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Water vulnerability and community livelihoods: A case study of the Kaleya rural farmers
in Mazabuka, Zambia

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MPhil in Integrated Water Management

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Abstract

This study sought to explore the influence of water vulnerability on community livelihoods dependent on small-scale sugarcane farming. Using a qualitative approach, the study investigated the changes that had been brought about by water vulnerability to the livelihoods of the Kaleya rural sugarcane farmers in Mazabuka. Water vulnerability is a growing phenomenon across the globe known to affect both the availability of water assets and the sustainability of community livelihoods. While water vulnerability is deeply rooted within water assets, the challenge for water availability is that most water assets are at a gradual stage of reduction. Not only does water vulnerability affect these assets, but also it influences other components that make up a community's livelihood structure. The functionality of a community's water asset facilitates the capabilities, outcomes and strategies associated with the livelihoods. The analysis of the Kaleya rural farmers' capabilities, outcomes and strategies involved not only questioning the nature and the levels of vulnerability in this community's livelihood, but also probing water availability.

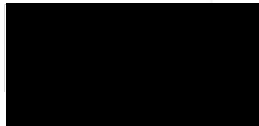
The study revealed that water vulnerability brought about changes to the Kaleya rural farmers' livelihood capabilities and outcomes and influenced the ensuing strategies. These changes manifested through the noticeable decline in the farmers' capability to perform infield irrigation. As a consequence, sugarcane production and household incomes were concomitantly affected. These changes had a knock-on effect on the farmers' job security as the farmers feared losing their jobs. As a counter action, the farmers opted to adjust their livelihood strategies by way of defending their water assets. The implications of the study are that examining community livelihoods has the potential to provide an in-depth understanding of the extent to which communities are susceptible to the symptoms and effects of water vulnerability – particularly in circumstances where a community's livelihood is dependent on water assets for the execution of daily activities. Prudent management of water assets unlocks potential to reduce water vulnerability and enhance water security, not only for individual livelihoods, but for entire nations. Accordingly, it is recommended that further studies should be conducted to evaluate the effectiveness of existing policies in securing water assets.

Key words: vulnerability, livelihoods, water assets, water security, sustainability

Declaration

I, Thandiwe Annastacia Mpala, declare that this thesis submitted for the degree of Master of Philosophy in Integrated Water Management at Monash South Africa, Monash University Australia, is completely my own work. This work contains no material that has been accepted for the award of any other degree or diploma at any university or other institution. To the best of my knowledge, this thesis contains no materials published or written by another person, except where reference is duly made in the text of the thesis.

Signature:

A black rectangular box redacting the signature.

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Print Name: Thandiwe Annastacia Mpala.....

Date: 13.04.2017.....

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Dedication

I dedicate my thesis to my Lord Jesus Christ, my parents, Mr Patrick Mpala and Mrs Victoria Mpala, my siblings, Kimberly Mpala, Antony Mpala, and Lloyd Mpala, and my partner, Bjorn Moyo. You as my family have been the source of my strength and confidence.

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Abbreviations and Acronyms

CNC	Critical Natural Capital
DFID	Department for International Development
GDP	Gross Domestic Product
GWP	Global Water Partnership
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resource Management
IWSN	International Water Security Network
KASCOL	Kaleya Smallholders Company Limited
KASFA	Kaleya Smallholders Farmers Association
KAST	Kaleya Smallholders Trust
NRAC	Natural Resource Advisory Committee
OXFAM	Oxford Committee For Famine Relief
SL	Sustainable Livelihoods
SLAF	Sustainable Livelihoods Analytical Framework
UNDP	United Nations Development Program
WWF	World Wildlife Fund

1.Chapter One: Introduction to the Study

1.1 Overview

This study sought to explore the influence of water vulnerability on community livelihoods. Using a case study of small-scale sugarcane farming, the study probed the changes that water vulnerability had brought about to the community capabilities, outcomes and strategies of the Kaleya rural farmers in Mazabuka, Zambia. This was premised on the understanding that globally the effects of water vulnerability were increasing, leading to the reduction of freshwater assets on which community livelihoods dependent. The findings of the study suggest that the reduction of water availability could have brought about noticeable changes in the livelihoods of the Kaleya rural farmers. Indeed, a community's livelihood is deeply rooted in freshwater assets and as such is vulnerable to reductions in water availability. For this reason, the study sought to examine the changes that water vulnerability brought to the Kaleya rural farmers' capabilities, outcomes and strategies within their context as small-scale sugar farmers.

This chapter comprises six sections that follow. The first section offers an account of the links between water security and resilience in community livelihoods. The second section looks at how freshwater ecosystems play a vital role in sustaining community livelihoods in Zambia. In the third and fourth, the research problem and research questions are presented respectively. The final section gives an outline of the chapters contained in this thesis.

