an insider, there are always other overlapping social factors such as gender, ethnicity, and socio-economic status (Mullings, 1999). Being aware of these can be a source of great pleasure and surprise (Dowling, 2014). However, a possibility of failure to accurately locate own self's position in the context of the research is possible (Rose, 1997). Nevertheless, a crucial awareness needs to be maintained on how one's own understanding about the research may have possibly changed as its process unfolded and progressed (Waitt, 2014).

Along this DPhil path was a realisation that true intelligence and rationality is much more than just novel thinking. It is also about being critically self-aware, including a sense of just how wrong one is likely to be as researcher in the research process. The human mind is a complex mixture of both rational trains of thought, subjectivity and convoluted biases that emanate from existing narratives, ontology and social conditioning (Waitt, 2014). As a researcher, I argue that the ability to maintain a constant self-conscience-scrutiny - recognising subjectivity or bias when is occurs and taking every necessary measure to avoid it and enhance rationality is what distinguishes great scholarship from the ordinary. This can be quite hard to achieve.

4.9 Data analysis

As a continuously reflexive process, data analysis combined both qualitative and quantitative techniques: moving from the generic descriptive interview responses and transect-walks onto the specific quantitative socio-economic profiling (Ellis, 2000; Nielsen et al., 2014) and rainfall data analysis (Neumann et al., 2015; Tilya and Mhita, 2007; Lei et al., 2016). Generally, the process involved categorisation, coding and indexing information to meet the research aim. As scientific abstraction procedures, these processes created a manageable data organisational structure from a seemingly chaotic hotchpotch. Data complexity was reduced, making it easier to analyse and identify patterns and associations embedded within or between datasets (Harvey, 1969; Stringer, 2004; Cope, 2014). For instance, descriptive data obtained from in-depth interviews utilised in vivo coding (coding directly) from statements of respondents and noting common phrases and words used (Cope, 2014). When asked about how their past farming season had been, most respondents repeatedly lamented about changing climatic conditions, high cost of fertilizers and other farming inputs including lack of government support in produce marketing. In this regard “change” “cost” and “support” became in-vivo descriptive words that were later developed into deeper analytical codes (i.e., “environmental change” “cost of production” and “farmer in-put support programme,”) linking directly into the research themes.

From this process, the codes developed allowed an assessment of data to identify emerging patterns and further investigations for meaningful inferences to be made about the meaning of both people's responses, and the various environmental conditions observed. This process also created an opportunity for further critical reflexivity about how knowledge was being deconstructed or constructed (Rose, 1997; Dowling, 2014). Similarly, in the interview processes of households, government department heads and CSO officials, reflexivity on positionality particularly gender, age and socio-economic status was maintained. These may have influenced the production of information and knowledge under specific circumstances (Rose, 1997; Dowling, 2014).

With quantitative data confirmed as normally distributed, statistical tests of significant differences between variables at $p \leq 0.05$ were performed where applicable (e.g., rainfall parameters). However, although quantitative measurements yield numerical data, it is no more or less valid than the qualitative measurements (Philip, 1998). Integrating both datasets allowed results triangulation, highlighting similarities, discrepancies and contradictions which in turn increased the strength of validity and interpretation on formal epistemological grounds (Valsiner, 2000). Thus, as data analysis interacted with the theory, new and clearer explanations emerged. These are presented in five thematic chapters 2, 5, 6, 7 and 8; with chapters 2 and 6 specifically dealing with the Zambian background context, and climate change respectively.

4.10 Summary

In this chapter, the focus was to present the various methods applied in this research insofar as linking the theoretical framing of data collection and analysis processes are concerned. It has also been shown how both processes can never really be devoid of partiality. In social science methods for example, factors such as positionality, power relations, including informant's expectations may introduce bias and subjectivity at any stage in collection, analysis and interpretation processes of data. Similarly, the natural science methods suffer different forms of

ambiguity which may introduce errors. These errors may be propagated into analyses, resulting in wrong conclusions. For instance, the onset and cessation of rainfall have numerous interpretations, rendering subjectivity dependent on the purpose and focus of study. Human errors too do exist in quantitative data measurements, raising epistemological concerns about validity and truth. In this regard, this chapter has generally shown how 'methodological promiscuity' can be drawn to address concerns about 'validity' and 'truth' associated with the quantitative; and the 'bias' and 'subjective' associated with qualitative methods (Valsiner, 2000; Thomas et al., 2007). By integrating quals and quants, epistemological rigour can be achieved under which the concerns and assumptions about validity, truth, bias and subjectivity can be challenged.

CHAPTER 5: LINKING INDIGENOUS AND SCIENTIFIC KNOWLEDGE FOR EFFECTIVE ADAPTATION

"Different knowledge systems have always cross-fertilized and benefitted from each other and have rarely developed in isolation." (Tengö et al., 2014, p.582).

5.1 Introduction

Building on the foundation laid in Chapter 2, and based on Robbins' (2012) degradation and marginalisation conceptualisation (see Table 3.2), this chapter presents the political ecology of marginalisation in climate change adaptation. Scientific knowledge singularly dominates, while indigenous knowledge remains somewhat marginalised. As demonstrated in Chapter 2, all intervention approaches to adaptation tend to prescribe solutions based on technical considerations of scientific knowledge. This approach disproportionate exposure of minorities or indigenous people from geographically remote locations in many parts of the world (Tsosie, 2007). Indigenous people inhabit nearly every biome and have managed many of the world's most valuable agricultural and biodiversity spots amidst continuously changing climate. They are arguably an important source of local knowledge. In this regard, this chapter examines indigenous knowledge in environmental change adaptation and links findings with scientific knowledge with a view to open dialogue that stimulates a broader and all-encompassing evidence-based policy for effective adaptation.

Based on in-depth interviews of ethnic agriculturalists and pastoralists, this chapter discusses how indigenous people of the African continent have historically been adapting to changes and variabilities in climate conditions. Climate change is probably the most unprecedented global environmental challenge of our time. Its slow but long-term impacts span across various sectors of industry and sections of society upon which casualties are often discounted for decades and even generations (Rob, 2013). Of the sectors, the most directly affected is probably rain-fed agriculture (Culas, 2012; Sheffield et al., 2014); while indigenous communities dependent on this sector for livelihoods are the most affected section of society (IPCC, 2014b). Given that climate has always been changing, albeit usually at rates slower than those currently being

experienced (IPCC, 2014b), examining coping and adaptation strategies of indigenous people in traditional African society is important. It could provide useful insights for future adaptation policy debates on intervention approaches. By identifying areas of indigenous knowledge that have proved to be useful, informed knowledge integration may have far reaching impacts on enhancing climate change adaptation.

5.2 Methods

Based on knowledge complementarity anchored on multiple-evidence base (MEB) concept (Tengö et al., 2014), thematic areas that emerged from in-depth oral interviews conducted in 2016-2017 among ethnic agriculturalists and pastoralists in Zambia are extracted, contextualised and discussed. An assessment and validation of the themes in relation to mainstream secondary sources in the form of textual content is made. Further, a discourse assemblage in the discursive spaces on some of the indigenous knowledge contents and practices on adaptation with changes in environmental conditions and climate is also made with a view to highlight the importance of complementarity with scientific knowledge. Core questions to respondents were four-fold:

i. According to local experts, how were the indigenous people able to cope from and adapt to changes in environmental conditions and climate in the past?
ii. How do their adaptation strategies compare to modern-day (scientific) approaches?
iii. With specific examples, please share what you think was not working well with indigenous adaptation?
iv. What do you think has not worked well with the modern-day approach?

Responses are outlined and discussed in the context of indigenous or traditional African knowledge system through which potential ways for linking this knowledge with scientific knowledge for effective adaptation are explored.

5.3 Themes emerging from interviews

The responses to the above interview questions covered broad and diverse themes. However, after analysing the responses, 11 thematic areas emerged. With the focus group approach and clarifications, these were narrowed down to seven thematic areas through the merging of related areas. These are outlined and discussed to highlight some of the evidence gathered on the approaches, techniques and mechanisms indigenous people claim to have drawn upon for centuries in climate change adaptation. However, within indigenous knowledge, the political ecology questions emerge about who has the power to determine and define what is, and what is not 'legitimate' indigenous knowledge. As evidence suggests, it appears that 'legitimacy' is tacitly determined and defined by recognised village elders. However, how some among many village elders become recognised is unclear, but age and credibility seem to be major determinants. The older someone was, the more likely they were to gain respect intellectually and therefore, socially vested with powers to drive particular narratives that shape community opinions into 'facts. From the political ecological standpoint, this shows how unequal power relations and marginalisation manifest within and across sections of the same community. Power relations are politically motivated and therefore unequally distributed. As shown in Appendix C 2, the average age of 'legitimate knowledge' holders recommended by community members is believed to be 81 years (since they could not produce birth certificates for age verification).

5.3.1 Migration, traditional agroforestry and management of degraded farmlands

Moving from one place to another and closer to resources was important. From the interview responses, the concept of "proximity" or locating near sources of resources and "maintenance of available sources" for continued sustenance occurred frequently, suggesting high value attachment to these as evidenced in the following dialogue.

SR-F10 (Male, 77 yrs., AEZ IIa):

> *One of the reasons why distance was kept at the minimum is that there was no transport as we know it today to transport goods or food. For instance,*

fishermen lived by the riverbank and as the water levels expanded or shrank, they shifted to safe distance accordingly, but never far away from the river. This allowed access to fresh fish, which would otherwise go bad in transit too far away villages.

SR-F17 (Male, 70 yrs., AEZ IIa):

As SR-F10 has explained using the example of fishermen, herders also followed the pasture with their cattle, sometimes taking months at one location as in the practice of shimunenga (shifting pastoralism) to allow pasture regeneration. However, there is an exception to this. Rainmakers for instance never lived by the shrines. As intercessors between people and the gods, and as guardians of the holy shrines, they didn't need to be close to the shrines: distance was not as important as these people had certain powers within themselves.

SR-F18 (Female, 88 yrs., AEZ IIa):

Yes, there is an exception as SR-F10 may not be probably aware that with time, fishermen also discovered techniques of preserving fish, such as drying using natural sunlight after adding salt. This way, fish would stay tasty though not fresh, but fresh as dry fish and it could be transported over long distance.

Proximity may have also meant moving away from diminishing sources or those that could not be maintained and locating closer to the newly identified sources. Traditional agro-forestry and management of degraded farmland partly determined the migration patterns as practices developed over centuries to cope from unproductive or degraded cropland, grazing pastures and diminishing stocks of fisheries.

This was found to be consistent with the evidence in the writings by Vickery (1986) and Chevo (2014). Adaptation and management strategies was largely anchored on swidden agriculture which involved shifting cultivation, prune or slash, coppicing and burning (Bayala et al., 2008; Ando and Shinjo, 2017). With swidden agronomy, remnant ash obtained as a by-product from burning was used as a soil-conditioner for degraded farmland (Ando and Shinjo, 2017). As evidenced by findings in northern and central Zambia, the Bemba people originally from the Democratic Republic of the Congo (DRC) continue to use this technique where it is locally called "Chitemene". As respondent SR-F7 (Female, aged 79, AEZ IIa) narrated:

Tree branches were coppiced down on a small portion around an anthill and burnt. The stumps and uncut portions of the tree allowed re-growth while burnt trims yielded remnant ash used to mix with umushili (soil) *to act both as repellent to termites and as fertilizer for cassava and pumpkin cultivation.*

During wild-fires, slashed and burnt portions acted as fire breakers (containment points). *Cassava took 3-4 years to harvest, a period that allowed trimmed trees to regenerate. After harvesting, cassava-tree branches were collected either as firewood, or burnt for more ash. This allowed a prolonged usage of the same piece of land before moving on to another anthill and coming back later, after 20 or so years. In those 20 years, the abandoned farmland also acted as range land for grazing livestock.*



Figure 5.1: Plate A: Typical swidden agriculture in Kabwe; Plate B: Some of the focus group respondents in back row and two sitting in the centre

Pastoralists also migrated at certain times of the year and came back at another time of the year after covering long distances in search of pasture. This seasonal or circular migration pattern can be considered as a traditional positive coping strategy for seasonal climate variabilities. Yes, there may be limits within certain thresholds of livestock and human population numbers to which such movements become restricted. However, these limits are mutable as issues such as values, ethics, risk, knowledge and culture construct societal limits to adaptation (Adger et al., 2009). Significant seasonal migration is still very common among some ethnic groups in the Sahel and sub-Saharan Africa. These include the Tuareg and Fulani in Mali, Chad, Niger, and Mauritania, UNEP (2011), the Basarwa and Khoisan of sub-Saharan Africa in Namibia, Botswana and South Africa, Sporton et al (1999), and the Lozi and Ila in Zambia Mwanangombe (2010). There may be significant lessons to learn from these for future adaptation needs.

5.3.2 Social networks: relief support against food shortages and hunger

What emerged from interviews and culminated into this theme was the interdependence nature of households and communities in times of adversity, uncertainty and misfortune. Interdependence was found to be highly valued and integrated into everyday proverbs and

teachings. As put in proverbial terms by a male respondent, SR-F8 aged 73 of AEZ I: "*tende ngulembwe amazuba ngunamasandu"* (we can never be so sure at dusk about how our feet will tread tomorrow, as each day at dawn comes with surprises); *"aceeco tabali boonse basimunyeu baweza buyani, pesi balalya kumukwashi buce-buce"* (and that is why even in the insects kingdom, not all ants come back with prey after hunting, but through comradeship, they are able to feed with those fortunate with prey. These proverbs emphasise a deep sense of interdependence and unconditional support, such that the one who has no sense of sharing or respect for collective responsibility in the community, is considered incapable of building a family. This was evident in the following dialogue in the focus group discussion:

SR-F15 (Female, 86 yrs., AEZ I):

> *In traditional society, togetherness and social cohesion was very important. They signified a sense of security and safety in numbers. Yes, grown up children could leave and start their own families, but would do so a few meters away from their parents. They farmed in the same fields with their parents and ate with the rest of the extended family.*

SR-F16 (Female, 78 yrs., AEZ I):

> *As SR-F15 has put it, therefore extended families were celebrated as a symbol of togetherness.*

SR-F9 (Male, 72 yrs., AEZ I):

> *In fact, even today, extended family dependence is still strong. It is a very difficult cultural practice to break because a nephew dependent and benefitted from uncles and aunties. It is therefore a natural reciprocity that the children of his aunties and uncles (cousins) will benefit from this long-standing relationship. In some cases, marriages have been encouraged among cousins to keep the wealth within from dowry within the extended family arrangement.*

As Mazrui (1986) argues, there are probably no other communities that have been more socialistic in approach to livelihoods than an African society. Partnerships have existed for hundreds of years with extended families living together, with a concept of safety in numbers characterising a complex customary land ownership system (Mazrui, 1986; Platteau, 1996; Brasselle et al., 2002). The support networks started from the extended family system through to the neighbouring community and kinship. To maintain community cohesion, related families located or migrated closer to each other as part of a larger family, extending into clans and

communities (Mazrui, 1986). In good harvest years, community members donated extra crop-yields and livestock to the kinship, who in times of distress and great difficulty donated to needy families, widows and orphans. The community shared everything, from a piece of land for cultivation to seeds for planting, and from food in the pot to water in the cup (Mazrui, 1986; Vickery, 1986). Similar behaviours in distressful ancient times among a general human species have been observed. A spirit of resource sharing has been one of the most important ways through which both ancient and modern indigenous communities have been able to adapt, build resilience and solidarity against food shortages in the face of environmental change (Salick and Byg, 2007). Today, despite mixed cultural influences leading to a more individualistic approach to livelihoods, the African society is still characterised by extended family support networks (Ratha et al., 2011; Adams and Cuecuecha, 2013; Mushinge, 2016). For example, this research found that households of related families lived closer to each other, connected by family lineage along clanship and larger extended communities. These families relied on same customary land, sharing tools for crop production including harvests.

5.3.3 Changing eating habits/diets

Like interdependence that gives rise to social networks, the theme of changing eating habits emerged from managing scarcity. This was highly regarded by the traditional knowledge holders and was integrated into everyday teachings. When people have been faced with hunger and did not have access to certain foods, there is evidence to suggest that changes in diet and the forms of food utilised can be accommodated easily. As respondent SR-F8 put it "*shyuumbwa cakamulisya bwizu bana bakwe takabakacizyibi paka bakakomene, pele muvwimi ulizyi kuti cakalishya shyuumbwa bwizu ni nzala*" (what made a lioness eat grass will never be clear to its cubs until they are grown, but a hunter knows that so many things can force a lioness to eat grass, among them, lack of prey and hunger itself, stomach upset and indigestion). This was clear from the following except of focus group dialogue:

SR-F1 (Male, 92 yrs., AEZ I):

> *In times of adversity, people tried everything including wild fruits, tubers or form of yams. In fact, this how lusala, or lwidi* (Dioscorea hirtiflora*) was discovered. It was an ancient Tonga food trial. Yes, some died from food poisoning as not everything was suitable for consumption. It was a learning process.*

SR-F12 (Male, 75 yrs., AEZ I):

> *There are efforts by the Zambia Agricultural Research Institute to domesticate lusala as it has been found to drought resistant and nutritious.*

An independent follow-up of lusala (Dioscorea hirtiflora) revealed that Zambia Forestry Department, in conjunction with the University of Reading have done studies with a view to domestication or commercialise lusala as evidenced by a recent publication by (Zulu at al., 2019).

Work in East Africa by Rufino et al (2013) attest to similar social behaviour with compelling evidence. Within two to three decades, staple diets changed from being dominated by bananas to being maize-based, because frequent droughts, pests, diseases and a declines in soil fertility led to the decline in banana productivity (Rufino et al., 2013). Alternatively, people preferred maize because it was then considered easier to store and needed less growing period than bananas. A similar observation has been made in Ghana, DRC, and Nigeria where yams (tubers) are slowly being replaced by cassava, rice and maize (Chima, 2007; Nweke, 2017). In Zambia, rural communities in the southern part of the country that relied heavily on maize, now grow drought resistant food crops such as cassava and millet which they rely on during times of low maize yields (UNDP and GRZ, 2010; Smale et al., 2015). Similar practices have been cited in Zimbabwe (Chimhowu and Hulme, 2006).

5.3.4 Spirituality and taboos

Consistent appearance in responses under different guises, such as assumed invisible power of ancestors, value accorded to divine intercessors through sacred places, punishment from the invisible judge, or forgiveness through offering, this theme emerged to combine this line of thought. There is a strong evidence to suggest that spirituality and taboos are possibly tacit rules for resource governance that encourage collective efforts in responsible resource utilisation,

protection and nature preservation. The extent of sacrifice to invisible powers for instance, suggests a deep sense of remorse for failure to obey these tacit rules believed to guide the peaceful interactions and cordial relationships between the living and the dead; and nature or environment and the living.

This "spirituality" comprising traditional practices has far reaching benefits in resilience building in many cultures and as both Cutter et al (2008) and Mowbray (2012) have shown, the human spirit of resilience is often invoked by what cannot be changed. While spiritual solace is not adaptation *per se*, it has been a useful form of cultural capital that influenced and shaped the perception of risk and shock (TAF, 2012). After shock, the first thing people usually did was to accept that it was impossible to change what had happened. With that recognition came the realisation that picking-up from what was left and moving on was inevitable (Mowbray, 2012). Spiritual solace is well documented in many indigenous communities across continents (Saha, 1994; Derek et al., 2005; TAF, 2012; UNEP, 2011). As a form of managing shocks and losses, people relied upon their spirituality to re-organise, offer themselves emotional comfort and accept unchangeable circumstances. In Africa, literature evidence suggests that people did not usually recognise their own agency in the causal-effect scenarios of nature's calamities. They attributed almost everything to the wrath of the offended gods or ancestors (Haruna, 1997; Colson, 2006; Murphy et al., 2016; McPherson et al., 2016), accepting negative changes as a consequence of wrongdoing. Wrongs included failure to protect forests, river systems, help the needy within the communities in the times of difficulty. Spirituality defined this perception (largely based on tacit rules) and made it possible for communities to pick-up from what was left from a disaster. They recommitted their energy with hope to nature conservation and togetherness (Derek et al., 2005). As an oldest female respondent of AEZ I aged 97, SR-F2 succinctly put it:

> *In traditional spirituality, our departed ancestors and gods of the rain handed down punishment under two circumstances: when people abused natural creation, or when they failed to take care of one another. Both taboos could*

> *only be corrected by offerings and sacrifices: It was a tradition and a spotless black or white goat with beer by the Mukula tree* (Mahogany/Rosewood) *at dusk cleansed the earth. But, with the coming of Christianity which brought colonialism, all this was considered as evil. At baptism with missionaries, people were asked to affirm they have discarded all these practices. See what we have today; anyone can cut down trees around malende* (dambo and its catchment area)*, we now have so many droughts, crops can't grow, the soils can't germinate seeds, and our future is uncertain: the gods and our ancestors must be having their last laugh, we are disconnected, and the youth have left to the city, leaving old and dying men to till the land.*

Farming was slowly being considered as a risky undertaking (Below et al., 2014; Makondo et al., 2014). As (Bryceson and Fonseca, 2006) argued, this process of 'de-agrarianisation', was spreading. There was a strong growing trend from indigenous small-scale farmers to re-orient economic activity away from farming, or alternatively relocate into urban settings. Youths have continued to migrate to cities for trading activities, leaving the older generation to farm the land. The low and uncertain income returns from smallholder production leave even the uneducated youth with less options, other than to seek alternatives to farming (Bryceson et al., 2007).

5.3.5 Ecosystem services and resource utilisation

The ecosystem services and resource utilisation theme emerged from the "close attachment to nature" conceptualisation by the indigenous' daily living and the ability (or lack of) to utilise this attachment. Responses showed how much dependence there was on nature in everyday lives and how compromising that relationship spiritually or otherwise was not accepted. From medicines to construction materials through to reading the moon (wrongly or correctly), or siting long-term sources of water, indigenous lives show a strongly tied dependence to ecosystems services, presenting a somewhat different human-nature nexus domain: one of overdependence. As findings revealed, their lives evolved around nature in nearly every aspect.

Indigenous communities have tended to migrate and locate into semi-wet lands as a form of strategy to cope with drought (Scoones, 1991; Sichingabula, 1998; World bank, 2009). For this reason, semi-wet lands such as dambos have been of great importance to food-crop production (Scoones, 1991). Given their high moisture retention and organic matter content, dambos have

been key land resources for sustaining production of both crop-agriculture and pastoral systems. In this investigation, findings show that as an adaptation strategy from poor soils, droughts and rainfall variabilities, both dambos and uplands are still being used (in an integrated manner) to ensure food-crop production and livestock grazing. In both southern and central provinces of Zambia, small-scale and commercial farmers utilise these zones. However, when these form part of the flood plain, they can expose both crops, cultivators and their livestock to a new set of environmental shocks (Conway et al., 1983; Dumenu and Obeng, 2016).

With water shortages, literature evidence suggests that as people became aware of any major drought threat, extending water usage (reduce, recycle or reuse) was prioritised as a coping strategy to evade such phenomena (Colson, 2006; Mwanangombe, 2010). Traditional "climatologists" are also believed to have known and conceptualised the relationship between the moon's position and rainfall occurrence. Arguably, they were able to predict droughts or floods by reading the moon's shape and its position. Whether this relationship was correctly interpreted or not, it was a "disaster warning tool" that gave guidance on when to migrate to safer ground during floods (Mwanangombe, 2010), or to dambo zones during droughts (Gyampoh et al., 2008; Gyampoh et al., 2009). Shifting from one drier zone to a wetter zone during droughts, and doing the opposite in times of floods helped indigenous communities escape droughts and floods (Mwanangombe, 2010; UNEP, 2011). The claims by Colson (2006) and Mwanangombe (2010) seem supported by transcribed interview data. For instance, respondent SR-F6 (Female of AEZ IIa, aged 78) stated:

> *In those days, because of water challenges, the water initially used to wash vegetables, fruits and pots was reserved. It was kept either for irrigating gardens or left out on the open as drinking water for smaller domestic animals and poultry.*

On climate and disaster management responses, traditional climatologists were valued in the circular migration strategies as respondent SR-F2 of AEZ I narrated:

> *In ancient tradition, the position and orientation of the new moon crescent spoke a language understood by rainmakers of that time. It signified either doom or gloom. The tilted u-shaped of the moon symbolised flooding. With flooding, water-borne related illnesses were eminent. Conversely, the stable shape promised plenty and good health.*

Water table fluctuations were monitored using hand-dug wells which were sited and positioned using sediments and vegetation biomarkers. This traditional skill continues to be practiced by the Tonga people in Zambia (Saha, 1994) as a 79-year old male respondent of AEZ I, SR-F3 affirmed:

> *By looking at the type and quality of vegetation and the soils that lie beneath, siting water wells, identifying good quality grazing land and type of game became part of your everyday life. You learnt this skill at birth, through observation of your father and village elders. Ultimately, the skill became intrinsically entrenched in you as the same water in trees and rivers flowed in your blood.*

This ability to identify long-term sources of water was very important. Similarly, as a direct coping mechanism, the rationing of water and economical use of other related resources reduced wastage and it has been documented in many parts of sub-Saharan and Sahel Africa (UNEP, 2011). Osbahr et al (2008) encountered this strategy in Mozambique where supplementary activities in households included picking wild fruits or plants and collection of fodder for kraaled animals. These practices potentially result in minimal wastage of resources, thrift preservation of assets and reduce expenditure. However, these practices were usually abandoned as soon as the first good rains began (Osbahr et al., 2008), but as a behavioural change strategy, they helped communities in managing scarcity in hard times.

5.3.6 Rainwater harvesting and rainmaking

The rainwater harvesting, and rain-making theme emerged from terminologies such as *musena* or dambos, siting water sources, and the ritualization of rain through sacred places or shrines. Rain shrines are perennial wetlands considered as holy sites, divine and sacred natural designs because of their associations with biodiversity and a life sustaining system -water. Rainmaking especially through shrines appeared to have been one of great importance: a life support system

for both biodiversity and human survival. Local knowledge holders explained how water has been sought after in living memory and why shrines tended to be the ultimate answer to the water scarcity question. Although communities were unable to harvest enough rainwater under poor rainfall periods, rainwater harvesting, a traditional way of diverting, impounding or collecting and storing rainwater was practiced for domestic use and food-crop production.

Rainwater harvesting and rain-making has continued to be practiced in many parts of Africa (Lebel et al., 2015; Owen and Goldin, 2015). The practice, which was also usually abandoned with more than adequate rainfall (possibly to manage flooding) is being revitalised. For instance donor funding agencies operate and promote rain-harvesting projects in rural communities in sub-Sahara and the Sahel to manage droughts and rainfall variabilities resulting in frequent intermittent drying-up of wells (UNEP, 2011). Similarly, the formation of rainwater harvesting networks in southern Africa particularly in Botswana, Namibia, Zambia and Zimbabwe is also a response to frequent droughts in the region (Lebel et al., 2015; Owen and Goldin, 2015; Botha et al., 2015). Within these countries, traditional beliefs and rituals for rainmaking have been documented (Bryceson and Fonseca, 2006; Siamonga, 2015). For instance, rain shrines are still highly regarded among the indigenous peoples of southern Africa. They are still considered largely as places where the gods of the rains reside and are sources of food not only for the local communities, but also for their fallen ancestors and the gods (Murphy et al., 2016). There was restricted cutting down of trees along streams and on the river catchment (Murphy et al., 2016; Antwi-Agyei et al., 2014). In this regard, conducting any harmful activities such as cutting down trees or migrating into or near perennial wetlands was frowned upon. As an oldest male respondent aged 92-year of AEZ IIa, SR-F1 recounted:

> *The malende* (dambos and its catchment) *at Gonde for example were very important, and still so even today, although they have been trivialised. These were places of worship where rain priests talked directly to the god of the rains. If the basangu* (angels and oracles) *were in good mood, borne out of an exemplary community standing with the gods, it would start raining before rain rituals ended. At the end of every rainy season, the malende oracles were consulted about the rainfall situation in the year ahead.*

Rain-making practices are widely documented on the African continent: for instance in West Africa, Haruna (1997); Gyampoh et al (2009); Cobbinah and Anane (2016); Southern Africa Jarus (2013); Siamonga (2015) and parts of eastern Africa, Akong'a (1987); Sanders (2008). However, the observation of traditional rain-making has declined (Siamonga, 2015) as evidenced in the focus group-dialogue below:

SR-F11 (Male, 81 yrs., AEZ IIa):

> Today, it is not clear whether or not rainmakers can make rain at ll. The gods have been violent and offended beyond measure. What has remained is just a one-day commemoration of rain shrines once a year. Shrines are now bare land and abandoned. The practice has been ridiculed.

SR-F13 (Male, 89 yrs., AEZ IIa):

> *You see SR-F1, the have lost powers as Christianity took over everything including cultural practices. You see Christianity banned drums in early church on the pretext that they were evil but introduced guitars. Aren't they the same guitars used in rock music...?*

SR-F13 (Female, 92 yrs., AEZ IIa):

> *While SR-F 13 is right about the banning of the drums, these were reintroduced in Christian worship around 1970s after post-colonialist missionaries began to understand local culture. Churches now play both drums and guitars in their services of worship. It is also true that rainmakers are no longer relevant. The customs have "died"*

As a 70-year-old female respondent of AEZ IIa (SR-F5) concluded, "*today, this* (Christianity) *is a sensitive issue in communities and some of the traditional practices considered useful have been abandoned: they are now interpreted as witchcraft."*

5.3.7 Energy, forests conservation and healing

Related to the theme of migration is ecosystem services is energy, forestry conservation and herbal-based medicines. As the gathered evidence from interviews seem to suggest, forestry resources have a dual importance in African traditional societies. This theme therefore emerged to separately outline and discuss the dual importance of forest resources (i.e., biomass energy, and herbal healing) and the traditional conservation of these for continued access to benefits and sustenance associated with them. During fieldwork, it was also witnessed first-hand the importance of forest resources as all the respondents that formed the basis of this investigation

had no access to electricity or medical care insurance. They relied either on firewood and charcoal for cooking and heating; and only relied on clinical medicine in extreme illnesses. To them, a healthy forest is as important as a health human life and the need for ecosystems services and their protection was highly rated.

> *Just like the rivers, the trees and all that which lives in the thickets is as important as human life. Traditional experimentation taught our ancestors the linkages between rainfall, forests, game and food for mankind. Trees are a source of healing not only to life in human form, but to soils and the air and the blossoms of life that live in them* - Respondent SR-F4 (Male of AEZ I, aged 90).

Energy needs continues to push people towards forest land as firewood and charcoal were the main sources of domestic energy. As evidence suggests, this practice remain common in Africa and Zambia in particular. However, with competing demands for agriculture and biomass energy, forestry resources continue to be under pressure as deforestation continues. Related to forestry, African traditional medicine is perhaps the oldest and most varied of all therapeutic systems (Gurib-Fakim, 2006). In their various forms, these healing practices have been framed to potentially offer a holistic approach to both the body and the mind (Mahomoodally, 2013) although their continued use is arguably linked to cultural and economic reasons. People use traditional medicine when they cannot afford clinical care (Chintamunnee and Mahomoodally, 2012). However, plants with healing properties have been traded for hundreds of years in different parts of Africa, diversifying income sources while stimulating conservation in the process (Gurib-Fakim, 2006; Wyk, 2008; Rana et al., 2014). In this research, the use of traditional medicine was found to be common among rural communities in Zambia. Herbal medicines were orally taken or ingested in the mix with food. They were also found traded openly in informal local markets. The need for herbal healing may have indirectly drove conservation agendas on forests and the protection of specific plant species with medicinal properties.



Figure 5.2: A 400+year's baobab tree conserved by indigenous people in southern Zambia signifying conservation (2017)

5.4 Implication for policy and wider academic debate

The implementation of climate change response programmes for adaptation and resilience is anchored on western scientific knowledge. However, this has led to a tendency to marginalise indigenous knowledge as it is considered unimportant in this process (Belfer et al., 2017; Lesperance, 2017; Whitfield et al., 2015). Yet, knowledge systems rarely develop in isolation as they normally tend to cross-fertilize and benefit from each other. In this regard, it is thought that indigenous knowledge is just as important as scientific knowledge and the two must be integrated through multiple evidence base approach for climate change adaptation and mitigation. In this chapter, focussing on African traditional society, oral history with the available literature is combined to examine traditional knowledge and awareness of climate change and related environmental risks. Interesting themes emerge from the knowledge holders themselves and the analysis uncovers a wide range of adaptive strategies applied with mixed success. From spotting and reading the position and shape of the 'new moon' to the interpretative correctness of its symbolism in "applied traditional climatology," and from rain-making rituals to conservation of wetlands and forests. Generally, findings seem to suggest that traditional African knowledge of environmental change may be as old as the society itself, with

local knowledge transmitted from one generation to the next. Based on the perceived vulnerability of indigenous communities, many scholars tend to argue *generically* for the integration of indigenous knowledge into climate change policies and implementation (Ross, 2009; Maldonado et al., 2016; Etchart, 2017). In this chapter however, these arguments are supplemented by providing *specific* and *contextualised* evidence of indigenous knowledge linked to climate change adaptation. It is demonstrated that indigenous knowledge is neither singular nor universal, but rather, a voluminous, diverse and highly localised source of wisdom. It is concluded that integration of such unique and *specific* indigenous knowledge systems into other evidence bases of knowledge, could be one of the best ways to the more effective and sustainable implementation of climate change adaptation strategies among target indigenous communities.

However, although indigenous people are already widely acknowledged as the most vulnerable to the impacts of climate change (Culas, 2012; Whitfield, 2015; UNFAO, 2011; Thomas and Twyman, 2005), their unique knowledge and experience remain largely under-utilised by interventions aiming at reducing vulnerability by increasing adaptation capacity to new circumstances. The three IPCC Working Groups (WGs I, II, and III) do realise the importance of indigenous knowledge and have been making efforts to include this knowledge into the assessment processes. Nevertheless, as evidence in the most recent assessment reports (AR4 and AR5) show, engagement has often been limited in scope. For instance, in the physical science assessment by WGI; impacts, adaptation and vulnerability by WGII and mitigation by WGIII, indigenous knowledge is only mentioned in few lines within paragraphs. Yet the measures covered are designed for the most vulnerable, and indigenous communities in particular (Ford et al., 2016; Belfer et al., 2017) where local knowledge holders and expertise could be highly valuable.

There are varied reasons for this negligence and omission, but most can be explained using lenses of critical political ecologies and discursive spaces (Robbins, 2012; Death, 2014;

Mcdonell, 2016; Belfer et al., 2017). Scholars have however demonstrated that there is much to learn from indigenous and community-based approaches to climate change adaptation, resilience and disaster preparedness (Thornton and Manasfi, 2010; Berkes, 2012). Borne out of their long-term experience and experimentation, indigenous people have often adapted to environmental change through techniques and approaches using knowledge transmitted both orally and in practice from one generation to the next (Salick and Byg, 2007; Mcdonell, 2016). Through this process, they have been able to develop or enhance and maintain locally or regionally, a wide array of coping and/or adaptation strategies (Tengö et al., 2014). Arguably, their knowledge and practices can provide an important basis for today's efforts in dealing with even greater challenges of climate change (Belfer et al., 2017; Fairhead et al., 2017).

Despite significant seasonal and annual rainfall variabilities, erratic crop yields, poor soils, and depleted natural resources; rain-fed agriculture, herding and fishing remain the dominant livelihood activities in rural Africa (World bank, 2009; UNEP, 2011). As demonstrated in this chapter, indigenous societies adapted and managed unproductive or degraded farmlands based on their own long-term experience (Vickery 1986; Chevo, 2014). Without any sophisticated equipment, people quite accurately identify and distinguish fertile soils from poor ones, sited long-term source of water and cultivated land with basic methods that arguably, had limited impacts on forests or wetlands (Vickery, 1986). A shift from traditional conservation farming was instigated with the arrival of missionaries leading to colonialism. Indigenous communities that practiced certain traditional forms of agronomy found themselves persuaded to adopt new approaches and voluntary agricultural extension initiatives to enhance their farmland productivity (Mazrui, 1986; Colson, 1971). For instance, when the first Christian missionaries arrived in 1903 in southern Zambia, the indigenous Tonga people (having practiced successful agronomy and pastoralism) became the perfect pilot cohort for agricultural extension cultivation initiatives by colonialists. Commenting in his first report to the Jesuits Catholic Order, Fr. Joseph Moreau described the Tonga as a sustainable social formation of peaceful domestic

communities, with a clearly distinguishable mode of production for self-sustenance dominated by agriculture and pastoralism using simple tools and human strength as the main source of power (Vickery, 1986). As Hogendorn (1975) remarked:

> *it's true that early European observers exaggerated the degree of devastation experienced; they cherished a 'liberator' self-image and developed a stereotype of the 'mild or 'docile'* (indigenous), *an image often contradicted by actual behaviour in the colonial period* (Hogendorn, 1975 p.291).

70 years later, the people of southern Zambia were again subjected to a second wave of *agricultural extension* initiatives, and green revolution but this time, by the Zambian government (Chevo, 2014). In the colonial period, the aim of agricultural extension initiatives and diagnostic-prescription-intervention models were introduced to build capacity for communities to increase agricultural production and lower food prices (Dawson et al., 2016). Post-independence, this agenda was inherited with the same aim and applied in the same manner by African governments themselves. Intervention approach continued to be top-down persuading communities to accept new methods and technologies (see Chapter 2). In prescribing solutions, government technical officers rather than communities identified problems; then technical considerations took priority over economic considerations (Tiffen et al., 1994). Governments continued to impose schemes they thought would be beneficial for recipient communities. They established institutions to scale-up efforts through dissemination of technical agricultural information, subsidized seed, synthetic fertilisers and other chemical based inputs (Jarosz, 2012; Dawson et al., 2016). Consequently, agriculture went 'chemical' and it continues to do so. Huge capital injections are required for land improvement, animal disease control, pests and weed control and genetic engineering in spite of both public health outcomes and visible environmental consequences (Thorn et al., 2015; Chagunda et al., 2015; Van Damme et al., 2014). Organic food production, which has traditionally been part of indigenous agronomy, has become relatively expensive, at least in the short term, given lower yields to those of 'improved' systems and, therefore, the least sought for option. Arguably, even at global scale, what has accelerated deforestation, wildlife habitat destruction and environmental

degradation in recent decades are the extractive industry-related projects by governments and multinationals. For example, sea-sand mining destroying hinterlands and beaches (Beiser, 2017), minerals and oil extraction destroying the mangroves and forests in west and mainland Africa (Butler, 2012; Steiner, 2016; Krause, 2015) and agriculture extensification depleting the rainforest belt and the Amazon (Butler, 2012).

In Zambia the green revolution may be responsible for semi-arid environment and unproductive soils where growing crops without fertilizer is increasingly becoming difficult (Chevo, 2014). Similarly, large-scale and commercial agriculture continues to clear additional forested land, and in some cases displacing indigenous peoples in the process without compensation (Friis and Reenberg, 2010; Fahmida, 2017). Extensification of agriculture and logging may have cleared more forest and destroyed more wildlife habitats than indigenous livelihoods.

The approach in climate change adaptation programmes seems to be anchored on a similar platform insofar as the diagnostic-prescription-intervention model is concerned. Experts diagnose local problems and prescribe solutions based on their worldviews. However, if lessons from analyses *of agricultural extension* initiatives are anything to go by, disenchantment and resentment can result among communities when technologies promoted for adoption are regarded as inappropriate solutions to inaccurately diagnosed problems (Tiffen et al., 1994; Blaikie, 1985; Simtowe and Muange, 2013; Dawson et al., 2016).

Based on human population dynamics and natural resource economics, swidden agriculture and similar strategies have attracted criticisms in the literature driving conservation agendas (Adomako and Ampadu, 2015). For instance, swidden agriculture, a form of agroforestry has largely been stereotyped as “slash and burn” by modern critics and the media. Slash and burn is a term rooted in the scientific and colonial encounter of 18-19th Century (Thrupp et al., 1997). However, as a form of agronomy, swidden agriculture may have allowed faster forestry regeneration than today’s extensive commercial agriculture, which clears considerably larger areas of forest cover (Rueda, 2012). Indigenous people have lived sustainably with nature for

centuries using spirituality and taboo as tacit governance mechanisms (Tengö et al., 2007). For instance, restrictions on cutting down trees around wetlands and river systems may have been nothing but a traditional conservation strategy. This management strategy was useful in maintaining wetlands, river systems and associated resources. Similarly, cultivation managed forestry resources. For example, while using ash as soil conditioner on degraded farmlands, swidden agriculture may have prevented desertification, thereby preserving forest habitat against environmental impacts more than would be if uncontrolled wild-fires engulfed un-trimmed forest (Ando and Shinjo, 2017). The Bemba of northern Zambia and DRC have used these methods for centuries. Forests in these areas are not as depleted as in the southern part of Zambia where modern farming techniques resulted in a semi-arid environment where nothing can grow without fertilizer. From the IPCC reports, it is known that climate change driven by deforestation and fossil-fuel carbon emissions are far greater in magnitude and speed of onset than anything previously known in the Holocene or indeed in human history (IPCC, 2014a). The contribution to these emissions is lowest among indigenous peoples (IPCC, 2014b).

Traditional swidden agroforestry allowed a sustainable tree regeneration process that protected crops from harsh climatic conditions such as extreme heat and wind storms (Teklehaimanot, 2004). Trees are more resistant to drought and rainfall variability than crops. Pruning prevented the negative effects of tree-shade on adjacent crops (Le Houérou, 2000) while decomposing organic matter maintained moisture in soil during droughts (Bockstaller et al., 1997; Bayala et al., 2008). Swidden farmers understood this relationship. For example, acacia (*faidherbia albida*) leaves were known to produce fodder which not only supported livestock during the dry season, but also fertilized farmlands from the decomposition process of remnant leaves giving off nitrogen (Teklehaimanot, 2004). The point being stressed is that such knowledge as a means of adaptation, can be integrated and scaled-up for sustainability and resource efficiency in resilience and agroforestry or conservation agricultural innovation programmes. For example, crop-yield remnants such as folder can be used as cattle feed, and by-products (cattle manure)

used as a soil conditioner or to produce another product, e.g., biogas, resulting in closed-loop resource efficiency.

Thus, swidden agriculture may not result in forest depletion with increasing populations, if managed sustainably (e.g., integrating with scientific approaches). It has the potential to offer long-term benefits to livelihoods and conservation agendas. Perhaps the question should be: how does the environmental footprint of traditional adaptation strategies compare with what may be termed as elite-centric top-down strategies? The idea that increasing populations can increase deforestation and result in environmental degradation may not always be true. This has been illustrated in the now-classic rural Kenyan study of Tiffen et al, (1994). Although the study has been criticised as a "miracle" for lack of replicability (Siedenburg, 2006), it shows that as population increased in Machakos, conservation outcomes improved resulting in less land degradation and more robust soil erosion containment. Natural resource-based livelihoods flourished along conservation and agriculture, supplementing income sources as forestry resources were traded either as energy, fibre or building materials (Tiffen et al., 1994). With population increase, destruction of the commons did not happen in Machakos. Instead, forestry conservation and population increase became positively correlated. Deforestation, soil erosion, energy needs and food challenges were addressed simultaneously by locally organised knowledge. Such means of adaptation and resilience are important as closed-loop approaches to resource utilisation: they can greatly enhance sustainability in the face of climate change.