1.2 Water Security and Resilience for Rural Community Livelihoods

On most continents, particularly Asia and Africa, more than 40% of the annual crop production comes from irrigated agriculture (Postel et al. 2009 p.4; Du et al. 2015). Water is a critical asset to boosting and stabilising crop production because it allows farmers to capitalise on higher yielding seeds and to grow higher value crops (Postel et al. 2009). Water supply from freshwater ecosystems at a local scale in agriculture usually stabilises their level of water security. Agriculture is the backbone of rural economies not just in Southern Africa, but throughout Africa. However, there is a national concern regarding the water availability and the decline in agricultural production and decline in sustainability of community livelihoods. Several studies showed that production in Africa is likely to fall by fifty per-cent by 2020 and in Southern Africa

by 2080 (Mutanga et al. 2014 p.35) and this is because of the estimated fifty-percent decline in water levels (Moodley and Arcangeli 2017 p.1). The assessments on production has been backed up by process based assessments showing from eighty-four per-cent to sixty-two per-cent and by statistical assessments showing from fifty-seven per-cent to thirty per-cent (Mutanga et al. 2014 p.35). This particularly highlights the need to assess the status of every freshwater ecosystem that is available within the country, because such impacts on agricultural production bring out serious water and food security challenges. The increased pressures of frequent droughts and anthropogenic stresses on freshwater ecosystems, has made the reduction of water availability become prevalent (Cook and Bakkher 2012; Du et al. 2015).

There is thus a growing concern in the existing literature regarding the potential changes that water vulnerability could generate within community livelihoods, particularly because of the unknown, undesirable effects that water scarcity could bring to these communities' livelihood outcomes and capabilities in the long term (Verner 2010). If the adverse effects of water vulnerability were known, it would provide a critical platform that would aid in the building and enhancing of water security and resilience within community livelihoods (Rockstrom 2003; Plummer et al. 2013). Verner (2010) and Grafton et al. (2013) further highlight that one of the important issues of water security is the amount of water that is accessible for livelihood use. Regardless of the measure that is used to measure water scarcity, if the water assets are insufficient to meet a community's demands, it becomes difficult to mitigate the levels of water scarcity (Grafton et al. 2013). Water scarcity can only be eradicated if there is strategic, effective and sustainable management of water assets to meet the economic demands of the local population (Lankford et al. 2013).

The enhancement of water security within people's livelihoods requires managing and conserving the availability of water assets, whether they are in the form of rivers, wetlands, springs, streams or rainfall (Dudgeon et al. 2006; Bond et al. 2008; Grafton et al. 2013). Wani and Ramakrishna (2005) gave the example of rainfall as a water asset, explaining that rainfall increases the level of water security within people's livelihoods for urban and rural areas. It reduces the levels of water scarcity within the geographical region and further aids the communities in obtaining adequate water to sustain their capabilities and livelihood returns.

Communities therefore capitalise on the opportunity to harvest rainwater to avoid the future effects of water scarcity (Wani and Ramakrishna 2005). However, the critical challenge revolves around the need to balance the availability of water assets against the increasing demand for water use (Xu et al. 2009; Sun et al. 2016). In some circumstances, farming communities often compound the impacts of the reduction in water availability by placing high demands on water that exceed their threshold (Wilhite 2007). Farming communities and the organisations often expect normal water supplies and disregard the task of adapting to the reduction in water supply, which may be extended over several years (Wilhite 2007 p.21). Declines in water security affect not only food security for rural communities, but also food security for entire nations (Allan et al. 2013; Cook and Bakker 2012; FAO n.d).

Because water supply accounts for 70% of the crop and food production within agricultural schemes (Allan et al. 2013; FAO n.d), rural communities are key players in food supply and strategic managers in water supply for both themselves and the country that they support (Allan et al. 2013). However, there are water scarce and water stressed regions that suffer from shortages of water, and therefore these communities do not produce as much food. There is also evidence that suggests that there is an on-going intensification of the hydrological cycle, which highlights the increasing rate of evaporation and decreasing rate of precipitation (Salinga 2005; Bond et al. 2008). For instance, Bond et al. (2008, p.4) found that several of Australia's freshwater ecosystems water availability were below forty-percent and this was indicated in the river's depth and record flows. It was further suggested by Bond et al. (2008) that the increase in temperature and decline in rainfall was proposed to have played a role in the reduction of water availability of Australia's freshwater ecosystems and the situation had a detrimental effect on the human settlements that depended on the ecosystem's water for their daily activities. To compound the problem is the fact that the impact of water vulnerability on livelihood outcomes such as crop production and household income has become very difficult to mitigate because of the frequency and magnitude of climate change (FAO 2008), which remains uncertain (Huntinton 2010).

Bond et al. (2008) highlights that the re-occurrence of natural disasters, such as droughts has created serious effects on communities' natural assets, especially freshwater ecosystems, leading

to concerns over the resilience of these assets. Hollnagel (2015) and Saldana-Zorilla (2015) explain that researchers within the domain of disaster and mitigation management are looking to understanding and addressing the fundamental instabilities that turn shocks and stresses into crises. It is understood that resilience is economically linked to the availability of ‘entitlements’ such as water assets (Adger 2006). Adger explains that the application of entitlements increases the rate of resilience within people’s livelihoods by reducing susceptibility and exposure to hazards (Adger 2006). Additionally, it promotes long term resilience as an end outcome. However, without increasing resilience, particularly within people’s livelihoods with respect to their entitlements, the levels of vulnerability may increase and result in destructive outcomes such as the collapse of livelihood structures, which can be irreversible in the long term (Diaz and Murnane 2008; Johnson and Hutton 2014).

Vulnerability of natural assets in this context often results in structural changes or adjustments to communities’ capabilities, strategies and outcomes (Kang et al. 2009; Harvey et al. 2014; Johnson and Hutton 2014). Parizeau (2015 p.162) explains that ‘fragile assets can introduce vulnerabilities into an individuals’ life and in so doing, erode the sustainability of their livelihood’. Parizeau (2015) further suggests that there is a need to gain a wider perspective of the interactions and changes between an individual’s livelihood asset and their livelihood components. Such a broadened understanding could help policy makers and developers formulate livelihood approaches that are pragmatic and conceptual in order to reduce poverty and hunger and increase resilience. Thus, within the context of water security, it becomes important to recognise water vulnerability in community livelihoods and examine how communities cope with stresses in defending their water assets. By recognising and understanding the symptoms of vulnerability, a platform can be developed to integrate a deeper level of resilience (Hollnagel 2015; Vo 2015). The next section discusses the decline of freshwater ecosystems in Zambia and importance of freshwater to Zambia’s population.

1.3 Freshwater Ecosystems and Community Livelihoods in Zambia

Zambia has agro-ecological regions categorised as -AER I, AER II and AER III, which have been used as a policy and adaptive management tool in assessing agriculture and planning and

investment (Phiri et al. 2013, p.4). The Kafue River is in the Southern-Western side of Zambia and falls part of the AER I and AER II agro-ecological region. The river is primarily linked to the development of sugarcane and maize farming in Mazabuka and it has facilitated the development of sustainable livelihoods for farming communities (Phiri et al. 2013, p.4 and Pegasys and WWF Zambia 2016 p.8). The river provides bulk water for farming communities to carry out infield irrigation, which allow them to obtain livelihood outcomes such as crop production, household income and long term employment. However, there is a growing regional concern in Mazabuka regarding the gradual increase in average temperature of 0.3°C per year and a declining trend in precipitation from 2800mm -1900mm and how these changes in temperature and precipitation have affected the water availability in the Kafue River within the last ten years (Phiri et al. 2013, p. 4). What is concerning to the people of decision making body is the projected decline in agricultural output of thirty percent by 2080 and the effects that the projected decline will have on farming communities' livelihoods within the region (Phiri et al. 2013 p.5). The projected decline in agricultural input stems from the reduction in water availability of the Kafue river. According to Pegasys and WWF Zambia (2016, p.15), the increased frequencies in drought has been identified as a factor that has altered the Kafue River's temperature, river flow and water availability, and because of these changes that have taken place, it has spelled competition on water. What is unknown is the adverse impacts that the decline in water availability of the Kafue river could have on farming communities that have their livelihoods invested in agriculture in Mazabuka.

According to Pegasys and WWF Zambia (2016 p.10), 'there are economic sectors that are further adding to the limit of what can be administered within the current storage capacity', particularly for the Kafue River in Mazabuka. If the river's storage capacity is not maintained, agricultural communities and other water users will start to experience water shortages that will further aggravate economic losses within their livelihoods (ZVAC 2008 p. viii) For this reason, there is a need to assess the potential changes that communities could experience within their livelihood structure. Essentially, there is a need to identify the farming communities that are vulnerable in Mazabuka and understand the situation regarding their access to the Kafue River, their capabilities, their outcomes and the strategies they would have employed to mitigate the water shortages. This is to understand which specific components of these rural communities'

livelihoods are at risk; and identify what current or future investments should be made by decision makers, public and private sectors, or developers in decreasing their vulnerability.

1.4 The Research Problem

The reduction of water availability is transforming not only freshwater ecosystems, but also human livelihoods (Sivakumar and Hansen 2007; Bond et al. 2008; Beuel et al. 2016). It affects rural communities that are particularly dependent on the functioning of freshwater ecosystems for the provision of water (FAO n.d.; Naik 2016). In the literature, water vulnerability assessments have most commonly occurred at national scale. However, the local scale has been identified as an important level where actions need to be taken to address water problems (Plummer et al. 2014). For instance, there are special challenges to the development of irrigated and rain-fed agriculture systems in both Southern Africa (SA) and Sub-Saharan Africa (SSA) (De Trinchieria et al. 2015 p.2). It is in SSA and SA that have the poorest and most vulnerable communities. It is further stated that forty-per cent of the population in SSA live on less than 1usd a day and seventy per-cent of the poor people reside in the rural areas (De Trinchieria et al. 2015 p.2). On the one side, rain-fed agriculture has festered and on the other side, there is continuous strains imposed on irrigated agriculture because of the decline in water availability (De Trinchieria et al. 2015 p.2). Poor farmers take the risk averse approach whereby they are unwilling to let go of the access to natural assets such as freshwater ecosystems-especially when their livelihood outcomes such as their crop production and income seem so uncertain from season to season. While the effects of general economic vulnerability are well known (Adger 2006; Gallopin 2006), what is less known is how water vulnerability influences livelihoods that are dependent on water assets and how this relationship affects the type of structural changes that could occur within livelihood capabilities, strategies, and outcomes. To practically examine water vulnerability in livelihoods, there is a need to examine the changes that the reduction of water assets would bring to a community's capabilities, strategies and outcomes, and gain an overall understanding of the symptoms of vulnerability that the community could be experiencing.

Thus, the significance of this research centres around improving understanding of the relationship between water security, vulnerability and livelihoods, thus allowing for a broader understanding of the relationship between water vulnerability and the structural changes it brings about to the livelihoods of rural communities. Furthermore, the study will identify those factors that would help build resilience for the poor people who are dependent on natural assets such as freshwater ecosystems for their economic survival and human wellbeing (Vo 2015). In so doing, it is envisaged that this study will contribute in helping decision makers and developers to implement better alternatives to water governance and sustainable livelihoods regarding institutional and conservational policies on freshwater ecosystems.