Flexibility in changing eating habits can be taken advantage of by scientific knowledge. With consultations of indigenous people's preferences, more sustainable food choices can be integrated with diversification. Diversification increases both efficiency of farming systems and builds resilience to climate change as it spreads the risk, providing an increased economic resilience at farm or local level. Diversified crop rotation (.e.g., combination of leguminous plants, including crop varieties and species with different temperature, nutrients requirements and resistance to pests or disease) coupled with water use efficiency enhances the effectiveness

for reducing risks and increasing efficiency among rural farmers (FAO, 2010). Similarly, combining crop-cultivation and livestock rearing is a useful adaptation approach and a means for resilience building against climate related uncertainties (Scoones et al., 2013; Thornton and Herrero, 2015). It is evident in literature that diversification of farming systems reduces vulnerability and strengthens resilience of rural communities to climate-related shocks (UNEP, 2011; FAO, 2010; Arslan et al., 2015; Ngoma et al., 2015). However, if recipient communities are not involved in making these choices, no matter how efficient the farming system may be, acceptance remains subject to local preferences. For example, after the Tonga people of southern Zambia lost most of their cattle to East Coast fever disease, the government introduced donkeys (Equus asinus) as an alternative, resistant to both drought and disease. However, having reared cattle for centuries, this gesture was outrightly rejected by the Tonga because they did not subscribe culturally to the use of donkeys (MoA, 2003). As Vickery (1986) recounted in her ethnographic work among this ethnic group now found in Malawi, Zimbabwe, Zambia and Mozambique, both the lived-lifestyle and archaeological evidence indicate a basic cultural heritage continuity based on rearing cattle, nature conservation and crop cultivation. This tradition dates back to the fifth century A.D., and is believed to have been eroded and destroyed by European contacts in 19th Century and government policies thereafter (Hogendorn, 1975).

Globally, indigenous peoples have generally shown detailed local ecological knowledge about biodiversity and value which can be tapped for greater impact conservation (Colson, 1971; Saha, 1994; Derek et al., 2005; Gyampoh et al., 2009; McPherson et al., 2016). The baobab tree in Figure 5.2 (nick-named by indigenous people as *Ngombe Illede* -sleeping cow) exemplifies a conservation practice that has taken place for centuries which also served as a trading centre for more than 100 years between the Arabs and indigenous communities. Considered a community resource and shrine, it remains undisturbed by human activities after 400 years (McIntosh and Fagan, 2017). However, most of the wetland shrines have disappeared and the baobab tree in question is now a protected site by the Heritage and Conservation Commission of Zambia. The argument being made is that integrating invaluable traditional ecological knowledge into the

main-stream science is important. From these arguments emerge four broad critical features of knowledge integration that may enable a more productive and mutually beneficial relationship between and among different knowledge systems. These are: identification of new frameworks for integration, greater cognizance of the social contexts of integration, expanding modes of knowledge evaluation, and more involvement of inter-cultural "knowledge bridgers" (Bohensky and Maru, 2011). These can be achieved through multiple-evidence base approach (Tengö et al., 2014).

5.5 Summary and conclusion

Drawing on the political ecology conceptualisation of marginalisation and degradation thesis, this chapter discussed the potential usefulness of a political ecology perspective for improving climate change adaptation in rural livelihood. The chapter demonstrated and made suggestions about how a political ecology lens can offer insights into resolving some of the challenges and criticisms levelled against how current intervention approaches to climate change adaptation are constructed and conceptualised. Centrally driven by knowledge and identity politics dominated by the global North, the current approach to climate change adaptation is nothing but capital accumulation, political power, and economic hegemony that exist in institutions in the global North and South. Because as shown in this chapter, to indigenous communities, there is nothing new about climate change. These communities have lived with and adapted to it for centuries (Bridges and McClatchey, 2009). The life of mobility of pastoral and hunter-gatherers constitutes a traditional response to seasonal and drought-induced shortages of water and food. Without mobility, supplemented by other traditional practices of kinship and support networks, it would have been unlikely that opportunities for occupation of the arid zones such as the Kalahari would have occurred (Sporton et al., 1999). Similarly, over much of the Sahel which has been extensively dry for centuries, opportunities for food-crop cultivation have been slim: pastoralism have traditionally turned to be the most viable livelihood (UNEP, 2011). However, what is new to people living in these and other regions referred to in this study is the accelerated

anthropogenically induced climate change (Ross, 2009). As consensus ties adaptive capacity to sustainable livelihoods capital (e.g., information technology, material resources, infrastructure, institutions and entitlements) indigenous peoples worldwide are found to be the most vulnerable to even small changes in climate (McLeman and Hunter, 2010; White, 2012; Bryceson et al., 2003; Connolly-Boutin and Smit, 2016).

There is no doubt that adaptation and mitigation efforts in addressing climate change are essential, but as Whitfield (2015); Lesperance (2017); and Belfer et al (2017) have shown, the concern that such efforts and actions may be perpetuating marginalization need to be addressed and the political ecology lens offers the insights into addressing this marginalisation. If they remain unaddressed, they are likely to increase vulnerability as adaptation agendas continue with little or no reflection of the worldviews, needs, and rights of indigenous communities. Recognising this concern, this Chapter assessed and highlighted some of the coping and adaptation strategies used by agrarian populations amidst adversity of climate change and related environmental stresses. Certainly, not useful in every context. For example, seasonal migration and nomadism no longer provide certainty that those migrating into new areas are free from any environmental risk, or that those who remain are any safer (Morrissey, 2013; UK-GOS, 2010). But by highlighting some of these strategies, it is hoped that this narrative has brought forth to the global climate change agenda and conservation debate, a view of a uniquely positioned cultural capital base that may be useful to both the policy maker and the knowledge bridger. Yes, past prescription may have solved some urgent problems here and there, but without local people's cultural capital injection; without working closely with communities and integrating their local knowledge into such projects, sustainability is brought into question. There is only so far such a prescription-approach can go before becoming self-defeating as there is no guarantee that the imposed solutions will be continued by the target group after project financial support is no longer available. Thus, while indigenous communities may undoubtedly need significant support to adapt to climate change using scientific knowledge, they have knowledge of adaptation (Berkes, 2012). The identification and validation through the multiple

evidence base approach proposed by Tengö et al (2014) and the integration of this evidence into the main-stream science agenda, potentially promises to provide one of the surest ways for the development of more effective and sustainable strategies. It is concluded that a more nuanced understanding of context-specific socio-political challenges that operate across scales, and their consequences can be useful in making adaptation more effective than currently is. Modern problems cannot be solved with singular, mechanistic, science-centred solutions alone. The impetus in this chapter is to invite an open and honest dialogue within the marginalisation and degradation thesis that extends into sections of chapters 6, 7 and 8. The dialogue must recognise that political structures, unequal scalar relations of power and economies of scale can undermine the very adaptation ability of the poor and marginalized communities, interventionists seek to address. Knowledge politics does exist but recognising that knowledge systems do not develop in isolation is important; and therefore, integration of different knowledge systems is necessary as it has great potential to strengthen adaptation agendas at different scales.

CHAPTER 6: CLIMATE CHANGE AND VULNERABILITY ASSESSMENT

"Climate change is no longer some far-off problem; it is happening here; it is happening now." Barrack Obama (Keynote address to COP21 in Paris, 2015).

6.1 Introduction

The underlying factors shaping rural livelihood vulnerability are embedded in the political ecology of resource governance. Amongst the key factors are marginalisation, access and control in entitlements, property rights, market access and price fairness, equity and access to technology and credit (Chandra et al., 2017). Although indigenous rural farmers produce about 80 percent of the food consumed in the developing world, on average, over 500 million rural farmers globally are vulnerable to climate change because they manage less than ten hectares of land each on the margins (IFAD, 2013). This is probably because of how global, regional and national institutions financing and overseeing policies and/or programmes construct vulnerability of communities, for example through development aid or poverty reduction interventions (Chandra et al., 2017). As discussed in Chapter 5, it is largely by socio-political inclinations, embedded in discursive space, that the marginalised representation of local or indigenous knowledge or views in shaping climate change adaptation policies and programmes are essentially fuelled.

This chapter aims at bringing a more nuanced understanding of context-specific socio-economic and political challenges that may operate across scales, and their consequences for addressing the vulnerability of rainfed agriculture. It extends the degradation and marginalisation thesis of political ecology highlighted in Chapter 2 and 5, to examine vulnerability at regional or zonal level. The approach is twofold: First, the extent to which local climate has changed or varied over time is examined and compared between agro-ecological zones I and IIa. Second, livelihood vulnerability levels are assessed using the IPCC-AR4 framework and inter-zonal comparison made to ascertain where climate risks are greater, given the rural-rural migration pattern between the zones. Of the known challenges facing humanity today, there is little doubt

that climate change is one of the most unprecedented (Steffen et al., 2007). Other than impacting on various sectors of industry and socio-economic systems, climate change and variability threatens every life-form and species. Adapting and mitigating its impacts will require science-informed and evidence-based policy formulation and implementation (IPCC, 2014a). This is essential to ensure that programmes designed to minimize the negative impacts of climate change and variability on various natural and socio-economic systems are effective and sustainable. Experts argue that this is particularly urgent in least developed nations where impacts on food security, water availability, socio-economic and health are already manifesting. Furthermore, based on a CO_2 doubling scenario in these regions, estimates predict a yield reduction of approximately 66 percent under rain-fed conditions (Niang et al., 2014).

6.2 Agro-climatic zones

Although Zambia lies within the tropics, climate is largely moderated by high altitude. Most of the land is part of an undulating central African plateau with altitudes ranging between 1,000–1,600 metres above sea level (a.s.l), resulting in cool and comfortable climatic conditions. However, in the valleys of the Zambezi, Kafue, Luangwa and Luapula lying below 500 metres a.s.l., daily maximum temperatures can reach up to 40°C in October. Overall, Zambia experiences a predominantly humid sub-tropical climate (Köppen climate classification) with small patches of semi-arid savannah in the south-west. It is characterised by three distinct seasons, namely; rainy season (November to April), a cool dry season (May to August) and a hot-dry season (August to October) (FAO, 2005). However, with changing climate conditions, onset and cessation of rainfall has become irregular in recent years which tends to shift all other seasons either by prolonging or shortening them (UNDP and GRZ, 2010). Rainfall is strongly influenced by the movement of the Inter-Tropical Convergence Zone (ITCZ) as well as the El Nino/Southern Oscillation (ENSO) phenomenon and ranges from an annual average of 600 mm in the lower south, to 1300 mm in the upper north of the country (FAO, 2005), see Figure 1.1. Using long term climatic data, particularly rainfall distribution, Zambia has been categorised

into three main agro-ecological zones (AEZs) by Zambia Agriculture Research Institute (ZARI) namely: Agro-Ecological Zone I, II (a, b) and III (UNDP and GRZ, 2010). However, as shown in Figure 6.1, a 60-year observational record shows a gradual northward shift of the zones. This may have an implication on future migration patterns of people.

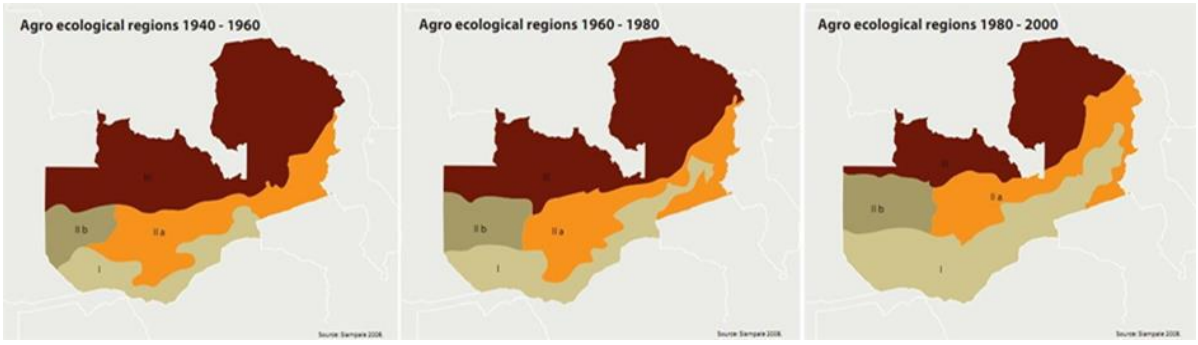


Figure 6.1: Shifts of Agro-ecological Regions 1940-2000 (ZEMA 2012, p.48)

AEZ I covers the western and southern part of Zambia including three study communities - Choma, Kalomo and Livingstone, receiving less than 800 mm of annual rainfall mean (Stern and Cooper, 2011). Meteorological data for the last 25-30 years indicate that the zone is currently the driest in Zambia. This zone constitutes about 12 percent of Zambia's land area (CGIAR, 2017). To the contrary, Agro-Ecological Zone subdivided into IIa and IIb covers the central part of the country, extending from the east part of the country through to the west. It is the most populous region with over five million rural inhabitants and has the greatest agricultural potential. The region receives about 800–1000 mm of rainfall annually, which is evenly distributed throughout the crop growing season (See Figure 1.1 of Chapter 1).

Agro-Ecological Zone III covers much of the northern part of the country and has a rural population of over just over 3.5 million people (UNDP and GRZ, 2010). It receives well over 1000 mm of annual mean rainfall. As a result, the soils within this region are highly leached and acidic. AEZ III, which covers most of the Copperbelt (not covered by this study) has a growing season of more than 160 days (FAO, 2005). Due to abundant availability of fresh water in this area, there is potential for irrigation. This zone constitutes about 46 percent of Zambia's land area (CGIAR, 2017).

According to Zambia historical weather assessment and observations using both observed and climate models (CMIP3 and CMIP5) the following has been observed (McSweeney et al., 2010):

a) Ambient temperature has increased by about 1.3°C since 1960 at an average rate of 0.29°C per decade.
b) Since 1960, there has been an average decrease in annual rainfall of about 1.9 mm per decade.
c) There has been an increase by about 20 percent in the frequency and intensity of drought and flooding events since 1960.

These observed changes are likely to have serious implications on agriculture, public health, water resources and ecosystems in Zambia.

6.3 Analysis of rainfall variability and drought

For farmers and other similar land users, it may not be enough to consider changes over time in mean annual climate parameters alone (Thomas et al., 2007). Similarly, the concept of extreme rainfall or drought may be too broad and not sufficient to fully capture the climate variability dynamics that farmers face in their daily decision-making processes (Deressa et al., 2009; Below et al., 2014; Lei et al., 2016). Within the broader concept of rainfall variability lies intra-seasonal factors such as timing of onset and cessation which determine the crop planting regime and growing period (Mugalavai et al., 2008). In between planting regime and growing period are intermitted rainfall disturbances such as dry-spells and floods which ultimately influence the effectiveness of the rainy season in a year (Dunning et al., 2016). All these factors determine the effectiveness of farming activities and ecosystems utilisation as they introduce an element of uncertainty, leading to certain changes in social behaviour and livelihoods (Thomas et al., 2007). For this reason, and to address the local climate change question, daily rainfall data from 1980-2016 were obtained from Zambia Meteorological Department climate records and

analysed for evidence of change and variability. The analysis utilised various methods such as those by Ayanlade et al (2018); Stern and Cooper (2011); Jaiswal et al (2015); and Asfaw et al (2018). Based on rainfed agriculture and similar land uses in Zambia's rural livelihoods, the duration of rainy season, total amount of annual rainfall, number of rain days, dry spells and distribution have been analysed. Statistical tests have also been performed at 95 percent level of significance and several comparisons made between and among parameters in the dataset.

6.3.1 Rainy season duration

Rainy season duration analysis is not only important for understanding climate change and variability, but also useful for rainfed crop production as it is directly linked to the growing period. In theory, the longer the rainy season, the longer the growing season. The opposite is true for short rainy season (Stern and Cooper, 2011). However, both long and short rainy seasons affect crops. For example, short rainy season (meteorological drought) may affect crop growth and results in crop failure. Similarly, long rainy season may also damage crops if extended beyond what is considered as normal (Sichingabula, 1998; Tilya and Mhita, 2007; Masupha et al., 2016). Complexity emerges when the amount of rainfall received is considered, as it can result in either flooding or drought - regardless of the rainy season duration. In this regard, understanding both rainfall amounts, and rainy season duration was important to this study as findings have potential to influence government policy and farming support planning.

Results from rainy season duration and rainfall amounts analysis are presented in Figure 6.2 with general summary statistics in Appendix A1. As findings have shown, there was a wide gap on the rainy season duration over place and period examined. For example, Kabwe (AEZ IIa) had a lesser rainy season duration than Livingstone (AEZ I) from about 1995 onwards. However, there was a steady decrease for Livingstone from about 1998 to 2005 before a steady increase between 2006-2011. From 2011 onwards, the duration of the rainy season in Livingstone tended to get shorter. However, over the entire period studied, the longest rainy season duration experienced in Livingstone was 223 days in 1995 compared to Kabwe's 246

days in 1985. The shortest period was 112 days in Livingstone in 1991 compared to 104 days for Kabwe in 2016.

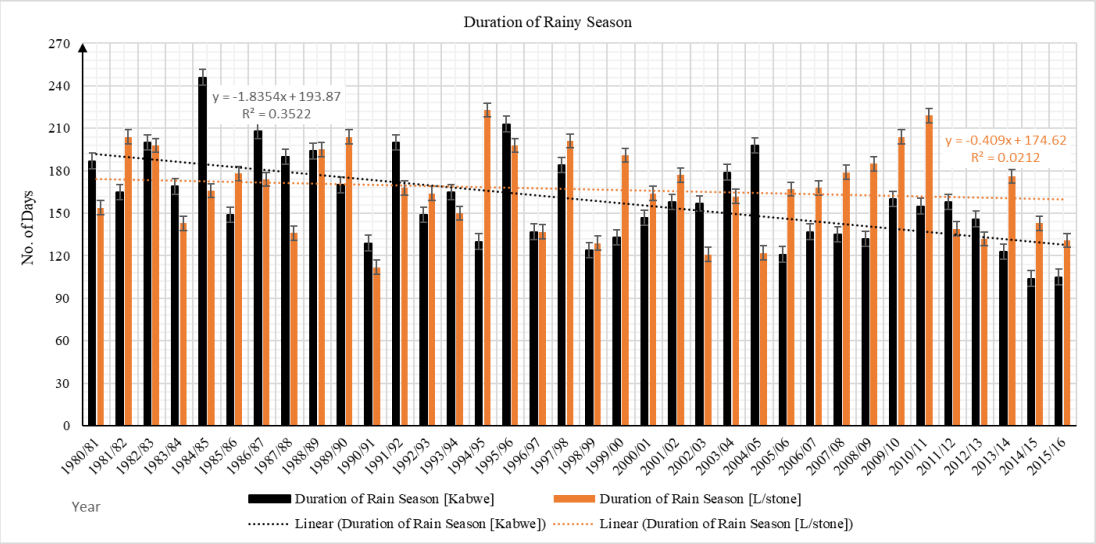


Figure 6.2: Rainy season duration (Kabwe and Livingstone) 1980-2016

However, as Figure 6.2 shows, despite the different rates, there has been a general downward trend in rainy season duration in both areas over the 36 year-period. To understand the magnitude of this trend, further assessments were carried out using statistical tests for significance in which the MK and Z-test were utilised. The results summary of the general climatic parameter scores are displayed in Appendix A2. As Sen's slope score seem to suggest, Kabwe had a bigger downward trend with a β-score of -1.8 in the rainfall season duration over the 36-year period, compared to Livingstone whose β-score was only -0.4. Similarly, Tendall's tau score shows a 41 percent reduction for Kabwe, and only a 9 percent reduction for Livingstone. To understand the significance of these reductions, a Z-test statistic for two samples was performed. Figure 6.3 shows the results.

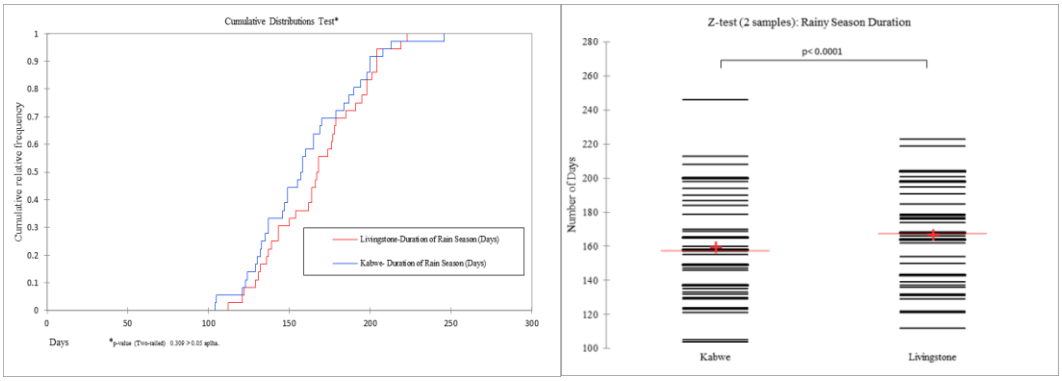


Figure 6.3: Distribution and Z-test of rainy season duration (1980-2016)

As the Z-test results seem to suggest, the difference in the duration of the rainy season between Kabwe and Livingstone was not statistically significant. The computed mean for Livingstone was only one week longer at 167 days, compared to 160 for Kabwe. Furthermore, the distribution test statistic on the difference in the rainy season duration shown in Figure 6.3 also suggests a no statistical significance as the observed p-value 0.30 > 0.05 α.

6.3.2 Onset and cessation of rainy season

Figures 6.4 and 6.5 show results from onset and cessation analysis. As shown, there were variations within and between the agro-ecological zones throughout the 36-year period examined. Generally, results suggest that the rainy season duration was increasingly getting shorter in both AEZI and IIa because onset was increasing starting late, while to the contrary, cessation was increasingly starting early. As shown in Figure 6.4, onset in Livingstone shifted from about mid-October in 1980 to mid-November in 2016 resulting in a one-month delay over the 36-year period. Similarly, in Kabwe, it shifted from mid-October in 1980 to about mid-December 2016 as shown in Figure 6.5 suggesting that by 2016, onset was starting about two months late compared to 1980.

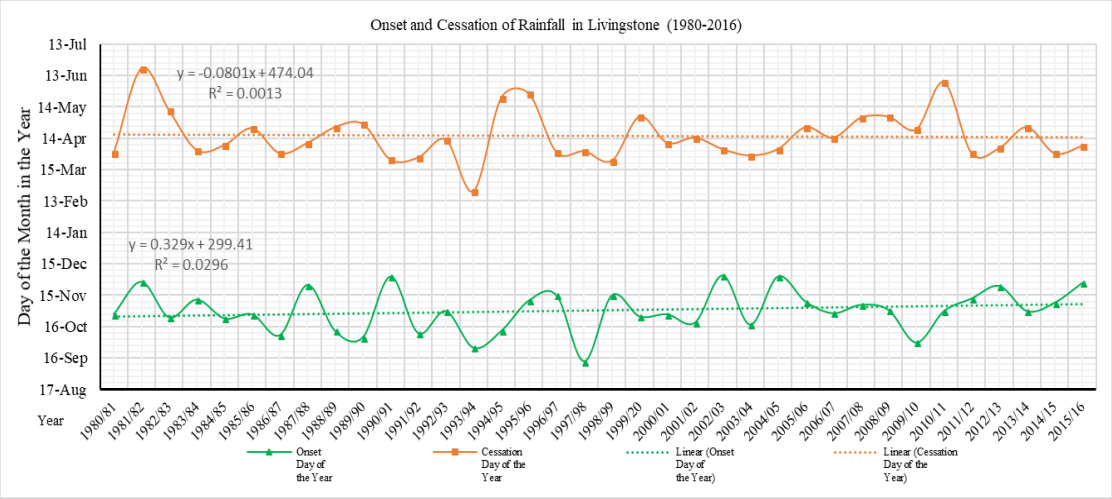


Figure 6.4: Onset and cessation of rainfall in Livingstone (AEZ I)-1980-2016

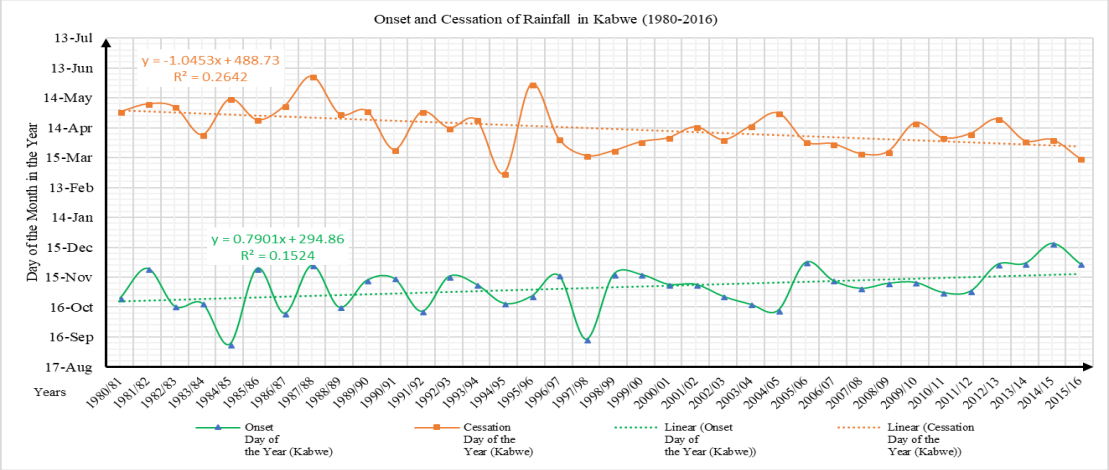


Figure 6.5: Onset and cessation of rainfall in Kabwe (AEZ IIa) 1980-2016

Conversely, as Figure 6.5 shows, cessation in Kabwe was about two months earlier as it shifted from about mid-May in 1980 to about mid-March by the year 2016. For Livingstone, evidence in Figure 6.4 shows that there was only a very minimal shift in cessation which falls within a week of the month, around mid-April. To ascertain the magnitude of onset and cessation variation, statistical tests for significance using MK and Z-test were performed. For onset, the results are shown in Figure 6.6 while cessation results are shown in Figure 6.7.

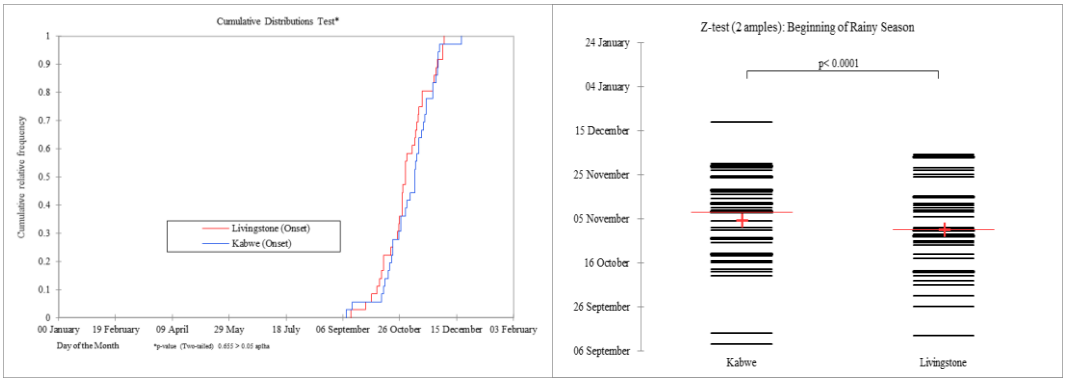


Figure 6.6:Distribution and Z-test of onset of rainy season (1980-2016)

Both the Z-test results seem to suggest that that there was no significance difference in the onset of rainy season between areas as the observed p-value 0.665 > 0.05 α. Furthermore, the Distribution test statistic also showed no statistical significance in the difference. However, as the Sen's slope shows in Appendix A2, there was more onset delays in Kabwe as its β-score of 0.79 is more than twice the β-score for Livingstone. Similarly, Tendall's tau score suggests a 25 percent delay on onset in Kabwe, and 15 percent delay in Livingstone.

While both the distribution test statistic and the Z-test results seem to suggest that there was no significance difference as the observed p-value 0.651 > 0.05 α (Figure 6.7) on the cessation of rainy season, the Sen's slope or β-score shows a shift in cessation in Kabwe by more than tenfold the β-score for Livingstone. A similar phenomenon was observed as results in Appendix A2 show that rainy season now ends about 37 percent early in Kabwe, and three percent late in Livingstone.

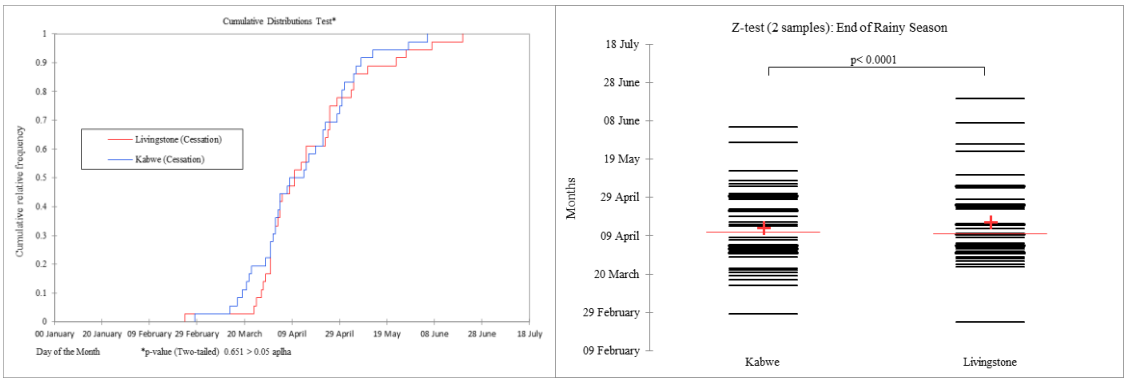


Figure 6.7: Distribution and Z-test of rainfall period cessation (1980-2016)

6.3.3 Wet or rainy days

The analysis of wet or dry days followed the pre-determined threshold values as outlined in the methods section in Chapter 4.

Figure 6.8 shows the number of wet days per year for the 36-year period analysed. As the evidence suggests, there are variations within and between the agro-ecological zones. For study communities – Chibwe and Chikonkomene in Kabwe/Chibombo area in agro-ecological zone IIa shows a wider range of variations than Livingstone in agro-ecological zone I for study communities -Kalomo, Choma and Livingstone.

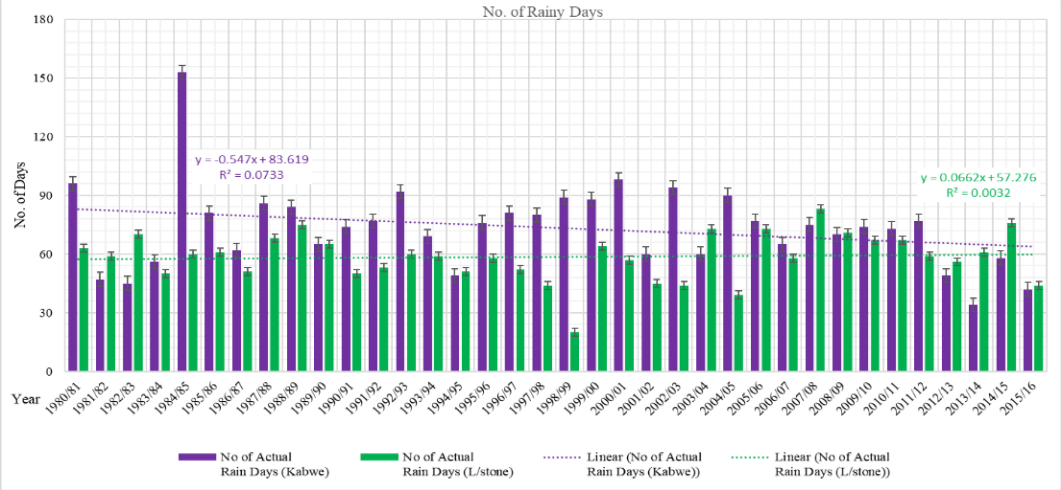


Figure 6.8: Number of actual rainy days in the rain season (Kabwe and Livingstone-1980-2016)

However, despite the variations, evidence suggests that the downward trend in the number of rainy days was only in Kabwe over the period examined. And as Sen's slope estimate evidence shows in Appendix A2 and in Figure 6.8, Kabwe had a bigger downward trend with a β-score of -0.5, compared to Livingstone's β-score of 0.6. Similarly, Tendall's tau score shows further differences between Livingstone and Kabwe with Kabwe's rainy days reduction at 15 percent, compared to negligible 0.5 percent increase in Livingstone. Further assessment with MK and Z-test firms this evidence as shone in Figure 6.9.

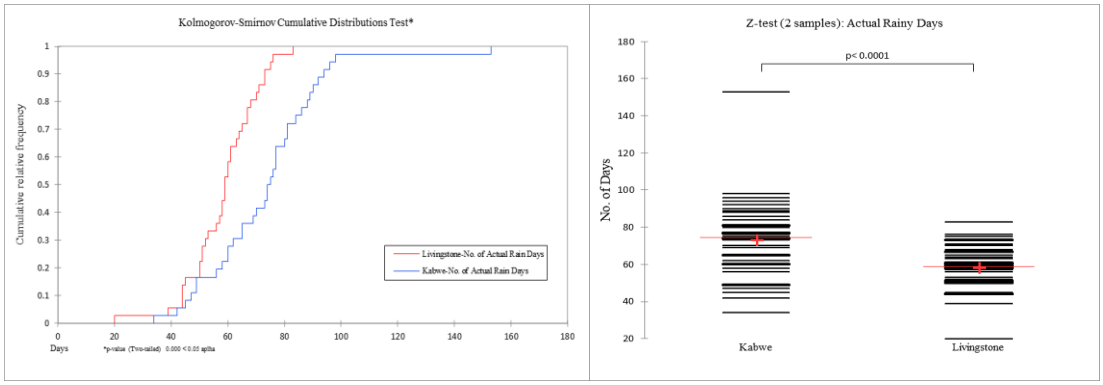


Figure 6.9: Distribution and Z-test of actual rainy days in the rainy season (1980-2016)

The difference in the number of rainy days between Kabwe and Livingstone is statistically significant as the observed p-value 0.000 < 0.05 α.

6.3.4 Number of dry spells, frequency and distribution in the rainy season

Figure 6.10 shows the variations within and between areas of study on the number of dry days. Generally, evidence suggests a general decrease. However, between areas studied, Livingstone experienced a greater number of dry days than Kabwe in the examined period.

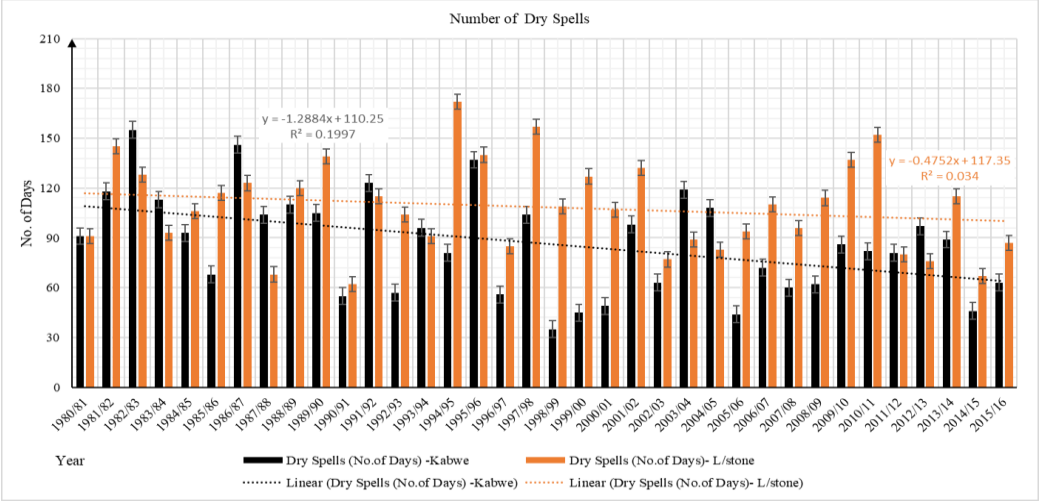


Figure 6.10: Number of dry days in the rainy season in Livingstone and Kabwe (1980-2016)

As Sen's slope evidence suggests in Figure 6.10 and Appendix A2, Kabwe experienced a bigger downward trend with a β-score of -1.3, compared to a negligible -0.5 for Livingstone. Similarly, Tendall's tau score seems to suggest that the number of dry days in Kabwe reduced by about 28

percent; twice the reduction in Livingstone. However, as shown in Figure 6.11, the distribution test statistic indicates no statistical significance as the observed p-value 0.064 > 0.05 α.

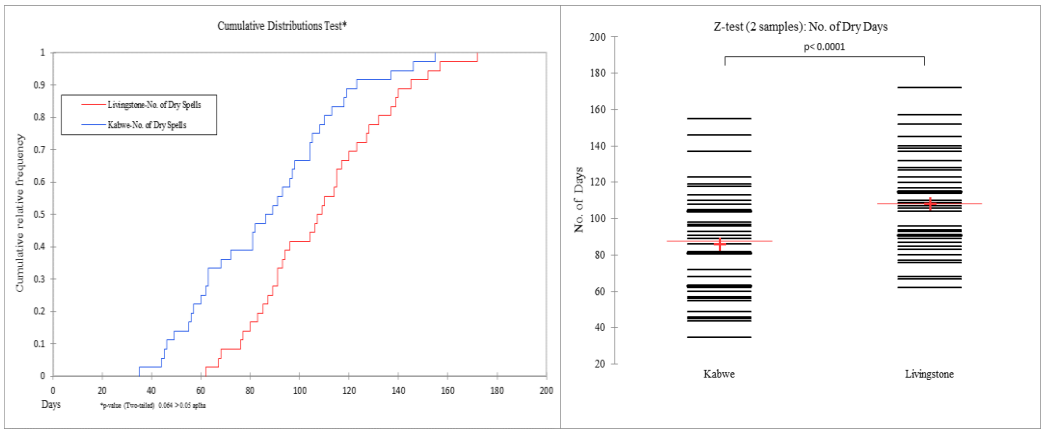


Figure 6.11: Distribution and Z-test of dry days in the rainy season (1980-2016)

Further assessment was carried out on consecutive dry days for dry spell analysis of the rainy period for each year in both agro-ecological zones. Figure 6.12 shows some graphic presentation of the characterised types of dry spells and how each category was distributed throughout the rainy season from 1980-2016.

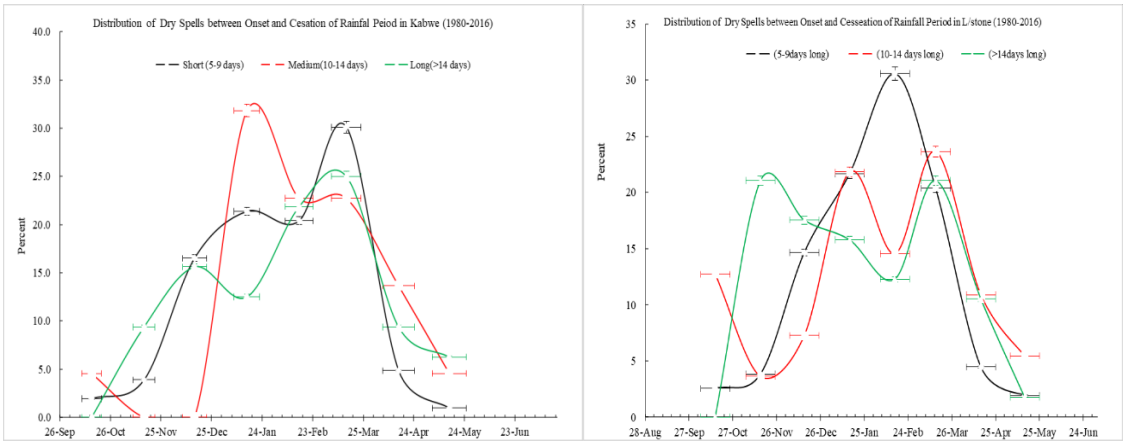


Figure 6.12: Distribution of dry spells in the rainy season for Kabwe and Livingstone (1980-2016)

Longer dry spells occurred mostly after onset in Livingstone while these occurred mostly towards cessation in Kabwe. The peak of short dry spells was distributed almost similarly in both agro-ecological zones around mid-term of the rainy season while the medium dry spells varied greatly between agro-ecological zones.

6.3.5 Total annual rainfall

As evidence seems to suggest, there are variations and fluctuations on annual total rainfall in both Kabwe and Livingstone. Figure 6.13 shows the magnitude of these variations over the period examined. Generally, there were more fluctuations in Livingstone than Kabwe, with the former recording most of the lowest annual rainfall figures for the period assessed. Further assessment showed that the reduction in annual rainfall was negligible with Sen's slope β-score of -0.05 and Kendall's tau correlation coefficient suggesting a no change for Livingstone. As shown in Appendix A2, the β-score for Kabwe was about 0.9 with Kendall's tau correlation coefficient of only 2.9 percent increase.

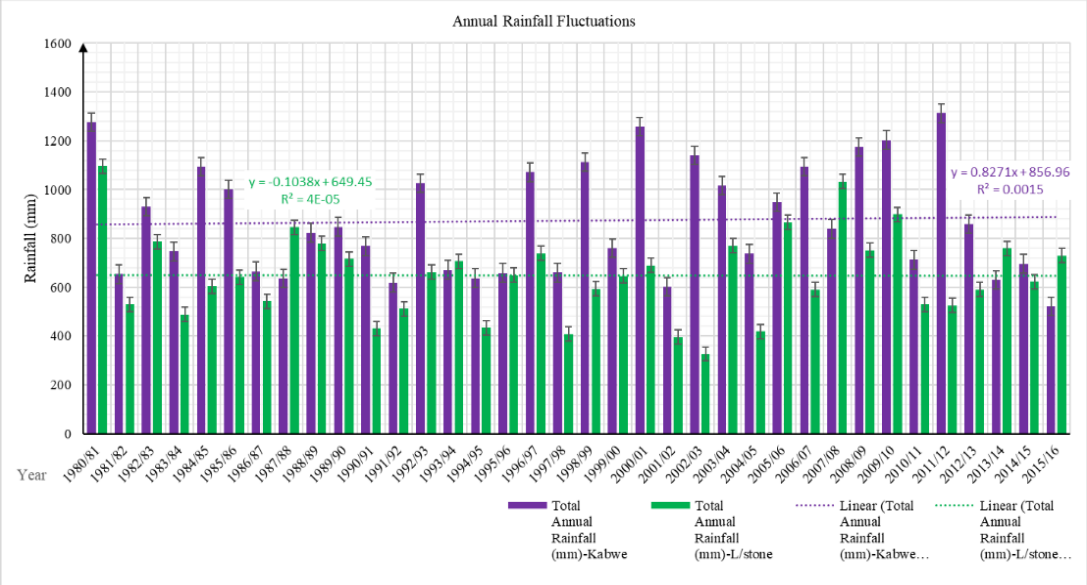


Figure 6.13: Total annual rainfall fluctuations in Kabwe and Livingstone (1980-2016)

However, Z-test results suggest a statistically significant difference in the annual rainfall between Kabwe and Livingstone as shown in Figure 6.14. The distribution test statistic suggests a statistically significant difference in the total annual rainfall distribution where the observed p-value 0.008 < 0.05 α.

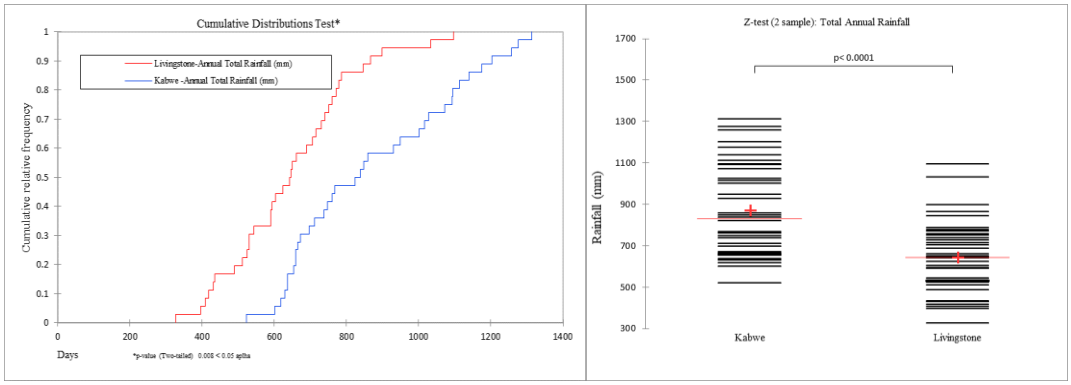


Figure 6.14: Distribution and Z-test of total annual rainfall (1980-2016)

6.3.6 Intra-seasonal rainfall variations

For intra-seasonal variations, Figure 6.15 shows the results. Evidence suggests that peak monthly mean rainfall has been experienced between December and mid-February for both agro-ecological zones. However, monthly rainfall has been generally lower in Livingstone than in Kabwe. Similarly, evidence shows that intra-seasonal coefficient of rainfall variations (CV) or anomalies were above 30 percent in both areas. However, there appears to be a stronger anomaly signature in Livingstone than Kabwe as evidenced by the results shown in Figure 6.15.