1.5 Main Research Question and Sub-Questions

To understand the influence of water vulnerability on community's livelihoods, there is a need to examine the practical changes that water vulnerability brings to the structure of the community's livelihood. Therefore, the main research question of the study is:

- How does water vulnerability influence community livelihoods in (small-scale) sugarcane farming?

Sub-questions

- How does water vulnerability affect capabilities as a function of community livelihoods?
- How does water vulnerability shape outcomes and strategies associated with community livelihoods?

1.6 Outline of the Chapters

This section briefly presents an overview of each chapter that is included within this document.

Chapter One: Background to the Study

The thesis has been divided in six sections. The first section, the introduction to this thesis, has briefly introduced the general subject of water vulnerability and community livelihoods, the

decline in water security and resilience, and the decline in freshwater ecosystems in Zambia. It has also summarised the main questions guiding this research.

Chapter Two: Literature Review

The second section of thesis describes in detail the nature of water availability and its influence on community livelihoods as well as the theoretical foundation of sustainable livelihoods, vulnerability, resilience and water security. It also discusses the conceptual framework, which is the Sustainable Livelihoods Analytical Framework (SLAF), looking at the concepts of vulnerability, shocks, assets, livelihood capabilities, outcomes, strategies and water security, which were used to analyse water vulnerability in community livelihoods.

Chapter Three: Research Setting and Methodology

The third section offers a detailed background of Zambia and its economy, a description of the research setting of the Kafue River basin and the Kafue Flats in the district of Mazabuka, followed by an overview of the Kaleya Smallholder Scheme. It also presents the research approach and paradigms that guided the study, as well as the data collection techniques. The techniques and the coding scheme that were utilised in analysing the data are discussed, followed by a description of how the study maintained validity and trustworthiness, as well as an overview of the ethical procedures that were applied in investigating the study.

Chapter Four: Research Results

The fourth section presents the results of the data collection. It re-addresses the objectives and the results of this study, then provides a brief explanation regarding the recurrence of droughts in Mazabuka. The section also explains in detail the changes that water vulnerability has brought to the Kaleya rural farmers' capabilities, outcomes and strategies, and addresses the complications that the rural farmers encountered.

Chapter Five: Discussion

This fifth section forms a discussion of research findings in conjunction with the existing literature (presented in Chapter Two). The changes that occurred within the community's capabilities, outcomes and strategies are contrasted and compared to results of similar studies. The section also highlights the application and significance of the SLAF conceptual framework in analysing the main research question of the scientific study.

Chapter Six: Recommendations and Conclusion

The sixth and final section includes a summary of the research findings and the main conclusions drawn from the study. Lastly, implications and recommendations for policy and future research are presented.

2. Chapter Two: Literature Review

2.1 Introduction

This chapter introduces the theoretical foundation of the study. It discusses the nature of water availability and its influence on community livelihoods and further explains the theories behind sustainable livelihoods, vulnerability, resilience and water security. It also addresses the SLAF conceptual framework, which links the concepts of vulnerability, sustainable livelihoods, resilience and water security. The core theories are explained with specific reference to shocks, water assets and livelihood capabilities, strategies and outcomes.

2.2 Water availability and Its Influence on Community Livelihoods

Reduction of water availability has the potential to affect human economic production systems by decreasing their capacity to provide freshwater assets (Kangalawe 2017; Sun et al. 2016) and this is because freshwater ecosystems provide water as an asset to both biodiversity and the human population (O'Connor 2000). However, when an economic system's capability is diminished due to reduction of water availability, concerns arise regarding the allocation of the available water in meeting population demands. Because freshwater ecosystems have been and will continue to be exposed to innumerable stresses (DaCosta Silva 2012), there is a need for effective water governance and management of freshwater ecosystems (DaCosta Silva 2012).

One of the most important tasks of Integrated Water Resource Management (IWRM) is the effective management of the available water resources to meet the interests of water users dependent upon freshwater ecosystem services products (DaCosta Silva 2012; Wyman 2013). Several water users such as farming communities in Africa and Asia are dependent on products such as water supply from freshwater ecosystems for their daily activities. For instance, three quarters of the poor communities live in Southeast Asia and they live in areas that have difficult places to farm. They live in the region that is characterised by combination of unpredictable rainfall, steep slopes, poor soils, marginal land and have freshwater ecosystems that are under

pressure (Khanal et al. 2014 p.1). Most of the households survive on water supply that aids them in cultivating a small parcel of land, or they farm tiny plots that are inadequate to feed their families. Capitalising on water helps the poor communities in Southeast Asia meet their basic-necessity such as food and it helps in creating a productive life (Khanal et al. 2014 p.2). However, the communities in Southeast Asia live in areas with poor natural resource conditions, where lack of water is the fundamental cause of their low crop production as well increasing vulnerability to the effects of droughts and floods. From this example, we can understand that agricultural communities are dependent on freshwater assets for the sustainability of their livelihoods and generation of their daily activities. When the freshwater assets of these communities are undermined, their livelihoods become vulnerable to symptoms of water poverty and hunger (Vo 2015).