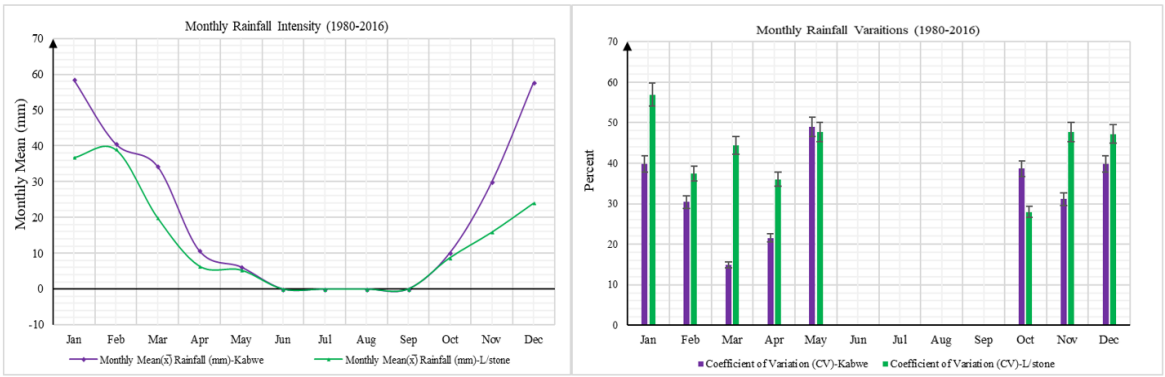


Figure 6.15: Monthly mean rainfall intensity and intra-seasonal variations (1980-2016)

Generally, for all months in the rainy season, anomalies in Livingstone have been higher than Kabwe, except for October. These findings show that rainfall in Livingstone has been less reliable than in Kabwe for the period analysed.

6.3.7 Association: Total annual rainfall and other parameters

With monthly rainfall intensity and the anomalies evident in the rainfall dataset, there was need for further assessment of the data. In this regard, an association test between rainfall variables was performed to gain further insights on total rainfall, rain season duration and number of actual rain days. However, it is important to be clear that although an association test is important, it does not test for causality. As evidence in the data suggests, since there was a general declining trend in the number of wet days and duration of rainy season which may be attributed to e.g., late onset and early cessation in both agro-ecological zones, a possibility that annual rainfall may have been concentrated over short rainy periods does exist. This trend if continued, could potentially result in intense floods in the future. As association test results show in Figure 6.16 and 6.17 for the two agro-ecological zones, there appears to be a relationship between variables in both cases.

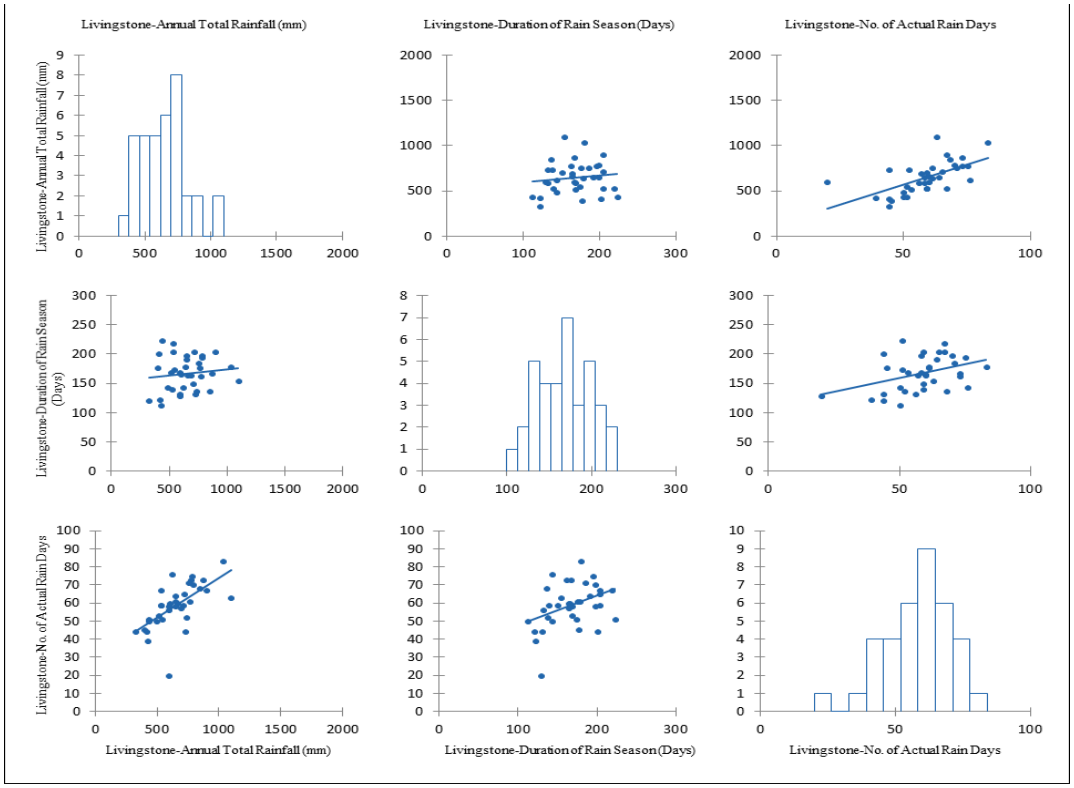


Figure 6.16: Testing for association on rainfall parameters in Livingstone (AEZ I)

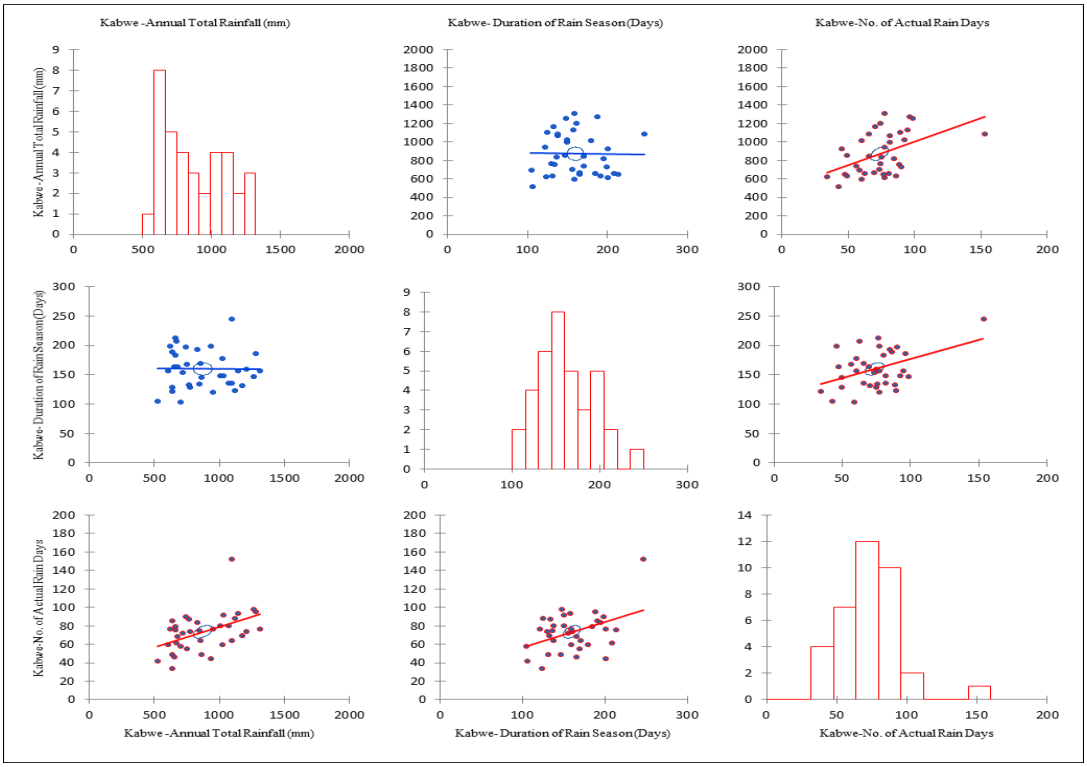


Figure 6.17: Testing for association on rainfall parameters in Kabwe (AEZ IIa)

In Livingstone for example, there is a positive association between all variables tested. A stronger association is evident between the number of actual rainy days and total annual rainfall, while the weakest association is between the amount of annual rainfall and duration of rainy season. A similar association is evident in Kabwe with test results suggesting a stronger association between the number of actual rainy days and the total annual rainfall. However, there appears to be completely no association between the amount of annual rainfall and duration of rainy season in both agro-ecological zones.

6.3.8 Standardized anomalies of annual rainfall

Assessed using the standardized ratio (SRA) method, annual rainfall anomaly results for both agro-ecological zones are presented in Figure 6.18. From the SRA scores, a total of 21 years or 65 percent of the 36-year period recorded annual rainfall below the 36-year long-term mean in Kabwe compared to 17 years or 47 percent of the same period in Livingstone. The magnitude, distribution and length of the period during which rainfall was below long-term mean varies between agro-ecological zones. For instance, in AEZ IIa, the longest period recorded is five

years from 1987-1992 with the second longest (four-year period) recorded between 2012 and 2016. In AEZ I however, there were two longest periods recorded, but these were only three years long from 1984-1987 and from 2000-2003. Similarly, there were years during which rainfall fell well above the long-term mean, a potential flood risk.

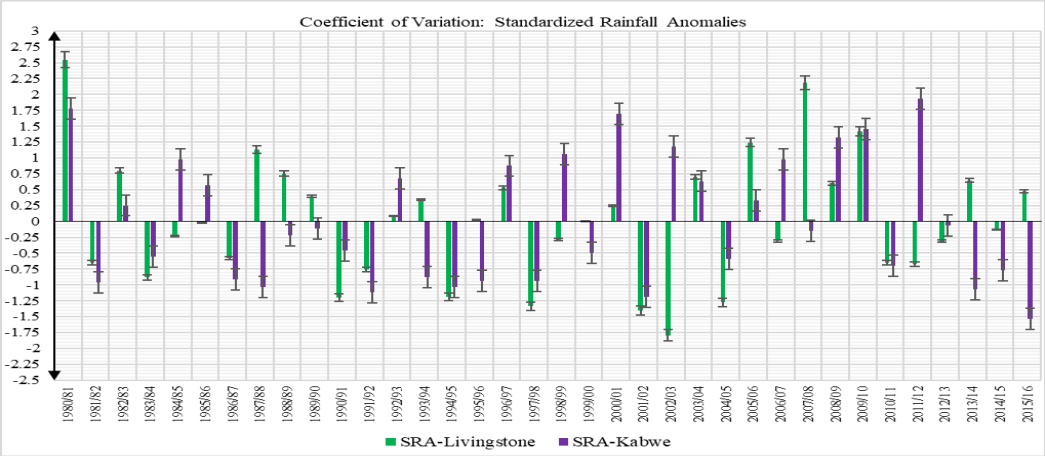


Figure 6.18: SRA of annual rainfall during 1980–2016 for Livingstone (AEZ I) and Kabwe (AEZ IIa)

As results in Figure 6.18 indicate, there were more droughts recorded in Livingstone with a slightly higher magnitude in the period 1991-2005 compared to Kabwe. However, Kabwe recorded droughts of a slightly higher magnitude in the last nine years, 2007-2016. Of all the droughts recorded in Livingstone, one was *extreme* in 2003, three were *severe* in 1998, 2002 and 2005 and only one was *moderate* in 1984. The rest can be categorised as *zero* since they fell below the threshold value SRA > -0.84 (Agnew and Chappell 1999). Similarly, in the case of Kabwe, only one *extreme* drought was recorded in 2016. However, unlike Livingstone, Kabwe did not record any *severe* drought during the 36-year period examined. Nevertheless, ten droughts can be considered as *moderate* and the rest as *zero*.

Comparing these findings on rainfall patterns to the qualitative traditional knowledge data examined in Chapter 5, there is evidence to suggests that people can see these anomalies and variabilities in rainfall without measuring instruments. Perhaps the argument about traditional climatologist's ability to have known and conceptualised the relationship between the moon's position and rainfall occurrence holds true. Arguably, they were able to predict droughts or

floods by reading the moon's shape and its position, although contention remains as to whether this relationship was correctly interpreted or really worked as a disaster warning tool. What is clear however, is that the number of disasters in form of severe droughts reported by respondents in both ecological zones is confirmed to be correct by scientific climatic data for both ecological zones (Table 6.1 vs Figure 6.13). Nonetheless, contention remains - people are more likely to remember sudden and severe environmental disasters, than slow, isolated and non-severe ones (Rob, 2013).

6.4 Livelihood vulnerability assessment

6.4.1 Livelihood vulnerability indicator (LVI) in the IPCC context

Processed from interviews, Table 6.1 shows the maximum and minimum values for all the 35 sub-components identified under the eight major components of the livelihood vulnerability index (LVI). These values were used to harmonise the measurement scale using equation (2) in Chapter 4. Table 6.2 shows the results from equation (2) and equation (3). Most notable is the percentage of the household dependent solely on family farms for food: 100 percent in each study area or zone. Similarly, the percentage of households without access to electricity is 100 percent in both areas. Coupled with the percentage of households that did not receive any warning about the pending natural disasters at 90 and 86 percent in agro-ecological zones (AEZs) I and IIa respectively, the percentage of households with damaged crops and/or property exposure due to natural disasters is equally at 83 and 71 percent in AEZ I and IIa respectively. Other notable figures are the number of households without market access of their produce, distance to both market and nearest medical facility, percentage of households reporting poor soils on farmland, and the percentage of households with capital index below overall mean of surveyed households. Household capital index assessment is dealt with in the next chapter. With no access to electricity, all households rely on wood fuel through which firewood collection and charcoal making.

Table 6.1: Maximum and minimum values for calculating indices of sub-components for AEZ I and AEZ IIa

Major Component	Sub-component	Units	Zone I	Zone IIa	Minimum Value (both Zones)	Maximum Value (both Zones)
Socio-demographics	-Household dependence ratio.	Ratio	3.52	2.31	0	13
	-Percent of female-headed household.	Percent	56.66	32.43	0	100
	-Percent of child headed household (<18yrs).	Percent	0	1	0	100
	-Elderly headed household (>65yrs).	Percent	3	2	0	100
	-Percent of household where one or more members did attend formal education.	Percent	0	3	0	100
	-Percent of households with capital index below overall mean of surveyed households	Percent	55.32	44.68	0	100
Health	-Percent of households with one or more members with terminal illness	Percent	6.66	5.71	0	100
	-Average time to reach nearest health facility.	Minutes	123.3	89.3	30	270
	-Percent of households without medical care.	Percent	76.66	75.71	0	100
	-Percent of household with children as care-givers.	Percent	10	14.28	0	100
	-Percent of household where one or more members miss school due to ill health.	Percent	16.66	20	0	100
Market Access	-Percent of households with access to market for produce.	Percent	23.33	42.85	0	100
	-Percent of households with access to timely farming inputs (seed, fertiliser etc).	Percent	23.33	37.14	0	100
	-Time it takes to reach market place.	Minutes	115.25	110.34	60	220
	-Percent of household who sell produce below market value.	Percent	77.67	62.86	0	100
Livelihood strategies (migration, social network, crop diversification, piecework etc)	-Average give: receive ratio.	Ratio	1.28	2.15	0.5	7
	-Percent of household whose one or more members migrated.	Percent	53.33	35.71	0	100
	-Percent of household in co-operative or access to loan/technology.	Percent	30	47.14	0	100
	-Percent of household members diversifying income sources.	Percent	43.33	80	0	100
	-Percent of household dependent solely on family farm for food.	Percent	100	100	0	100
	-Mean crop diversity index.	1/n	0.35	0.27	0.17	1
	-Animal rearing diversity index	1/n	0.56	0.24	0.19	1
Natural Disasters and Climate Change/ Variability	-Total number of floods and droughts in the past 5 yrs.	Count	3	3	1	5
	-Percent of households that did not receive a warning about the pending natural disasters.	Percent	90	86.71	0	100
	-Percent of households with damaged property or crops due to disaster (2011-2016).	Percent	83.33	71.42	0	100
	-Mean standard deviation of monthly precipitation in rain season (2011-2016).	Millimetres	56	78	6.3	254
Water	-Percent of households reporting water conflicts or restricted access.	Percent	6.66	21.42	0	100
	-Average time it takes to reach primary water source (minutes).	Minutes	40.34	30.21	20.11	63
	-Percent of households without primary water availability during certain times of the year.	Percent	53.33	38.57	0	100
Environmental Degradation	-Percent of households reporting poor soils on farmlands.	Percent	93.33	51.52	0	100
	-Average amount of soil conditioner used per hectare (Kilogram pe hectare)	Kilogram	140.45	85.73	50	200
	-Average bare land estimate as percentage of total farmland for a household	Percent	76.34	72.64	0	100
	-Average percentage estimate of eroded part of bare land of farm for a household.	Percent	15.23	10.45	0	100
Energy Sources and types/mix	-Percentage of households without access to electricity.	Percent	100	100	0	100
	-Percentage of households relying on charcoal/firewood.	Percent	100	100	0	100

Table 6.2: indexed sub-components and overall LVI for AEZ I and AEZ IIa

Major Component	Sub-component	Zone I	Zone IIa	LVI Zone I	LVI Zone IIa
Socio-demographics	-Household dependence ratio.	0.2692	0.1776	**0.237**	**0.168**
	-Percent of female-headed household.	0.5666	0.3243		
	-Percent of child headed household (<18yrs).	0.0000	0.010		
	-Elderly headed household (>65yrs).	0.0300	0.020		
	-Percent of household where one or more members did attend formal education.	0.000	0.0300		
	-Percent of households with capital index below overall mean of surveyed households	0.5532	0.4468		
Health	-Percent of households with one or more members with terminal illness	0.666	0.571	**0.443**	**0.409**
	-Average time to reach nearest health facility.	0.5138	0.3720		
	-Percent of households without medical care.	0.7666	0.7571		
	-Percent of household with children as care-givers.	0.10	0.1428		
	-Percent of household where one or more members miss school due to ill health.	0.1666	0.20		
Market Access	-Percent of households with access to market for produce.	0.2333	0.4285	**0.491**	**0.530**
	-Percent of households with access to timely farming inputs (seed, fertiliser etc).	0.2333	0.3714		
	-Time it takes to reach market place.	0.7203	0.6896		
	-Percent of household who sell produce below market value.	0.7767	0.6286		
Livelihood strategies (migration, social network, crop diversification, piecework etc)	-Average give: receive ratio.	0.1969	0.3307	**0.511**	**0.512**
	-Percent of household whose one or more members migrated.	0.5333	0.3571		
	-Percent of household in co-operative or access to loan/technology.	0.30	0.4714		
	-Percent of household members diversifying income sources.	0.4333	0.80		
	-Percent of household dependent solely on family farm for food.	1	1		
	-Mean crop diversity index.	0.4216	0.3253		
	-Animal rearing diversity index	0.6913	0.2962		
Natural Disasters and Climate Change/ Variability	-Total number of floods and droughts in the past 5 yrs.	0.75	0.75	**0.677**	**0.662**
	-Percent of households that did not receive a warning about the pending natural disasters.	0.90	0.8671		
	-Percent of households with damaged property or crops due to disaster (2011-2016).	0.8333	0.7142		
	-Mean standard deviation of monthly precipitation in rain season (2011-2016).	0.2260	0.3148		
Water	-Percent of households reporting water conflicts or restricted access.	0.666	0.2142	**0.713**	**0.435**
	-Average time it takes to reach primary water source (minutes).	0.9405	0.7043		
	-Percent of households without primary water availability during certain times of the year.	0.5333	0.3857		
Environmental Degradation	-Percent of households reporting poor soils on farmlands.	0.9333	0.5152	**0.696**	**0.479**
	-Average amount of soil conditioner used per hectare (Kilogram pe hectare)	0.9363	0.5715		
	-Average bare land estimate as percentage of total farmland for a household	0.7634	0.7264		
	-Average percentage estimate of eroded part of bare land of farm for a household.	0.1523	0.1045		
Energy Sources and types/mix	-Percentage of households without access to electricity.	1	1	**1**	**1**
	-Percentage of households relying on charcoal/firewood.	1	1		
	Overall LVI			**0.537**	**0.475**

Deforested portions of total farmlands are estimated at 76 percent in AEZ I and 72 percent in AEZ IIa while soil erosion was at 15 and 11 percent respectively. Potentially, this can impact future changes in climate as deformation alters the hydrological cycle which impacts on climate change in turn, either in terms of hydrological or meteorological drought with implications for agriculture (Bosmans et al., 2017).

Related to Table 6.2 above is Figure 6.19 below showing the vulnerability spider graph of the 8 major components in both agro-ecological zones.

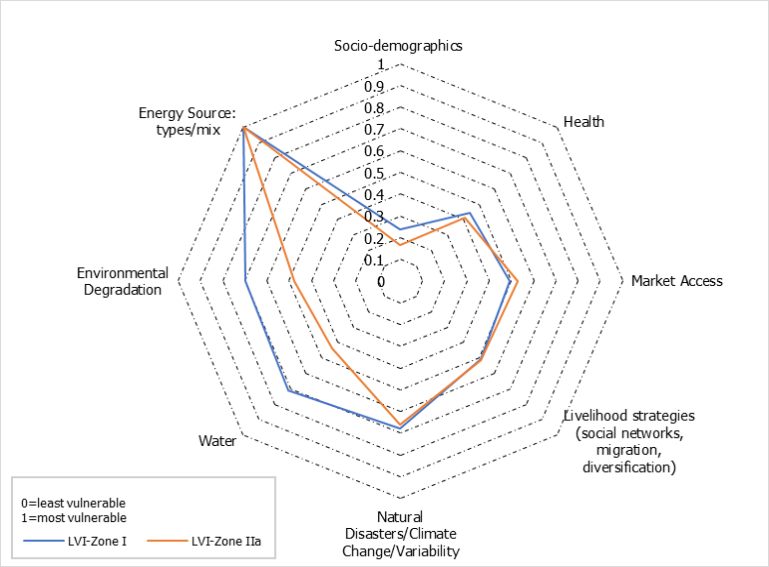


Figure 6.19: LVI comparison

Table 6.3: LVI-PCC values comparison

Contributing factors	**Major component**	**Major component values**		**Number of sub-components per major component**	**Contributing factor values**		**LVI – IPCC Values**	
		Zone I	Zone IIa		Zone I	Zone IIa	Zone I	Zone IIa
Adaptive Capacity	Socio-demographics	0.237	0.168	6	0.385	0.353	**0.1794**	**0.1159**
	Livelihood strategies (migration, social network, diversification etc)	0.511	0.512	7				
Sensitivity	Health	0.443	0.409	5	0.594	0.534		
	Market	0.491	0.53	4				
	Water	0.713	0.435	3				
	Energy	1	1	2				
Exposure	Natural Disasters Climate Change/ Variability	0.677	0.662	4	0.687	0.571		
	Environmental Degradation	0.696	0.479	4				

Among the highest vulnerability values are natural disasters, energy, water and environmental degradation. Overall between zones however, AEZ I is more vulnerable than AEZ IIa with an overall LVI value of 0.537 (see Table 6.2). This is also reflected in the LVI-IPCC value shown in Table 6.3 obtained using equation (1) whose terms are stated in Chapter 4.

6.5 Implications for policy and wider society

6.5.1 Vulnerability

The 35 sub-components constituting the eight major components contributed differently to the overall Livelihood Vulnerability Indices (LVIs) for the areas studied. As shown in Figure 6.19, energy, water and environmental degradation had the strongest contribution to the overall scores. While health, number of disasters and socio-demographics including livelihood strategies did not differ much between zones, they influenced the overall LVI-IPCC scores differently. Consequently, the LVI-IPCC score for AEZ I was lower than that of AEZ IIa by 0.0635 or 22 percent. However, both areas remain vulnerable in the context of LVI interpretation. Measured on the scale of -1 to 1 (with -1 being the least vulnerable and 1 the most vulnerable) scores in both zones are towards 1, implying moderate to most vulnerable (Hahn et al., 2009).

Core to resilience consideration are the differences on the number of households with market access for their produce, distance to nearest market and medical facility. In assessing the distances to these social amenities, the assumption was that those households with easy access to market were better placed to sell their produce and therefore access financial capital easily than those who had poor or no access. Similarly, households near medical facilities were assumed to have easy access to medical care and therefore more likely to experience good health assuming that medical facilities had appropriate drugs. As evidence suggests, the number of households with access to market was lower in AEZ I at 23 percent compared to 42 percent in AEZ IIa. Similarly, households in AEZ I walked longer distances to medical facilities than

their counterparts in AEZ IIa. The same applies to the number of households with access to timely supply of farming inputs which was lower in AEZ I than in AEZ IIa. This lowered the LVI-IPCC score for AEZ I in relation to that of AEZ IIa.

Given this scenario, any intervention programmes seeking to improve rural livelihood resilience to climate change in AEZ I is probably more likely to have far reaching impacts if it focussed on timely supply of farming inputs and market access support. There were more households selling produce below normal market value AEZ I than IIa. However, households in AEZ I were adaptation through livestock and crop diversification at 42 percent for crops and 69 percent for livestock. They also grew an average of at least three types of crops and reared an average of six types of animals. Crops included drought resistance varieties of maize, cotton, groundnuts and sunflower while livestock included goats, guinea fowls, pigs and sheep among cattle. In AEZ IIa, crop and livestock diversification were only about 32 and 29 percent respectively. Households grew an average of just over two types of crops and diversified animal rearing at an average of two. Cattle and goats were the main livestock types while crops included maize, groundnuts and sun-hemp in some cases. However, income diversification was broader in AEZ IIa at 80 percent than in AEZ I where it was about 50 percent lower. This may account for the differences observed in the livelihood diversification indexes between the zones.

In terms of environmental degradation, 93 percent of households in AEZ I reported poor soils on their farmland compared to 53 percent in AEZ IIa. This may explain why AEZ I applied more soil conditioners such as fertilizer and manure than AEZ IIa. This may also account for the emigration rates observed in AEZ I where 53 percent of households reported that one or more members had migrated, compared to 35 percent in AEZ IIa. Most of the migrants cited environmental related reasons for migration. Migration creates wide social networks that potentially lead to remittances (at least in rural-urban and international movements) with potential to improve recipient households' financial capital in emigration areas (Craven and Gartaula, 2015). For migration drivers' assessment results, see chapter 8. In this assessment,

remittances were measured in form of a give-receive ratio with an assumption that a household with a high ratio gives more than it receives and therefore, have a stronger economic standing than the one with a low ratio. Results show that households in AEZ IIa gave more than they received implying a stronger economic standing than in AEZ I where the ratio was nearly two times less.

6.5.2 Climate change and variability

Climate change assessment employed rainfall data to investigate the occurrence of meteorological-drought-years, fluctuations and variations. As opposed to other types of droughts such as hydrological -which occurs when low water supplies become evident in streams, reservoirs, and groundwater levels, meteorological drought refers to conditions that result when dry weather patterns dominate over an area (IPCC, 2014b). However, regardless of type, drought is a complex phenomenon which generally refers to the absence of precipitation or water (NOAA, 2018). Both hydrological and meteorological drought may result in agricultural drought, i.e., crop failure, and socioeconomic drought, i.e., poor supply of various produces (Nelson, 2010). It should be noted that, in the Zambian context, meteorological drought is best examined as an agro-climatic phenomenon where both spatial and temporal variation are important (Stern and Cooper, 2011). In this research however, analysis only focussed on temporal amount of annual rainfall fluctuations and variability analysis over a 36-year period. There are two main reasons for this: sparse and poor data records to enable an accurate assessment of inter-seasonal variations, and climatic nature of the study area as it only experiences one rainy season per year. Therefore, inter-seasonal variations analysis cannot be performed.

Rainy season onset and cessation is important to the scheduling of agricultural activities, right from land preparation, through crop selection and planting, to harvesting (Sutcliffe et al., 2015). Any erratic and significant delays in onset potentially translates to a short growing period and can affect the overall farming process especially staple food-crop production. In addition, rainy

season onset and cessation dates can also influence the transmission of vector-borne of crop and livestock diseases. Life cycle of diseases and peak transmission e.g., foot and mouth, corridor disease, locusts and army-worms can be sensitive to the variability and changes in temperature and rainfall (Amekudzi et al., 2015). Climate change also impacts human health due to associated outbreaks of illnesses such as malaria, diarrhoea, cholera, fever and zika which are often triggered by increased temperatures amidst humid conditions or intense rainfall. Furthermore, surges in allergy prevalence due to increased pollen production as a result of more CO_2 concentrations in ambient air can compound airborne illnesses (Tong et al., 2016). Thus, the variability in the rainy season onset and cessation is important not only for farmers to avoid crop failure as it threatens food security and nutrition, but also for public health management and other socio-economic activities (Bylander, 2015; Asfaw et al., 2018). Within rainy season duration, there are dry and wet days. The frequency and duration of both dry and wet days has implications for livelihoods as extremes can lead to droughts in the case of prolonged dry days, and floods in the case of heavy or prolonged rainy days. Essentially, some form of balance between dry and rain days is important for agricultural and hydrological applications (Wood et al., 2000). Similarly, understanding dry spells frequency of occurrence and duration in the rainy season is important for crop production (Masupha et al., 2016). For maize production, dry spells that occur during tasselling and silking (flowering stage of the maize plant) are specifically critical. For most maize varieties grown in Zambia, tasselling and silking starts at about 60 days from planting and extends to about 21-days window (Stern and Cooper, 2011).

The extent to which annual or seasonal rainfall vary over time and place is an important aspect of water availability. It is an important indicator of climate change with implications for both policy and livelihood activities. Rainfall variability takes two forms, namely; areal and temporal (Ngetich et al., 2014). However, in most climatological characterisation of weather dynamics and modelling, temporal variability (rain event occurrence frequency and intensity) is the most useful means for in-depth understanding of climate change at a local scale (Ayanlade et al.,

2018). As the availability of water is a major phenomenon related to rainfall with direct impacts on food-crop production, it has continued to attract a bulk of agro-climate related inquiries. These inquiries attempt to demonstrate the importance of rainfall in annual water supply, plant growth, crop and livestock production. See for example, Agnew and Chappell (1999); Barbé et al (2002); Seleshi and Zanke (2004); Ngetich et al (2014); and Asfaw et al (2018). As Feng et al (2013) argues, examining the dynamics of rainfall parameters in the context of changing climate is vital not only for understanding its impacts on livelihoods - particularly in countries where rainfed agriculture is predominant, but also for evidence-based adaptation strategies formulation.

As evidence seems to suggest, changes and variations in the rainfall variables over the 36-year period examined are clear in both areas studied; from annual rainfall, through to actual number of wet days and dry days, to dry spells. Generally, change and variability appear to be greater in Kabwe than Livingstone for annual rainfall, number of rainy days and rain season duration. However, this change, which is generally a reduction trend (except for dry days and dry spells) occurred in both agro-ecological zones. Wet days were increasingly getting fewer in Kabwe, including the duration of rainy season. The beginning of the season shows some delays of about seven weeks, while cessation shift suggests it is coming earlier than before. In Livingstone however, although both onset and cessation show variations from year-to-year, the rainy season duration seem not to have changed much as both onset and cessation are generally within two-four weeks range of delay. As evidence suggests, cessation period has not changed much as it was ending one weak early by 2016. However, the length or duration of the rainy season was still relatively shorter in Livingstone than in Kabwe as cessation in Kabwe continues to come slightly later than in Livingstone. Nonetheless, Kabwe generally still received more rainfall except for 2016, implying that rainfall intensity in the area was still higher than in Livingstone, and thus, the potential for flooding occurrence (if the trend continues) is more likely in Kabwe

than in Livingstone. However, given that there were less intra-seasonal anomalies that occurred in Kabwe with fewer dry spells, rainfall was still relatively more reliable than in Livingstone.

6.5.3 Economy, agriculture and food security

As presented in Chapter 2, agriculture accounts for 18-20 percent of the country's gross domestic product, employs approximately two-thirds of the country's labour force, and is a key source of livelihoods for about 80 percent of the country's population who depend on rainfall (UNDP and GRZ, 2010). However, the ability of the agricultural sector to cope with increases in temperature and potential reductions in rainfall is negligible given low levels of investment, land degradation, limited access to agricultural inputs and market.

As food-crop and livestock production are largely dependent on rainfall, high rainfall variability and limited irrigation capacity potentially make them vulnerable to climate change. Any increase in frequency of drought and shorter rainy seasons is likely to result in the increase in crop failure, which may trigger food shortages and malnutrition. High frequency of drought may also degrade grazing land and lead to loss of livestock, with negative consequences for food security and overall household capital. As evince suggests, if variabilities and anomalies continue with the same trend as evidenced in this investigation, rainfed agriculture is likely to be much riskier in the future, especially in Livingstone. The growing season may get shorter and the wet days fewer resulting in many or long dry-spells and droughts. Droughts have an impact on soil moisture and general water availability. Even if drought-tolerant crop varieties were introduced, water is still a critical factor for sustaining crop productivity.

In this regard, inter-seasonal or seasonal rainfall variability can significantly affect plant-available water and increase crop production risks such as low yields from crop failure (HarvestChoice, 2010). Similarly, floods can have devastating impacts on crop yields and livestock production. Too much rainfall damages crops and greatly impacts yields due to flooding. However, the extent of the damage varies from crop to crop and between varieties, its

growth stage, the duration of flooding, and temperatures during flooding (Butzen, 1996). For example, one-two week-old maize plants may die if submerged in water for more than five days in warmer weather conditions. If ambient temperatures are above 26^{o}C daily mean, death may result in only two-four days due to increased metabolism processes as the demand for oxygen supply to the root system is high (HarvestChoice, 2010). Soil nitrogen is also lost during flooding and can severely limit yields. Yield losses due to flooding is most substantial immediately before and during tasselling or silking (Nielsen, 2003). After the fifth-seventh week stage, maize plants can tolerate water submergence for more than eight days but may experience limitations in root development. This makes it more susceptible to stem and root diseases. Recorded effects of past floods on agriculture include inundation of farmland, soil erosion, reduced cultivatable land, and loss of livestock (CGIAR, 2017). Generally, these changes and variability in rainfall are likely to have a greater impact on poor smallholder farmers relying entirely on rainfed agriculture. With these changes, farmers are likely to experience hardship as food crop production is likely to become more difficult.

6.5.4 Environment and public health

Climate change and variability is already impacting on public health in Zambia (Kasali, 2008). Warmer temperatures, droughts, and floods are likely to exacerbate current impacts of climate-sensitive diseases that have persistently increased mortality and morbidity rates in Zambia. These are diarrhoea, cholera, respiratory infections, and malaria. Malaria has the highest rate of incidence with temperature increase and stagnant water from flooding (Caminade et al., 2014). In the event of increases in rainfall, floods and rising temperatures - both of which facilitate mosquito breeding, the spread of malaria is likely to increase in Zambia. Increases and changes in geographic coverage and survival of mosquito populations may expose more people, including some that may not have been previously exposed to the disease. A recent study on water-borne related illnesses in Lusaka by the Centre for Disease Control and Prevention, found that outbreaks were strongly associated with the quantity of precipitation: increase in

precipitation was positively linked to higher occurrences of cholera (CDC, 2018). Poor drainage systems, solid waste-contaminated water, and lack of adequate access to potable water also contribute to waterborne outbreak frequency. Non-climate stresses, such as inadequate health care facilities and health providers, high poverty levels, poor water supply and sanitation, food insecurity, and poor nutrition, exacerbate the impacts of climate change on public health. Similarly, the country's high rate of HIV/AIDS with infection rates now standing at 12 percent (CSO, 2015) is likely to place further strain on individual health and livelihoods. The provision of public health services, the demand for food and nutrition are related as the disease raises the nutritional and dietary requirements of those affected (CDC, 2018).

6.5.5 Water resources and other ecosystems

Total annual rainfall yields surface water estimated at 100 km^3 $year^{-1}$ of which only half is an estimated annual renewable groundwater potential (MEWD, 2010). Ground water storage estimate is below 12300km^3 (MacDonald et al., 2012). Surface water is unevenly distributed with just under half of freshwater in Southern Africa passing through Zambia. Of Zambia's total area estimated at 752618 km^2, only about 9220km^2 or 1.23 percent is water (FAO, 2005). With climate change and variability evidenced in this chapter, reduction in both surface and ground water is expected. The impacts of droughts for instance are likely to be severe in the southern part of the country where water shortages have always been experienced (ZARI, 2008). During drought periods emanating from declines in amount of precipitation, reductions in the flow and volume of rivers, streams, and lakes have been experienced. This has almost always impacted hydroelectric power generation (Sladoje, 2016). Accessibility and availability of surface water and groundwater for drinking, fisheries and related livelihoods such as agriculture and livestock rearing have also been affected (MEWD, 2010). Furthermore, with the rising ambient temperatures shown to be at the rate of about 0.29°C $decade^{-1}$ (McSweeney et al., 2010) , evapotranspiration rates - transfer of water from the earth's surface into the atmosphere are likely to increase. Similarly, in view of rainfall intensity which seems to be increasing in Central

Zambia, flooding events are likely to be frequent. Flooding has potential to increase siltation and contaminate freshwater bodies from washed off chemicals e.g., fertilizers and insecticides used in crop-production. This could exacerbate health and sanitation problems.

In this regard, I posit that no natural resource is likely to prove more critical to human health and well-being than water. Yet, even when there is enough evidence that the condition of water resources in Zambia are already deteriorating due to increased demand and climate change (MEWD, 2010), institutions responsible for managing these resources appear to have limited capacity. While some form of legislation is in place to regulate water and associated natural resources, it lacks harmonisation across sectors. For this reason, the implementation of contradictory legislation has been chaotic.

6.6 Summary and conclusion

This chapter investigated the extent to which climatic conditions have changed or varied over the 36-year period of analysis and compared the changes or variations observed between agro-ecological zones. The chapter also assessed and compared inter-zonal livelihood vulnerability using the IPCC-AR4 framework. It is concluded that trends in rainfall, droughts and environmental degradation between zones are comparable. While the number of droughts show an increase as rainy season and amount of rainfall reduced in both areas, AEZ I appears to be the most affected by these changes. However, while evidence suggests that AEZ IIa received relatively high rainfall, the year-on-year rate of reduction appears to be more than what was observed in AEZ I. Nevertheless, the number of droughts is still lower in AEZ IIa than in AEZ I though climatically, there is no significance in the difference between the zones. This suggests that while respondents attribute the environment as a cause of their migration (see chapter 8) – they are essentially migrating to a region that has the same climatic variability. Therefore, these movements suggest that anthropogenic induced environmental factors are contributing to their decision to move, particularly fertile land.

With regards to vulnerability in the IPCC-AR4 context, it is concluded that both zones are vulnerable. Factors shaping vulnerability are degraded environmental conditions, lack of water, electricity, and natural disaster warnings and/or preparedness. However, when evidence is compared between zones, it is further concluded that AEZ I is more vulnerable than AEZ IIa. This is probably due to the long historical land degradation from farming extension emanating from the green revolution highlighted in Chapter 2. Rural farmers continue to view deforestation as part of agriculture extension. It is concluded that vulnerability of rural communities and their socio-economic struggles in both zones are characterized by political ecology - weak environmental protection, resource use dynamics, inequalities in the distribution of socio-economic benefits, market failure and access problems. And as highlighted in Chapter 2, these challenges have been so strongly propagated across various political regimes by elite-centric political institutions that they still exhibit a strong signature in vulnerability differentials and adaptive capacity.

Finally, because LVI-IPCC method aggregates data into an overall index which may not reflect subtle variations in the populations within an area, the next chapter considers these compendia of categories such as gender, age, household size, education level, migration status and geo-political location. These variations are a complex reality that are oversimplified in form of composite indices as sub-components are averaged into one major component score, without incorporating variance between study populations or categories (Vincent, 2007). Thus, the SLF method applied in the next chapter improves this power of analysis with focus on categories e.g., gender and power relations (Morse and McNamara, 2013) and how vulnerability of households and/or their livelihoods are shaped and affected by capital structure and external factors (Antwi-Agyei et al., 2012; 2014; Hua et al., 2017)

CHAPTER 7: LINKING LIVELIHOOD ACTIVITIES AND VULNERABILITY TO ENVIRONMENTAL CHANGE

"The economy is a wholly owned subsidiary of the environment, not the reverse." Herman E. Daly (2007, p.19).

7.1 Introduction

This chapter narrows down the zonal/regional level vulnerability assessment presented in Chapter 6 to the household level. The analysis is focussed on livelihood activities and capital endowments as represented by socio-economic profiles. Using these profiles, comparisons of the levels of vulnerability have made between and within agro-ecological zones. Furthermore, linkages between environmental change, livelihood activities and impacts analysis are investigated. The analytical approach draws strength from the DPSIR-Framework (i.e., *Driving Factors*, *Pressures*, *State-change* and associated *Impacts* for possible *Policy Response* (Bell, 2012). This facilitates an in-depth understanding of the internal factors that might shape adaptive capacity to environmental change. As consensus ties adaptive capacity to livelihood capital, including information technology, infrastructure, institutions and entitlements (IPCC, 2014a), the value of the research in this chapter lies in its potential to bring out the variance in socio-demographics that eludes the LVI-IPCC approach utilised in Chapter 6. Furthermore, adaptive capacity, resource access, land rights, food security, power relations, and land reforms are often framed apolitically or are simply absent from environmental change adaptation agendas (Collins, 2010; Taylor, 2014). By combining degradation and marginalisation with some aspects of political objects and actors thesis conceptualisation of political ecology (shown in Table 3.2, of Chapter 3), this chapter examines livelihood capital across socio-demographics.

Given the climatic stressors revealed in Chapter 6, understanding vulnerability based on socio-demographics is important. For example, how livelihood activities impact on the environment, and the environment on livelihood. To address these questions and ascertain levels of vulnerability including adaptive capacity potential, the research approach drew methods and tools from the Sustainable Livelihood Approach (SLA). Conceptualized as a holistic capital-

asset-based approach (Ellis, 2000; Adger, 2003; Osbahr et al., 2010; Nielsen et al., 2014; Hua et al., 2017), SLA application ascertained levels of households vulnerability. As a theory, SLA was derived from systems thinking of the 1960s in relation to agricultural ecosystems analysis (see section 3.7.1 of Chapter 3). International development praxis in alleviation and intervention projects targeted at the economically disadvantaged societies continues to draw impetus from the SLA (Scoones, 1998; Morse and McNamara, 2013; USAID, 2014).

Figure 7.1 shows a simple interpretation of the region-by-region generic livelihood activities in Zambia, demonstrating broad reliance on primary resources within agriculture and mining. Agriculture is well entrenched as the key livelihood activity in the two agro-ecological zones of this project.

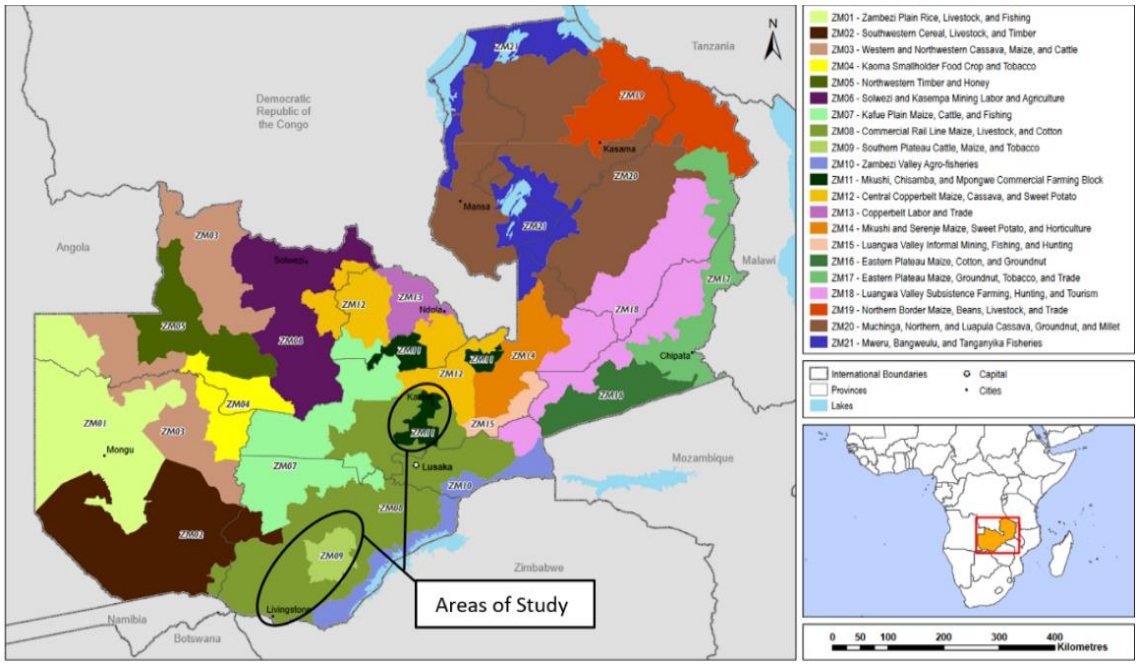


Figure 7.1: Generic livelihood activities in Zambia (USAID, 2014)

7.2 Livelihood activity-profiling in the migration source area (Southern Province)

7.1.1 Current livelihood activities

Table 7.1 shows a summary of the current activities in the seasonal calendar based on household interview information.

Table 7.1: Summary of Livelihood Activities: Seasonal calendar in source areas based on interviews

DESCRIPTION	SEASONALITY (Calendar Month)											
SEASONAL LIVELIHOOD ACTIVITIES	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain season												
Dry Season												
Peak (Lean Season)												
CROPPING												
Land preps												
Planting												
Weeding												
Green Harvest												
Harvesting/shelling												
Tobbaco Curing												
LIVESTOCK												
Grazing												
Calving												
Milking												
HAZARDS												
Livestock disease outbreaks												
Crop/pest/disease outbreaks												
NATURAL RESOURCE HARVESTING												
Firewood collection/ sales												
Wild fruits harvesting												
Honey Harvesting												
OTHER												
Piecework												
Business												

7.1.2 Agriculture: food-crop production

The analysis of interview data shows that food-crop cultivation is labour intensive. In migration source areas, land preparation takes five-six months from June to November. Actual planting starts in November subject to onset of rainfall. Due to onset variability (see Chapter 6), planting activities take two-three month during which farmers plant three-four times to avoid crop failure in an event of a prolonged dry-spell. As evidence suggests, the main food crop grown is maize. However sweet potatoes and peanuts are also grown. Sunflower, and to a lesser extent cotton and tobacco are the main cash-crops. Weeding takes three months from December to February

and is often dependent on rainfall onset and conditions of farmland. Farmers who apply animal manure were found to encounter a relatively longer weeding period than those who do not.



Figure 7.2: Land preparations and animal manure to be spread before ploughing (2017)

During good crop-years, harvesting, drying, shelling and packaging of produce occur over four and half months from mid-April to August. Households that grow cash-crops such as tobacco, sunflower and cotton were found to spend additional time on harvesting, curing and treating of produces.

7.1.3 Herding and livestock production

Overall, Southern Province still leads other provinces in Zambia in both livestock and poultry rearing (see Table 2.2 in Chapter 2). Table 7.2 below shows livestock estimates based on survey data. Rearing cattle has been cultural with a greater role in livelihoods. Findings reveal that it is still considered as a symbol of great wealth: a source of draft power, milk and income including bride-price. By cultural connotation, households without cattle are considered very poor in Southern Province.

Table 7.2: Livestock population estimates in Southern Province

No. of Cattle Per H/H (Large Livestock)[a]					No. of Goats Per H/H (Small Livestock)[a]		
Range		Freq	Percent	Catttle Popn. Estimates	Freq	Percent	Goat Popn Estimates
Valid	1-5	1	3.3	5	0	0.0	0
	6-10	4	13.3	40	0	0.0	0
	11-15	4	13.3	60	0	0.0	0
	16-20	3	10.0	60	0	0.0	0
	21-25	4	13.3	100	0	0.0	0
	26-30	5	16.7	150	0	0.0	0
	31-35	3	10.0	105	4	13.3	140
	36-40	3	10.0	120	4	13.3	160
	41-45	0	0.0	0	6	20.0	270
	46-50	0	0.0	0	6	20.0	300
	51-55	1	3.3	55	3	10.0	165
	56-60	2	6.7	120	3	10.0	180
	61-65	0	0.0	0	3	10.0	195
	66-70	0	0.0	0	1	3.3	70
	Total	**30**	**100.0**	**815 (36%)**	**30**	**100.0**	**1480 (64%)**
a. Current Location = Southern Province (study area only)							



Figure 7.3: Animal rearing in southern Zambia: a symbol of great wealth and utility (2017)

Table 7.3: Poultry population estimates in Southern Province

No. of Poultry Per H/H (Chicken)[a]					No. of Poultry Per H/H (Guinea-fowls)[a]		
Range		Freq	Percent	Chicken Popn. Estimates	Freq	Percent	Guinea-fowl Popn. Estimates
Valid	1-5	10	33.3	50	0	0.0	0
	6-10	14	46.7	140	0	0.0	0
	11-15	3	10.0	45	0	0.0	0
	16-20	2	6.7	40	0	0.0	0
	26-30	1	3.3	30	0	0.0	0
	31-35	0	0.0	0	11	36.7	385
	36-40	0	0.0	0	4	13.3	160
	41-45	0	0.0	0	0	0.0	0
	46-50	0	0.0	0	4	13.3	200
	51-55	0	0.0	0	4	13.3	220
	56-60	0	0.0	0	1	3.3	60
	61-65	0	0.0	0	1	3.3	65
	66-70	0	0.0	0	1	3.3	70
	71-75	0	0.0	0	0	0.0	0
	76-80	0	0.0	0	1	3.3	80
	91-95	0	0.0	0	1	3.3	95
	96-100	0	0.0	0	2	6.7	200
	Total	**30**	**100.0**	**305 (17%)**	**30**	**100.0**	**1535 (83%)**
a. Current Location = Southern Province (study area only)							

While Southern Province may still be experiencing the long-term impacts of green revolution, the local people seemed to have adapted to environmental change. Apart from the continued cattle rearing for draft power and cultural pride, they are shifting toward the more drought and disease-resistant livestock such as goats, and poultry such as guinea fowls. Table 7.3 shows the

poultry population estimates based on survey data. Poultry is dominated by guineafowl and chickens, but guineafowls constitutes the largest number to as much as 100 per household.

Due to cultivation in the rain season, animal grazing is controlled for about 8 months from November to July/August dependent on how long harvesting and shelling activities take. After this period, livestock is no longer under controlled grazing and cattle travel long distances (up to 70 km) dependent on the availability of water and vegetation for grazing. Cattle's where-about was found to be generally unknown for months by owners, but this is not something they regard as a problem since herds were rarely stolen. With the changing climatic conditions resulting in frequent droughts as demonstrated in Chapter 6, which potentially results in poor pasture conditions, livestock rearing difficulty can be expected in these communities in the future. Similarly, as the assembled evidence seems to suggest, livestock diseases such as swine-fever, foot and mouth, including bird-flu are frequent during rainy season, making it difficult for farmers to utilise ox-draft power. For this reason, and as a way of adaptation, livestock rearing seems to be largely diversified from cattle to goats. Goats are considered more resistant to animal-diseases and as such, their numbers are higher per household. They were also found to be the most frequently sold animals with proceeds directed toward the acquisition of farming inputs. Food crop attacks from grain-borers and armyworms are common. As shown in Figure 7.4, armyworms are frequent during rainy season.



Figure 7.4: Armyworms infested maize field in both source and destination areas (2016-2017)

7.1.4 Natural resource harvesting

As survey results show, natural resources gathering is dominated by wild-fruits and firewood collection. Both activities are carried out by women and girls. Other than firewood, timber and twig branches have many applications in construction and fencing around household yards and farmlands. Construction and fencing are activities for men and boys. Honey-harvesting occurs just before the cold season (around mid-May) and later in the year in October and November. Wild fruits gathered throughout the year are numerous and of different types. As shown in Figure 7.5, picking mushroom was found to be among the dominant natural resource-gathering activities during the rainy season. However, as all the studied households were found to have no access to electricity, firewood collection and charcoal making are core community activities. Sometimes these activities include clearing forest to claim land for agricultural purposes.



Figure 7.5: Natural resource harvesting in both source and destination areas (2017: Cephas M., CFU)

7.1.5 Other activities

With commercial farms around Choma and Kalomo, households in these districts usually engage in piecework at nearby farms throughout the year. Works include weeding, applying fertilizer, gardening and herding cattle. Other households engage in various businesses, especially the selling of goats. Dealers buy goats locally and cover long distances to as far as Democratic Republic of the Congo (DRC) where a goat can sell three-four times its cost price in southern Zambia. Petty trade and make-shift shops are also common and often locate near main roads to increase sales due to travellers. Products sold are simple groceries such as matches,

sugar, salt, candles, radio batteries, paraffin, washing and laundry soaps. Fresh maize and roasted goat-meat are also sold by highways and during communal gatherings.

7.3 Livelihood activity-profiling in the destination area (Central Province)

7.3.1 Current livelihood activities

Findings show little livelihood activity differences between Southern and Central provinces. What differs is the amount of time allocated for activities. A summary of the current activities in the seasonal calendar based on household interviews has been summarised in Table 7.4. As evidence suggests, fishing, charcoal making, firewood collection and other natural resource-gathering activities (e.g., wild-fruit harvesting) occur throughout the year. Other notable throughout-the-year activities include piecework, usually at nearby commercial farms.

Table 7.4: Summary of livelihood activities: Seasonal calendar in destination areas based on interviews

DESCRIPTION	SEASONALITY (Calendar Month)											
SEASONAL LIVELIHOOD ACTIVITIES	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain season												
Dry Season												
Peak (Lean Season)												
CROPPING												
Land preps												
Planting												
Weeding												
Green Harvest												
Harvesting/shelling												
LIVESTOCK												
Grazing												
Calving/kidding												
Milking												
HAZARDS												
Crop/pest/disease outbreaks												
NATURAL RESOURCE HARVESTING												
Firewood/Charcoal burning/sales												
Wild fruits harvesting												
Caterpillar harvesting												
Fishing												
Honey Harvesting												
OTHER												
Piecework												
Business												

7.3.2 Agriculture: crop-production

Like other provinces, except the Copperbelt (UNDP and GRZ, 2010), food-crop production still constitutes to be the main livelihood activity in Central Province and maize is the main food-

crop grown by both commercial and small-scale farmers. Sun-hemp, Virginia and burley tobacco are also grown. Cotton and confectionery peanuts were common among smallholder farmers. As shown in Table 7.4, land preparation only lasts three months from September to December and relatively less laborious than in Southern Province, where it occurs over a five-month period each year. Actual planting lasts two months from November to December. However, weeding was found to be as laborious as in Southern Province and took three months from December to February. Green harvesting starts in mid-February to the end of April while dry harvesting, curing and shelling starts at the end of May and lasts till August as shown in Table 7.4 above.



Figure 7.6: Maize harvest ready for sale; and cattle rearing in Chibwe Village, Mukonchi (2016)

7.3.3 Herding and livestock production

Like Southern, Central Province livestock constitutes cattle and goats. The livestock population survey estimates are shown in Table 7.5

Table 7.5: Livestock populations estimates in Central Province based on survey data

No. of Cattle Per H/H(Large Livestock)[a]					No. of Goats per H/H (Samll Livestock)[a]		
	Range	Freq	Percent	Catttle Popn. Estimates	Freq	Percent	Goat Popn Estimates
Valid	0	7	10.0	33	4	5.7	0
	1-5	18	25.7	392	12	17.1	60
	6-10	15	21.4	1959	24	34.3	240
	11-15	8	11.4	1543	14	20.0	210
	16-20	2	2.9	349	3	4.3	60
	21-25	12	17.1	914	7	10.0	175
	26-30	2	2.9	410	3	4.3	90
	31-35	2	2.9	429	3	4.3	105
	41-45	4	5.7	180	0	0.0	0
	Total	**70**	**100.0**	**1010 (52%)**	**70**	**100.0**	**940 (48%)**
a. Current Location = Central Province (study area only)							

Based on perception of respondents, findings also suggest that there is less occurrence of animal diseases in Central Province compared to Southern Province. However, stealing of livestock was found to be common in Central Province, making farmers spend one or two-months longer in cattle grazing monitoring than their counterparts in Southern Province. While sheep and pigs are reared, cattle constitute the largest population numbers of livestock of up to 45 per household. Similarly, while birds such as pigeons were occasionally found among respondents, guineafowls and chicken constituted the largest percentage of the poultry population. From survey data, Table 7.6 shows population estimates of dominant poultry.

Table 7.6: Poultry population estimates in Central Province based on survey data

No. of Poultry Per H/H (Chickens)[a]					No of Poultry Per H/H (Guinea-fowls)[a]		
Range		Freq	Percent	Chicken Popn. Estimates	Freq	Percent	Guinea-fowl Popn. Estimates
Valid	0	7	10.0	0	29	41.4	7
	1-5	22	31.4	110	25	35.7	22
	6-10	16	22.9	160	3	4.3	16
	11-15	9	12.9	135	5	7.1	9
	16-20	10	14.3	200	5	7.1	10
	21-25	6	8.6	150	2	2.9	6
	71-75	0	0.0	0	1	1.4	0
	Total	**70**	**100.0**	**1210 (62%)**	**70**	**100.0**	**455 (38%)**
a. Current Location = Central Province (study area only)							

7.3.4 Natural resources harvesting and charcoal production

Natural resources gathering in Central Province is throughout the year with firewood collection and charcoal-burning being the main activities. Findings reveal large deforested land parcels which may be attributed to both agricultural-related activities and charcoal making. At a much larger scale, commercial farmers especially in the north and north-north-east of the study area have cleared much larger portions of forest for agricultural production. This is discussed later in this chapter.



Figure 7.7: Large trees freshly cut-down for charcoal making in Chibwe Village, Kabwe (2016)

Charcoal is transported on bicycles or oxcarts to the local urban market in town or sold by highways as shown in Figure 7.8. On average, a charcoal trader sells between 1000-3500kg of charcoal per month at about US$10 per 50kg bag. Traders mainly target motorists by the highway where the price can be 25-30 percent higher than the local urban market value.



Figure 7.8: Charcoal sales by highway in Kabwe, and transportation to other towns (2016)

Unlike selling from the designated urban market, traders by highways have additional advantages in that they do not have to obtain trade permits, thereby cutting down on taxes payable to local council authority. Although charcoal trading without permit is illegal, traders do it anyway as enforcement is difficult and complicated. Other than local councils and the Department of Forestry (DoF), local chiefs also have powers to allow people encroach forests for firewood or settlement. In this regard, it is difficult for the enforcement institutions to judge whether the charcoal being sold is from the national reserved forest or from a local forest sanctioned by the local chief. In addition, both the local authorities and the DoF often have inadequate resources to conduct extended monitoring and policing activities. What they prosecute through local courts are intercepted charcoal-loaded trucks in transit on highways

without clear documentation. If found guilty, conviction penalties can reach US$1,500, a five-year jail sentence or both.

As in Southern Province, various fruits are also harvested throughout the year in Central Province and trading in some of these was observed during fieldwork. Mopane worms or caterpillars (*Isoberlinia paniculate* and *Gonimbrasia belina*) locally known as *vinkubala* are harvested all year round except between May and July. Vinkubala are usually harvested by women and children and have been endorsed locally by nutritionists as a source of cheap protein (Ghaly, 2009; Editorial, 2014). However, due to commercial farming expansion and clearing of trees in Mukonchi farm-block, harvest has been dwindling. Harvesters are increasingly covering long distances in search of vinkubala. The harvesting process is also complex as the caterpillars usually locate on leaves and barks of trees, making it a laborious task which calls for concerted efforts from family members. Families leave for harvesting in early mornings and return in the evenings. In peak periods around January and February, school turn-out can be very low as children accompany adults to maximise harvesting to sell surplus harvest for books and other related school requisites (Editorial, 2014).



Figure 7.9: Honey from wild and 'domesticated' bees on sale by highway in Kabwe (2017)

Honey, and bee-wax are also harvested throughout the year except between May and June when bees do not produce enough honey amidst cold-weather conditions. Findings show that extra honey is sold on highways in 2.5 litre containers while wax is sold to clothing factories where it is used in linen-colouring processes. Training and instruction in beekeeping has been conducted in both southern and central provinces by the DoF and Civil Society Organisations (CSOs) at

community grassroots level through donor aided programmes. While beekeeping in Kabwe had far-reaching environmental and economic positive impacts initially including great benefits toward protecting forests and wild bees while generating income, poaching for honey and wax has been a constraint. Each time people find a beehive, they extract the honey and wax from it. But because bees often locate their nests high in tall and hard to climb trees, poachers often resort to either cutting down host trees to reach hives or light-up fire at the base of the tree to smoke out the bees. This practice kills both bees and trees. Given the deforestation rates, it is increasingly becoming unlikely that beekeeping would continue in Central Province. Similarly, caterpillar harvesting often lead to cutting-down host tress to reach them. However, as evidence suggests, harvesters are already travelling long distances in search of caterpillars and may soon be unable to harvest.

7.3.5 Fishing

Fishing in Central Province is common given there are perennial local streams -Mulungushi and Lusemfwa rivers. Both streams and Lukanga swamps feed the Kafue River which drains southwards to join the Zambezi River. Despite government annual fishing restrictions from December to March to allow spawning, local people continue to fish as was witnessed during field survey in December (Figure 7.10). Fishing is conducted throughout the year in Kabwe. Common fish species are tilapia, tiger and barbel. As an activity, fishing is mainly for consumption although surplus is sold locally.



Figure 7.10: Fishing in Kabwe (2016 & 2017: credit (Davis Mulenga & Kelvin Chisanga)

7.3.6 Other activities

Evidence suggests that piecework at nearby commercial farms has been an important source of supplementary income for both Chikonkomene and Chibwe villagers in Kabwe. Type of work varies dependent on the period of the year. Findings show that planting and fertiliser application - basal and top dressing for maize-crop is usually done between December and January. From mid-February to April, picking and harvesting proceeds after which shelling, weighing and packaging follow.



Figure 7.11: Local people providing labour at local commercial farms in Kabwe (2017)

Planting and fertilizer application activities are dominated by men while women dominate the shelling and packaging activities. Harvesting was the only activity conducted by both sexes. Payment was found to be based on the amount of work done, and not based on the time spent on the activity.

7.4 Vulnerability in the context of sustainable livelihoods framework

Household capital endowment can be influenced by many variables (Lapeyre, 2013). In this research however, only area of location, migration status, location, gender, level of education, household size and age constituted the main factors assessed. The findings on how each of these variables influenced household capital are outlined and discussed below.

From the same procedure for calculating the LVI in Chapter 6, vulnerability assessment in the context of household capital endowment was done using equations (2 - 4) shown in Chapter 4 for the 22 sub-components under the five major component of livelihood capital assets. The

interest was to understand in depth, differentials that cannot be obtained through the generic LVI approach. The results were compared between and within specific categories.

7.4.1 Locational differences

Figure 7.12 shows results from capital endowment comparison between villages, within and between zones. See also Appendix A4.

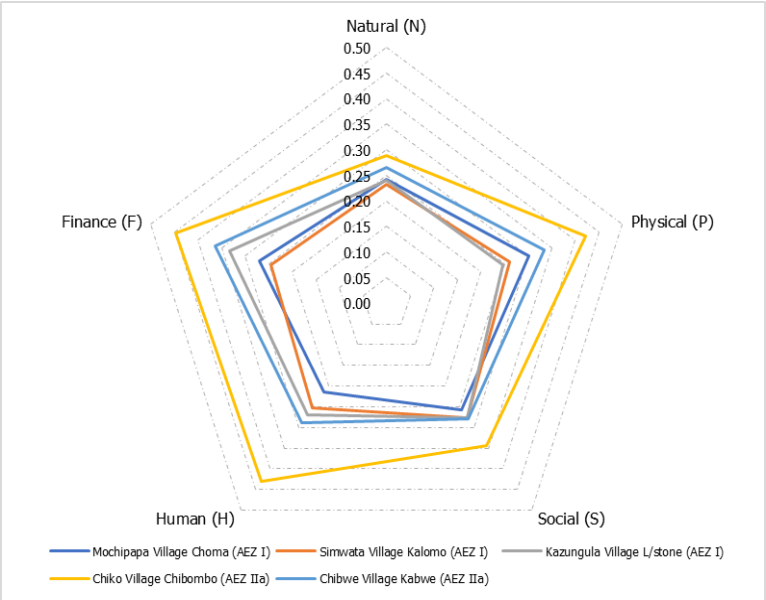


Figure 7.12: Capital structure: comparisons by village

Disparities in capital strength between villages, within and between zones are observable among households. As shown in Figure 7.12, Chikonkomene Village households followed by Chibwe Village (both in AEZ IIa) possess a relatively stronger capital base in all the five major components of household capital. At third position is Livingstone in AEZ I while Kalomo posted the weakest household capital structure. Of the capital five types, natural capital was the weakest in both study zones. Capital strength for financial, social, physical and human varied greatly between zones and villages.

7.4.2 Gender

Capital endowment comparison results based on gender within and between zones are displayed in Figure 7.13 and in Appendix A5. As can be seen from the results shown in Figure 7.13,

capital endowment for female-headed households is generally less than that of male-headed households in AEZ IIa. Similarly, findings show that male-headed households in AEZ I have a stronger capital endowment when compared to their female counterparts in the zone.

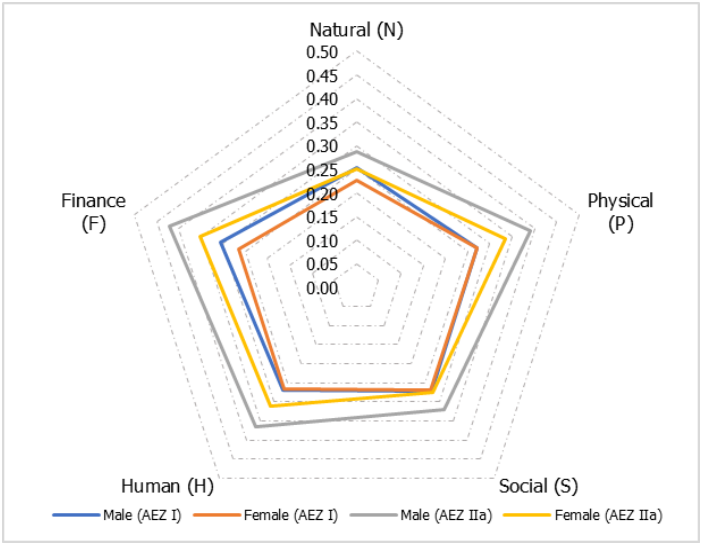


Figure 7.13: Capital structure: comparisons by gender between and within areas

Nevertheless, when male-headed household in AEZ I are compared with female-headed households in AEZ IIa, results that show that female-headed households possess stronger capital than male-headed households in AEZ I.

7.4.3 Level of formal education attainment

Capital structure based on level of formal education was found to be contrary to what was premised. The underlying factors confounding the significance of the formal education variable is not clear in this case, perhaps given the sample size differentials in the categories. However, based on the results, what is clear is that households with people of no formal education posted comparable capital strength scores to that of those with tertiary level education. In terms of specific capital assets, their financial capital is slightly stronger than those with primary and secondary-level education. They also have the highest index for both human and natural capital. Figure 7.14 below shows the results (see also Appendix A6).

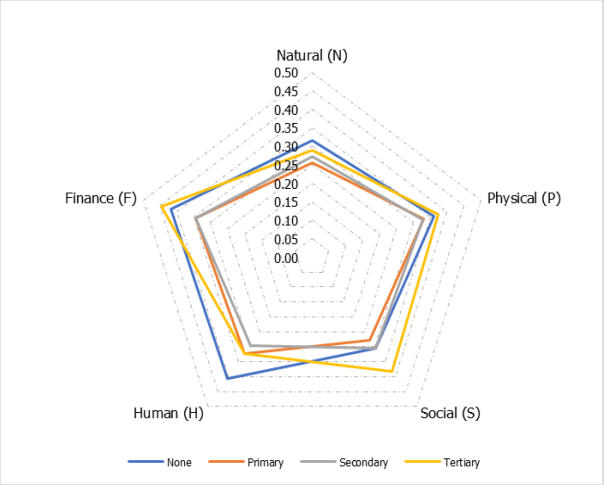


Figure 7.14: Capital structure: comparisons by level of education

However, further investigations revealed that all the households headed by people with no none-formal education educated households occupy some of the largest land sizes, ranked locally as prime land with 'good quality soils' with potential to influence natural capital score. As locals or indigenous people, owners rent out part of their land to migrants which may explain why they also posted a strong financial capital despite their lack of formal education training. They may have been able to raise financial capital from land rent income.

7.4.4 Age

The categorisation of age into age-groups of youth, middle age and old can be problematic. However, the UNESCO definition is useful in this regard as a guide without bias or prejudice to member state definitions. The lowest level consists of six broad population groups -comparable to infancy, youth, young adulthood, middle adulthood, older adulthood to average retirement and retirement (under 1, 1-14, 15-24, 25-44, 45-64 and 65 and over respectively (UN, 1982) However, UNESCO also recognises the different definitions of "youth" that can be used regionally or by particular member state. For example, the African Youth Charter definition of youths includes every person between the ages of 15 and 35 years (UNESCO, 2017). In this regard, the African Charter definition is adopted in this thesis given that most under 25s would still be residing in their parents' homes or are at college with little asset ownership. The Zambian Government also recognises youths as those under the age of 35 the government

regards middle age as 36-54 and an early retirement age of 55 years, which here is regarded as 'old' (CSO, 2010; 2015). Results using this categorisation are shown in, Figure 7.15 and in Appendix A7.

Unlike the level of formal education variable, the role of age in capital assets accumulation is relatively clear in both zones. Except for human capital, evidence generally suggests that the older one was, the stronger the capital.

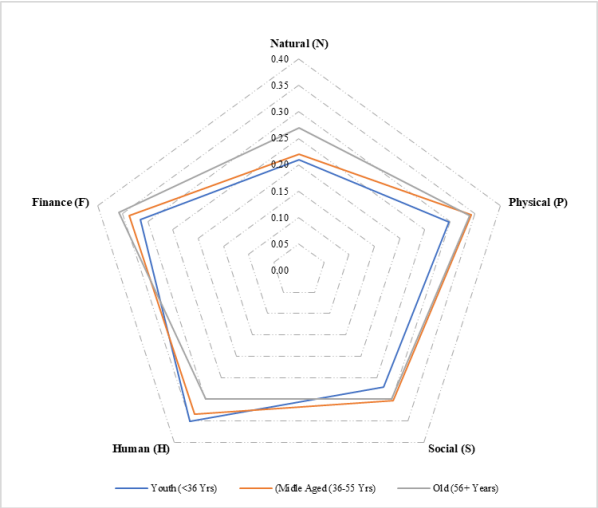


Figure 7.15: Capital structure: comparisons by age-group

The 'old-headed' households category exhibits a stronger natural and finance capital than the youth or middle-aged categories. Physical capital appears comparable between the middle-aged and old categories. In contrast, the youth-headed households show a weak capital structure except for human capital. Generally, the strength of all the five capital assets seems to increase with an increase in age, creating inter-age differentials except for human capital with appears to fall with increasing age. This is probably due to the health aspect as youth and middle-aged households reported few or no prolonged sickness conditions.

7.4.5 Migration status

On household capital endowment based on migration status categorisation in AEZ IIa, evidence seems to suggest that capital asset indices are generally stronger among migrant-headed

households than those headed by their indigenous counterparts. Figure 7.16 below shows the results, see also Appendix A8.

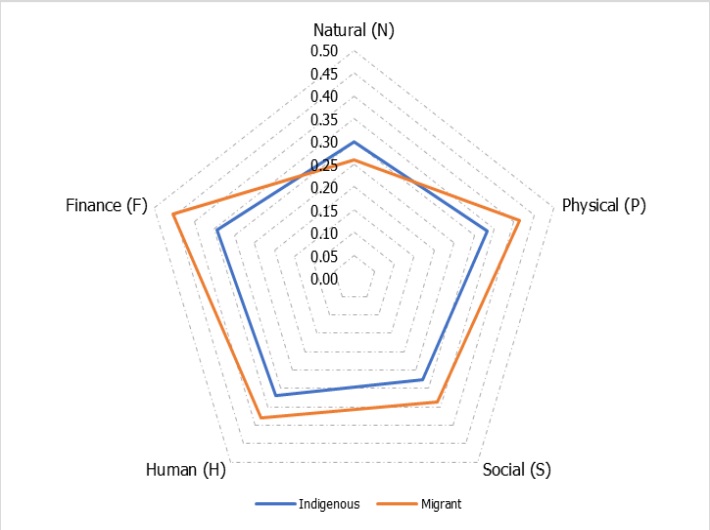


Figure 7.16: Capital structure: comparisons by migration status

Migrant-headed households have the strongest capital structure among all major capital components except for natural capital. The indigenous headed-households have the strongest natural capital. However, natural capital is the weakest of all major capital assets for both categories. However, underlying the natural capital asset or natural resource is the fact that as an environmental asset, it has a political dimension - access and control. In this regard, the migration status attribute reveals an inherent political ecology at play within the community. There are significant power relations and land tenure structures in environmental asset access, management and control between locals and immigrants. Locals own and occupy some of the finest land portions available, while immigrants occupy any other and can only access fine land portions through renting from the locals. To paraphrase Lewis' (1947) celebrated dictum : the locals' power over natural capital turns out to be a power exercised over immigrants, with natural capital as its instrument.

7.1.6 Household size

Average household size is calculated as the mean average number of people (adults and children) per household for households of a given type (OECD, 2016). There are substantial

differences across countries and within countries between rural and urban. In Zambia, the average was 5.3 in rural area and 5.1 in urban areas - last census data (CSO 2010). Based on this baseline and given the range of household average size in the data of 8.2, an average of five is interpreted as small-size household, while a range of six-ten and above ten as medium and large respectively. Based on this categorisation, Figure 7.17 shows the results (see also Appendix A9). Capital structure based on household size was found to be as premised. Generally, the larger the household size, the stronger its capital base appears to be. Larger households appear to possess the strongest capital overall. However, capital portfolio greatly varies in shape or structure. Conversely, small households exhibit the weakest capital overall. The reason for this is that larger households engaged in more activities and therefore able to spread and reduce risk through diversified income sources.

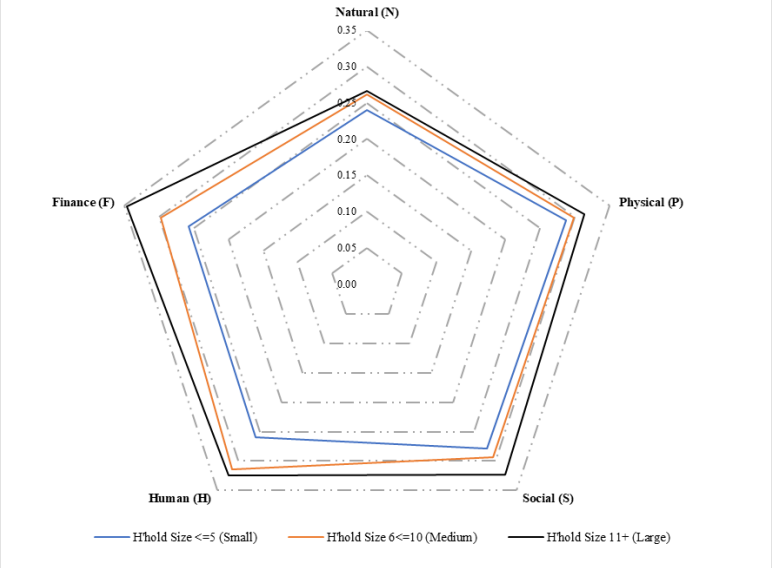


Figure 7.17: Capital structure: comparison by household size

7.5 Potential environmental impacts from activities in the context of the DPSIR-Framework

Human-environmental interactions are complex because ecosystems and human social systems have many structures and many connections among structures. Both systems may impact on

each other in complex ways through feedbacks (Adua, et al., 2016). To understand this complexity, it was important to be aware of specific characteristics of the human social systems. The type of society strongly influences people's attitude and behaviour towards the environment, and ultimately determines their impact on it. Important characteristics of human social systems include cultural values, knowledge, technology, population size, and organisation. Of these, cultural values and knowledge strongly influence a society's worldview, and how it identifies resources. Consequently this defines its livelihood activities and the likely impacts of the activities on the environment (Moshy et al., 2015). In this investigation, two main livelihood activities emerge: natural resources harvesting and agriculture.

7.5.1 Natural resources harvesting activities: firewood collection and charcoal making

Forestry-based natural resources harvesting is dominated primarily by firewood collection, wild fruits harvesting and mushroom picking. As secondary production, charcoal making from cut-down trees was also found to be among the prominent activities. These among other activities, could be responsible for deforestation in both migration source and destination areas. From the findings, all household studied in both areas and zones rely on local forests as the only source of energy in form of biomass. Harvested volumes per year vary considerably as disparities between and within areas are evident. Table 7.7 shows the average consumption rates per village. As results show, there is more firewood harvesting and consumption in destination than source area. 50 percent of households studied in Chibwe harvest between 6 -11 tonnes of firewood per annum. In Livingstone, evidence suggests that all respondents harvest and consume below 8 tonnes of firewood per annum. Similarly, within destination areas, findings reveal further disparities suggesting that there is more firewood harvesting in Chibwe than Chikonkomene village, and more harvesting in Kalomo than Livingstone. This has implications for environmental conditions from deforestation and land degradation.

Table 7.7: Mean firewood harvest and consumption rates per year in specific villages per household

Average amount of Firewood Consumption Rate: How much do you consume per year? ('000kgs)							
Area of Location	Firewood Consumption (tonnes per Year)	Frequency	Percent	Percent of indigenous	Precent of immigrant	No. of Male HH	No.of Female HH
Chibwe (Destination Area 1)	<or=2	1	2.5	0.0	100.0	0	1
	3-5	6	15.0	16.7	83.3	2	4
	6-8	10	25.0	30.0	70.0	8	2
	9-11	10	25.0	40.0	60.0	5	5
	12-14	8	20.0	50.0	50.0	6	2
	15-17	4	10.0	25.0	75.0	2	2
	18-20	1	2.5	0.0	100.0	1	0
	Sub-Total (A)	**40**	**100.0**			**24**	**16**
Chikonkomene (Destination Aea 2)	0	1	3.3	100.0	0.0	1	0
	<or=2	3	10.0	0.0	100.0	2	1
	3-5	13	43.3	15.4	76.9	11	2
	6-8	7	23.3	28.6	71.4	6	1
	9-11	5	16.7	20.0	80.0	3	2
	15-17	1	3.3	0.0	100.0	1	0
	Sub-Total (B)	**30**	**100.0**			**24**	**6**
Choma (Source Area 1)	<or=2	1	10.0	100.0	0.0	1	0
	3-5	3	30.0	100.0	0.0	1	2
	6-8	4	40.0	100.0	0.0	0	4
	9-11	2	20.0	100.0	0.0	1	1
	Sub-Total (C)	**10**	**100.0**			**3**	**7**
Kalomo (Source Area 2)	6-8	6	60.0	100.0	0.0	4	2
	9-11	3	30.0	100.0	0.0	1	2
	12-14	1	10.0	100.0	0.0	1	0
	Sub-Total (D)	**10**	**100.0**			**6**	**4**
L/stone (Source Area 3)	3-5	6	60.0	100.0	0.0	2	4
	6-8	4	40.0	100.0	0.0	2	2
	Sub-Total (E)	**10**	**100.0**			**4**	**6**
Grand Total (Sample)		**100**				**61**	**39**

Figure 7.18 shows an aerial view of the environmental impacts and extent of deforestation in Kabwe. As can be observed, trees have been cleared with evidence of ash from charcoal making and clearing for farmland.



Figure 7.18: Remnant ash from charcoal making and forest clearance for farmland in Kabwe (2016)

As shown in Table 7.8, disparities in the extent of involvement are evident along gender and migration status. Based on survey data summarised in Table 7.8, cutting down trees for firewood and charcoal making including selling, appears to be dominated by men, while within the male cohort, the indigenous appears to be more actively involved than their migrant counterparts.

Table 7.8: Mean charcoal consumption rates per year in specific villages per household

Average amount of charcoal Consumption Rate: How much do you consume per year? ('000kgs)							
Location of Location	**Charcoal Consumption (tonnes per Year)**	Frequency	Percent	Percent of indigenous	Precent of immigrant	No. of Male HH	No.of Female HH
Chibwe (Destination Area 1)	0	11	27.5	100.0	0.0	7	4
	<or=2	12	30.0	75.0	25.0	9	3
	3-5	10	25.0	60.0	40.0	6	4
	6-8	5	12.5	40.0	60.0	2	3
	9-11	1	2.5	100.0	0.0	0	1
	12-14	1	2.5	100.0	0.0	0	1
	Sub-Total (A)	**40**	100			**24**	**16**
Chikonkomene (Destination Aea 2)	0	13	43.3	92.3	7.7	12	1
	<or=2	3	10.0	100.0	0.0	2	1
	3-5	11	36.7	72.7	27.3	8	3
	6-8	1	3.3	100.0	0.0	0	1
	9-11	2	6.7	50.0	50.0	2	0
	Sub-Total (B)	**30**	100			**24**	**6**
Choma (Source Area 1)	0	8	80.0	100.0	0.0	2	6
	3-5	2	20.0	100.0	0.0	1	1
	Sub-Total (C)	**10**	100	100	0	**3**	**7**
Kalomo (Source Area 2)	**Sub-Total (D)**	**10**	100			**6**	**4**
L/stone (Source Area 3)	0	4	40.0	100.0	0.0	2	2
	<or=2	1	10.0	100.0	0.0	0	1
	3-5	4	40.0	100.0	0.0	1	3
	6-8	1	10.0	100.0	0.0	1	0
	Sub-Total (E)	**10**	100			**4**	**6**
Grand Total (Sample)		**100**				**61**	**39**

On charcoal consumption and trading, evidence seem to suggest that women are more actively involved in the trading of charcoal than in the production. Disparities in the levels of involvement within gender and migration status are also evident as shown in Table 7.8. As evidence seems to suggest in Table 7.9, within the female cohort however, indigenous women appear to be the most actively involved compared to their migrant counterparts.

Table 7.9: Trading in charcoal/firewood in specific agro-ecological zones

Do you sell, buy or make charcoal? Select all that applies							
Area of Location	**Responses**	Frequency	Percent	Percent of indigenous	Precent of immigrant	No. of Male HH	No.of Female HH
Chibwe Village (Destination Area 1)	No, neither buys nor sells	9	22.5	0.0	100.0	5	4
	Buys only	8	20.0	37.5	62.5	4	4
	Sells only	8	20.0	75.0	25.0	0	8
	Both buys&sells/makes	15	37.5	80.0	20.0	15	0
	Total	**40**	**100**			**24**	**16**
Chikonkomene (Destination Aea 2)	No, neither buys nor sells	14	46.7	21.4	78.6	10	4
	Buys only	1	3.3	0.0	100.0	0	1
	Sells only	1	3.3	0.0	100.0	0	1
	Both buys&sells/makes	14	46.7	35.7	64.3	14	0
	Total	**30**	100			**24**	**6**
Choma (Source Area 1)	No, neither buys nor sells	8	80	8.0	0.0	2	6
	Sells only	2	20	2.0	0.0	1	1
	Total	**10**	100	10		**3**	**7**
Kalomo (Source Area 2)	No, neither buys nor sells	**10**	100	10		**6**	**4**
L/stone (Source Area 3)	No, neither buys nor sells	9	90	9.0	0.0	4	5
	Sells only	1	10	1.0	0.0	0	1
	Total	**10**	100	10		**4**	**6**
Grand Total (Sample)		**100**				**61**	**39**

7.6 Agriculture and environmental conditions

As findings show, agriculture is the main livelihood activity in both source and destination areas as all the households studied engaged in small-scale farming, relying entirely on rainfall for crop production.

7.6.1 Southern Province

Figure 7.19 shows the relative location of the 30 households studied in Southern Province. Six of these cases were selected through their linkages with migrants in Central Province through the defined criteria discussed in subsection 4.3.1 of Chapter 4.

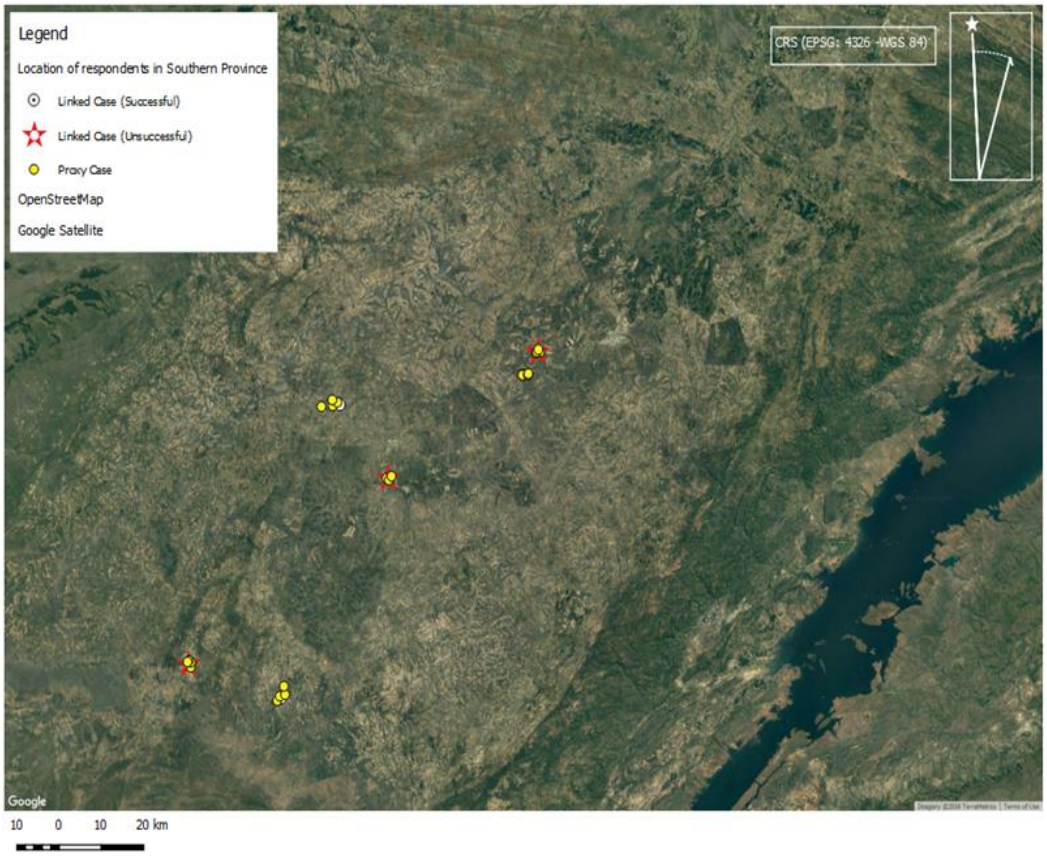


Figure 7.19: Relative location of households in (source areas) Southern Zambia

The remainder (24 households) were selected randomly for capital structure profiling and comparison purposes, including farmland and other surrounding environmental conditions assessment.



Figure 7.20: Commercial agricultural activities at source area (Kalomo-Southern Province) (1cm:2km scale)

However, as satellite evidence seems to suggest, large areas of forest have been cleared in Southern Province and as Figure 7.21 shows, agriculture could have largely been responsible for this forest clearance. There is also evidence of exhausted soils and the demand for fertile land could have led to more forested-land encroachment.



Figure 7.21: Environmental conditions at source area (Kalomo- Southern Province) (1cm: 200m scale)

For the prevailing environmental conditions in Southern Province, both satellite evidence and field surveys point to cultivation as the most possible cause of bare land. Riparian vegetation loss around dambo areas is evident with negligible regeneration due to human activities.