In the past, freshwater water ecosystems were described and perceived as ‘abundant free stocks’ to rural communities, because there were vast amounts of water available for consumption (O’Connor 2000). However, over time the ‘abundant free stocks’ came to be recognised as ecosystems that were in fact decreasing (O’Connor 2000 p.14). Freshwater ecosystems, such as deltas, springs, wetlands, lakes and rivers, are fragile systems and, once degraded, they are very difficult to rehabilitate (O’Connor 2000). For instance, it was found that the effects of wetland intensification were particularly evident in Uganda. Denny and Turyatunga’s (1992) report disclosed that many small upland valley swamps had suffered from intensive drainage and cultivation that was facilitated by the government (Dixon and Wood 2003 p.119). Of which, within their traditional farms with the utilisation for livestock fodder, water crafts and small-scale cultivation, these wetlands regulated the flow of water from the catchment (Dixon and Wood 2003 p.119). When the wetlands were drained, and used for intensive grazing, the water was conveyed downstream reducing the wetland’s ability to buffer peak flows and retain nutrients (Dixon and Wood 2003 p. 119). It was concluded that wetlands were degrading from intensive use regimes and it played a role in decreasing the rural community’s livelihood base in Uganda. This example highlights the United Nations Development Program’s (2013 p.5) view in that the degradation of freshwater ecosystems is a factor that facilitates a decrease in a community’s overall livelihood base. The reduction in freshwater availability constitutes a threat to a community’s livelihood base because communities are dependent on the availability of

water assets, which provide the members of that community with a necessary foundation for achieving a substantial and sustainable livelihood (Krants 2001; Carney 2002; UNDP 2013). As such, the effects of water vulnerability are known to have repercussions not only on the availability of water assets, but also on a community's livelihood (Wilhite 2007; Vo 2015).

Frequent droughts are known to play a major role in the reduction of freshwater assets as well as in weakening the livelihood capability of communities to absorb stresses and shocks (Bond et al. 2008; Sun et al. 2016). Lack of rains and high temperatures as conditions of drought may cause a reduction in water availability and provide severe risks such as crop failure, which may facilitate economic consequences such as a long-term decline in crop yields and profits for communities' outcomes (Sivakumar and Hansen 2007 p.2). The fourth assessment of the IPCC indicated by De Trinchieria et al. (2015 p.3) stated that the estimated median rise in temperature will be at 3-4°C by the end of the 21st Century. The authors further stated that, there will be a greater temperature rise in June, July and August with a median rise of 3.4°C in Southern Africa than in Eastern Africa where temperature is 3.1°C. De Trinchieria et al. (2015 p.3) further suggests that there will be a greater temperature rise in September, October and November with 3.7°C. As it is indicated, evidence of drought- with regards to temperature and precipitation- is already a concern in Southern Africa. The annual rainfall is predicted to decrease by four per-cent in Southern Africa by the end of the 21st century and this will play a critical effect on the water availability of freshwater ecosystems (De Trinchieria et al. 2015 p.3). In mitigating the risks of these conditions, several agricultural communities around the globe have been looking for ways to cope with the reduction in water availability. It is safe to suggest that changes in global climate over the next 100 years are almost certain and, irrespective of whether they are human- or climate-induced, they will impact on the spatial and temporal distributions of surface water ecosystems, which may further place communities' livelihoods at a vulnerable risk to the future occurrence of extreme events (IPCC 2001 p.3).

These climatic effects on water availability threaten the ability of communities to meet their basic needs such as adequate food and stable income flows (Fraiture et al. 2010; Johnson and Hutton 2014), without which communities' struggle to sustain their general wellbeing (Bond et al. 2008). For instance, Reid et al. (2006 p.621) found that the rural farmers' livelihoods in the

Perth County were greatly affected by water vulnerability because of the decline in access to bulk water supply from their springs. There were climatic statistics that were recorded with an average temperature of 20°C in the Perth County and a decrease in rainfall from 100mm to 80mm (Reid et al. 2006 p. 617). There was increased evapotranspiration from high temperatures and reduced rainfall which increased their crop stresses and reduced their crop yields (Reid et al. 2006 p.613). The farmers' capabilities to produce and increase their crop yields, which accounted a great proportion of their livelihood outcomes such as their household income, were reduced (Reid et al. 2006 p.623). The reduction in water availability reduced the effectiveness of the farmers' herbicides and pesticides increasing the potential for losses accumulated by the increased number of pest manifestations (Reid et al. 2006).

Another study done by Sallu et al. (2010 p.5) found that rainfall was a critical water asset for the Khawa and Khedia settlements. Their rainfall became unpredictable between 1996 and 2004, causing negative changes for the pastoralists that relied on the rainfall for the supply of water to the lakes that provided them with the source of food (i.e. fish). The rainfall was recorded at 200mm being the lowest in the southwest and 800mm in the north east (Sallu et al. 2010 p.5). The lack of rainfall had reduced the soils fertility in lacking ingredients such as phosphorus, nitrogen and potassium, which made the pastoralists' land unfitting for crop cultivation and breeding livestock (Sallu et al. 2010 p.5). Sallu et al. (2010) proposed that the fluctuations in rainfall had a serious effect on the pastoralists' capabilities to provide and generate food security as their livelihood outcome.

From the examples indicated above, sustainability of freshwater ecosystems has progressively become a significant concern considering the increasing water demand for environmental, domestic and agricultural uses to sustain the 9.4 to 10 billion world population expected by 2050 (United Nations 2015 p.3; Sun et al. 2016 p.857). The issue of sustainability has become even more difficult to manage because of climate change and anthropogenic changes (Singh 2014 p.1689; Sun et al. 2016 p.857). Thus, the growing difference between supply and demand of water calls for more hands-on, integrated water management practices (Kim Leng Poh 2015 p.1330; Sun et al. 2016 p.857). But to promote sustainability, the status of the freshwater assets must be determined with regards to who benefits from them. If poor people are overlooked here

by developers, governments and institutions involved in the management of the water, then effective allocation of water assets will be very difficult to implement (Sun et al. 2016 p.858).