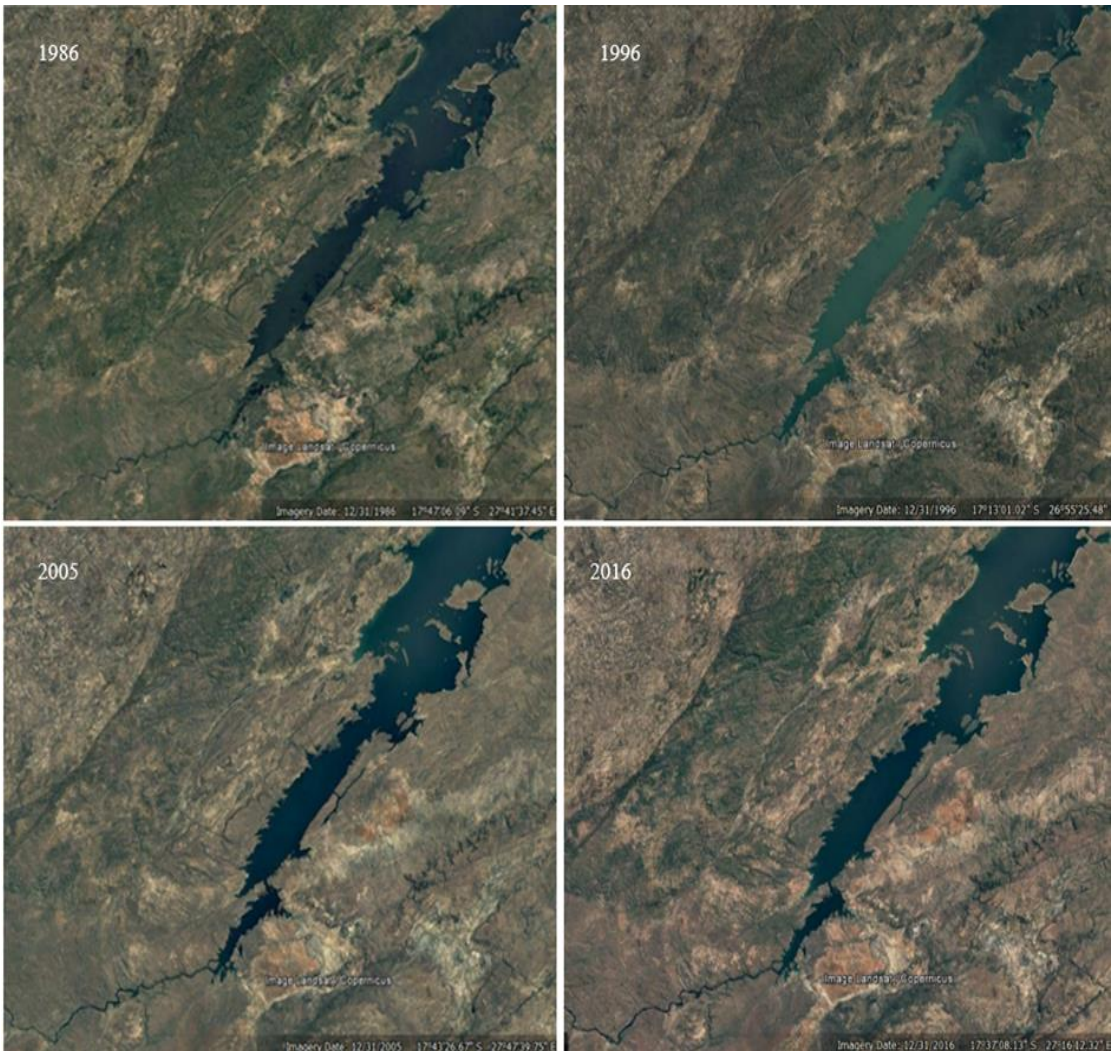


Figure 7.22: Water levels variabilities in source areas over past 3 decades (Kariba Dam)

Although respondents reported that livestock covered long distances in search of pasture and water, this does not seem to be supported by satellite evidence. Local streams and water levels in reservoirs do not seem to have experienced variabilities over the period assessed. The reasons for this may be difficult to ascertain. However, it would be useful to keep in mind that all rivers' drainage system in the western half of Zambia eventually drain into the Zambezi River which feeds into the Kariba reservoir. There could be other probable factors at play, such as the groundwater recharge rates. However, these are beyond the focus of this thesis.

7.6.2 Central Province

The relative location of the 70 households studied in Central Province are shown in Figure 7.23. These comprise 35 migrants and 35 indigenous households. Also transposed on the imagery are commercial farming activities. While commercial farmers also depend on rainfed agriculture, field evidence suggests that all commercial farming activities shown in the imagery are supplemented by irrigation. Water for irrigation is obtained either through stream water abstraction, ground water extraction through boreholes, or both in 75 percent of the cases. As can be seen from satellite evidence, most of the large-scale farms are in the northern part of Kabwe while households studied are located mostly not far away from streams in the south east.

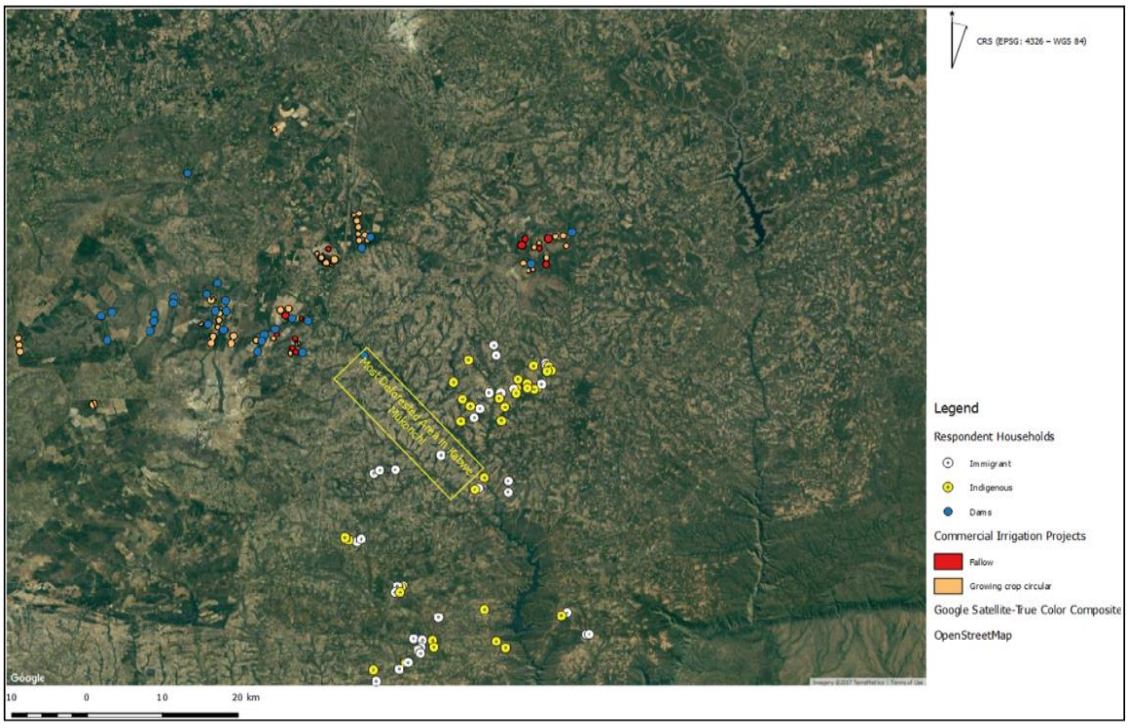


Figure 7.23: Relative location of households in destination areas, with commercial projects: location data: courtesy of Lusemfwa Hydro Power Company)

Based on field survey, findings show that nearly all households initially located in this area have migrated to the north-east within the settlement except one migrant-headed household, though also in the process of migrating further north. As satellite evidence shows, the environmental conditions observed in Southern Province also exist in Kabwe. With local authority approval, much of the 7,100 hectares of Kabwe National Forest has been cleared by agricultural activities

and settlement encroachment. The Lusemfwa and Chowa streams which are part of Kabwe National Forest's ecologically sensitive catchment area are drying-up as the result. This may have significant local hydrological impacts in the future. Similarly, in the north, the source of the Mulungushi stream is increasingly becoming bare due to extensive commercial activities. Gully and sheet erosion are evident, with potential to increase siltation and sedimentation problems in the Mulungushi reservoir. Given the prevailing political practices in which voter appeasement is celebrated, illegal land allocators take advantage of the situation as illegal settlers do not always suffer eviction. There are several examples countrywide where illegal settlers have claimed legitimacy through an in-situ formalisation of informal settlements (UN-HABITAT, 2007).



Figure 7.24: Commercial agricultural activities at destination area (Kabwe Central Province) (5mm:2km)

Shown in Figure 7.24 are large-scale farming activities in Central Province. Most of the farms are highly specialised irrigation ventures using both stream and ground water for irrigation. For example, all the commercial farms shown in Figure 7.23 and 7.24 had irrigation systems. Based on satellite evidence of both agro-ecological zones, the density and distribution of commercial farms differs between areas with Kabwe seemingly having more commercial farming activities than Choma, Kalomo or Livingstone (Figures 7.20 vs. Figure 7.24). However, as field survey evidence suggests, the problem of degraded soils, gully and sheet erosion was widespread in central Zambia especially on the household farms studied. Environmentally, Central Province was not any different from Southern Province. As shown in Figure 7.25, some part of the province is experiencing deforestation largely driven by agricultural activities.



Figure 7.25: Environmental conditions at destination area (Kabwe-Central Province) (5mm:200m scale)

Frequent bushfires and late burning were also affecting vegetation and forest regeneration. Burning is done around November/December.

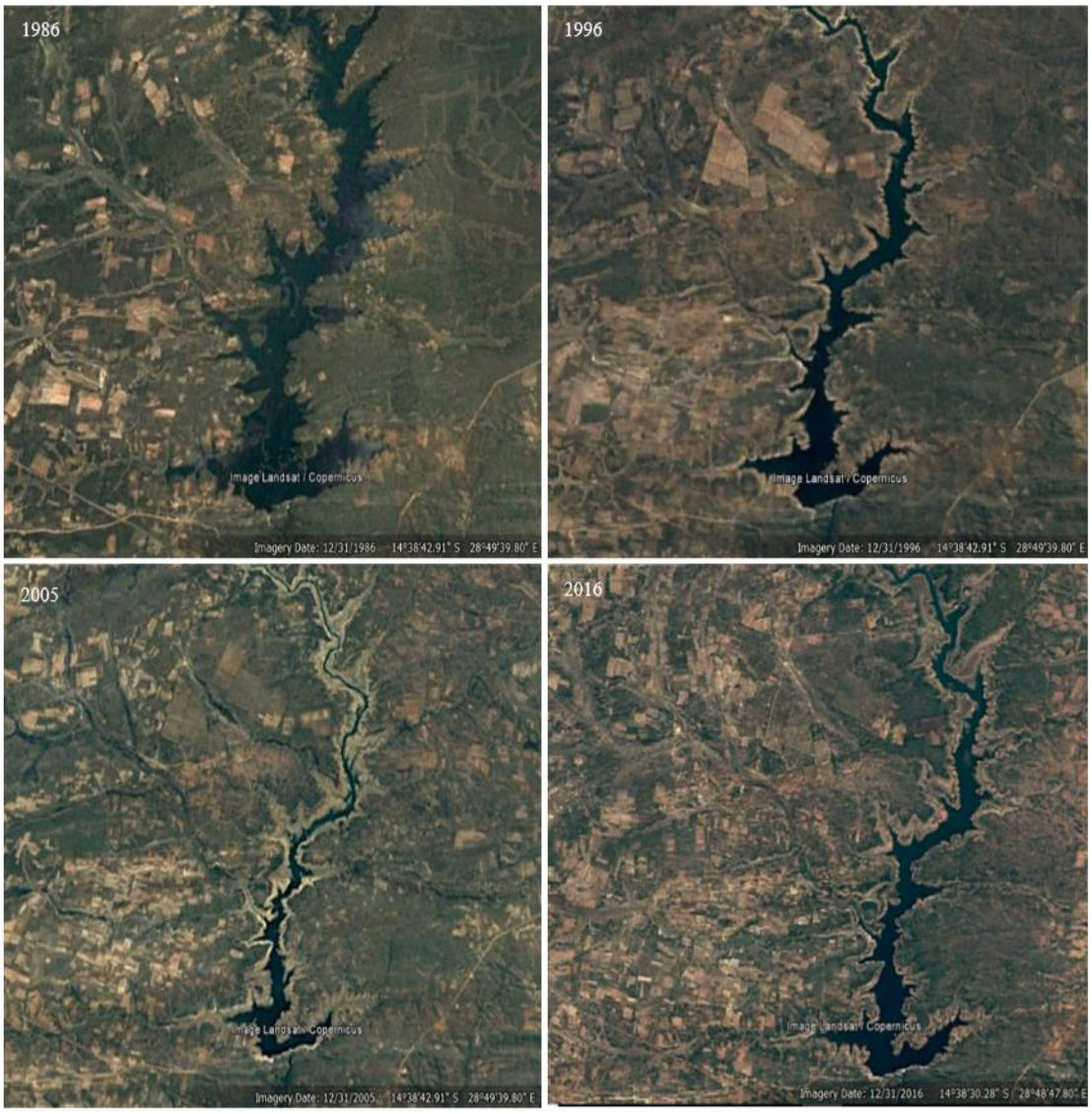


Figure 7.26: Water level variabilities in destination areas over past 3 decades (Mulungushi Dam)

Based on satellite evidence, Figure 7.26 shows how water levels have varied over three decades at Mulungushi reservoir in Kabwe. 2005 was one of the severest years during which the lowest water levels were experienced. Although, the area experienced normal duration of the rainy season, dry spells were numerous. No other year experienced dry spells higher than recorded in 2005 (See Chapter 6). Although the annual rainfall received was higher than that of Livingstone by approximately 25 percent, evidence shows that it fell below the long-term mean of the period studied. Thus, other than low rainfall, there may have been other factors that led to the low water levels, such as hydrological droughts, low ground water recharge rates and upstream feeder river abstraction for commercial irrigation which seem to have been more rampant in

Central than Southern Province. These differentials may account for the extent or intensity of environmental impacts between source and destination areas and how that may have impacted on the local hydrology.



Figure 7.27: Dambos encroachment: loss of riparian vegetation on streams and Mulungushi Dam in Kabwe (2016)

Based on gathered evidence, the impacts of deforestation could have led to the observed eroded poor soils and other sets of interrelated impacts as shown in Figure 7.27.

7.7 Implications for wider society and policy

7.7.1 Livelihood capital

The political ecology of livelihoods that emerges in this chapter is that changes in environmental conditions do not affect individual members or communities equally and therefore, costs and benefits are also unequally distributed. The political, socio-economic differentials may account for and unequal distribution along social stratification. As results have shown in this chapter, household capital endowment comparison between and within agro-ecological zones varied greatly along factors such as gender, household size and age. Literature evidence also suggests that traditional practices that tend to disadvantage and inhibit women in accessing or inheriting livelihood productive assets (e.g., access to land and associated tools and resources) are common especially in developing nations (Arslan et al., 2015; Higgins and Coffey, 2016). In Africa generally, women still experience restricted access to credit and technology and rarely own productive assets such as land or cattle. Such assets are owned and controlled by men (Ali et al., 2016; Deininger et al., 2017). These practices can increase

vulnerability gaps along gender with women being at higher risk end (Shah et al., 2013; IPCC, 2014b). For instance, as field investigations revealed, women were generally found to have low capital endowment given the historical cultural beliefs in Zambia where land is rarely inherited by women, even in times of death of a husband. During divorce, property is rarely shared as a woman is always premised wrong. This leaves women generally vulnerable as they have little or no access to productive assets. Thus, social exclusion along gender has far reaching implications on rural poverty as it tends to leave women more vulnerable to even slightest changes in environmental-related conditions such as droughts or floods. Adaptation is made difficult among female-headed households without assets to fall back on. During migration, men leave first, leaving women behind. This was clear in the case of AEZ I where there were more female-headed households left behind by relatives or husbands who left for AEZ IIa. As shown in Appendix A5, about 57 percent of studied households were female-headed in AEZ I.

Given the hypothesis in economic-theory which assumes that the higher the level of formal education attainment, the wider the survival skills and therefore the lower the livelihood vulnerability (Peter, 1974), understating how capital endowment and livelihood diversification was influenced by the education variable was important. However, findings show that it was not a factor in rural livelihoods insofar as the studied household are concerned. Going by these findings, while the importance of formal education cannot be downplayed as one of the most important empowerment tools for poverty alleviation and sustainable development (Loewe, 2012), policy intervention may have far reaching impacts if focussed more on agricultural skills training within the context of building resilience and adaptation to climate change. As field investigations have shown, farming practices are not sustainable as they rely heavily on chemical fertilisers and deforestation in both zones.

Unlike the education variable which suggests no correlation with capital strength, findings on the age variable suggest a positive correlation except for a few outliers. Generally, the older the head of household was, the stronger the capital standing in the household. However, there were

also households with old household heads relying on children as main caregivers, resulting in children's irregular attendance of formal schooling. This has implications on the future as it is likely to increase vulnerability among such households.

The impact of the migration variable as an adaptation strategy was very clear on household capital as migrant headed households were found to have a stronger capital structure than households headed by their indigenous counterparts. Causes of this disparity are not clear. However, as demonstrated in Chapter 6, migrants diversified livestock, rearing goats, cattle, sheep and pigs all of which fetched high value when sold. Their farming strategies were also generally more diversified, growing a mix of drought resistant crop varieties such as sun-hemp, maize and soybeans. Moreover, of the 37 percent with input support, about 75 percent were migrants, compared to only 25 percent of the indigenous population who subscribed and belonged to locally organised agricultural co-operatives (See Table 6.1 of Chapter 6). Co-operatives facilitated easy access to simple loans and technical support from donor agencies and Civil Society Organizations (CSOs) such as Farming Conservation Unit (FMU) and Musika. However, as field investigations revealed, the indigenous population occupied relatively larger farmlands, some of which was not in use but graded as good land. The un-used farmland was rented out to some of their migrant counterparts. About half of the indigenous households occupying good land rented it out. Renting farmland was both monetary and in-kind costing about 100 kg of maize per hectare or monetary equivalent, dependent on prevailing market prices. These 'symbiotic' social dynamics may explain why the level of formal education in this investigation seem to have no probable influence on the overall capital endowment. Households that rent out farmland have been able to reasonably raise their financial and physical assets from natural capital while factors such as household size also had far reaching influence. Larger households allowed a broader approach to risk reduction on household capital as they reported more income diversification activities, among them, proving cheap labour at local commercial

farms during certain times of the year. Some households also managed small businesses run along family lines.

7.7.2 Environmental change

Insofar as the findings have shown, a complex interaction between human activities and the environment exists in both source and destination areas. Forests and dambos have been encroached, and without clear access rights in rural areas, tensions and conflicts over access and utilisation of dambos have been reported in many parts of Zambia (Scoones, 1991). In this study, social tension and mistrust was uncovered over both dambos and political power control between indigenous headmen in Chibwe village and migrants. However, while the general livelihood activities in both areas were found to be basically the same and largely revolving around agriculture and energy (i.e., food-crop production, livestock rearing, charcoal production and firewood gathering) the extent and levels of this interaction differ across place and space. Given these differentials, the severity of the environmental impacts is also found to differ across place and space. For example, there is more livestock rearing in the source than in the destination area, and the demand for pastoral land seems greater than in destination area. Evidence has also shown that there is less deforestation for farmland in source area other than for firewood and charcoal.

Conversely, the demand for firewood and charcoal is more in the destination than in the source area and thus cutting down trees has been more rampant in the destination than source area. Consequently, loss of forest potential is higher as the demand for firewood and charcoal has potential to speed-up the rate at which forests can be lost in the destination area than in source area. Within destination area however, firewood harvesting and charcoal making differ between villages. It is more rampant in Chibwe than Chikonkomene village. Due to the increasing demand for agricultural land, an additional stress on forests exists in destination area. Large portions of forests seem to have been lost due to energy demand from charcoal or firewood and clearing for agriculture and settlements. Based on the findings, much of the charcoal that has

been sold and consumed per annum in the last two-three years in Kabwe came from Chibwe village among others. Consequently, Chibwe village is the most environmentally degraded of the two villages studied in destination area. Furthermore, as satellite evidence has shown, the destination area has been having lower water levels than the source area for the period assessed. On the one hand is the sedimentation problem probably emanating from the deforested river catchment area as bare soils are eroded into the local reservoirs through run-off causing turbid conditions; on the other, is the potentially altered hydrological cycle due agricultural extensification. Turbid water conditions caused by siltation, coupled with low water levels can make both water extraction and treatment expensive (Tundu et al., 2018). The potential to damage power generation equipment by fouling from sediments is also high (Khurana and Kumar, 2016).With regards to agricultural extensification schemes, commercial farmers are relying heavily on both abstracted local stream water and borehole sources for irrigation in both agro-ecological zones. However, these activities are more intense in central than southern Zambia given that there are more commercial farmers in the former than the latter.

Irrigation from boreholes has great potential to affect ground water quantity and quality as local aquifers and the local hydrological cycle are altered (Meixner et al., 2016; Bosmans et al., 2017). Similarly, streamflow abstraction may result in reduced water flow and affect water level downstream (Madsen, 1988; Pathak, et al., 2016) creating preconditions for low fish stocks and spawning rates that ultimately affect fishing-dependent livelihoods and nutrition (Moshy et al., 2015). In Kabwe, streamflow abstraction may be largely responsible for both poor domestic portable water supply and the low potential for power generation. While both the Mulungushi reservoir and Lusemfwa stream have hydropower generation potential of 58; 32 and 26 Megawatts respectively (ERB, 2009), low water levels as evidenced in Figure 7.27 have made power generation difficult in the last five-four years. For instance, generation potential fell way below potential to 20 Megawatts in the same period, resulting in closing down operations from around 2013-2016 (Kasonde and Lumbe, 2014). The potential impacts are horrendous. Figures

7.28 and 7.29 conceptualise the possible local level causal-effect linkages of environmental impacts within the broader context of the DPSIR framework.

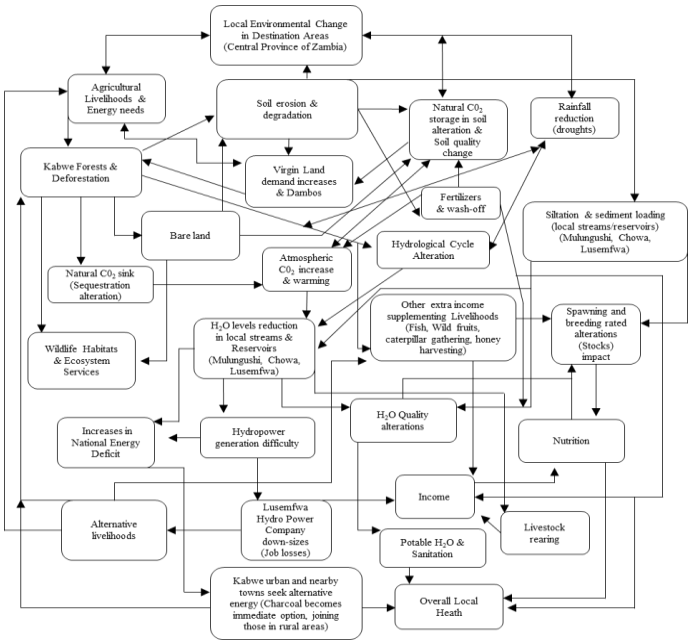


Figure 7.28: Horrendogram of Driving Factors/Pressures, State-change and Impacts conceptualisation in AEZ IIa

As demonstrated, the impacts have a far-reaching implication for livelihoods, energy, environment, general puplic health and welbeing in both agro-ecological zones. However, their management is a matter of policy.

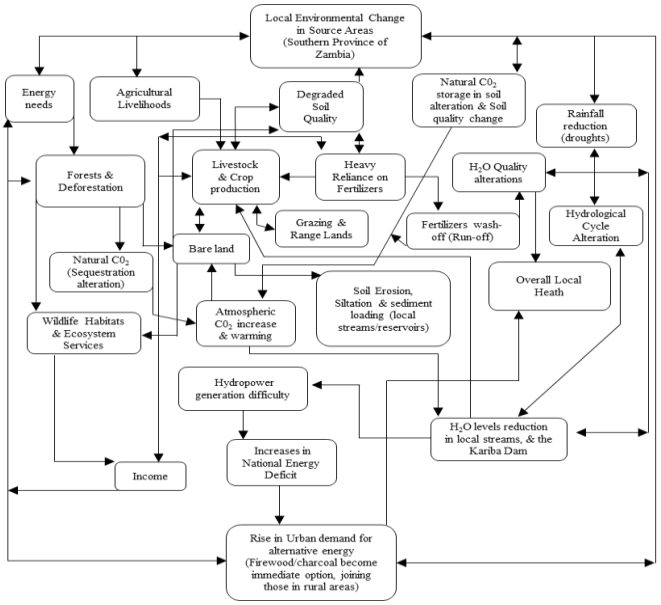


Figure 7.29: Horrendogram of Driving Factors/Pressures, State-change and Impacts conceptualisation in AEZ I

With regards to soil quality, although respondents generally perceived soil quality as declining yet must practice crop-production, noted that, with appropriate land management, a wide variety of crops can be grown in Central Province. Secondary data also shows that commercial farmers routinely produced more than 6 tonnes of maize per hectare in the province (Ng'ombe and Kalinda, 2015) compared to 4.5 tonnes in Southern Province (Shitumbanuma, 2014). Similarly, smallholder farmers produced around 3.3 tonnes of maize in Central Province, compared to 2.7 tonnes in Southern Province (Shitumbanuma, 2014). Due to exhausted soils, fertilizer application in Southern Province was about a third higher than in Central Province at 150kg/ha compared to 100 kg/ha. Despite heavy fertilizer application, 57 percent of respondents in source areas reported inadequate yields with frequent harvests of less than one-and-half tonnes of maize per hectare. As laboratory experiments have shown, maize response to fertilizer decreases above 100kg/hectare (Xu et al., 2009). Local farmers who had livestock also relied heavily on animal manure. However, animal manure application to cropland was generally a source of worry among farmers as it was understood to be a mode for weed introduction on farmlands. As studies have shown, un-composited animal manure has been associated with weeds that can reduce yield per hectare as plants compete for soil nutrients (Pleasant and Schlather, 1994).

With a long standing activity of clearing to claim, potential to perpetuate deforestation in Southern Province still exists (Kalaba et al., 2014; World bank, 2015). The province may continue to be deforested from both clearing to claim (Unruh et al., 2005) for farmland and cutting down trees to meet domestic energy needs. Due to loss of vegetation, local streams have also been affected by siltation and low water levels. Livestock such as cattle covered long distances in search of water and vegetation in dry season. Most of the livestock, especially cattle were visibly underweight, increasing susceptibility to disease, while poorly fed oxen may be unable to pull the plough, indirectly impacting on the size of cultivated hectarage and ultimately crop yield. Furthermore, given the energy deficit resulting in grid outages and load-shedding to domestic clients (World bank, 2015), national deforestation rate in 2014 was estimated at

3,000km^2 per year in Zambia (Day et al., 2014). However, with the grid outages and load-shading to domestic clients increase to about 34 percent in 2016/2017 (Sladoje, 2016) deforestation related to energy demand may have probably increased by the same percentage, especially on forests around peri-urban areas. However, while the demand and needs for energy and farmland demand differ between agro-ecological zones, the activities towards meeting these needs has great potential for indiscriminate cutting down of trees in both areas. Deforestation is likely to lead to further land degradation. With land degradation, desertification may result if net regeneration of forest continues to be negative. This has implications on the carbon-cycle as trees acting as natural sequesters for carbon-dioxide will have diminished (Bala et al., 2007). As bare land is exposed, soil erosion may take effect. This could disrupt both nutrients flow-loops and carbon budget, thereby increasing the demand for new farmland and fertilizer application, a scenario that will aggravate both negative environmental and socio-economic impacts (IPCC, 2014a; Thomas et al., 2014).

7.7.3 Socio-economic vulnerability

The political ecology explanation that emerges in socio-economic vulnerability is that changes in environmental conditions do not affect individual members or communities equally and therefore, costs and benefits are distributed unequally. Equality and equity on various fronts within wider rural or poor urban establishments must consider subtle differentials that exist between social classes for multidimensional poverty reduction. In this research, findings show that levels of vulnerability can greatly vary within and across class or categories i.e., between and within source and destination areas, migration status, gender, household size and age. Households in source areas were found to be more vulnerable than those in destination areas. Within source-area villages, disparities were also uncovered with Kalomo being the most vulnerable, followed by Choma. However, youths and women-headed households constitute the most vulnerable households in both areas. Similarly, indigenous-headed households are more vulnerable than those headed by migrants within and between villages in destination area. For

instance, Chibwe village's indigenous, youth, and female-headed households are the most vulnerable. Households with more members were found to possess relatively stronger capital structure than those with lesser number of family members. This suggests that larger households spread the risk more strategically by engaging in diverse livelihood activities and contributed in various ways to the overall household income.

7.8 Summary and conclusion

From the zonal level vulnerability assessment in Chapter 6, this chapter focused on household capital structure for an in-depth understanding of how available capital can reduce or increase vulnerability to environmental change. Types of activities likely to aggravate environmental change impacts have been identified as well as the potential effects of environmental change on livelihood within the context of political ecology. Capital structure differs along the lines of age, gender and location. Women and youth headed households, especially in AEZ I have the weakest capital structure. In AEZ IIa, differentials exist as indigenous and women-headed households have the weakest capital structure compared to migrants and other male-headed households. This shows that people of the same location, exposed to the same type of environmental risk can be impacted differently based on socio-economic demographics. This can provide useful information when targeting relief support to specific members in the same location. Furthermore, as demonstrated in this chapter, variations in natural resource demand between and within areas can provide useful insights in guiding resource governance. The extent of deforestation and environmental degradation associated with specific activities in AEZ I and IIa can be a useful starting point for evidence-based policy intervention programmes. Insofar as evidence suggests, energy pressure needs, and fertile farmland demands for food-crop production are among the main driving forces with direct implications on forests in both zones - source and destination areas. Understanding the extent of biomass reliance in Zambia is important for both policy intervention on deforestation while planning for cleaner and energy alternative sources that are sustainable in the climate change context.

While programmes addressing climate change do exist, largely, these tend to discount differentials in socio-economic demographics. As demonstrated in this chapter, as well as chapters 2 and 5, programmes addressing climate change are inherently political. Choices made at farm level in rural household setting are determined by national and international choices designed in view of the benefits behind climate change, food production and trade. As Anderson (2014) and Sugden (2015) have argued, these acts as a vehicle for transnational corporations to exploit peasant farming systems, using agendas that facilitate capitalist expansion of various markets in the 21st century. As evidenced in this chapter, there has been little comprehensive attention by government to the local drivers of deforestation and anthropogenic climate change itself for which energy demand and agriculture are the main driving forces. The energy needs remain un-addressed and the sector underdeveloped, while rural electrification remain politically driven and selective in approach. The consequences are that rural households engage more in natural resources harvesting like charcoal making as a source of energy and as an alternative source of income.

CHAPTER 8: MIGRATION AS ADAPTATION TO ENVIRONMENTAL CHANGE

"*Migration is a natural phenomenon. It happens all the time all over the world. If it happens legally, it's a good thing."* Angela Merkel (Address to the UN-Global Compact for Safe, Orderly and Regular Migration in Marrakech: 10th November 2018).

8.1 Introduction

Based on the evidence base of chapters 6 and 7, this chapter investigates the extent to which environmental conditions interact with other factors to trigger migration. Anchored on environmental change and migration theory, the chapter aims at improving the understanding of possible linkages between environmental change and migration, including determinants of the spatial scales of migration. Long-term environmental change and/or variability data - defined as data covering a period of at least 30 years (NASA, 2005) is used in the assessment at two levels. First, the extent to which environmental threats and stressors, particularly rainfall variability and land degradation triggers migration is assessed among other factors (Adger et al., 2015). Second, the opinions, perceptions and interpretations of environmental risk, threat or shock amongst study area residents is assessed. This includes, for example, the perception of the severity of environmental conditions to drive migration (Pellizzoni, 2014; Warner and Afifi, 2014). Because the dominant environmental-migration thesis posits that slow onset and long-term environmental change does not singularly drive migration (Piguet 2010; Kniveton et al., 2012; Adger et al., 2015), this investigation focusses on the five drivers fundamental to the thesis i.e., environmental, social, economic, demographic and political factors. The objective is to untangle the environmental change drivers from the other four drivers of migration. This is achieved through four related interview questions:

a) To what extent have environmental factors contributed to rural-rural movements of people in Zambia;
b) What is the social perception of environmental stressors and threats to drive these movements?

c) What are the spatial scales of movements?

d) What determines these scales?

Within the environmental factor interrogation, a political ecology lens focussing on uneven access to, and control over resources is utilised to bypass a minimalist approach, potentially allowing an extended explanation on how access and control - linked to the social cleavages of class, gender and power, may be shaping the migration decision. Environmental change is rarely enough to explain migration decisions. Factors that appear subliminal, e.g., local social and power relations, perception of risk, capital, and government policy are too important determinants of decision-making to be overlooked. They serve as a point of contact between the migration literature - which attempts to understand migrant subjectivity, and the political ecological literature - which attempts to understand the social construction of resources and their use (Carr, 2005; Fisher and Carr, 2015). This point of contact creates the potential for a link between environmental change and migrant subjectivities because of the ways in which local social relations form crucial bridges between changing local understandings of the environment and resources, capital flows and changes in government policy (Radel et al., 2018).

8.2 Environmental change and migration

As the effects of both short and long-term environmental change such as flooding, droughts and water scarcity appears to be on the increase (IFRC, 2016), patterns of migration are likely to be altered as affected people seek to avoid or adapt to the challenges that are posed. With people likely to be affected in the event that adaptation becomes difficult in their locations, there may be little guarantee that tensions and conflicts over access and control of land and resources will not result from these movements in host communities in the future (Piguet, 2010b). At the same time, there is little certainty that migration as adaptation to changing environmental conditions and variabilities may work or result in vulnerability reduction of migrants (Jacobson et al., 2018). Migrants could find themselves exposed to a new set of environmental risks and shocks (Black et al., 2011). Similarly, there is neither guarantee nor certainty that those who fail to

migrate and/or choose to remain ('remainers') in most affected areas will be any safer from shocks and risks of environmental change (Geddes et al., 2012). These developments put enormous stress on natural, social and political systems since they affect agricultural patterns, food, water, health, and human security. While most studies tend to put more emphasis on rural-urban and cross-border or international migration, this analysis focuses on less studied rural-rural migration. The sources of migrants in the host area villages are traced by province and district.

Table 8.1 shows the number of migrants and their origin by province. About 77 percent of the migrants in destination or host areas (Central Province) were found to have originated from Southern Province, followed by Copperbelt at about nine percent, and Eastern at about six percent. Only about nine percent were found to have originated from Western, Muchinga and Central provinces with three percent each.

Table 8.1: Origin of migrants in Kabwe by province

Migrants in host areas and their source of origin by province				Gender		
Migration Status		Frequency	Percent	Male	Female	Sub-Total
Immigrant	Central Province	1	2.9	0.0	1.0	1.0
	Copperbelt Province	3	8.6	2.0	0.0	2.0
	Southern Province	27	77.1	23.0	4.0	27.0
	Eastern Province	2	5.7	2.0	0.0	2.0
	Western Province	1	2.9	0.0	1.0	1.0
	Muchinga Province	1	2.9	2.0	0.0	2.0
	Total	**35**	**100.0**	**29.0**	**6.0**	**35.0**

Based on snowball sampling in the host area, 30 non-migrant respondents were selected for interviews in the main source area district in Southern Province, ten from each district. Table 8.2 shows the number of respondents by migration status and location. In host area, a total of 70 respondents were selected for interviews (see methods in Chapter 4).

Table 8.2: Immigrants and indigenous respondents summaries: Figures by source and destination area location

Migrants & Non-migrants by village				Gender		
Migration Status		Frequency	Percent	Male	Female	Sub-Total
Source & Destination Areas: Sampled Number of Housholds by district or village						
Non-migrants (source area)	Choma	10	33.3	3.0	7.0	10.0
	Kalomo	10	33.3	6.0	4.0	10.0
	Zimba/Livingstone	10	33.3	4.0	6.0	10.0
	Sub-Total	**30**	**99.9**	**13.0**	**17.0**	**30.0**
Indigenous (Destination area)	Chibwe	22	62.9	18.0	4.0	22.0
	Chikonkomene	13	37.1	6.0	7.0	13.0
	Sub-Total	**35**	**100.0**	**24.0**	**11.0**	**35.0**
Immigrant (Destination area)	Chibwe	18	51.4	9.0	9.0	18.0
	Chikonkomene	17	48.6	15.0	2.0	17.0
	Sub-Total	**35**	**100.0**	**24.0**	**11.0**	**35.0**
	Grand Total (No.of Respondents)	**100**	**100.0**	**61.0**	**39.0**	**100.0**

In terms of location 52 percent of migrants are in Chikonkomene village and 48 percent in Chibwe village in Kabwe rural in chief Mukonchi's area.

8.3 Assessing the environmental driver in the context of migration theory

In this research project, determining and assessing migration drivers utilised both climatic data, and responses from the semi-structured interviews. Due to the lack of meteorological stations in Kalomo district, only rainfall data for two migration sending districts (Choma and Livingstone) was obtained. However, given record gaps, the data for Choma only cover up to 30 years, while that of Livingstone is 36 years. Respondent perception of farm-land conditions were utilised as gradual and slow onset of environmental change factors. To ascertain how specific drivers interacted in the 'stay' or 'migrate' decision by respondents, economic, social, political and demographic factors were assessed using respondent-perception based responses. This was done through scoping opinion and ranking risk perception of individual respondents. Within and between factors, respondents were asked to rank factors based on specific questions on the migration drivers.

8.3.1 Environmental drivers in rural-rural migration

While there were no migrants encountered in host areas who may have left in earlier years with low rainfall before 1991, evidence from the following years suggests that there has been a link between low annual rainfall and emigration in source or migration sending areas. Figure 8.1

shows the type of association uncovered between drought or rainfall amount and migration numbers in Choma/Kalomo area.

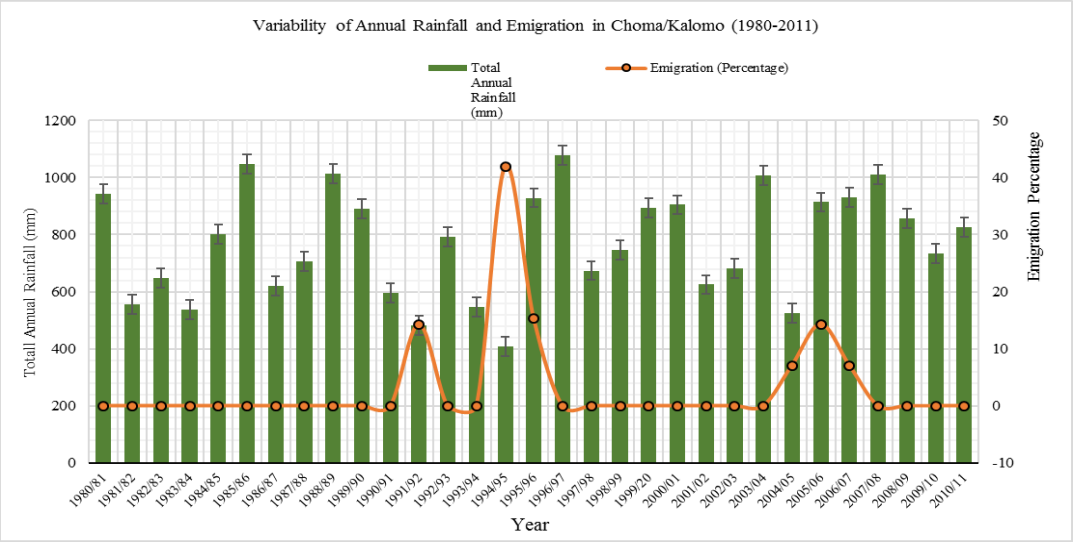


Figure 8.1: Migration and climate (environment-migration links/association assessment (Choma/Kalomo)

It appears that at some point, gradual and long-term environmental factors, in this case drought, triggered long-term or permanent rural-rural movements from the southern part of Zambia. While the seemingly positive association between drought and emigration does not necessarily imply causality in this case, most interviewees migrated during or immediately after a severe drought at their previous location. As the results in Figure 8.1 show, approximately 14 percent and about 43 percent of migrants left the drought hit Choma/Kalomo area during 1991/2 and 1994/5 rainfall-years.

With the second drought of 1994/5 (which was the severest recorded in three decades in the area, with an annual total rainfall of just below 400mm), an additional 15 percent migrated within the following year (1995/6). This addition was probably due to the impacts the two droughts within the space of three years might have had on the livelihoods in the area. To the contrary of the 1991/2 and 1994/5 rainfall periods, there were no migrants among the interviewed respondents who left from Choma/Kalomo between the years 1997/8 and 2003/4. This is probably because 1997-2000 recorded a gradual increase and a relatively normalised

rainfall pattern compared to the 1991-1995 period. Conversely however, with the 2004/5 drought, about 7 percent of those interviewed emigrated from this area. However, unlike other years that recorded relatively lower rainfall during which period most of the interviewed migrants left, 2005/6 and 2006/7 years are a slight exception. These years experienced a relatively higher rainfall of about 900mm each but had 14 and 7 percent of the interviewed migrants leaving the Choma/Kalomo area in 2005/6 and 2006/7 respectively. Why this happened, and with such a time-lag may neither be clear nor obvious without extending the assessment for an improved understanding of the roles other factors may have played. The time-lag, after the decision to migrate has been reached, is explored further within this chapter and I shall return to highlight some of the factors at play in the next sub-sections.

With regards to Livingstone/Kazungula source area, a similar trend of emigration is unveiled in the investigation. Figure 8.2 highlights the type of association uncovered between migration and droughts. The type of association is like that unveiled in Choma/Kalomo area. Similarly, there were no migrants encountered who may have left in earlier years with low rainfall prior to the 1990s. The first cases encountered to have migrated from this area left in 1997/8.

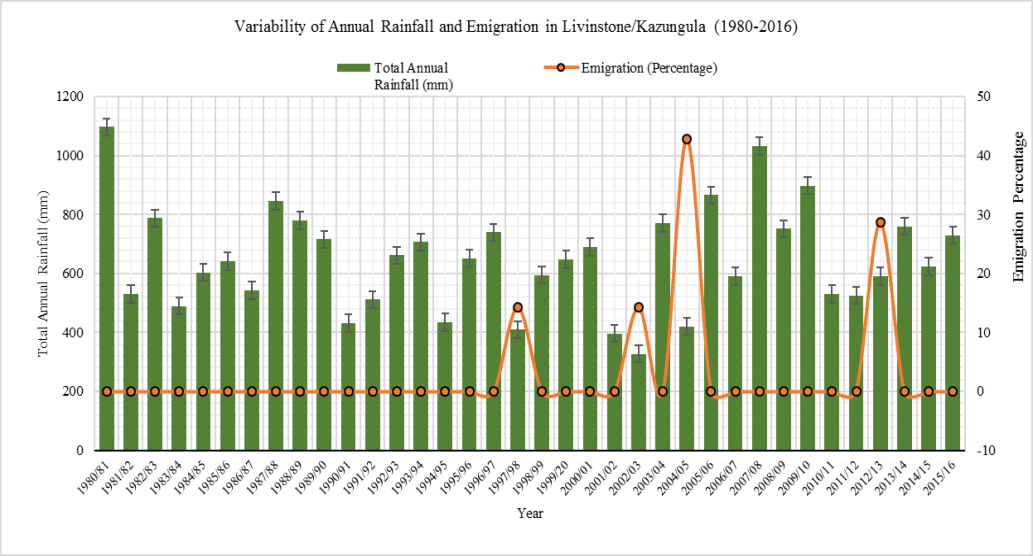


Figure 8.2: Migration and climate (environment-migration links/association assessment (L/stone Kazungula)

Contrary to the Choma/Kalomo source area however, where the highest number of migrating respondents left in the year which experienced the lowest rainfall, the highest number of migrants from Livingstone/Kazungula left two-three years later after the lowest rainfall period experienced in the entire 30-year period. As the year during which the lowest rainfall amount of about 327mm was recorded, 2002/3 only seem to have forced movements of about 14 percent of interviewed migrants, same as that for 1997/8. However, about 43 percent of migrants left in the 2004/5 rainfall-year following another drought. What may have trebled the 2002/3 records in 2004/5 is not clear, but the two consecutive droughts prior to 2004/5 may have played a role. Those with the means to migrate could probably not endure two years of droughts despite having experienced a relatively normal rainfall-year of about 770mm just before migrating. The 2002/3 drought was the severest in three decades in this area, just after the second severest earlier in 2001/2 (Figure 8.2). These three consecutive droughts separated by one relatively normal rainfall-year in between the second and third drought, may have created additional risk and difficulty in agricultural-based livelihoods. It may have inhibited meaningful recovery as just over 400mm of annual total rainfall was recorded in 2004/5. Similarly, 29 percent of other migrating respondents from this area left in 2012/13 after the two consecutive years of low rainfall records of 2010/11 and 2011/12. The received annual total rainfall was just about 530mm for both rainfall-years. In the year they left (i.e., 2012/13) however, annual total rainfall was about 70 mm higher at just below 600mm.

8.3.2 Determinants of migration time

Returning to the determinants of the time-lag factor after a decision to migrate has been made, it appears that the economic factor can offer a meaningful explanation on the different migration times. For instance, based on responses, the 15 percent of migrants who left Choma/Kalomo area in the relatively wetter years in 1995/6 and the 14 percent in 2005/6 with an additional 7 percent the following year (Figure 8.1) may have faced economic and logistical problems. Similarly, the 29 percent that left from Livingstone/Kazungula area in 2012/13 (Figure 8.2) may

have also encountered a certain degree of economic and logistical challenges. From the 35 migrants, Figure 8.3 shows the time-lag it took to migrate after decision was made. As shown, time-lag varied between six to over 18 months from the time the decision to migrate was made, to actual migration.

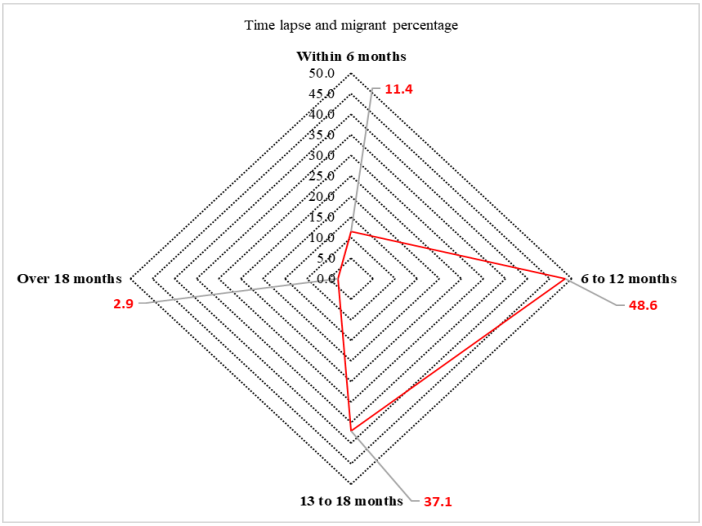


Figure 8.3: Time lapse in months from time decision to actual migration

Results from the responses show that only 11 percent of migrants were able to leave immediately (within six months) after decision was made to migrate. Of the 35 migrants, only 49 percent were able to leave within six-twelve months period. About 40 percent (2.9 and 37.1) were seemingly 'trapped' and may have experienced additional environmental risk exposure within the time-lag above twelve months.

However, it is not clear to what extent other factors may have interacted with the environmental threats to determine or influence the time-lag delays after decision to migrate was reached among those who migrated. While migrants in host or destination area left their previous location based on cited environmental factors (droughts and poor soils), arguably, the migration process itself required financial capital injection for transport and other logistics. From the findings, Figure 8.4 shows the main reasons for delayed migration after a decision to leave was arrived at. However, it can also be argued that if the migration was driven by the environmental factor, most likely it is about how the environmental threat was perceived by individual

migrants since movements are not group-based, but individual members of families. The other family members only join the first migrant once the platform for settling in is established, bringing into perspective cultural factors, social capital and attachment to land.

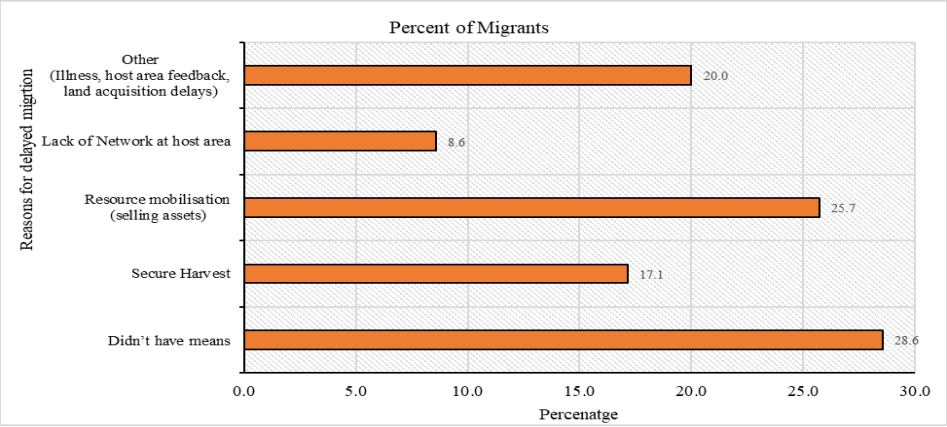


Figure 8.4: Main causes of migration delays from time of decision to leave

Five reasons emerged with 'lack of means' accounting for the highest number of migrants at about 29 percent. This was followed by 'resource mobilisation' - such as disposing of available assets and even contracting debt which constituted about 26 percent of migrants. Nearly half of the respondents who cited 'resource mobilisation' contracted financial debt in the process.

8.4 Assessing migration drivers' interaction in rural-rural migration

8.4.1 The 'stay' or 'migrate' decision

From the 30 respondents interviewed, Figure 8.5 shows a summary of the reasons for the 'stay' decision by non-migrants in the main migration sending area in Southern Province. Four factors emerged: cultural reasons (50 percent of respondents); economic (30 percent; lack of a social network (17 percent); and political (three percent).

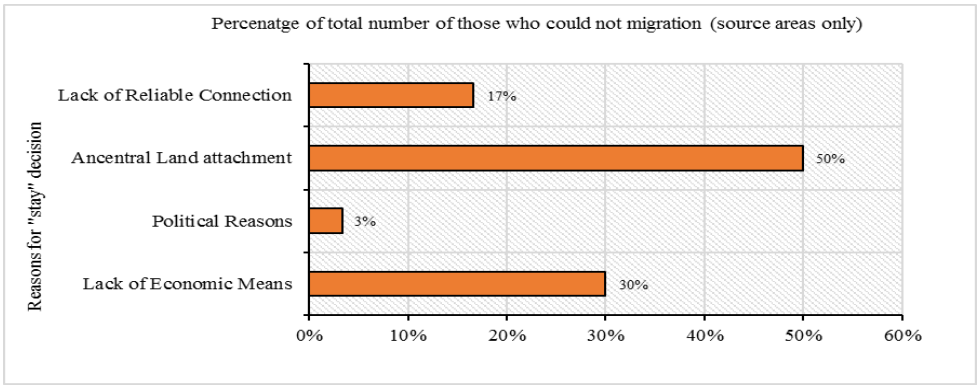


Figure 8.5: Summary of reasons for "Stay" as opposed to "Migrate" decision by non-migrants in source area

For the 'migrate' decision, Figure 8.6 shows the six contributory factors. The two common factors, escaping poor soils and escaping drought have a clear environmental component to them.

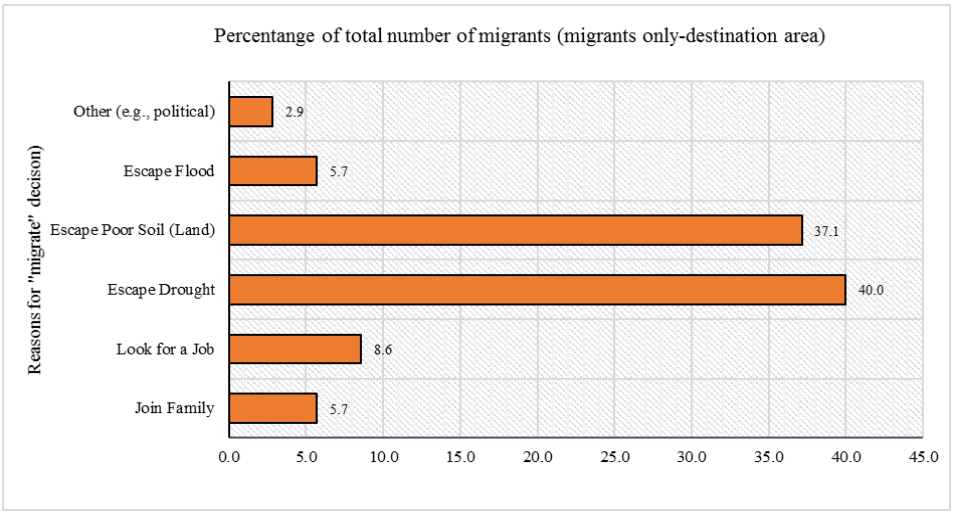


Figure 8.6: Summary of reasons for "migrate" as opposed to "stay" decision by emigrants

8.4.2 The role of social networks and remittances

Within the context of migration process and scale of movements lies the role of social networks and remittances - resources transmitted to those left behind. Social networks or connections between family, friends, community members, businesses and organisations are a useful aspect of both information, resources and capital flow between or among groups in the network: they can have implications for both migrants and 'remainers'. However, social networks vary in form, complexity, purpose and composition of membership. In this study, focus is only on

family, friend and community networks in the context of rural-rural migration. While the notion that social networks play a major role in networked individuals' lives may seem obvious, the importance of migration networks in impacting outcomes for migrants themselves, their families, and their communities cannot be overstated. These have different impacts (both positive and negative) on the people at 'home' and those working away from 'home'. Figure 8.7 shows the connections in the migration and settlement process between the 35 migrants, and members already in the target host community.

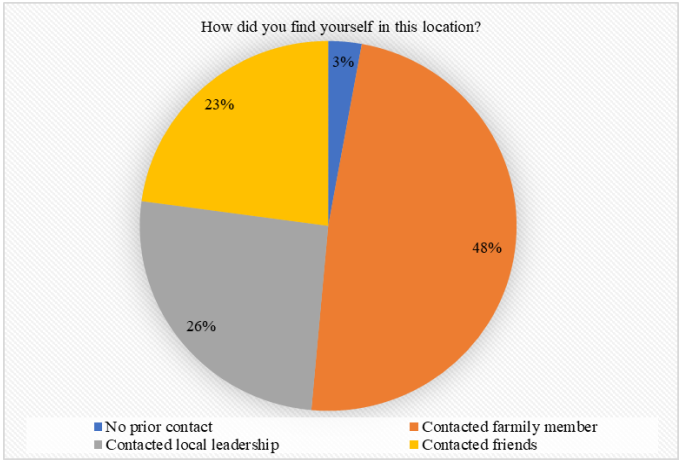


Figure 8.7: Social Network/Connections in the rural-rural movement of people in Zambia

Findings show that 97 percent of migrants already had connections in target host villages prior to migration. Of these, nearly half used their active family contacts already settled in host areas. Only three percent which also represents urban-rural migration in form of retirees reported not to have utilised any prior contacts since they did not have any. However, they also utilised the local leadership in the process of formalising land ownership after acquisition.

In terms of remittances between and within host and source areas, Figure 8.8 shows the proportion of the types of remittances among all the 100 respondents in the study. As findings revealed, only three percent of the total number reported the lack of network outside their present location. However, they had connections in form of friends and co-operatives within their community or village settlement.

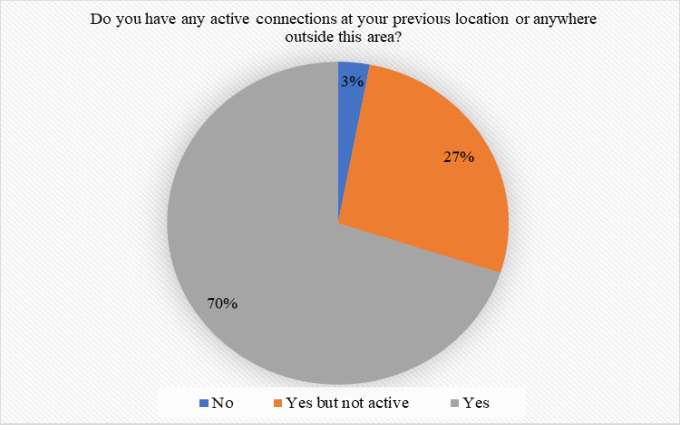


Figure 8.8: Social network connectivity

27 percent reported weak or inactive connections outside their present village or community location, while 70 percent reported strong or active connections. The 70 percent included all the 97 percent respondents in the 'migrant' category. These also appeared to have the largest network which comprised different people within host and source area villages or at their previous location. Network membership comprised of close family members, extended family members and local community leadership. Family network was basically kindred members such as grandparents, parents, spouse, cousins, uncles, aunties and friends. However, whether family or community connections, within these networks and at the centre between and within host and sending areas are remittances and constant information flow. Figure 8.9 below shows the types of remittances that were found to frequently flow between and within host and sending area networks.

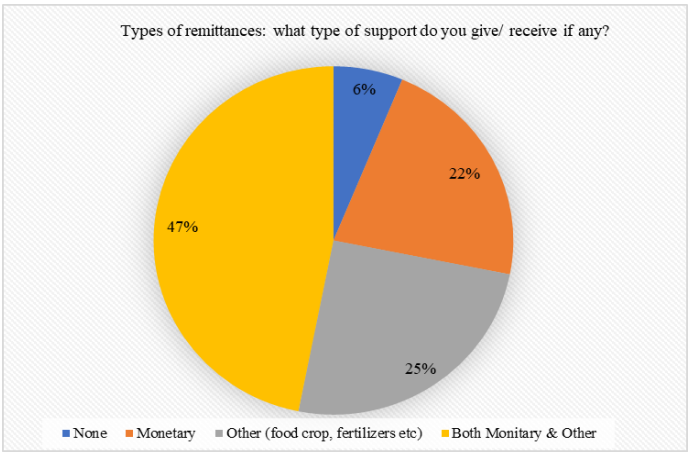


Figure 8.9: Types of remittances in the family network

8.4.3 Spatial scales of movements and determinants

Figure 8.10 shows both the spatial scale (estimated distance between villages in both source and destination areas) and the direction of migration. On average, the distance covered between source and destination areas ranges from 400-550 km.

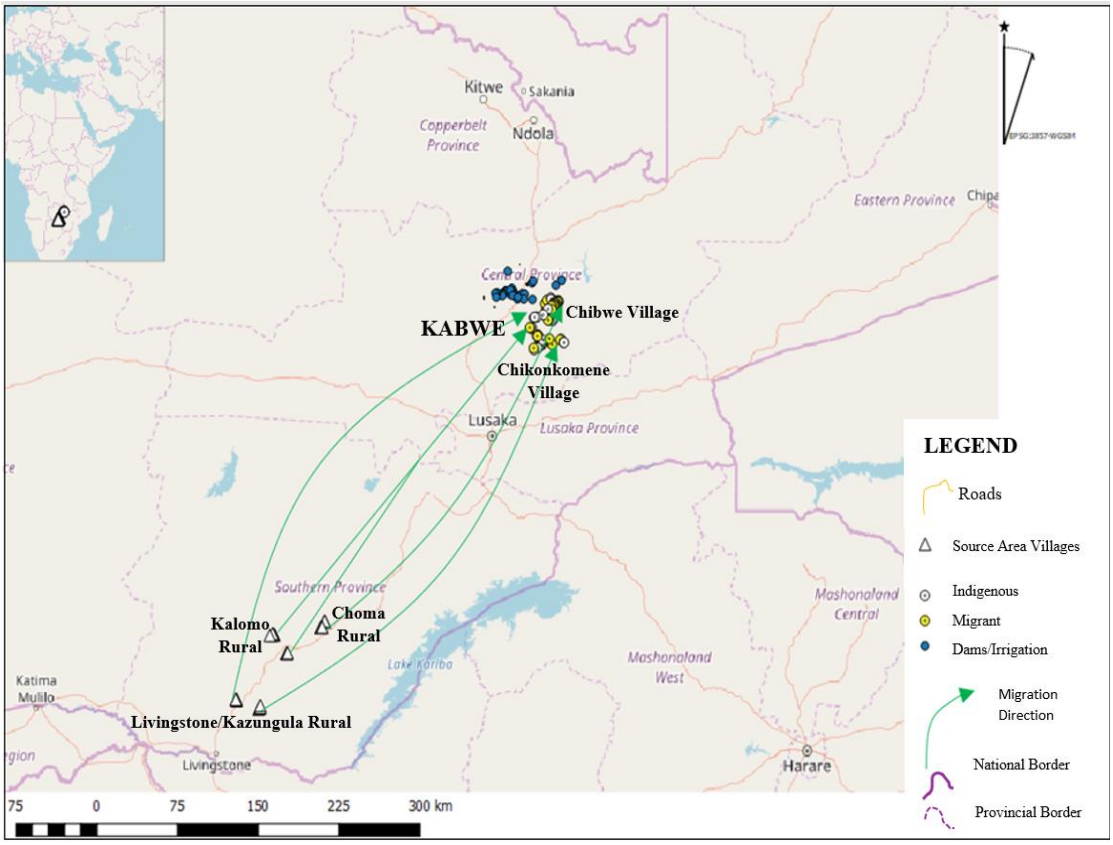


Figure 8.10: Scales of movement and direction

Understanding what criteria migrants use in choosing one settling area against another in the context of distance is important. It provides a hint about area preferences, and what attributes of an area migrants consider as important in their decisions. In this research, the five migration drivers were weighed against distance. It was found that distance mattered least in all migration drivers at about three percent in rural-rural movement. Figure 8.11 shows the results of how the scale of movement of the 35 migrants from Southern Province into Central Province was shaped or influenced.

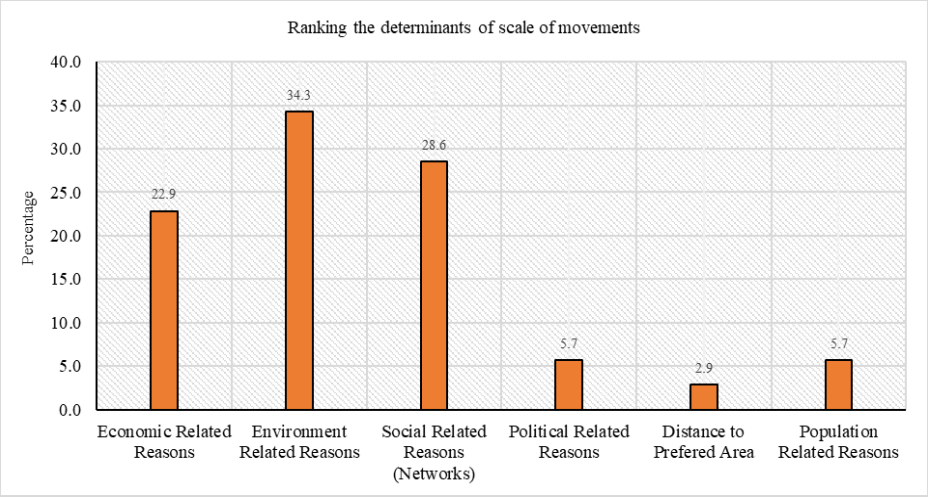


Figure 8.11: Determinants of scale of migration

As results suggest, environmental factors do dominate the determinants of scale of migration. People tended to look for suitable environmental conditions for their livelihood before any other. In this regard, 34 percent of migrants ranked the environmental factor highly, indicating that it was the most important to them. In their decision to migrate, they preferred areas that not only experience relatively higher rainfall compared to previous location, but also have fertile land with easy access. After environmental factors, social links was the most important. Respondents relied heavily on their already-settled family members and friends on the process of obtaining land in host areas. The already settled friends and family members acted as 'agents' between local chiefs in the host areas for obtaining land. The 'agents' also provided information and advice not only on availability of land, but also on type of land and quality. However, obtaining land this way is becoming difficult as one of the oldest migrating respondents (RS 28 - male, 63 years old) remarked during socio-economic profiling interview:

> *It is becoming difficult to obtain good quality land nowadays. In the 1990s, and before 2010, it was very easy to obtain large and good quality land from local chiefs. Even headmen used to appropriate and give land. Today, many of the migrants who arrive before land is assured spend two -three years with family members or friends before finding where to live independently or cultivate crops.*

Ranked third most important, the economic related factors powered the movement logistics and the entire process of migration, settlement and establishment of homesteads. With social links

however, settling and establishing homesteads in host areas was less a burden. The burden was logistics or the means to migrate and payment for land at host area as land was no longer given free like before. For instance, the 15 percent of migrants who left Choma/Kalomo area in 1995/6 and the 14 percent in 2005/6 with an additional seven percent the following year had economic and logistical problems (see section 8.3.2). These only migrated after having economically secured themselves for the migration and settlement process. Unlike economic factors however, political factors only became important in the context of social cohesion. People were more concerned about staying in areas where they would be welcome to settle and integrate easily. In the case of population, while it did not appear ranked highly in the investigation, all respondents indicated that they did not want to stay in areas where there were no other people nearby. 86 percent of migrating respondents were looking for areas already settled but with virgin farmland. Conversely however, they did not want areas already settled with too many people (above 20 homesteads per square kilometre) as they feared lack of animal grazing land and potential disputes over the same.

8.5 Risk Perception in rural-rural migration

Risk perception, which is essentially a subjective judgement about the characteristics and severity of a threat (Wildavsky and Dake, 1990) is influenced by many factors. Among these are personality, economic, political and culture factors (Maccrimmon et al., 1988). However, other than viewing individuals as active organisers of their own perception, the intricacies of risk theory and explanation is beyond this thesis. To investigate risk perception in this research, respondents were treated as active agents responsive to risk. As such, respondents were asked to rank factors according to what they felt or considered as the greatest risk: what was more likely to make them leave their present location (Klabunde and Willekens, 2016). Findings varied considerably between destination and source areas. These are presented along with other findings in the sub-sections below.

8.5.1 Evaluating and ranking risk among migration drivers

In evaluating and ranking risk among migration drivers, the factors were categorised and considered according to the theoretical framing i.e., social, economic, environmental, political and population dynamics (Milan et al., 2015). Figure 8.12 shows the results from 100 respondents of this study organised by area (i.e., destination and source area).

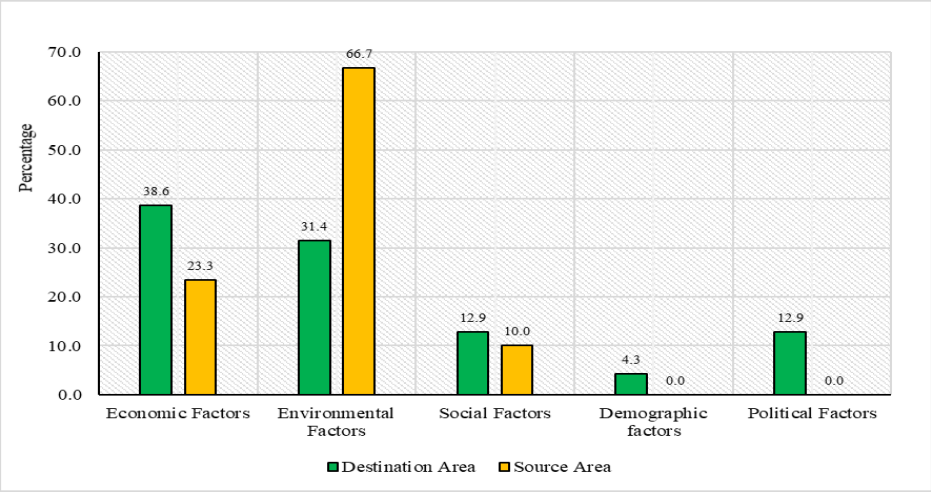


Figure 8.12: Perception of risk: Ranking current migration drivers by location

Figure 8.12 shows that the environmental risk factors, stressors and threats still ranked relatively higher in both source and destination areas; with droughts, land quality, and water availability being the main contributing factors in the main environmental risk category. However, while the environmental factors were considered as the highest risk in both areas, there were differences between areal perceptions. In source area, it ranked at about 67 percent: more than twice the destination area ranking. Ranked second, the economic risk factors in the destination area was about one-and-two thirds times more than source area. Political factors and social factors did not emerge as risk factors in source area. In destination area however, these were ranked fourth and fifth respectively. The political risk factor was about three times that of social factor, compared to the social factor risk.

However, when respondents were asked about what was more likely to make them migrate in the future (if they really had to), an interesting pattern of responses emerged. Figure 8.13 shows

the response results with an additional factor emerging. As results show, while the environmental factor ranking dropped by about half in source area and only by a negligible percentage in destination area, it was still ranked highest among all other factors.

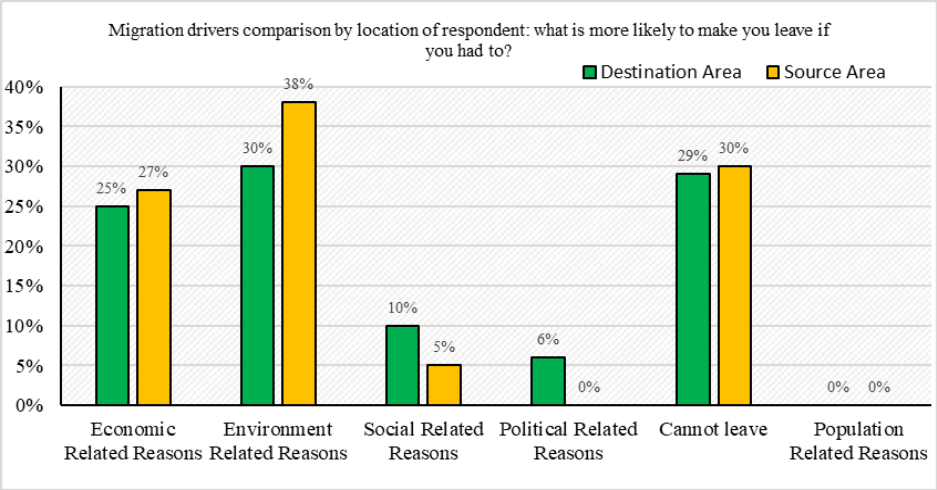


Figure 8.13: Perception of risk: Ranking future migration drivers by location

The economic factor increased by about four percent in source area but dropped by about 14 percent in destination area, and this time it was ranked third in both areas. Both the demographic and political related risk factors disappeared completely in destination area. Instead, new factors emerged – under 'cannot leave'. When asked further about the reasons for not wanting to migrate under any circumstances, respondents cited numerous factors, largely centred on cultural and social capital, as attachment to land. This can make some households stay put regardless of the magnitude of the environmental threat. Perception of the environmental threat appears to have a powerful role in this regard. As a 68-year-old female respondent (RS-L71) in source area remarked:

> *I cannot leave! I was born here and will die here. All my children were born here. There are a lot of people buried here: my great grandparents, my grandparents and my father, my mother, including my second born son, who was my only male child are all buried in this solitary ground; around that tree* (pointing at a tree in the western direction of his homestead). *This place is spiritually and physically important to me and those coming after me. If I did leave for any reason, it would be surely disgraceful. Besides, how am I going to travel with all the livestock I have here. Selling them is not an option. It would be a give-away price… and what would be the point, to be a laughingstock in the community?*

Similar remarks were raised in destination area where more than half of the indigenous respondents, and about 25 percent of migrants preferred to be buried next to their forefathers. As one 60-year old male migrant (RS 29) put it:

> *Surely, I would be more at peace when I die if my body was taken back to my home village. It is very important as there lies all my clan's blood line. There, I will join and lie next to my ancestors and rest in peace. However, I know my family would be overstretched economically to take my body back there. I just pray that when that happens, there will be a way to get my body back to my birthplace.*

Both these cultural-charged sentiments (RS-L71 and RS 29) suggest a deep sense of traditional attachment to land and family lineage. The amount of value it is accorded cannot be accurately measured or totally understood by an outsider. It is a traditional practice, a cultural symbol whose meaning and significance may only be clear to those who live it.

8.5.2 Weighing the environmental factor against all other drivers

As evidence suggests, the environmental risk factor emerged dominant in the evaluating and ranking process among migration drivers by respondents. However, when four other risk factors were combined on the one hand and considered against the environmental factor on the other, the four factors only ranked higher in destination area. In source area, the environmental factors still ranked highest at 67 percent, two-times more likely to drive future migration than all other factors combined. Figure 8.14 shows the results of this comparison from 100 respondents.

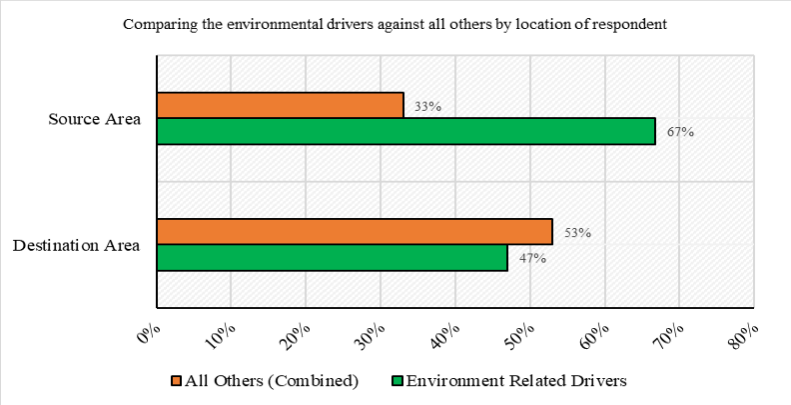


Figure 8.14: Four-factors combined against the environmental factor

In the destination area however, environmental factors were six percent less likely to drive migration than all other factors combined. In terms of 'between areas' comparison, it was found that in source area, the environmental factors were 20 percent more likely to drive migration than in destination area where it was only 4 percent more likely to drive migration than all other factors combined. However, all other factors in the destination area were found to be 20 percent more likely to drive future migration than in source area.

8.6 Other forms of risk in rural-rural migration.

Other than the environmental related risks, rural-rural movements face various forms of risk. For example, land ownership insecurity, social conflicts over access or control of resources, and a lack of clear government or institutional support of rural development may expose rural-rural migrants to multi-dimensional risks, probably more than in other forms of migration. If not addressed as a key resource, land ownership insecurity for instance has potential to increase vulnerability of rural-rural migrants and indeed any natural resource-based livelihood. Similarly, in a worst case-scenario, social conflicts may potentially lead to loss of lives, sustained hatred and revenge across generations of the parties involved.

8.6.1 Land ownership and titling

Figure 8.15 shows the type of land documentation types possessed by interviewed respondents per given category. As findings seem to suggest, more than three quarters of respondents do not have any form of documentation as proof of ownership of land they are currently occupying. However, this situation varied across place and migration status.

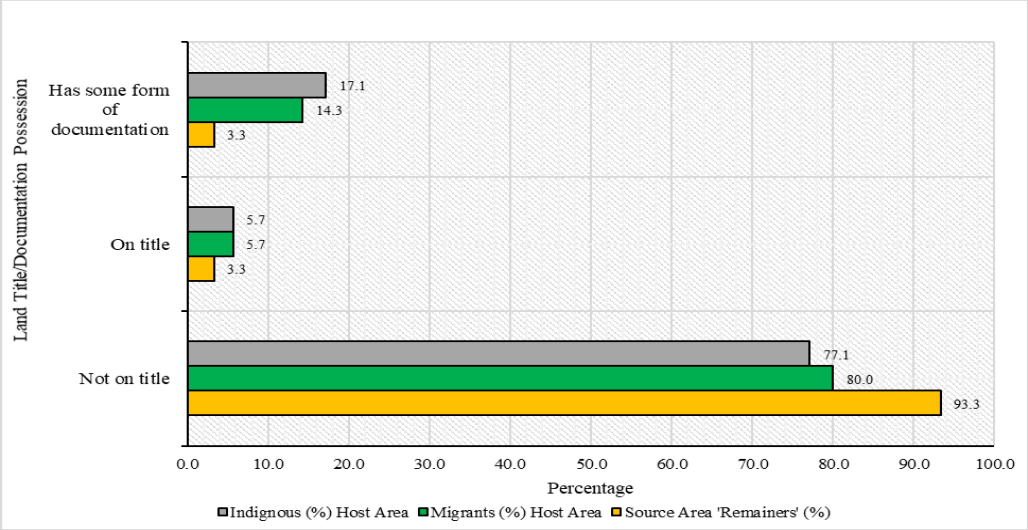


Figure 8.15: Percentage of households with or without land title by area

In the source area for example, results show that about 93 percent of the interviewed did not have any form of documentation. In destination or host area however, only about 77 percent of the interviewed indigenous respondents and 80 percent migrant respondents did not have any form of documentation or title. In source area, a negligible number had title and some form of documentation.

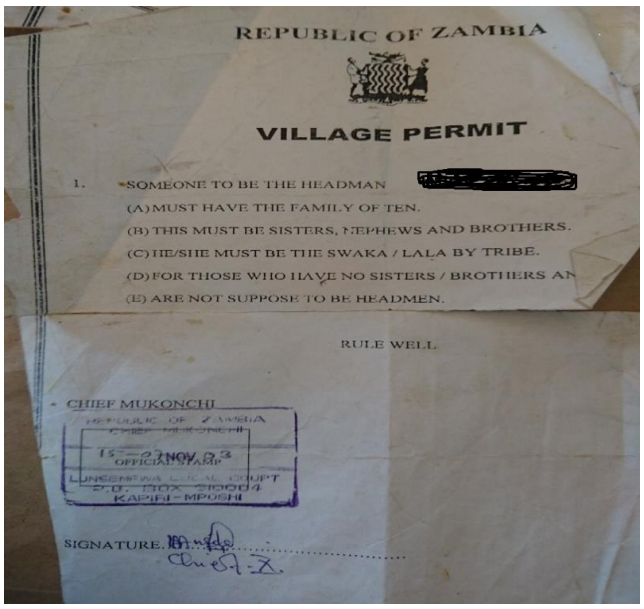


Figure 8.16: Village Permit for village headship.

In destination area, about six percent of migrants had title with an additional 14 percent having some form of documentation. The village permit shown in Figure 8.16 is a typical form of

documentation held by the 17 percent indigenous and 14 percent migrants in host area. This situation may increase the vulnerability levels uncovered in the previous chapter and those highlighted in Chapter 2. As findings have shown, the lack of title or appropriate documentation by majority of respondents involved in this study, reveals a vulnerable situation where most of the interviewed are potentially at high risk of being landless. There is little, if any land security in both areas and this confounds the multidimensional poverty levels in the studied rural parts of southern and central Zambia.

8.6.2 Conflicts

As established in previous chapter, migrants were generally more economically wealthy (see chapter 7). However, with wealth accumulation by migrants, findings reveal that some of the indigenous people in the host villages are uncomfortable about both the current economic and political influence of migrants in the local communities. There is spreading fear that migrants are likely to take over local political leadership as they are becoming too powerful economically. Investigations revealed that differences and misunderstandings between some indigenous and migrants over local leadership positions were already happening. In Chibwe village for instance, migrants were accused of wanting to inaugurate their own village headman in 2013 and later in 2017. As one respondent RS 68 (aged 69-year-old man) who is also local village headman remarked:

> *The migrants are becoming too powerful to be overlooked. When they arrive, we receive them with open arms because they usually come with little or nothing. However, as soon as they are given a piece of land, 2-3 years later they become very rich and they want more land. They also start creating parallel community structures meant to destabilise the peace that has been enjoyed for a long time in these villages. Because they are economically powerful, they may eventually plot to take over the chiefdom. In 2013, they wanted to install their own village headman. In both instances, it took the intervention of Chief Mukonchi to resolve the matter, but some migrants continue to fund parallel structures that are threatening the original owners of the land they are occupying. This year* (2017) *they have renamed part of the village as New Monze.*

This is quite a strong remark from a local leader. The name Monze refers to a historical cultural centre for rainmakers at Gonde or Malende (rain shrines; see chapter 5), now a town named after the traditional chief rainmaker, Chief Monze. It is located on the heart of the plateau zone in southern Zambia where farming has flourished for centuries (Saha, 1994; Colson, 2006).

Investigations on the parallel structures attributed to migrants accused of seeking to take over kingship revealed no more than rural farmers' cooperative branches. Local conservation farming projects supported by donor aid have formed local cooperatives that allow members to access farming inputs cheaply after they pay membership of K 100 (US$ 10), and a K20 monthly subscription thereafter. However, an outstanding feature of these farming cooperatives is that while membership composition is open to all, investigations revealed that 75 percent of the members were migrants. Probably, this is since migrants were generally more likely to afford the membership fees than most of their indigenous counterparts. Nevertheless, the misunderstandings between the indigenous on the one hand, and the migrants on the other; are potentially likely to increase and may spark conflicts in the future. Already, the six percent of respondents (see Figure 8.13) who cited the political factor as the main reason likely to make them leave in the future were all migrants, suggesting they no longer feel welcome.

8.6.3 Unclear government policies on rural development

Rural areas in Zambia are largely underdeveloped and lack public facilities and infrastructure. For instance, poor transport infrastructure seems to restrict rural-urban integration in the country's development and governance agenda. While the broad-based development approaches have attempted to integrate rural development into the mainstream development agenda (e.g., induce an increase in agricultural output through new technologies, reduced transport costs, and widened market base through liberalisation), they have often tended to favour more well-established farm blocks than villages. Enabling efforts for easy flow and distribution of goods and services between rural and urban, within and between villages have largely been ineffective. Without road infrastructure in place, there is only so far such efforts can go. As findings show,

roads in both source and destination areas are in very poor conditions. Figure 8.17 shows the typical rural road conditions in both source and destination areas during rainy season.



Figure 8.17: Poor access roads in both source and destination areas (December 2017)

Bridges on main access roads have been partially damaged or washed away by floods. Roads are generally not only poorly designed (without drainage or run-off disposing structures), they are also not of bituminous standard. As such, potholes and flooding during rain seasons are common. Access can be quite difficult and risky after heavy downpours in both source and destination areas as roads become small 'streams' in the rainy season. Just like between villages, most movements to nearest urban marketplaces involve travelling on foot through small access paths and tracks. With the transport burden falling mainly on women, this stresses their role as walking with heavy loads on their back and/or head can be physically demanding even over short distances. The potential of having fresh produce going bad before it reaches the marketplace, let alone able to sell, is often high. This means that farmers must either sell their produce at source if buyers appear (albeit usually very low prices decided by the buyers themselves) or risk long distances and poor road conditions to nearest urban or highway vending markets. The average walking time to the nearest marketplace is about 110 minutes in destination area villages, and about 115 minutes in source area villages (See Table 6.1 in Chapter 6).

With poor infrastructure and lack of clear rural development plans by government (see Chapter 2), delivery of produce to markets, or accessing inputs on time by farming households continue to be difficult in both agro-ecological zones. In addition, with government price fixing policy on

maize crop on the market, there is frustration among small-holder farmers. Price fixing brews uncertainty and low returns on the produce. Thus, lack of government support, poor rural access roads and fixed marketing potentially reinforce rural poverty and make rural livelihood difficult. Given the multidimensional poverty levels revealed in chapters 6 and 7, many rural households continue to lead a life without savings and on a hand-to-mouth basis with no clear prospects for a better future. This is reflected in the expression made by some of the respondents in both source and destination areas. As a 24-year-old female indigenous respondent RS 43 in destination area remarked:

> *The government through the minister of agriculture last year decided to sale fertilizer at K380 per 50Kg for basal dressing, and K360 per 50 kg for top dressing. It is the same this year. After we harvested, it* (government) *announced to buy maize at K60 per 50kg through the Food Reserve Agency. On top of that, it had never bought maize on cash. How do we recover our costs?*

In source area, RS-L83 (55 years old male) highlighted the government's failure in providing farming inputs on time as well as a generally failing system on the dispensation of inputs. He complained:

> *This year, it* (government) *has re-introduced an electronic voucher-based system which already failed in the previous government. We must pay K400 as upfront to access farming in-puts* (seed and fertilizer). *But how can we pay the K400 upfront fee when we have not yet been paid for our maize, we sold last year…and this system* (e-voucher) *is not working even for those who managed to pay upfront. There is no one I know who has received inputs so far among friends who paid upfront.*

Respondent RS 52, an indigenous 48-year old male in destination area also complained:

> *Today is 22 December, I have only planted ten lines of my maize-field as I do not have enough seed. I paid the K400 upfront fee with a hope of inputs. Nothing has come as the system is not working. Maize seed costs between K280-320 per 10 kg bag depending on the dealer. As for fertilizer, I don't even want to think about it because it may just bring me depression. You can do your math and see how much we are suffering under these politicians. And you think that if a Chinese man came to give me something in exchange for a portion of land I would refuse no! After all, sometimes they* (Chinese) *come with government backing and displace people out of their land and so I would be lucky if China man came to pay me something.*

Echoing the above remarks were some of the leading CSOs in poverty reduction, such as Civil Society for Poverty Reduction (CSPR). CSPR called on the president to accept failure, fire the

agriculture minister and declare 2017/2018 agricultural season a national disaster (CSPR, 2017). This year (2018) a follow-up on respondent RS-L83's comments made in December last year revealed that government has again fixed the market maize price at K65 in this year's crop marketing season (LusakaTimes, 2018).

8.7 Implications for adaptation and wider academic debate

Rural-rural movements are probably better viewed as part of a larger phenomenon – symptoms of the political ecology of environmental change and degradation. In this investigation, human induced environmental change, rural-rural migration and socio-economic factors appear to be closely related. In addition, although the political factor is not recognised by migrants, analysis show that it is economically – at least indirectly – of basic significance for environmental change-motivated migration. Elite-centric policies that have been propagated by different governments have not only widened but also sustained inequalities between and within the rural and the urban. There is generally a lack of basic services e.g., schools and healthcare facilities in rural areas. Because of this, rural inhabitants generally lack formal and are mostly unskilled. This appears to reduce their confidence to migrate to cities where job opportunities can be highly competitive and rare. However, because they must avoid droughts and poor soils, they migrate to other rural areas judged to be better and continue to engage in what they already know – subsistence agriculture. Evidence suggests that rural-rural migration neither facilitates adaptation to environmental change nor reflects a failure to adapt, but rather, reflects the weak position of rural households in cross-cutting relations of power and the relative productive land scarcity. This type of migration merely maintains basic subsistence food production while reinforcing existing social inequalities. It thus raises new questions about the conceptualization of 'migration as adaptation' including the benefits of rural-rural migration and livelihood diversification that accompanies it.

Moreover, migration in the context of environmental degradation and drought challenges normative and political perceptions of migration, which tends to be viewed as a problem. In this study, permanent abandonment of an environmentally degraded area is rather a solution. Immobility may be a major constraint, potentially leading to continuing degradation and acute malnutrition. Rural-rural migration demonstrates that the choice of destination for environmental-related migrants is not random, but rather systematic and dependent on various conditions at the destination. Two factors emerge; favourable environmental conditions, and the presence of social networks - sense of familiarity on cultural practices and language.