Freshwater ecosystem functionings are essential for human health and the systems are termed as 'critical natural capital' (CNCs) (O'Connor 2000 p.13). This is because the ecosystem's functionings are irreplaceable – there is no substitute or trade-off to replace the freshwater assets that communities ultimately depend on once they are fully degraded. As argued by English Nature in 1995 (as cited by O'Connor 2000 p.14), there should be no further net loss in quantity or quality -especially if the objective is to try and accomplish sustainability- in water assets and, because they are irreplaceable, CNCs should have the strictest monitoring and protection. In addition, Archer (2011 p.2) argues that indigenous communities see water as their 'means of support' and that their culture is heavily reliant on freshwater ecosystems, because it is an important asset that facilitates the security of their human wellbeing. Communities should therefore be able to identify their own freshwater assets within their livelihoods in terms of their functional symbolic significance to them (Archer 2011 p.2). However, the reality is that communities are often left out of decision making and thus they have no voice in the governance of their water (Mudege and Zulu 2011 p.222). Therefore, for water vulnerability to be reduced within livelihoods, there is a critical need to implement integrated resilient and governance strategies that facilitate the securitisation of freshwater ecosystems to secure the security of people's livelihoods.

As highlighted in chapter one, it is argued that the reduction in water availability increases the risk of communities that are reliant on agriculture for the security of their livelihoods (Mubaya et al. 2012 p.10; Kangalawe 2017 p.191). It is important to note that the development of agricultural production is indeed responsible for many rural communities' livelihoods in Southern Africa and Asia (Mubaya et al. 2012 p.11). When communities work for the agricultural sector, it implies that people are deeply invested in the physical, social, financial, natural and human capital in which they are provided, and this aids in the generation of their livelihood capabilities, strategies and outcomes. The concern with agriculture is that the sector is extremely reliant on water availability from freshwater ecosystems, and it is unfavourably affected by the reduction in water availability (Sivakumar and Hansen 2007 p.1). According to the Disaster Handbook (1998 p. 3), a reduction in water availability stems from 'deficiencies in

surface and subsurface water supplies. It is measured in accordance with streamflow, and as a river, reservoir and ground water levels'. The Disaster Handbook (1998 p.3) further highlights that if there has been a long period where rain has been absent in the region, then there is a high chance that there is less water in the streams, lakes and rivers. When precipitation is reduced over an extended period, the deficiency is reflected in the declining surface and subsurface water levels. The effects of the reduction in water availability on community livelihoods are outlined when physical water shortages start to affect their daily activities. Normally it is when there is lack of physical water supply to meet the high demands (Disaster Handbook 1998 p.3).

Rural communities that work for agricultural schemes depend directly on water assets for their overall survival and sustainability of their livelihoods. Freshwater assets support important capabilities such as infield irrigation, as well as livelihood outcomes such as household income and job security, which are all beneficial to the welfare of rural farmers (Nkala et al. 2011). However, when the agricultural scheme is vulnerable to the reduction of water availability, this affects the community's capabilities and outcomes and it influences their strategies- of which all support the community's overall means of living (Hay 2007). Rural agricultural systems are prone to multiple hazards, but in the case of drought, what is unfortunate is that usually there is nothing much that can be done by the locals to alter the occurrence of this phenomenon (Wilhite 2007). This situation is also compounded by the communities themselves who often place demands on freshwater assets that exceed supply (Wilhite 2007). As highlighted in chapter one, such farming communities often expect normal water supplies and disregard the effects of reduction of water availability and ignore calls for the need to adapt to the reduction in water supply (Wilhite 2007). Thus, the farmers operate in poor conditions in trying to meet their livelihood and agricultural demands. Agricultural communities' dependency on freshwater assets plays a key role in understanding the vulnerability of these communities to future water demands and supplies.

It is vital for communities to be aware of the status of their water assets and the impacts that the reduction of water availability poses to their livelihoods, so that they can build their adaptive capacity against other water-related hazards (Chang and Martens 2010 p.2). Kim Leng Poh (2015 p.1330) highlight that the only problem with assessing the effects that water vulnerability

has on community livelihoods is that the damage created is not immediately recognised. Communities only feel the effects of vulnerability later, or when the conditions of water availability become severe (Sullivan 2011 p.628). If the threat is not recognised immediately, it becomes difficult for communities to participate and organise their water assets to enhance their adaptive capacity for the long term. Cannon (2008 p.351) explains that although a community's livelihood may not be vulnerable now, owing to the short term adaptive measures or institutional guidance it may have in place, it is important to realise that the reduction in water availability is not preventable (Gines 2012; McEntire 2012 p.206) and that the probability of that community being exposed to the conditions again in the near future -especially if the damage is not immediately recognised, may continue to critically weaken their livelihood security.

Furthermore, it has been shown that some people who experience water vulnerability have also faced economic vulnerability within their livelihoods (Saldana-Zorilla 2015). In practice, it means that the investments that are made by organisations to maintain the water demand for farming communities, are constrained by financial, human and institutional capacity (Fraiture et al. 2010), therefore making it difficult to control the effects of water vulnerability. Reduction of water availability does not only create water vulnerability, but also results in additional stresses such as economic vulnerability that go beyond the institutional and human capacity of rural farmers.