As consensus stands, in the narrow sense of the word referring to people exclusively moving for environmental reasons, "climate" or "environmental migrants" do not exist except for sudden environmental disasters (Piguet, 2013). This is because establishing whether people move purely for environmental reasons presents difficulties given time-lags in slow onset or gradual environmental change (Piguet, 2010). As demonstrated in this chapter however, there is evidence to suggest that slow onset or gradual long-term changes in environmental conditions do force human migration in rural-rural movements as resilience or tolerance thresholds eventually collapse in some households. However, given social attributes such as risk perception differentials across gender, age, culture and tolerance or resilience across economic status, there is difficulty and uncertainty in establishing the permanency or temporality of these movements as these differentials tend to confound social behaviour dynamics (Geddes et al., 2012). The tolerance thresholds and the impacts of environmental change differs on households given the trio importance of adaptive capacity, resilience and vulnerability (William et al., 2016). While migration may be an adaptation strategy to environmental change, it may not always be successful. There is no guarantee that those who migrate will be free from similar or new set of environmental risks, or that those who remain are any safer (see Chapter 7). However, as demonstrated in this chapter, long-term environmental change and variabilities can dominate other drivers in rural-rural migration, particularly in rainfed agricultural and natural

resource-based livelihoods. Local precipitation patterns and land productivity have been found to be of primary importance in this regard. Other drivers (e.g., social and economic) were found to be of secondary importance and only slightly influential on the long-term or permanent migration decisions due to logistical requirement to power the migration processes. In this vein, the economic factors were still closely linked to the environmental drivers while demographic and political factors appeared to have had the weakest influence. What largely drove the movements insofar as the findings seem to suggest, was the need for productive soils and adequate rainfall. In spite of this however, there is still some consistence with the environmental-migration theory suggesting that slow onset or gradual long-term environmental change only drive migration in an interactive manner with other factors, and not singularly (Kniveton et al., 2012; Anon, 2011; Adger et al., 2015).

From the analyses, six key characteristics of migration emerge (1) rural-rural migration appears to be a reactive, survival-oriented response strategy to environmental change; (2) environmental factors (droughts, water shortages and poor land quality) appear to play the biggest role in driving migration on the one hand, and in shaping households' migration decisions and/or direction on the other, including the scales of migration; (3) migration inevitably results in socio-demographic shifts in both sending and host communities that, in the long-run, may have long-term impacts on both poverty and food security; (4) subtle cultural implications of migration has potential to negatively impact on social cohesion as emerging conflicts over land and associated resources in host communities deepen; (5) environmental change and lack of clear policies for rural development appears to be perpetually holding rural households in an endless cycle of food insecurity and poverty; and (6) as climate variability becomes increasingly unpredictable, exposure to economic risk is likely to increase multidimensional poverty levels already experienced among rural population in the studies areas.

There are various ways or steps through which the above challenges can be addressed to enhance planned adaptation and reduce both vulnerability and multidimensional poverty. The

first step may require building adaptive capacity of rural households through responsive agricultural support programmes, fair pricing and marketing of produce, early supply of inputs and up-grading rural infrastructure. This must ensure that both migration and rural livelihoods are not maladaptive over the long run as fair pricing and marketing of produce, early supply of inputs and up-grading rural infrastructure determine the efficiency of rural economic success or failure. The second step may require climate resilience improvement of crops to ensure productivity. In this regard, research and proportion of drought resistant varieties need to be given priority while enhancing co-operative schemes easy access of inputs and market for produces. Migration probably ought to be treated as part of livelihood development given the capital flows between and within communities. Alongside migration, an improved understanding of gendered perspectives, cultural, adaptation threats and opportunities are therefore critical to building effective long-term adaptation strategies that build resilience. However, this may not adequately address the gender role differentials given the fact that women are culturally restricted in terms of access to productive assets, markets, and technology including literacy (Chapter 7). Similarly, migration may also musk the interaction between gender and economic status which affects livelihood outcomes. In this vein, adaptation strategies may require greater attention to the intersections of marginalisation, vulnerability and poverty. This is because attention to e.g., land, healthcare access, education, water, technology and credit may have more benefits to multidimensional vulnerability reduction of the most disadvantaged groups in communities than the reactive or direct efforts such as increasing agricultural productivity would (William et al., 2016).

The third step and probably one of the most important is to address the insecurity that exists in traditional or customary land tenure system where ownership largely lacks title. This is compounding the environmental change threats and vulnerability levels. As the demand for land rapidly increases in Zambia (for commercial agriculture and industrial activities) displacement of the rural populations is likely to increase proportionally as such displacements are already

taking place, see Fahmida (2017). There are two main reasons to these displacements insofar as the evidence suggests. First, and most important is the intersection of the distinctive political ecologies and socio-spatial dynamics of the ongoing global food and energy crises triggering a tidal wave of large-scale land acquisitions by multinationals and governments. As argued by Makki (2014), through this land grabbing exercise or development by dispossession of community land (largely traditionally owned) is framed as empty or underutilized landscapes awaiting redemptive development. By enclosing the village commons and displacing rural farmers from their traditional land, a new form of neo-colonialism is emerging. Land grabbing for large-scale crop production is accelerating the homogenization and consolidation of chemical-intensive commercial agriculture. Second, is the inequality and injustice propagated through complementary normative visions and economic interests in state relations, Zambia on the one hand, and China on the other. In these relations, Zambia as a host government views large-scale land acquisition as foreign direct investment, a move that brings economic benefits such as job creation and infrastructure development. To the contrary however, China appears to see an opportunity for its economic influence expansion and secure a long-term source of cheap food and materials for its population. Essentially, the distinctive political ecologies of food and energy shortages; and the widening socio-economic inequalities between states and populations highlight one important issue – capital accumulation is principally interested in geographies and settings where it can generate profit, regardless of institutional, structural conditions, location, boundaries, or nationalities. For this reason, Chinese investment influx into Zambia and the Robert Mugabe nationalisation policies in the neighbouring Zimbabwe exemplify these specific cases in point. The Mugabe land redistribution policies that displaced many commercial farmers of European descent without compensation drove an estimated 200 into rural Zambia. These were offered by the Zambian government ‘empty or underutilized spaces’ of land awaiting redemptive development (Makki, 2014). The second problem and probably the most important, involves Chinese investment. The coming of the Chinese into Zambia has been at the centre of land ownership controversy since 2010. Chinese firms as well as individual Chinese nationals

have been cited for obtaining and occupying prime land in nearly every district, facilitated by some corrupt government officials and local chiefs (Chatelard, 2014; Chu, 2013). Most of the Chinese 'investors' deal in everything; from manufacturing fake or imitation products of anything trending locally and on the global market, to farming and mining.

There are also those specialised in obtaining lucrative government contracts on road construction while some deal in scrap metals and mining green-fields (BBC, 2017). Of these activities, mining and commercial agriculture are at the centre of much of the land displacements on customary land in Zambia (Fahmida, 2017). And as consensus ties adaptive capacity to sustainable livelihoods capital asset portfolio (i.e., human, social, natural, financial and physical capital including information technology, material resources, infrastructure, institutions and entitlements) rural people are among the most vulnerable in this regard. For instance, research has demonstrated how climate change presents an unprecedented threat to poor herders and rain-fed agriculture among rural indigenous communities in the Sahel and sub-Saharan Africa (McLeman and Hunter, 2010; White, 2012; Bryceson et al., 2003; Connolly-Boutin and Smit, 2016). The findings in this research are not very different form these. While people may leave their locations for 'better' areas, migration has tended to expose some of these to new set of environmental problems. While they are, on average relatively more economically stable, the migrants in this research were found to be experiencing similar environmental conditions they tried to avoid in source areas (see Chapter 7).

However, while the bulk of environmental-migration narratives generally tend to cast these displacements in a negative light, migration can be a form of adaptation to environmental change (Ober and Sakdapolrak, 2017). Displacement of people by both sudden and long-term changes in environmental conditions are lived realities and migration has been an adaptation response to environmental risks (William et al., 2016). Both choices and rights to mobility are essential. However, challenges do exists in the rural communities in most developing nations dependent ecosystems for livelihoods (Kubik and Maurel, 2016). Generally, the first order

impacts of climate change affect both rainfall patterns and amounts, while these variabilities impact on food crop production and therefore, food security and socio-economic wellbeing. Given that the studied communities rely on rainfed agriculture, understanding the range of rainfall and its variability over any given time series is crucial to the sustenance of livelihoods. While the rainfall volumes may not be dramatically different between the zones studied, small differences can have great implications on crops and ultimately on livelihoods of people dependent on rainfed agriculture (Connolly-Boutin and Smit, 2016). Policy response to aide adaptation cannot be overemphasised. This, as shown in this chapter, can trigger migration to other rural areas by some members of the affected areas. In this regard, an improved understanding about the complexity of the multi-causal relationship between climate, land productivity and food security on the one hand, and the social–ecological systems and human mobility on the other, is probably more needed than determining whether migration is truly an adaptive response in rural communities. Without this understanding, it may be difficult to design effective strategies that prioritise resilience from environmental change in rural development. While rural-rural migration appears to be a survival-oriented response strategy, it may as well be maladaptation over the long-term, resulting in climate-induced poverty traps. As the dominant migration thesis posits, a 'survival threshold' exists above which migration provides a means of diversifying economic risk (Ng'ang'a et al., 2016). However, below this 'survival threshold', migration drivers may include food insecurity, indebtedness and land displacement fears. Of these, only food insecurity may be addressed by remittances (Adams and Cuecuecha, 2013; Naiditch et al., 2015). Thus, more research efforts are needed in addressing the interconnections among factors such as poverty and climate adaptation, including longitudinal investigations on the nexus between climate, debt, migration, land and food security.

8.8 Summary and conclusion

This chapter investigated the extent to which environmental change, among other factors contributes to the rural-rural migration patterns in Zambia. Insofar as the findings demonstrate, environmental change played a major role among other drivers. It was largely responsible for the movements of most of the respondents interviewed especially those from the southern part of Zambia. This is perhaps because rural-rural migration does not particularly require as much resources as rural-urban or international migration. Thus, as evidenced in this case suggests, it can be concluded that gradual and long-term environmental factors do force rural-rural migration. However, other factors also play a part. For instance, although the economic factor appeared to have been a secondary determinant, it influenced and drove the migration process. However, a point that is not made early enough is that while it sounds trendy and fashionable to state that migration is an adaptation strategy, realities facing rural communities may be totally different and more nuanced. With analysis at household and community scale, an unexpected pattern of climate-reinforced poverty was uncovered. On the one hand, some households were unable to migrate immediately when they needed to, given the restricting economic factors they found themselves in at the time, while on the other, some were just unwilling to move given their strong cultural attachment to the land. This inability or failure to move has its own range of consequences from both the environmental and economic risk perspective, given the additional or incremental exposure potential it creates. Thus, while uncertainty remains about how exactly climate variation manifested in cumulative inter-annual impacts, the poor rainfall years and migration numbers suggest an association. As stands, migration appears to be an immediate survivalist option in rural-rural movements between the areas studied and may, given climate projections, prove to be a maladaptive response in the long-term. There is little or no economic security in rural-rural migration given the lack of titles on land ownership, clear policy direction and infrastructure.

CHAPTER 9: DISCUSSION AND CONCLUSION

9.1 Introduction

Based on multi-disciplinary methods, this research investigated rural-rural migration and the causes of environmental change. Using Zambia as a case study, the extent of environmental change was examined using climate, land cover, soil and/or land degradation as indicators. Also examined were ways in which environmental factors interact with other migration drivers to force rural-rural movements of people. Furthermore, the socio-economic attributes at household level were assessed to gain an insight of environmental change adaptive capacity, including ways by which people recognise and respond to change and/or variability. Findings are discussed in this chapter with conclusions drawn based on the patterns observed in the dataset. As demonstrated in this thesis, human-environmental interactions are complex. Therefore, a reflection on how the research approach strives to build a methodological framework that cut across various disciplines in the physical and social sciences to understand this complex human-environmental interaction is also highlighted. This includes what may be considered as academic or theoretical contribution, narrowing the conceptual gaps in migration theory where focus has been on economic differentials and sudden environmental threats.

9.2 Migration and adaptation

Social systems or institutions of governance and culture play a major role in shaping livelihood activities for, and outcomes from environmental asset striping (Elie, 2017). Within the broader concept of migration theory and adaptation in the face of environmental change, this research focussed on teasing out the social, economic, demographic and political drivers from the environmental driver. Insofar as the results suggest in Chapter 8, gradual and long-term environmental change factors seem to have played a major role in driving migration among most respondents interviewed. While uncertainty remains about how exactly environmental change and climate variation manifests in cumulative inter-annual impacts to force movements

in rural-rural migration, the poor rainfall years and migrating population numbers suggest a positive association. However, association is not causality. Nevertheless, although other factors e.g., economic, appeared to have been of secondary drivers in this study, results show that they determined when to migrate and therefore 'powered' the migration process. Given such restricting economic factors, some migrants were unable to migrate within a year after conclusion to do so had been made. Findings also show that within the context of migration, risk perception on spatial, temporal environmental variabilities and economic differentials between places, can influence the *remain* or *migrate* binary decision including the spatial extent of migration.

Degraded environmental conditions in form of poor soil quality and rainfall or drought were perceived and ranked highest as major livelihood risks in this study. Respondents in migration sending areas ranked poor rainfall and poor soils the highest among *push* factors. Conversely, good soils and adequate rainfall ranked highest among *pull* factors in migration host areas. Nearly all migrant respondents cited poor soils and droughts in source areas as their main reason for migrating. Similarly, more than half of those who could not migrate – *remainers*, also ranked these factors as highest threats, although their decision to remain was influenced by other factors. As findings show, cultural or traditional considerations e.g., attachment to land can prevent migration. About three quarters of *remainers* cited cultural and traditional factors as their main reasons for remaining.

From both the environmental, and economic risk perspective, this inability and failure to migrate by the *trapped*, based on culture connotation has its own range of consequences. The potential for additional or incremental risk exposure exists and this, can increase or compound vulnerability levels among the *trapped* (Adger et al., 2015). However, while findings have shown that migration can improve economic conditions, as stands, it appears to be an immediate survivalist option in rural-rural movements. Given climate projections, it may prove to be a maladaptive response in the long-term. As evidence suggests, there is little or no economic

security in this type of migration given for instance, the lack of titles on land ownership, changing environmental conditions and rainfall patterns. Security of ownership is vital as it potentially creates intergenerational economic resilience, a more productive and inclusive economic system with access to credit (Ng'ang'a et al., 2016).

9.2.1 Household vulnerability and livelihood diversification

By human agency, ecological systems can be altered in ways that result in gradual or long-term impacts on human social systems and the environment (IPCC, 2014b). As findings presented in Chapter 7 demonstrate, because they are not sudden event-focussed, gradual, longer-term changes in environmental conditions continue to dispense impacts on social systems, livelihood options, and socio-economic pressure dynamics at various spatial and temporal scales. For instance, because of green revolution and agricultural extension programmes administered in colonial and post-colonial Zambia in the 1930s through to the 1980s, some parts of Zambia were deforested and remain largely so. Southern Zambia particularly was the most affected during this period (Chevo, 2014). Owing to agricultural activities, central Zambia has also experienced a similar deforestation pattern in the recent past comparable to that observed in southern Zambia. Given historical engagement with extension officers of the colonial and post-colonial era, findings reveal that rural communities continue to view agricultural extension as forest cover removal to pave the way for farmland.

Furthermore, with only 21 percent of the total population having access to electricity (World bank, 2015), pressure on local forests continues to steadily increase due to the energy demands of a population increasing at about 3 percent per annum (CSO, 2015), and a 35 percent electrical energy supply deficit (2015 data) (Sladoje, 2016). Taking advantage of this rising demand, rural households engage in charcoal production for extra income away from farming. Insofar as findings have revealed, land-use change due to demand for agricultural land and energy needs appear to have been the major driving forces perpetuated by the political ecology of marginalisation, access and control, especially in agro-ecological zone IIa. As demonstrated by

Bosmans et al (2017), these changes have long-term implications on forestry, local hydrology, climate and livelihoods. In the context of climate change mitigation, understanding the magnitude of land-use change and wood fuel demand dynamics is important for policy intervention on deforestation, development of sustainable and cleaner alternative energy sources (Bowman, 2010). And as evidence presented in Chapter 7 seems to suggest, forest clearance for agriculture and wood fuel remain the major causes of the deforestation and land degradation challenges observed in agro-ecological zones I and IIa, with potential to accelerate local climate change.

While programmes addressing climate change do exist, there has been little comprehensive response in addressing local drivers of deforestation and anthropogenically driven climate change. As presented in Chapter 2, energy needs remain unaddressed and the sector underdeveloped, while rural electrification remain politically driven and selective in approach. Without alternatives, charcoal making in rural areas, and selling in urban areas continue as immediate options for additional income away from agriculture. However, it is unlikely that poverty levels and hunger would be adequately cushioned in the agro-ecological zones. Income from selling charcoal is insufficient to meet competing and rising costs of food, education, clothing and healthcare. Government policy on poverty reduction remains irresponsive to such realities; a rhetoric at best to rural development. If there is anywhere where this rhetoric becomes clear, it is the Agriculture Input Support Programme (AISP). While government has made clear commitment -at least on paper to AISP, its failure to supply inputs to farmers on time continues, even after farmers pay required upfront fees. In addition, the amount owed to farmers from the maize 'bought' by government remain unpaid for long periods, sometimes even up to 18 months. This has made it difficult for rural livelihoods dependent on agriculture to practice farming as a viable business. Thus, vulnerability to climate change may increase given the multidimensional poverty levels and weak adaptive capacity potential according to findings in Chapter 6. What this suggests is that adaptation is likely to be difficult as farmers remain

long-term casualties with social-mobility foreclosure, trapped in a failing policy and crop marketing system.

As demonstrated in Chapter 2, the continued inimical approach by government to rural development priorities is not new. It is what appears to be a cycle of 'new leaders, same problem'. For example, following agricultural extension programmes and green revolution in both colonial and post-colonial regimes designed to lower maize costs for urban consumption by increasing maize crop production in rural areas, soil erosion problems regularly resulted due to deforestation and land degradation (Chevo, 2014). Similarly, findings show that the main agenda currently is to extract surplus of staple food-crop cheaply with little or no attention to environmental impacts that might arise. Insofar as findings have demonstrated, with overproduction of maize crop, maize prices plummet to the benefit of the political bureaucrats and urban dwellers. This is consistent with the findings of Gewald and Soeters (2010) examining the colonial and post-colonial period. While farmers continued to internalise losses from plummeting maize prices on the one hand (Chevo, 2014), the environment on the other continued as an infinity sink for negative impacts that resulted from cultivation and mono-cropping of maize. Similarly, evidence suggest that today's government soil erosion and agricultural conservation agendas continue to be inimical to the natural resource-use priorities of the local people and farmers. The approach appears to perpetuate past governance strategies through which the urban population continues to benefit from rural population: obtaining food-crops cheaply while the rural producers internalise the losses around an inefficient crop-marketing system, including environmental change impacts on livelihoods. Thus, while there have been several significant changes in socio-economic landscape of Zambia, the political ecology around agriculture and rural development in the colonial, post-colonial and current setup, are staggeringly comparable. Rural farmers worked the land and continue to do so without just income for their produce and labour. Obtaining cheap food supplies from rural

areas for indigenous bourgeoisies – the post-colonial politicians and new bureaucrats who replaced the European colonialists continue.

Consistent with Blaikie's (1985) findings, four salient features of political ecology common in post-colonial and current governance systems include:

a) Reinforcement of regional differentiations and income disparities between urban and rural areas. Rural provinces (e.g. Western, Northern, North-western, and Luapula) continue to be neglected while provinces along the main transport network (e.g. Southern, Central and to some extent, Eastern) became relatively developed with the commercialisation of small-scale agricultural production;
b) Underpayment of farmers by government continues through fixing selling price of main food crop – maize;
c) Emphasis on single food-crop production continues. As in the past, maize continues to be supported by government through seed subsidies and marketing. The Kanchomba Agricultural Research and Training model discussed in Chapter 2 and similar agricultural research centres that supplemented its agenda continue to experiment on various maize and other crop varieties - all of which disregard environmental impacts of the rural farmland;
d) Rural population continue to be viewed as people without own aspirations or priorities of their own, and therefore often discounted by policy makers.

As findings demonstrated, the continued emphasis on extension programmes of mono-crop agriculture , coupled with massive use of chemical fertilizers to increase yields is resulting in similar long-term environmental impacts on soil quality and land cover reduction attributed to the green revolution movement highlighted by Chevo (2014) and Dawson et al (2016). Using a top-down approach, government has been discounting local or small-scale farmers at three levels: First, as a people of culture with own experience, possessing ecological knowledge and worldview of their own; second, as political agents; thirdly, as long-term casualties of social

policy decision outcomes. Yet, as evidence in Chapter 5 suggests, indigenous peoples can have sound local ecological knowledge and conservation understanding with great potential to effectively deal with environmental conservation and climate change adaptation (Makondo and Thomas, 2018). However, as demonstrated in chapter 2, policy makers seem to assume that local and indigenous peoples have no significant knowledge useful enough to shape sustainable development. Their knowledge, remains underutilised and often ignored (Belfer et al., 2017). Two important points are worth highlighting. First, political ecologies and discursive spaces have led to this neglect as demonstrated in Chapter 5; second, public policy - centrally driven, has been and continues to be shaped primarily around the perceived immediate needs, addressing sudden aspects of change whose impacts can be felt or seen almost immediately. Conversely, gradual but long-term changes do not have the same visceral power as sudden or short-term changes, and therefore, easily fall too far beyond the immediate or the visible to attract policy attention. As Rob (2013) argues, because they are cataclysmic and scientifically convoluted, gradual and long-term impacts such as soil erosion, deforestation and dwindling land fertility tend to evade the social memory bank.

Yet, despite their lack of eye-catching or 'page-turning power', gradual and long-term environmental change impacts tend to operate as major threat multipliers. Amidst political-economic dynamics, they potentially proliferate conflicts where conditions for sustaining livelihoods become increasingly but gradually degraded and unbearable (Verhoeven, 2011). Given wealth and access disparities between groups, findings presented in chapter 7 show that conflicts are present in the study area due to the increasing mistrust between the indigenous population on the one hand, and the migrants on the other.

Household capital endowment can be influenced by many factors. As evidenced in chapters 6 and 7, household capital varied greatly along gender, household size and age, and between areas. Along gender, variations were not surprising as literature evidence suggests that traditional practices in developing nations tend to disadvantage women in accessing productive

assets in livelihoods (Arslan et al., 2015; Higgins and Coffey, 2016). Right of access to productive assets such as farming tools and land are not held equally between gender in most developing nations (Ali et al., 2016; Deininger et al., 2017). In this research, findings on these differentials are consistent with those of Ali et al (2017) and Deininger et al (2017). Generally, results demonstrate that women still experience restricted access to credit and technology and rarely own productive assets. Productive assets are culturally controlled and owned by men. In case of marriage failure ending in divorce, property is rarely shared as a woman is normally premised as wrong. Perhaps these cultural beliefs and practices explain why women were generally found to have low capital endowment, making them more vulnerable. Social exclusion of this sort has far reaching implications on rural poverty. It tends to leave some more vulnerable than others, even to slightest changes in environmental-related conditions (Shah et al., 2013; IPCC, 2014b). Adaptation potentially becomes difficult among the excluded as they are without assets to fall back on during times of adversity. As findings revealed, because migration tend be at individual level initially, before entire family can follow, women also tend to remain behind as men leave first. Most initial migrants leave permanently, sometimes connections completely. St that stage, even sending remittances stops. This was clear in the case of AEZ I where there were more female-headed households left behind by relatives or husbands who migrated to AEZ IIa. As shown in Appendix A5, more than half of the studied households were female-headed in AEZ I.

Other factors such as level of education also play a role in poverty vulnerability reduction. Given the hypothesis in economic-theory around formal education attainment, understating how capital endowment and livelihood diversification was influenced by the education variable was important. Formal education potentially results in multiple skills, and therefore, lower the livelihood vulnerability (Peter, 1974). However, as results presented in Chapter 7 suggest, the education variable seems to have no impact on livelihood vulnerability insofar as the studied household were concerned, probably due to some underlying characteristics within the data as

shown in Appendix A6. Households headed by those without any formal education training constituted the smallest percentage of the sample, while those headed by primary level education attainment constituted the largest. Secondary and tertiary level constituted the third and second smallest. While the importance of formal education cannot be ignored, policy intervention may have far reaching positive impacts if focussed on agricultural skills-training within the context of building resilience and adaptation to climate change in rural livelihoods. As findings show, current farming practices are environmentally unsustainable. Households heavily utilise chemical fertilisers while forest clearance, based on extension agriculture concept continues to be viewed as a norm for increasing crop production.

Unlike the education variable which has no correlation with capital strength, findings on the age variable suggest a positive correlation except for a few outliers. Generally, the older the head of household is, the stronger the capital standing of the household. The reasons for this trend may be complex but access to land could partially provide an explanation. Most young people below 30 years were found to have little access to land. For instance, one child-headed household (below 18 years old) was found to have the weakest standing in all capital types, just as senior citizens-headed households relying on children as caregivers were. Households comprising children as caregivers have are affected with far reaching impacts on the future as vulnerability levels among such households potentially increase. Future social-mobility foreclosure is likely to be high due to irregular school attendance by such children.

Unlike education or age, the influence of the migration variable as an adaptation strategy was very clear on household capital. Migrant-headed households possess a stronger capital structure than those households headed by their indigenous counterparts. Causes of this disparity remain unclear. However, results suggest that migrants diversify livestock than indigenous farmers; rearing goats, cattle, sheep and pigs which easily convert to cash when needed. Their farming strategies are also generally more diversified, growing a mix of drought-resistant crop varieties. Similarly, larger households allow a broader approach to risk reduction on household capital as

they reported more diversification activities and hence more income. Among such activities ss cheap labour provision at local commercial farms during certain times of the year. Extra income is sometimes invested in small-scale businesses run along family lines. Unlike much of the indigenous population, nearly all migrants interviewed subscribed to locally organised social clubs or co-operatives. Supported by CSOs or donor funds, community agricultural co-operatives facilitate easy access to simple loans and support on marketing cash-crops grown by members.

However, most migrants occupy relatively smaller farmlands with relatively poor soil conditions compared to those occupied by indigenous households. As such, most migrant farmers rent un-used farmland owned by indigenous farmers. Generally, the laws have been largely irresponsive to the land-value dynamics. Acquisition of title can take decades as a highly centralized system makes it tedious and expensive. In many instances, the process has been marred by corruption (ZLA, 2018).

While the law vests all land in the presidency for and on behalf of the Zambian people, it recognises that rural land, un-surveyed and not on title, is owned by traditional leaders. Decisions by traditional leaders are statutorily recognised and legally binding. Chiefs can give land of up to 200 hectares to anyone (Ng'ombe and Keivani 2013). As findings uncover, two legal systems function side by side, blending and clashing at points of interaction: one written and legally administered; the other unwritten and tacitly administered. It is this duality that is specifically problematic as argued by Chatelard (2014) and BBC (2017): it increases chances of land displacement of some of the poorest in Zambia. Rural displacement is made easy because most small-scale holdings are not on title. In the face of Chinese investors pushing for government contracts, while looking for mineral rights and agricultural land, rural land is at risk. Without title, securing agricultural loans using land as collateral remains remote and the rural poor are likely to remain poorer. Findings also show that traditional chiefs and community leaders demarcate and distribute land at will without subjects or stakeholder engagement. This

evidence is consistent with the findings by Ng'ombe and Keivani (2013). The powerful and privileged decide without stakeholder consultation, transparency and accountability. It is also consistent with the findings by Fahmida (2017) which suggest that displacement of the rural poor by 'investors' is occurring in much of Zambia's rural areas under the guise of investment and development. As Fahmida (2017) argues, land is given to the financially powerful. Chiefs continue to corruptly give more land than legally permitted. While some CSOs continue to advocate for secure customary land ownership through issuance of titles, results of this advocacy remain intangible (ZLA, 2018).

Furthermore, in urban and peri-urban contexts, local councillors and political party supporters at the community grassroots level continue to exploit loopholes and weaknesses that exist in the land administration procedures and corruptly allocate land. Arguably, this is what may have proliferated informal and unplanned settlement development in peri-urban areas and encroachment of some of the protected forestry reserves nearby. Given the desperation and ignorance of the general public over land laws, only about 30 percent property owners have genuine titles in Zambia (Mushinge 2016). Lack of title potentially hinders meaningful investment in real estates and the development of permanent structures. And as findings uncover, poor and weak housing structures particularly vulnerable to flooding tend to dominate both rural and urban landscapes. The provision of even the most basic of social amenities lags far behind. Given poor medical facilities, water and poor sanitation related diseases are perennial in unplanned settlements and rural settings (Kasali, 2008). However, despite these challenges, such settlements are important politically as they house a massive population of voters. Hoping for better living conditions, people in these areas vote in numbers and as such, they have been generally abused by politicians who continue using them as a launchpad to power their own political careers.

9.2.2 Climate change policy and adaptation programmes

There is no doubt that adaptation and mitigation efforts in addressing climate change are essential for socio-economic progress and sustainability (IPCC, 2014b). As findings reveal in Chapter 6, year-to-year rainy season onset and cessation variations have affected the scheduling of agricultural activities, right from land preparation, planting period, type of crops to grow, to amount of yields. Results suggest a shift in the rainy season duration with frequent onset delays and early cessation in both areas studied. This implies that the crop-growing season has been gradually reducing with potential for yields reduction as chances of crop failure increase. In addition, since transmission of vector-borne crop and livestock diseases are linked to variability and changes in rainfall and/or temperature (Amekudzi et al., 2015), rainy season onset and cessation periods have potential to influence transmission rates. As findings show, Agro-ecological Zone I (AEZ I) shown in Figures 1.1 and 6.1 had higher rainfall variabilities, experienced more crop and animal disease prevalence over the period studied, threatening food security, nutrition and other socio-economic activities. For the period examined, findings show that there were more droughts, fewer rainy days, shorter rainy season duration in AEZ I than in AEZ IIa. And as the household capital structure and overall HVI-IPCC results suggest, AEZ I is found to be more vulnerable in the face of climate change than AEZ IIa. Rainfed agriculture as the main source of food is likely to face more adaptation and resilience difficulties with such reductions in rainfall.

In this investigation, evidence shows that the policy framework for climate change adaptation is inadequate and lacks coherency as adaptation tends to be addressed by a plethora of fragmented environmental and developmental policies. This lack of harmony potentially counteracts efforts in building resilience. For example, strategies are generally positioned within the environmental sector, mostly focused on biophysical vulnerabilities with very little or no synergies with other sectoral plans. In most cases, projects to adaptation tend to be ‘stand-alone’, limiting effective integration for broad and robust responses. Findings also show that there is limited public and

decision makers' understanding of climate change and its potential impacts on rural livelihoods, environment, infrastructure and national economy. This has also tended to undermine political 'buy-in' for prioritisation and resource mobilisation for adaptation. Addressing the impacts and sectoral planning for adaptation is reactive, mostly done in an ex post facto manner. Similarly, the interpretation of adaptation and/or resilience programmes and their implementation tend to continuously shift, dependent on sources of funding.

Donors and international development agencies dominate the resilience and adaptation agenda at both national and community grassroots level. Poor coordination and lack of communication limit efforts to integrate other important sectors such as agriculture and energy, other than poverty reduction where the bulk of development fund is channelled. Often, without exchange of experiences or lessons learnt, this approach has tended to yield no tangible results especially at community level. In some cases, donors merely rebranded existing initiatives as climate change adaptation and resilience projects. In the long run, this has created challenges for government and donors alike to accurately assess the funding requirements for adaptation strategies. As findings show, this makes micro-level adaptation requirements difficult to assess while international funding access remains hard to justify. Where government implements projects, irregular flow of funding dominates while political rhetoric takes to the floor hindering delivery of tangible outcomes.

Similarly, stakeholder needs, and interests are not adequately reflected in the centrally driven adaptation responses. A review on the formulation of the adaptation policies and strategies revealed a process that is highly donor/state actors dominated in which there has been limited space for civic engagement. Local CSOs and communities have so far played a limited role in adaptation policy formulation processes. As Chandra et al (2017) argues, environmental change, degradation and rural development policies in developing nations tend to continue understating human rights related issues, inequality and injustice due to the normative visions and economic interests in state relations. The same approach is observed in developed nations when

governments deal with indigenous communities, see e.g., Mearns and Norton (2010) or Shearer (2012). Without recipient involvement, governments and donors shape programmes. For instance, under international climate solutions such as CSA, and Certified Emissions Reductions, international institutions determine loans and subsidy policies. As argued by (Jost et al., 2016), this approach leads to negative externalities, the exclusion of poor groups and indigenous communities as accrued development benefits are captured by multinationals, elites and political bureaucrats. This situation potentially undermines key governance principles of equity, stakeholder participation, accountability and transparency. A participatory approach to the assessments and development of adaptation responses is specifically important for sustainability purposes. As demonstrated in this thesis, knowledge integration is needed for effective adaptation. The existing weak coordination framework within the donor community working in Zambia, where climate related matters are confined to environment working groups only, need to be addressed. Similarly, if there are any sectors where coordination and policy harmonisation is urgently needed, it is in the energy and agricultural sectors. The energy sector remains underdeveloped with more than 80 percent of the population dependent on wood fuel. As demonstrated in Figures 7.28 and 7.29 of Chapter 7, lack of access to electricity potentially leads to environmental degradation through charcoal making and cutting down of trees for wood fuel. In view of these impacts, policies need to be harmonised and made responsive to the increasing deforestation and environmental degradation problems. Otherwise, a vicious circle of environmental change and degradation is likely to continue, while the associated impacts affect livelihoods of the poor.

9.3 Methodological and theoretical contribution

Within the broader concept of human-environment interaction and migration, this thesis makes a conceptual, empirical and methodological contribution on five fronts. These are discussed in the subsections below

9.3.1 Methodological framework

Focussed on human-environment interactions in the broader philosophical foundation of political ecology, this research breaks methodological silos and contributes a methodological and philosophical approach that draws tools from multiple disciplines. In the context of the human-environment nexus and climate change, a scientifically credible understanding of social behaviour warrants an integrated multidisciplinary approach. For example, behaviour related to resource extraction and responses to environmental hazards and extremes, and how responses are influenced by socio-economic factors emanating from a given governance system may not be adequately addressed by a single-handed disciplinary approach (Hodbod and Adger, 2014). Only a multidisciplinary approach promises to bring out important information, given that ecological and social dynamics can be compounded by prevailing socio-economic and political underpinnings which context specific (Rissman and Gillon, 2016). For example, by focussing on shocks and trends of environmental change, this thesis demonstrates how techniques in Sustainable Livelihood Framework (SLF) can be applied and contextualised with other methods e.g., IPCC- framework. This allows a nested, multiscale vulnerability analysis from a household to regional or zonal level.

SLF is shown to be a useful lens for examining complexity of rural livelihoods - how they respond, cope or adapt from various shocks and trends. Through an inductive process, and placing emphasis on quantifying livelihood capital predisposition, this thesis positions findings in the context of existing theory. It is demonstrated how household living standards can be measured and evaluated based on available capital and contextualised in the face of adaptive capacity to environmental change. The methodology also demonstrates how available assets play a fundamental role in shaping livelihood choices and how external intervention can use this evidence to focus support on specific capital assets of households. This focus, which can be guided by evidence or empirical information is important as it has potential to guide

interventions that may not only reduce inequality between or within demographic categories, but also improve adaptive capacity to environmental change across the categories.

Similarly, to assess historical and current environmental change, it is demonstrated how a multidisciplinary approach can assemble different timeframes into a single research project. For example, in investigating the environmental aspect of deforestation, land cover and land-use change over 40 years, time series satellite images were used to track changes. This information was then supplemented by oral histories which go back even further in time, while transect walks assessed impacts and driving forces of environmental change. Furthermore, while profiling socio-economic status of households, a semi-structured questionnaire was also used to scope perception, opinions and understanding of most recent and current environmental change aspects. In this regard, it is demonstrated how a wealth of information can be collected. Such a multidisciplinary methodological embodiment allowed a more broad, thorough assessment and evaluation of various factors that cannot be adequately dealt with through a single methodological approach to research of this sort.

9.3.2 Philosophical framework

This thesis has shown how such aspects as adaptive capacity, resource access and control, land rights, food security, power relations, land reforms and gender (often framed apolitically) can be critically examined through a philosophical lens of political ecology. The thesis demonstrated in how injustice and inequality that are often subliminal but deeply embedded in social demographics can be uncovered. When viewed in the context of the five-dominant theses conceptualisation of political ecology proposed by Robbins (2012), this research builds on the marginalisation and degradation thesis. It is shown how environmental degradation usually blamed on marginal population can be uncovered in its larger political and economic context. For instance, when considering the major underlying driving forces of the changing environmental conditions, it is shown how driving forces in their larger political economic context are nothing but capital and wealth accumulation. The green revolution in southern

Zambia is a classic example of this illustration in the thesis where efforts to improve production systems of local people led to decreased sustainability of local practice with linked decrease in the equitable distribution of resources.

The thesis shows how political ecology helps uncover and explain how inequalities and injustices are created, reinforced and propagated by the political establishment linking arguments that highlights identity politics and capital accumulation as the real causes of failure, e.g., in mainstreaming indigenous knowledge in climate change adaptation programmes dominated by the global North. This ignites a debate within the broader philosophical concept of political ecology and discursive spaces that makes it possible to rethink the marginalisation of indigenous knowledge in climate change policy design and programmes of action.

9.3.3 Migration theory

While mainstream debates on environment-migration and adaptation have tended to focus almost entirely on displacements and cast migration as a problem, the influence of environmental change can be variable and is still largely poorly represented in standard theories of migration (Black et al., 2011; 2011; Geddes et al., 2012a; Joseph and Wodon, 2013). A bulk of research has dedicated much effort to international movements which are largely driven by economic reasons and income differentials. When focussed within borders of specific nations, rural-urban movements and involuntary resettlement somehow take the focus by default. Little attention is given to rural-rural migration. Similarly, little attention has been given to the potential impacts *of* migration *on* environmental change, i.e., the agency of people moving from one area to settle in another remains among the least understood. Focus has largely been on

By focussing on rural-rural movements, this thesis potentially narrows the gap that exists in environmental-related migration where rural-urban, involuntary resettlement, sudden and extreme environmental disasters dominate with income differentials as factors driving migration. Within environmental explanations of migration, long-term events tend to be tilted

towards abrupt and short-term events e.g., tsunamis, typhoons, tornadoes and floods (Carr and Kenyon, 2015). Studies on gradual or long-term environmental change events such as desertification, soil erosion and droughts are few and limited in scope (Hugo, 2011; Piguet, 2013; Adger et al., 2013a; 2015). In this regard, this thesis contributes theoretically to the understanding of the extent to which the environmental factor interacts with other migration drivers in the binary 'stay' or 'migrate' decision process. The thesis untangles and establishes the extent to which the least studied long-term environmental drivers can trigger migration in the least understood rural-rural movement of people. Potentially, this improves understanding within the broader concept of migration theory.

9.4 Study limitations and future direction

While this research employed a multidisciplinary toolkit to strengthen the methodological approach, it is not without limitations. For instance, there are challenges in utilising perception and individual personal judgement. Environmental indicators such as soil quality were determined using respondents' perception, which may not necessarily reflect the true condition of soils in question. However, because scientific measurement equipment would have required a vast number of samples to test soils since chemistry greatly varies over small distance, depth, and temporal scales (Liu et al., 2018; Appleton and Cave, 2018), farmer's perception was utilised. Given enough time, an opportunity lies ahead to assess soil quality in the same way rainfall has been, using equipment-based measurements to ascertain conditions and validate farmer's perception. Just like perception, interviews also have their own limitations. For example, focus group-based interviews tend to suppress views along such social stratification as age, gender and class. Also dependent on the type of information and length of time taken to administer, questionnaires can present difficulties as some respondents may just want to answer to finish an interview quickly, thereby providing non-useful information containing errors (Smith, 1996; Rolstad et al., 2011).

As demonstrated in Chapter 3, methodological approaches such as the Livelihood Vulnerability Index (LVI-IPCC), impact, vulnerability, and risk assessment also have limitations. For instance, sub-components used to construct the overall index may not reflect other populations within an area as human societies are a compendium category subject to infinite local differentials and 'speciation'. These are a complex reality normally oversimplified in form of composite indices of sub-components averaged into single major component score. Variance consideration between study populations or categories is discounted (Vincent, 2007). Other limitations involve the primary data used, which is dependent on how accurately the other sub-components fit in to quantify the major components including the weightings (Hahn et al., 2009). Furthermore, since LVI is done at local level, it cannot be merged with climate projection methods like the general circulation models (GCMs) which have potential to extend further, from 'the now' livelihood assessment, into the future than the LVI allows (Hahn et al., 2009; Vincent and Cull, 2010). In this regard, a more robust methodological development which can be merged with GCMs to allow future livelihood projection scenarios along climate change is needed. Similarly, other IPCC approaches to vulnerability assessment can be explored dependent on the needs and available data.

On migration, more data are needed to assess the linkages between gradual or long-term environmental change and rural-rural movements. Due to data challenges over the 36 years period, only the last 26 years with traceable migration data were assessed in this investigation. Therefore, there is need in future works to address the uncertainty that remains around how exactly environmental change and climate variations manifests in cumulative inter-annual impacts to drive rural-rural migration. Similarly, while recent estimates suggest that the Chinese immigration into Zambia has been steadily rising since 1990s (Postel, 2017), these estimates are somewhat economical on the figures and only go up to 2014. Therefore, are not inclusive of the recent past. As such, data are needed on Chinese migration flows and how these influence local land use and ownership dynamics, including local population flows within Zambia. As

highlighted in Chapter 2, the communist ideology-driven 'investment and cooperation' is a fully-fledged profit accumulation exercise with great potential to propagate negative externalities on the environmental. The land size occupied, including means and/or types of agricultural production are not clearly known or understood due to data unavailability.