2.3 Sustainable Livelihoods

This section explains and discusses in detail work done by the leading authors who conceptualised sustainable livelihoods: Chambers and Conway (1995), Ashley and Carney (1999), Carney (2002), Farrington et al. (2002), Morse and McNamara (2013) and others. Firstly, it is important to note that the foundation of sustainable livelihoods emanated from what is known as the 'intentional approach to development' (Morse and McNamara 2013 p.15). This approach is a directed and focused process whereby non-government and government institutions create development projects and programs to aid the poor. The objective is to invest in poor people, and raise their quality of life (Morse and McNamara 2013). This is also the primary goal of economic development, and it aims to make communities more skilful and

productive contributors to the economic progress of that country (Ashley and Carney 1999; Morse and McNamara 2013). The idea of the sustainable livelihoods (SL) approach specifically evolved within the context of ‘intentional development’, in which development specialists sought to amplify the efficiency of their interventions to help the disadvantaged (Morse and McNamara 2013 p.15). The SL approach is a diagnostic tool that aids in analysing people's current livelihoods and examining what is needed for their ‘enhancement’ (Carney 2002 p.13). The SL approach is based on the objective of making people's livelihoods less exposed to economic, environmental and social stresses such as poverty and climate change (Morse and McNamara 2013). Other authors such as Chambers (1985 p.174) and Ashley and Carney (1999 p.6) further narrow the objective by specifically stating that the SL approach should aid in the ‘eradication of poverty for poor people’, because the conditions of poverty play a role in the reduction of their overall wellbeing. Reducing poverty is a task that is still difficult to achieve, particularly for governments and development agencies (Chambers 1985 p.173; Farrington et al. 2002 p.III). However, applying the SL approach provides new insights into the livelihoods of the poor people, and by understanding the concerns they view as a priority, highlights the importance of working alongside them and supporting them in eliminating their current livelihood stresses (Ashley and Carney 1999; Morse and McNamara 2013).

SL approach stems from the approach of examining the ‘effectiveness of the development activities’ (Carney; 2002 p.13; Reuben et al. 2007 p.1). Poor people are placed at the centre of the approach and determine whether sustainable improvements have taken place in their livelihoods (Ashley and Carney 1999). It is anticipated that placing a focus on the poor people will contribute to the objective of eradicating the shocks and stresses they could encounter within their livelihoods. Even within the policy context, not all the initiatives are applied within the SL approach in practicality (Ashley and Carney 1999), but they are within the framework of achieving the objective, which is to make sustainable improvements in poor people’s lives (Carney 2002; Farrington et al. 2002). It may seem all ambitious, but the SL approach does try to take into consideration the concerns highlighted to improve the efficiency of development spending (Ashley and Carney 1999).

SL approach is not linked to any organisational type (Ashley and Carney 1999), but rather these approaches have been developed within research institutes (i.e. NGOs, UNDP, Oxfam and

DFID). During the evolution of sustainable livelihoods in 1997, different scholars from these research institutes gave their ideas as to how they could eradicate poverty in the best sustainable way within people's livelihoods within the context of the United Kingdom, which was the main objective (Chambers and Conway 1991 p.2; Ashley and Carney 1999 p.8). After the debate in 1998, the conversation between scholars on how to bring these ideas into policy and actions became the moving force in operationalising the concept of sustainable livelihoods (Ashley and Carney 1999 p.8). The Natural Resources Advisor Conference (NRAC) in 1998 discussed the SL approach, and some scholars took ideas from NRAC and utilised the NRAC approach of sustainable livelihood to inspire their research, whilst others outside continued to cultivate their own thoughts and practices on sustainable livelihoods (Ashley and Carney 1999 p.8). Even though we understand the consensus of how the evolution of sustainable livelihoods came about, there is still a need to understand the clear definition of what 'sustainable livelihood' means within the context of research. This concept is explained in accordance to Robert Chambers and Gordon Conway's (1991) definition in the next section below.

2.3.1 Defining the Concept of 'Sustainable Livelihoods'

Livelihoods have been defined in different ways depending on the context (i.e. rural or urban). However, there are standard definitions from which scholars derive their definitions when applying them to scientific research. Livelihood is defined as the 'means of securing the necessities in life' (Morse and McNamara 2013 p.8). The word 'sustainable' implies a sense of endurance – something that can sustain itself in future – and consequently implies resilience to the economic and environmental shocks and stresses (Morse and McNamara 2013 p.8). In the scientific context, Chambers and Conway (1991 p.5) and Scoones (1998 p.5) define livelihood as 'the application of assets -natural, social, human, physical and financial-, capabilities, strategies and means of living'. Once all these systems are in place, a livelihood at individual or group level would have the capability to withstand the shocks and stresses that would make them vulnerable. Chambers and Conway (1991, p.5) describe livelihood as:

A system that comprises of capabilities, assets (stores, resources, claims and access) and activities that are essential for means of living. A livelihood is resilient or sustainable when it can cope and recover from stress and shocks, maintain or

enhance its capabilities and assets and provide long term opportunities for the next generation and the system contributes net benefits to other livelihoods at local and global levels, in the short and long term.