9.5 Conclusions

As broadly demonstrated through a political ecology lens, the colonial and post-colonial government strategies toward rural development were the same. They both indirectly subjected rural subjects into multidimensional poverty with long-term social-mobility foreclosure. As demonstrated in this thesis, an uneven development pattern emerges. The pattern continues its trajectory across different political regimes with agrarian reforms and land distribution decisions reinforcing social division along class, gender and race. Ecological degradation and environmental injustice deepen in rural communities dependent on rainfed agriculture as vulnerability becomes acute in the face of climate change. Differentiated vulnerability and risks emerge across socio-economic demographics; gender, migration status, age and geo-political location. Overlooked in government statistics, household vulnerability increases with decreased access to basic social services such as education, healthcare and food security. With poor infrastructure, long distances to marketplaces, medical facilities and schools, rural people are confronted with a type of multidimensional poverty that makes them most vulnerable in the face of climate change. With an eroded 'social memory bank', compounded by the invisible, slow and long-term changes in environmental conditions, the rural population remains vulnerable given limited livelihood options. Deforestation for agricultural land and wood fuel are likely to continue as a norm. Driven largely by the political ecology of marginalisation in energy supply and agriculture, these activities remain among the main driving forces to the land-use change, land degradation and soil erosion observed. As forests rapidly disappear and bare land converts to farmland, sedimentation in dams impacting rural livelihoods and hydropower generation increases. While some people migrate and settle into AEZ IIa where their vulnerability level to

economic shocks become relatively lower than that of remainers in source areas, it is evident that their risk to environmental change remains the same. Overall, the following conclusions can be drawn:

1. Trends in rainfall, droughts and environmental degradation in AEZ IIa are comparable to AEZ I. The number of droughts has increased as rainy season and amount of rainfall reveal a reduction in both areas. Similarly, land degradation has increased especially in AEZ IIa. However, while AEZ IIa continue to receive relatively high rainfall, the year-on-year rate of reduction is faster than in ARZ I. Nonetheless, the number of droughts is still lower than in AEZ I.
2. Changes in environmental conditions are widespread. Land degradation, and land cover change is evident in AEZI and AEZ IIa. Energy pressure needs and demand for agricultural land are among the major drivers of the observed changes. All the 100 households interviewed in this study have no access to electricity and rely on wood fuel for cooking and heating. However, wood fuel demand differs between agro-ecological zones. There is more demand in AEZ IIa than AEZ I which is driving deforestation along with agricultural land needs. Soil erosion, land degradation, siltation of water reservoirs is evident in AEZ IIa. Similarly, due to poor soil quality, over cultivated soils can no longer sustain plant growth without fertilizer application. This has potential to drive further forest encroachment for farmland;
3. Gradual and long-term environmental factors do force rural-rural migration as evidenced in this investigation. However, economic and social drivers also do but to lesser extent insofar as results suggest. Only demographic and political factors seem to have little or no role in this type of movement. It is also true that environmental factors do not singularly drive migration as there is always an interaction between factors. In this study however, environmental factors are found to be the main drivers;

4. While environmental risk perception varies across households studied, environmental stressors and threats can rank relatively higher in both source and destination areas than other factors. Insofar as results suggest, droughts, land quality, and available rainfall are perceived as the main environmental risks to rural livelihoods - powerful enough to trigger migration as adaptation. However, as demonstrated in chapter 6 through scientific data, rainfall patterns between the zones examined is not any different. Therefore, the reason for migration if environmental-related, it more likely to be about individual perception of the environmental threats. Furthermore, findings reveal that people in the rural-rural movements view migration not as adaptation, but as an avoidance response to heightened environmental risk. The contexts in which such concepts are integrated and interpreted by political institutions, at what scales, for whom, and to what end widely vary. They are funding source-determined;
5. The impact of rural-rural migration on adaptation, vulnerability and resilience varies along gender and households between sending and host areas. Sending area households are more vulnerable. In cases where migration separate families leading to more female headed households in sending areas, vulnerability levels are high. Even with remittances, female-headed households still posted weakest capital standing overall. While migration has shown to be a working adaptive strategy as migrants generally posted the strongest capital base thereby making them least vulnerable, it may prove to be a maladaptive response in the long-term given the observed changes in climate. There is little or no economic security in this type of migration given land insecurity, changing environmental conditions and shifting rainfall patterns. Insofar as findings uncover, rural-rural migration seems to be no more than just an immediate survivalist option as migrants try to avoid job competition associated with rural-urban migration. They believe they are better off sticking to what they know best -farming;
6. Spatial scales of rural-rural migration are determined by many factors. Amongst these, risk perception, environmental conditions, social networks and to a lesser extent,

economic expectations. Migrants settle in areas they perceive to be arable and fertile with favourable rainfall conditions in view of economic benefits;

7. In terms of policies, contradictions continue to present implementation difficulty in both land administration and climate change resilience programmes. If there is anywhere where this is clear, it is in the priority constraints of government departments. There is a pattern of opposing behaviour between actions on the ground and policies on paper. Rural infrastructure remains underdeveloped while multidimensional poverty and high vulnerability levels continue to threaten natural resources. Yet, even when there is enough evidence that the climate change is deteriorating water resources and forest conditions, institutions responsible for managing these resources appear to have limited capacity. While some form of legislation is in place to regulate land use, water and forestry resources, it lacks harmonisation across sectors. For this reason, the overall policy implementation has been contradictory and chaotic especially where overlaps of institutional mandates exist.

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APPENDICES

Appendix A: Summary of datasets

1. *Climate dataset (1980-2016)*

Description	Amount of Rainfall (mm)		Duration of Rainseason (days)		No. of Actual Rain Days		Number of Dry Days		Frequency of Dry Spell Occurence in the Rain Season (5-9days long)		Frequency of Dry Spell Occurence in the Rain Season (10-14days long)		Frequency of Dry Spell Occurence in the Rain Season (>14days long)	
Study Area Name	Kabwe	Livingstone	Kabwe	Livingstone	Kabwe	Livingstone	Kabwe	Livingstone	Kabwe	Livingstone	Kabwe	Livingstone	Kabwe	Livingstone
Totals	31401	23311	5757	6014	2646	2106	3111	3908	103	157	22	55	32	57
Length of Time (Years)	36	36	36	36	36	36	36	36	36	36	36	36	36	36
No of days of data used	5757	6014	5757	6014	2646	2106	3111	3908	5757	6014	5757	6014	5757	6014
Mean	872.3	647.5	159.9	167.1	73.5	58.5	86.4	108.6	2.9	4.4	0.9	1.5	1.3	1.6
Min	522.1	326.8	104.0	112.0	34.0	20.0	35.0	62.0	0.0	1.0	0.0	0.0	0.0	0.0
Max	1312.2	1096.6	246.0	223.0	153.0	83.0	155.0	172.0	6.0	8.0	2.0	5.0	3.0	4.0
Range	790.1	769.8	142.0	111.0	119.0	63.0	120.0	110.0	6.0	7.0	2.0	5.0	3.0	4.0
St.Dev	227.620	175.342	32.583	29.586	21.292	12.244	30.377	27.166	1.726	2.270	0.728	1.362	0.979	1.052
Var.S	51810.667	30744.902	1061.679	875.311	453.343	149.914	922.764	737.968	2.980	5.152	0.530	1.856	0.959	1.107
Coefficient of Variation (CV)%	26.095	27.078	20.375	17.710	28.969	20.930	35.152	25.025	60.337	52.044	81.709	89.180	75.968	66.455

2. *MK test results, Kendall's tau correlation coefficient and Sen's slope for different climatic parameters*

Mann-Kendall Trend \Test Climatic Parameter	Kendall's tau (t≠0)	p-value	Sen's slope
Kabwe -Annual Total Rainfall (mm)	0.029	0.568	0.876
Livingstone-Annual Total Rainfall (mm)	0.002	1.000	-0.056
Kabwe- Duration of Rain Season (Days)	-0.410	< **0.0001**	-1.833
Livingstone-Duration of Rain Season (Days)	-0.094	**0.004**	-0.420
Kabwe-No. of Actual Rain Days	-0.153	**0.007**	-0.499
Livingstone-No. of Actual Rain Days	0.005	0.964	0.057
Kabwe-No. of Dry Spells	-0.275	< **0.0001**	-1.177
Livingstone-No. of Dry Spells	-0.143	**0.001**	-0.485
Kabwe- Dry Spells (5-9days)	-0.126	0.060	0.000
Livingstone-Dry Spells (5-9days)	-0.008	0.929	0.000
Kabwe-Dry Spells (10-14days)	0.067	0.320	0.000
Livingstone-Dry Spells (10-14days)	-0.079	0.380	0.000
Kabwe-Dry Spells (>14days)	-0.417	< **0.0001**	-0.036
Livingstone-Dry Spells (>14days)	-0.149	0.077	0.000
Onset Day of the Year (Kabwe)	0.248	< **0.0001**	0.785
Onset Day of the Year (L/stone)	0.145	**0.001**	0.339
Cessation Day of the Year (Kabwe)	-0.368	< **0.0001**	-1.046
Cessation Day of the Year (L/stone)	0.034	0.468	-0.076

3. *Dry spell occurrences in Kabwe and Livingstone (1980-2016)*

Dry Spells Characterisation Based on Duration									Dry Spells Combined by Category for Kabwe and Livingstone			
	Kabwe				Livingsone							
Season (Month)	Short (5-9 days	Medium(10-14 days)	Long(>14 days)	Total	Short (5-9 days	Medium(10-14	Long (>14 days	Total	Short (5-9 days	Medium(10-14 days)	Long (>14 days)	Grand Total
15-Oct	2	1	0	3	4	7	0	11	6	8	0	14
15-Nov	4	0	3	7	6	2	12	20	10	2	15	27
15-Dec	17	0	5	22	23	4	10	37	40	4	15	59
15-Jan	22	7	4	33	34	12	9	55	56	19	13	88
15-Feb	21	5	7	33	48	8	7	63	69	13	14	96
15-Mar	31	5	8	44	32	13	12	57	63	18	20	101
15-Apr	5	3	3	11	7	6	6	19	12	9	9	30
15-May	1	1	2	4	3	3	1	7	4	4	3	11
Grand Total	103	22	32	157.0	157	55	57	269	260	77	89	426

4. *Livelihood capital endowment comparison by agro-ecological zone, district/village*

	INDICES				
	Agro-ecological Zone District & Village				
	AEZ I			AEZ IIa	
	Choma District	Kalomo District	L/stone District	Chibombo District	Kabwe District
Type of Livelihood Capital Asset	Mochipapa Village	Simwatachela Village	Kazungula Vilage	Chiko Village	Chibwe Village
Natural (N)	0.242	0.232	0.240	0.289	0.266
Physical (P)	0.302	0.262	0.246	0.423	0.336
Social (S)	0.257	0.277	0.276	0.343	0.279
Human (H)	0.214	0.253	0.270	0.429	0.289
Finance (F)	0.269	0.246	0.333	0.446	0.363
Population (n)	10	10	10	30	40
Capital Index by District /Village	0.2568	0.2540	0.2730	0.3861	0.3064
Capital Index by Agro-ecological Zone	0.2511			0.3167	

5. ***Head of household by gender by Agro-ecological Zone***

	INDICES			
	Gender within and between Agro-ecological Zone/ District/village			
	I		IIa	
Type of Livelihood Capital Asset	**Male (AEZ I)**	**Female (AEZ I)**	**Male (AEZ IIa)**	**Female (AEZ IIa)**
Natural (N)	0.252	0.227	0.287	0.251
Physical (P)	0.270	0.270	0.391	0.334
Social (S)	0.272	0.268	0.320	0.276
Human (H)	0.269	0.265	0.366	0.312
Finance (F)	0.306	0.265	0.420	0.351
Population (n)	13	17	48	22
Capital Index by Gender by Agro-ecological Zone	0.2740	0.2515	0.3568	0.3049
Capital Index by Agro-ecological Zone	0.2511		0.3167	

6. ***Level of education attainment***

	INDICES			
	Level of of Formal Education Attainment			
Type of Livelihood Capital Asset	**None**	**Primary**	**Secondary**	**Tertiary**
Natural (N)	0.317	0.254	0.273	0.289
Physical (P)	0.360	0.331	0.328	0.373
Social (S)	0.303	0.277	0.305	0.383
Human (H)	0.407	0.322	0.296	0.323
Finance (F)	0.417	0.345	0.345	0.446
Population (n)	3	62	24	11
Capital Index by Level of Education Attainment	0.3607	0.3058	0.3092	0.3627

7. ***Age range of head of household***

	INDICES		
	Age-group (Years)		
Type of Livehood Capital Asset	Youth (<36 Yrs)	(Midle Aged (36-55 Yrs)	Old (56+ Years)
Natural (N)	0.21	0.22	0.27
Physical (P)	0.30	0.34	0.34
Social (S)	0.27	0.30	0.30
Human (H)	0.35	0.33	0.30
Finance (F)	0.31	0.34	0.36
Population (n)	27	55	18
Capital Index by Age-group	0.289	0.308	0.313

8. ***Livelihood capital endowment comparison by migration status in destination area (AEZ IIa)***

	INDICES	
	Migration Status	
Type of Livelihood Capital Asset	**Indigenous**	**Migrant**
Natural (N)	0.298	0.259
Physical (P)	0.333	0.413
Social (S)	0.276	0.337
Human (H)	0.319	0.379
Finance (F)	0.343	0.453
Population (n)	35	35
Capital Index by Migration Category	0.3139	0.3684

9. ***Household capital comparison by household size***

	INDICES		
	Household Size		
Type of Livehood Capital Asset	H'hold Size <=5 (Small)	H'hold Size 6<=10 (Medium)	H'hold Size 11+ (Large)
Natural (N)	0.24	0.26	0.27
Physical (P)	0.29	0.30	0.31
Social (S)	0.28	0.29	0.32
Human (H)	0.26	0.31	0.32
Finance (F)	0.26	0.30	0.35
Population (n)	30	48	22
Capital Index by Household Size	0.265	0.293	0.314

Appendix B: LVI-IPCC Assessment approach calculation examples

STEP 1:

Using equation 2 e.g. average give receive ration in the in the livelihood strategy main component/category for Zone I

$$Index_x = \frac{x - x_{min}}{x_{max} - x_{min}} = \frac{1.28 - 0}{7 - 0.5} = \frac{1.28}{6.5} = 0.1969$$

This operation is done for Zone IIa and for each of the 35 subcomponents organised along the 8 main/major components as shown in Table 6.1, and the results in Table 6.2

STEP 2:

Using equation 3, the indices are averaged per major component (or category in the case of household capital) e.g., for livelihood strategies there are 7 subcomponents, thus for Zone 1; $Y_x = \sum_{i=1}^{n} \frac{index_{xi}}{n} = \frac{0.1969+0.5333+0.3+0.4333+1+0.4216+0.6913}{7} = \frac{3.5764}{7} = 0.511$

STEP 3:

The indices obtained in Step 2 are weighted for each Zone or category in the case of Household Capital using equation 4; $\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$. Thus, for the 35 sub-components that make up 8 major components for e.g., Zone 1

$\bar{x} = \frac{6(0.237)+5(0.443)+4(0.491)+7(0.511)+4(0.677)+3(0.713)+4(0.696)+2(1)}{6+5+4+7+4+3+4+2} = \frac{18.806}{35} = 0.537$. This is done for Zone IIa

STEP 4:

For Livelihood Vulnerability Index (LVI) in the context IPCC-AR4, equation 1 is drawn upon: $Index_V = (ex_v - ad_{cv}) * S$

To be able to carry out this calculation, the 35 sub-components are organised in terms of exposure, adaptive capacity and sensitivity (refer to Tables 6.1-6.3). Thus, the scores for each major component obtained in Step 2 to 3 are recalled and ordered in the context of IPCC-AR4. Thus, for Zone I, it is as follows:

Exposure = $\frac{4(0.677)+4(0.696)}{4+4} = \frac{5.492}{8} = 0.687$

Adaptive Capacity = $\frac{6(0.237)+7(0.511)}{6+7} = \frac{4.999}{13} = 0.385$

Sensitivity = $\frac{5(0.443)+4(0.491)+3(0.713)+2(1)}{5+4+3+2} = \frac{8.318}{14} = 0.594$

See Table 6.3: These calculations are done for each i.e., Zone IIa as well.

Therefore, for Zone I, $Index_V = (ex_v - ad_{cv}) * S = (0.687 - 0.385) * 0.594 = 01794$

Appendix C 1: Coded list of profiled respondents

Serial Number	Code	Age	Gender	Migation Status	Natural (N)	Physical (P)	Social (S)	Human (H)	Finance (F)	Capital Mean	Household Size	SAMPLE POPULATION SUMMARY	
1	RS 1	36	Female	Immigrant	0.14	0.26	0.23	0.18	0.21	0.20	4	RS 1-35	Indigenous
2	RS 36	37	Male	Indigenous	0.23	0.42	0.31	0.23	0.61	0.36	9	RS 35-70	Migrants
3	RS 37	35	Male	Indigenous	0.24	0.40	0.23	0.30	0.36	0.31	7	RS-L 71-100	Migrant Linked
4	RS 38	46	Male	Indigenous	0.27	0.34	0.24	0.32	0.39	0.31	11	35	Migrants H'holds
5	RS 2	65	Male	Immigrant	0.33	0.47	0.46	0.45	0.49	0.44	13	35	Indigenous H'holds
6	RS 39	42	Female	Indigenous	0.36	0.22	0.27	0.21	0.23	0.26	7	30	Migrant linked H'holds
7	RS 40	34	Female	Indigenous	0.16	0.18	0.23	0.23	0.32	0.22	5	100	Total
8	RS 41	38	Female	Indigenous	0.39	0.27	0.21	0.21	0.38	0.29	4		
9	RS 3	60	Male	Immigrant	0.29	0.47	0.49	0.25	0.53	0.41	11	27	<= 35 (Youth)
10	RS 4	37	Female	Immigrant	0.32	0.32	0.31	0.39	0.35	0.34	6	54	36<=55 (Middle Age)
11	RS 5	29	Female	Immigrant	0.23	0.35	0.42	0.29	0.38	0.33	9	19	56+ (Old)
12	RS 6	40	Female	Immigrant	0.16	0.27	0.24	0.28	0.33	0.26	7	100	Total
13	RS 42	47	Male	Indigenous	0.29	0.42	0.29	0.28	0.39	0.33	8		
14	RS 7	36	Female	Immigrant	0.18	0.27	0.26	0.32	0.32	0.27	4	30	H'hold Size <=5 (Small)
15	RS 43	24	Female	Indigenous	0.18	0.29	0.19	0.25	0.13	0.21	4	48	H'hold Size 6<=10 (Med)
16	RS 44	30	Male	Indigenous	0.25	0.32	0.25	0.19	0.30	0.26	3	22	H'hold Size 11+ (Large)
17	RS 8	44	Male	Immigrant	0.37	0.36	0.34	0.33	0.40	0.36	9	100	Total
18	RS 9	42	Female	Immigrant	0.17	0.37	0.25	0.34	0.39	0.30	8		
19	RS 10	25	Male	Immigrant	0.21	0.27	0.21	0.23	0.30	0.24	5	61	Males
20	RS 45	30	Male	Indigenous	0.17	0.37	0.19	0.18	0.34	0.25	3	39	Fenale
21	RS 46	59	Male	Indigenous	0.38	0.31	0.24	0.27	0.30	0.30	5	100	Total
22	RS 47	41	Male	Indigenous	0.30	0.29	0.20	0.25	0.28	0.26	5		
23	RS 48	46	Male	Indigenous	0.27	0.37	0.34	0.34	0.37	0.34	12		
24	RS 49	57	Male	Indigenous	0.38	0.27	0.39	0.23	0.34	0.32	10		
25	RS 11	41	Male	Immigrant	0.27	0.37	0.32	0.41	0.44	0.36	4		
26	RS 50	38	Male	Indigenous	0.24	0.27	0.24	0.45	0.25	0.29	11		
27	RS 51	57	Male	Indigenous	0.28	0.34	0.21	0.36	0.37	0.31	14		
28	RS 52	48	Male	Indigenous	0.45	0.32	0.23	0.23	0.34	0.31	11		
29	RS 53	53	Male	Indigenous	0.32	0.39	0.36	0.27	0.35	0.34	12		
30	RS 12	34	Female	Immigrant	0.24	0.40	0.20	0.32	0.43	0.32	4		
31	RS 54	43	Female	Indigenous	0.23	0.31	0.19	0.24	0.34	0.26	4		
32	RS 55	38	Male	Indigenous	0.32	0.45	0.23	0.31	0.58	0.38	5		
33	RS 13	27	Male	Immigrant	0.21	0.25	0.27	0.21	0.29	0.25	6		
34	RS 56	32	Male	Indigenous	0.34	0.30	0.45	0.33	0.46	0.38	7		
35	RS 57	27	Female	Indigenous	0.32	0.27	0.23	0.41	0.25	0.30	6		
36	RS 14	28	Female	Immigrant	0.18	0.32	0.34	0.28	0.32	0.29	5		
37	RS 15	29	Male	Immigrant	0.19	0.40	0.26	0.21	0.38	0.29	6		
38	RS 16	23	Male	Immigrant	0.21	0.31	0.37	0.18	0.39	0.29	3		
39	RS 17	26	Female	Immigrant	0.28	0.46	0.24	0.42	0.47	0.37	6		
40	RS 18	47	Female	Immigrant	0.27	0.38	0.24	0.39	0.40	0.34	5		
41	RS 19	55	Male	Immigrant	0.29	0.74	0.48	0.74	0.84	0.62	6		
42	RS 20	43	Male	Immigrant	0.16	0.27	0.32	0.21	0.36	0.26	8		
43	RS 58	31	Male	Indigenous	0.37	0.38	0.35	0.32	0.34	0.35	10		
44	RS 59	43	Female	Indigenous	0.42	0.71	0.56	0.65	0.54	0.58	12		
45	RS 21	30	Male	Immigrant	0.18	0.47	0.34	0.41	0.61	0.40	5		
46	RS 22	46	Male	Immigrant	0.34	0.59	0.45	0.53	0.64	0.51	11		
47	RS 23	28	Male	Immigrant	0.24	0.27	0.41	0.36	0.45	0.35	8		
48	RS 60	36	Female	Indigenous	0.17	0.27	0.28	0.27	0.31	0.26	4		
49	RS 24	39	Male	Immigrant	0.32	0.29	0.34	0.51	0.62	0.42	8		
50	RS 25	30	Male	Immigrant	0.19	0.42	0.54	0.24	0.26	0.33	6		
51	RS 61	31	Male	Indigenous	0.31	0.30	0.23	0.26	0.29	0.28	5		
52	RS 62	44	Male	Indigenous	0.31	0.32	0.23	0.38	0.21	0.29	9		
53	RS 26	19	Male	Immigrant	0.21	0.44	0.32	0.36	0.36	0.34	7		
54	RS 63	23	Male	Indigenous	0.35	0.32	0.42	0.41	0.33	0.37	10		
55	RS 27	35	Male	Immigrant	0.25	0.47	0.26	0.78	0.47	0.45	9		
56	RS 28	63	Male	Immigrant	0.33	0.84	0.45	0.80	0.83	0.65	15		
57	RS 64	41	Female	Indigenous	0.34	0.44	0.32	0.32	0.48	0.38	4		
58	RS 65	42	Male	Indigenous	0.32	0.38	0.31	0.32	0.42	0.35	5		
59	RS 66	54	Male	Indigenous	0.20	0.23	0.25	0.65	0.21	0.31	8		
60	RS 29	60	Male	Immigrant	0.37	0.71	0.34	0.61	0.75	0.56	15		
61	RS 30	42	Male	Immigrant	0.25	0.53	0.33	0.36	0.54	0.40	5		
62	RS 67	43	Male	Indigenous	0.35	0.42	0.23	0.36	0.34	0.34	6		
63	RS 31	41	Female	Immigrant	0.37	0.47	0.34	0.42	0.51	0.42	9		
64	RS 32	55	Male	Immigrant	0.35	0.56	0.45	0.67	0.63	0.53	12		
65	RS 68	69	Male	Indigenous	0.43	0.34	0.29	0.69	0.39	0.43	19		
66	RS 69	18	Female	Indigenous	0.16	0.18	0.20	0.17	0.23	0.19	3		
67	RS 33	28	Male	Immigrant	0.16	0.37	0.23	0.21	0.36	0.27	5		
68	RS 70	47	Male	Indigenous	0.34	0.24	0.26	0.28	0.25	0.27	5		
69	RS 34	33	Male	Immigrant	0.34	0.37	0.45	0.31	0.41	0.38	3		
70	RS 35	48	Female	Immigrant	0.25	0.34	0.32	0.28	0.41	0.32	6		
71	RS-L 71	68	Female	Linked 1	0.23	0.32	0.21	0.26	0.27	0.26	9		
72	RS-L 72	60	Female	Linked proxy	0.18	0.19	0.20	0.17	0.18	0.18	9		
73	RS-L 73	51	Male	Linked proxy	0.21	0.35	0.23	0.29	0.26	0.27	10		
74	RS-L 74	66	Male	Linked proxy	0.24	0.35	0.32	0.23	0.23	0.27	15		
75	RS-L 75	65	Female	Linked proxy	0.25	0.29	0.31	0.19	0.21	0.25	14		
76	RS-L 76	55	Female	Linked 2	0.28	0.28	0.27	0.18	0.23	0.25	11		
77	RS-L 77	60	Female	Linked proxy	0.18	0.36	0.26	0.21	0.31	0.26	13		
78	RS-L 78	62	Female	Linked proxy	0.21	0.31	0.23	0.17	0.42	0.27	10		
79	RS-L 79	47	Female	Linked proxy	0.32	0.23	0.28	0.21	0.35	0.28	6		
80	RS-L 80	60	Male	Linked proxy	0.32	0.34	0.26	0.23	0.23	0.28	8		
81	RS-L 81	57	Female	Linked 3	0.21	0.31	0.24	0.19	0.21	0.23	11		
82	RS-L 82	59	Female	Linked proxy	0.21	0.34	0.24	0.28	0.21	0.26	7		
83	RS-L 83	55	Male	Linked proxy	0.25	0.29	0.24	0.23	0.19	0.24	8		
84	RS-L 84	71	Female	Linked proxy	0.23	0.21	0.34	0.25	0.16	0.24	13		
85	RS-L 85	54	Female	Linked proxy	0.29	0.26	0.32	0.22	0.25	0.27	12		
86	RS-L 86	53	Female	Linked 4	0.19	0.25	0.31	0.21	0.27	0.25	8		
87	RS-L 87	46	Male	Linked proxy	0.32	0.24	0.21	0.23	0.28	0.26	4		
88	RS-L 88	47	Female	Linked proxy	0.20	0.27	0.32	0.38	0.26	0.29	10		
89	RS-L 89	57	Male	Linked proxy	0.19	0.23	0.30	0.31	0.31	0.27	7		
90	RS-L 90	51	Male	Linked proxy	0.23	0.22	0.25	0.23	0.32	0.25	11		
91	RS-L 91	55	Male	Linked 5	0.31	0.26	0.27	0.28	0.19	0.26	10		
92	RS-L 92	47	Male	Linked proxy	0.25	0.21	0.28	0.30	0.29	0.27	9		
93	RS-L 93	54	Male	Linked proxy	0.28	0.21	0.23	0.29	0.32	0.27	10		
94	RS-L 94	41	Male	Linked proxy	0.24	0.32	0.24	0.39	0.38	0.31	10		
95	RS-L 95	45	Male	Linked proxy	0.23	0.28	0.36	0.15	0.67	0.34	9		
96	RS-L 96	30	Female	Linked 6	0.19	0.23	0.34	0.21	0.34	0.26	3		
97	RS-L 97	53	Female	Linked proxy	0.24	0.27	0.25	0.21	0.31	0.26	6		
98	RS-L 98	45	Female	Linked proxy	0.22	0.26	0.21	0.31	0.23	0.25	5		
99	RS-L 99	46	Female	Linked proxy	0.23	0.21	0.23	0.22	0.29	0.24	7		
100	RS-L 100	52	Male	Linked proxy	0.21	0.21	0.35	0.34	0.31	0.28	6		
Totals					26.430	34.200	29.570	31.803	36.367	31.674	787.000		
Means					0.2643	0.342	0.2957	0.318026	0.36367	0.317	7.870		

Appendix C 2: Coded list of focus group respondents

FOCUS GROUP RESPONDENTS				
Serial Number	CODE	Age (Years)	Gender	LOCATION
1	SR-F1	92	M	Agro-ecological Zone I
2	SR-F2	97	F	Agro-ecological Zone I
3	SR-F3	79	M	Agro-ecological Zone I
4	SR-F4	90	M	Agro-ecological Zone I
5	SR-F5	70	F	Agro-ecological Zone II
6	SR-F6	78	F	Agro-ecological Zone II
7	SR-F7	79	F	Agro-ecological Zone II
8	SR-F8	73	M	Agro-ecological Zone I
9	SR-F9	72	M	Agro-ecological Zone I
10	SR-F10	77	M	Agro-ecological Zone II
11	SR-F11	81	M	Agro-ecological Zone II
12	SR-F12	75	M	Agro-ecological Zone I
13	SR-F13	89	M	Agro-ecological Zone II
14	SR-F14	92	F	Agro-ecological Zone II
15	SR-F15	86	F	Agro-ecological Zone I
16	SR-F16	78	F	Agro-ecological Zone I
17	SR-F17	70	M	Agro-ecological Zone II
18	SR-F18	88	F	Agro-ecological Zone II
AVERAGE AGE		81.4444		

Appendix D: Household questionnaire

QUESTIONNAIRE: HOUSEHOLD INTERVIEWS

Oxford University Centre for the Environment

School of Geography and Environment

UNIVERSITY OF OXFORD

South Parks Road, OX 1 3QY

UNITED KINGDOM

27/10/2016 -17/12/2016

Most Valued Respondent,

I am a DPhil Student at the University of Oxford conducting research on the connections between rural to rural migration, environmental change and degradation in your area. You have been purposively selected to participate in this interview exercise: please provide information to the best of your knowledge and as truthfully as possible. The information being sought is purely for academic purposes only and will not be used for anything else.

Please note the following:

1) **The interview may only take 20-30 minutes, depending on the responses;**
2) **That participation is voluntary and there is no payment associated with your participation;**
3) **That you can withdraw at any time from the interview process without giving any reasons;**
4) **That if you have any concerns, complaints or queries on the interview, you are free to raise them without fear as soon as possible to the above address, or to** linda.andrews@admin.ox.ac.uk **and** david.thomas@ouce.ox.ac.uk
5) **That the interview process may involve photographing and/or voice recordings. However, you will be asked for consent when this is needed. Please also note that at no time will you be recorded or photographed without your approval or consent;**
6) **That the interview process may require further in-depth interviews at some point, and your land/or crop field assessment.**

CONSENT INFORMATION:

PLEASE TICK ONLY ONE OF THE BOXES PROVIDED BELOW:

IF YOU **ACCEPT** TO PARTICPATE**, IT'S (A);** AND

IF YOU **DO NOT ACCEPT** TO PARTICIPATE, **IT'S (B)**

A) I **ACCEPT** TO PARTICIPATE
B) I **DO NOT ACCEPT** TO PARTICIPATE ☐

SECTION A: General Information and Migration History

1	Name of Head of Household													
2	Level of Education	Nil		Primary		Secondary		Tertiary						
3	Sex	Male		Female		Other;								
4	Marital Status	Married		Divorced		Widowed		Single						
5	Age (Years)	<16	17-25	26-35		36-50		51-65		66<				
6	Area of Origin/birth place	Southern		Western			Central	Lusaka	North Western	Eastern	Copperbelt	Muchinga	Luapula	Northern
	Specify District & Village													
7	Religious belief if any?													
8	When did you move to this place?	Was born here		<1 year ago		1≤3 years ago		4≤6 years ago	7≤9 years ago	≥10 years ago				
9	How did you find yourself here? Who did you contact	Family member		Chief		Friend		other						
10	What factors did you consider settling here?													
11	Which one of these matters most? rank these by numbering; starting with 1 on what mattered most in settling here)	Environmental		Economic		Social Network		Population Dynamics	Political	Distance				
12	Were you born in this place?	Yes	No	a) If "No" state, the month when you moved here: b) State the place you moved from: c) Reasons for moving: Select all that apply						Province				
										District				
										Village.				
										Join friends or family	Escape Drought	Escape Floods	Crop failure	Poor Soil Quality	Political reasons	Other; please specify
13	Are you planning to move away from here in future?	Yes	No	a) If "Yes" please state: b) If "No" give reason for staying						Reasons for moving:				
										Preferred destination if any; and why				
14	Please rank these by numbering; starting with 1 on what is more likely to make you move away from here?	Join friends or family	Drought	Floods		Crop failure		Look for fertile Soils	Political Reasons	Lack of resources		Look for a job		Other; please specify
15	Why did you leave your previous place?	Join family	Look for work	Needed to look for new land		If look for new land, please tick all that apply		Needed own Land	Escape Hunger	Escape Drought	Escape Crop Failure	Escape Poor Soils	Escape Floods	Escape Soil Erosion	Other Please Specify
16	How long did it take you to leave after you made up to?	<6months	6-12 months	13-18 months		>18 Months									
17	Why did it take this long?														
18	Did you leave any relatives or friends behind?	Yes	No	If "Yes" why did they remain? Tick all that apply				Lack resources	Elderly	Wealthy	Have no crop failure	Have fertile soils	Adequate land	No soils erosion	Other: Specify
19	Do you have any active connections at your previous location or anywhere else?														
20	a) How do you compare this place with the previous?	Same	Better	Worse	If "Better" or "Worse", Give details on the differences										
	b) Planning to go back?	Yes	No	Please specify the reason for your answer											
	c) Would you like to go back?	Yes	No	Please specify the reason for your answer											
	If "Yes" when would you like to go back?														
21	What would be more likely to make you leave? Please rank starting with 1 as most likely	Economic reasons		Environmental reasons				Political reasons	Social Reasons (family, friends etc)			Demographic reason		Cannot move	
22	Why did rank them this way?														
23	Length of stay at present location														
24	Length of stay at previous location														
25	No. of people in the household														
26	No. of dependents														
27	Age of each member of household														
28	How healthy do you feel?	Very poor		Poor		Fair		Good	Very Good	a) How healthy is the entire family					
29	How much do you spend on healthcare?														
30	How long does it take you to get to a health facility, school and market?														

FOR REMAINERS ONLY				
31	Why did you remain? Give reasons			
32	Do you plan to migrate?	Yes	No	Give details for your answer:

SECTION B: Socio-economic Status: Income; and Livelihood Diversification

1	State your livelihood; vocation or occupation?																		
2	Any other livelihood, vocation or occupation?	Yes	No	If "Yes" please state the livelihood, vocation or occupation															
3	Your main source of income: Tick all that apply	Farming	Piece Work		Business Trading			Family/Friends Help		Charcoal making		Other, Please Specify							
4	How much do you earn per month (US$ equi)	0-4.99	5-9.99	10 -14.99	15-19.99	20.1-24.99		25-29.99	30-34.99	35-39.00	40-44.99	45-49.99	50<						
5	How long have you stayed in this occupation? (years)	0-3	4-7	8-11	12-15	16-19		20-23	24<										
6	Do you have any additional source of income?	Yes	No	if "Yes" Please Specify the source and amount:															
7	What else do?																		
8	a) Do you have livestock (Animals)?	Yes	No	If "Yes": How many do you have, please tick:				Cattle											
								Goats											
								Sheep											
								Other; Please specify the number;											
	b) Do you keep Poultry (Birds)	Yes	No	If "Yes"				Chickens											
								Guineafowls											
								Other; Please specify the number											
9	Has the numbers of livestock changed in the last 5 years?	Yes	No	If Yes a) Why increased b) Why decreased				Bought		Loan		Bred		Dowry					
								Sold		Stolen		Died		Dowry					
10	For both livestock and poultry, have you lost any significant numbers in the last 2 years?	Yes	No	If "Yes" what was the cause of the loss				Thieves	Disease	lack of Pasture / Feeds,			Drought	Flood	Other, please specify:				
				How many did you lose?				Please Tick											
								Sheep											
								Goats											
								Cows											
								Chickens											
								Ducks											
								Other											
11	Why do you keep livestock/poultry? Tick all that apply	Income Reserve	Milk	Meat	Manure	Tradition		Other, Please Specify											
12	a) How do you compare your current socio-economic status to that of the past location?	worse		same		improved		c) Why do you say so? Please explain											
13	How much money you spend per year?																		
14	What constitutes the highest expense?																		
15	How much do you spend on medicals?																		
16	Do you receive or give support to anyone?	Gives	Receives		Neither gives nor receives														
17	How often do you give or receive? Specify:																		
18	To who or from whom?	Family member	Non-family member		Other			If "Other" please specify:											
19	Please state the type of support:	Financial	Other		Both financial and other			If "Financial" how much?		If "Other" Please specify:									

SECTION C: Land Ownership, Tenure, Crop Diversification and Productive Capacity Perception

1	Who has more power over land in this area?							
2	Who has more power over land in your house?							
3	What type of land ownership best describes yours?	Customary	Govt.Lease	Chief's Lease	Communal	Bought	Other	Please specify for "Other"

4	Do you have any ownership document?	Yes	No					If "Yes" please specify what type of document?										
5	Size of land owned (hectares)	0-2	3-5	6-10	11-15	16-20	21<											
6	How much of this land is for crop production (ha)	0-2	3-5	6-10	11-15	16-20	21<											
7	How much of this land is for other uses (ha)	0-2	3-5	6-10	11-15	16-20	21<											
8	From whom did you acquire the land?	Govt.	Local Chief	Headman	Relative	Friend	Other	If "Other" please specify										
9	Size of land allocated (hectares)	0-2	3-5	6-10	11-15	16-20	21<											
10	Are you able to acquire more land? Please tick	Yes	No	If "NO" why?														
11	How easy is it to get land? Please tick	Very easy	Easy	hard	Very hard	impossible												
12	If you died, who does the land revert to?																	
13	How long ago was land allocated? (years)	<1 1-3	4-7	8-11	12-15	16-19	20-23	24< or <1 year please specify										
14	Is this land enough for your needs	No	Yes															
15	Is your land good for food crop production?	No	Yes															
16	What is your annual food crop yield (kilograms)																	
17	Is this yield enough till next season?	Yes	No	If "No" how are you going to survive?		Family Help	Neighbours		Relief Food		Other	If "Other" Please Specify						
18	Have you experienced crop failure in recently?	No	Yes	If "Yes" what was the cause? Please select	Not enough Rains		Too much Rains	Poor Soils	Lack of Manure	Lack of Fertilizer	Illness,	Weeds,	Other (Please Specify)					
19	When was the last time you experienced crop failure?	2010	2011	2012	2013	2014	2015	2016										
20	How many times have you experienced crop failure?	0-2	3-5	6-8	9-11	12-14	15<	Other, Please Specify										
21	Was there any warning from authorities	No	Yes	a) If "Yes" who provided the warning?		(b) Is there any other disaster warming system?			Yes	No	If "Yes" Please Specify:							
22	How often do you get warnings of this nature?	Annually	Never	Other	If "Other", Please Specify													
23	How do you survive when you experience crop failure or poor yield? Please tick all that apply	Buy food	Family Help	Ask Friends/ Neighbours	Food Relief from Government or NGO			Other, Please Specify										
24	If "family help" or "friends" or "both"; where are these people based? Select all that apply	Within Settlement	Another Settlement	Another Town	Another country	Other		For "Other" "Another Settlement" or "Another Country, please specify Name of Location:										
25	How many people assist you? Please indicate																	
26	How strong is your relationship?	Very weak	Weak	Fair	Strong	Very strong												
27	(a) Do you belong to any social club?	Yes	No					(b) Provide details of club										
28	How good is the relationship/support from this club?	Very weak	Weak	Fair	Strong	Very strong												
29	Do you use any manure?	Yes	No	If "Yes", What Type of Manure														
30	Do you use any chemicals or fertilizers?	Yes	No	If "Yes" Please answer Question 28														
31	Do you use both?	Yes	No	If "Yes" Please answer Questions 28 and 29														
32	How much chemical fertiliser do you apply (no. of bags per field)		Basal dressing (D compound N;10, P; 20 and K:10)				0	1-5	6-10	11-15	15<							
			Top dressing (Urea: 46% N)				0	1-5	6-10	11-15	15<							
33	How much manure do you apply (kg/ha)		0-200	201- 250	251-300	302-350	350<											
34	How do you rate the quality of your farmland?	Very Good (5)	Good (4)	Fair (3)	Poor (2)	Very poor (1)	Extremely poor (0)											
35	Please explain why you rate it that way																	
36	What type of crops do you grow? please tick all that apply and indicate yield per annum	Maize	Tick	Yield														
		Other (Specify)																
37	Why these crops? Please explain																	
38	What has been the yield trend on the main food crops you grow in the last 5 years?	Increase	Reduced	No change	Why do you rate it that way?													
39	How much was your yield last year? (kilograms) (No. of Bags)	No. of Bags																
40	Do you expect a change this year and why?	Yes	No	Reason:														

SECTION D: Farming Practices and Environmental Change Perception

1	State your historical cultural livelihood practice					
2	Do you still practice it?	Yes	No	Why? Give details to your answer		
3	From whom did you learn this practice in (1)	From lineage elders	From Local People	Others, please specify		
4	Any other cultural related practices	Yes	No	If "Yes"	Please give details here	
5	Please select the farming methods you have heard about on this list:	Please Tick	Yes	No		
		Conservation Farming				

		Organic Farming			
		Crop rotation			
		Terracing			
		Mixed cropping			
		Shifting cultivation			
		Slash and burn			
6	From whom have you heard?	(please specify)			
7	Which above methods in (5) have you used?	(please specify)			
8	Which of the following are so important to you at the moment? Please tick all that apply	Conservation Farming		(b) State why they are so important to you:	Conservation
		Organic Farming			Organic Farming
		Crop rotation			Crop Rotation
		Terracing			Terracing
		Mixed cropping			Mixed cropping
		Shifting cultivation			Shifting Cultivation
		Slash and burn			Slash and burn

9	Have you observed any change in seasons?	Yes	No												
10	What has changed? Please give details														
11	Why do you say so?														
12	Do you think there is a change in the environmental conditions?	Yes	No	If "Yes", please tick what has changed	Rain	Temp	Drought	Soil Fertility	Soil Moisture Holding Capacity	Water Availability	Forest Cover extent	Soil hardness, Erosion	Soil hardness	Soil Erosion	

13	How do you know that there has been a change on environmental conditions? (please tick where applies)	Please Tick	Increased	Decreased	No Change	Other: Specify	
		Ambient Temperature					
		Amount of Rainfall/Distribution					
		Onset of Rainfall					
		Droughts					
		Crop Failure / Poor Yields					
		Number of trees (Forest Cover extent)					
		Bush quality					
		Soil fertility					
		Soil hardness					
		Soil Moisture Holding Capacity					
		Soil Erosion					
		Number of gullies					
		Pasture (grazing land quality)					
		Water quality					
		Water Availability					
14	What may have caused the changes you have observed? (please select) what applies	Change in Ambient Temperature	Lack of trees	Enough trees	Afforestation	Other, please specify	
		Change in Amount of Rainfall/Distribution	Lack of trees	Enough trees	Afforestation	Other, please specify	
		Change in number of Droughts	Reduced rainfall	Increased Rainfall	Other, please specify		
		Change in Crop Failure / Poor Yields	Poor rainfall	Too much rainfall	Lacks fertilizer/manure	Type of crop variety	Other, please specify
		Change in Forest Cover extent)	Need for Farmland	Energy sources	Afforestation	Farming practices	Other, please specify
		Change in Bush and grass quality	Overgrazing	Farming methods	Grazing land mgmt.	Other, specify	
		Change in Soil fertility	Farming methods	over cultivation	Fertiliser/manure	Other specify	
		Change in Soil hardness (Hard pan)	Farming methods	Lack of rainfall	Animal grazing	over cultivation	Other, please specify
		Change in Soil Moisture Holding Capacity	Soil type	Not enough rainfall	Too much rainfall	Farming practice	Other, please specify
		Change in Soil Erosion	Farming method	Lack of turf cover	Too much rain	Not enough rain	Other, please specify
		Change in Number of gullies	Increasing bare land	Reducing bare land	Drainage management	Too much rainfall	Other, please specify
		Change in Pasture (grazing land quality)	Increased stocking	Farming methods	Grazing land mgmt.	Other, specify	

		Change in Water quality	Increased chemicals use	Reduced chemicals use	Soil pH	Water Treatment	Other, please specify
		Change in Water Availability	Enough rainfall	Not enough rainfall	Shift in water table	Other please specify	
15	Please state how each of the following can be avoided or minimised?	Crop Failure / Poor Yields					
		Poor Soil Fertility;					
		Poor Soil Moisture Holding Capacity;					
		Water Shortages;					
		Soil hardness (Hard Pans);					
		Soil Erosion;					
		Desertification					
		Changing ambient Temperature					
		Change in amount of Rainfall/Distribution					
		Poor Bush and grass quality					
		Poor Soil quality					
		Poor pasture quality					
		Soil Erosion and gullies					
		Poor water quality and availability					
16	In the past year, have you heard about any conflicts over water in your community?	Yes No					
17	Where do you collect your water from?						
18	How long does it take to get to your water source?						
19	Is this water available throughout the year?						
20	What containers do you usually store water in? How many? How many litres are they?						

SECTION E: Energy Sources

1	What is your main source of energy? Please select all that apply	Firewood,	Charcoal,	Electricity,	Others Please specify							
2	If your answer in Q (1) include Firewood or Charcoal; How much do you use (Kg/week)	Charcoal	0-75	76-100	101-200	200<						
		Firewood	0-100	101-200	201-250	250<						
	How do you Source firewood or charcoal	Charcoal	Makes	Buys	If you buy, how much do you spend per week (US$ equi.)	2-4.99	5-9.99	10- 15	15<			
		Firewood	Collects	Buys		2-4.99	5-9.99	10- 15	15<			
3	Do you sell charcoal or firewood? How much do you make per week (US$)	Charcoal	Yes	No								
		Firewood	Yes	No								
		2-4.99	5-9.99	10- 15	15<							
4	If yes, do you have a permit?	Yes	No	If "No" are you aware that it is illegal to cut down trees for any reason without a Permit from forestry authorities					Yes	No	If "Yes", explain why you do it	
5	Do you harvest any other natural resources	Yes	No									
6	If Yes, what are these, please specify	fibre	fruit	poles	Other	If "Other", please give details on what you harvest						
7	If your answer includes fibre and poles, please state what these are used for:											
8	Do you sell any of the items in Q (7)?	Yes	No									
9	If Yes, how much is realised per month?											

End of interview: and thank you very much for your time!