Other scholars such as Farrington et al. (2002 p.1), Gregoire (2012 p.139), and McLean (2015 p.381) have similar definitions in their investigations. Chambers and Conway (1991 p.5) further describe livelihoods in the context of security and sustainability, defining outline livelihood security as:

A system that comprises of adequate stocks and flows of food and cash to meet basic standards. Security refers to the ownership and access to assets and income earning activities and having additional reserves to offset risk, ease shocks and meet contingencies. Sustainable refers to maintenance and enhancement of asset productivity on a long-term basis. For instance, (within the agricultural context) a household may be empowered to acquire sustainable livelihood security through ownership of land, water rights to irrigation, harvesting, planting, cultivation, through established employment with sufficient payment or through various lists of activities.

Security and sustainability ensure that there is improvement in the quality of people's lives and their future generations for the long term (Chambers and Conway 1991 p.5; Lindenberg 2002 p.304). A livelihood that is secure and sustainable means that communities have access to the basic commodities of water, food, healthcare, education, financial and political freedom, which not only add valuable meaning to their lives, but value to their overall human wellbeing (Bebbington 1999 p.2022). Indeed, having a livelihood is not just about the means of surviving, but also providing the adequate assets with which poor people can enhance and enjoy their lives (Morse and McNamara 2013). Incorporating sustainability would simply imply that poor people could earn a living and sustain the assets and enhance the returns they have into the future, without damaging anyone else's prospects along the way (Farrington et al. 2002 p.V). The only way this ideal can be achieved is if the institutional body such as the government and private and public sectors initiate development activities that incorporate principles of sustainable

livelihoods, especially for the rural context. The focus is directed towards the rural context, because, within the urban context, people are provided with greater opportunities in obtaining income and employment with fewer societal restrictions on livelihood possibilities. However, that only applies if the urban development is shaped to the livelihood aspirations of the poor people (Farrington et al. 2002 p. V). On top of that, within developing countries, more financial investment is applied to the urban context than it is applied to the rural context because of the high migration of people from the rural to the urban centres.

2.3.2 Principles of Sustainable Livelihoods

Ashley and Carney (1999 p.7) and Serrat (2008 p.2) state that there are six principles of sustainable livelihoods, which are core to eliminating poverty and other environmental and social stresses. These principles aid in improving the effectiveness of development activities in people's livelihoods. Ashley and Carney (1999 p.7), Hinshelwood (2003 p.247) and Serrat (2008 p.2) explain that for sustainable livelihoods to be effective:

1. The development activity must be people-centred. This can only be achieved if external support focuses on what is important to people, comprehends the differences between different groups of people and works with them in a way that is consonant with their social environment, livelihood strategies and ability to adapt.
2. The activities must be responsive and participatory. The poor must be key figures in addressing and classifying their own livelihood precedencies. The external support needs processes that can enable them to pay attention and respond to the poor.
3. It needs to be multi-levelled. Eradicating poverty is a difficult challenge that can only be practically managed at different levels, guaranteeing that micro level activity informs development of policy and effective enabling environment, and macro level structures and processes support people to build their own strengths.
4. Sustainable livelihood approaches must be conducted in partnership of both private and the public sectors.

5. It must meet all the key dimensions of sustainability, which are the economic, social, institutional and environmental. There must be an equilibrium within these four dimensions.
6. SL approach must be dynamic. The external actors must recognise the dynamic nature of livelihood strategies; there must be flexibility in responding to people's changes in situations and establishing long term commitments.

Ashley and Carney (1999 p.7), Farrington et al. (2002 p.1) and Serrat (2008 p.2) further state that these principles highlight the significance of understanding various livelihood components. But there are additional factors that need to be examined to understand the overall context of people's livelihoods. These factors are:

- Understand the priorities people identify
- Acknowledge that poor people develop diverse and changing livelihood cases accommodating their own views of shocks and stresses, but do so within the context of vulnerability;
- Examine the efficiency of their strategies implemented or impeded by the extent of policies, institutions and processes;
- Draw on the people's significant assets and examine their access to their assets (i.e. social, human, physical, financial and natural) and their ability to convert these into productive uses; and
- Understand the context of vulnerability in which people live, which is inclusive of the external shocks and stresses (climatic or anthropogenic) and seasonality.

Ashley and Carney (1999 p.7), Farrington et al. (2002 p.1) and Serrat (2008 p.2) all highlight these factors, but Chambers and Conway (1991 p.2) further add that sustainable livelihood principles are not just primarily centred on 'poverty thinking', but are also positioned on 'production and employment thinking'. Production thinking is defined as a sense of thinking that views problems that revolve around hunger (Chambers and Conway 1991 p.2). If livelihoods are centred on production thinking, the SL approach will be viewed as an approach of helping poor people produce enough food for their livelihoods to mitigate the high levels of hunger.

Employment thinking is based on the view that there is a lack of employment for rural people, and in certain cases, people look for assets and materials that enable them to generate multiple activities that facilitate a form of employment (Chambers and Conway 1991 p.2). If permanent forms of employment are established and sustainable for poor people, it can enable them to generate opportunities and high end returns. Therefore, Chambers and Conway (1991) and Ashley and Carney (1999) view these three dimensions (employment, production and poverty thinking) as indicators of human wellbeing in sustainable livelihoods.

However, Farrington et al. (2002 p.III) argues that regardless of the principles mentioned by Chambers and Conway (1991) and Ashley and Carney (1999), there are still substantial differences that need to be considered, especially when analysing a case study in rural as opposed to urban environments. There are substantial differences between rural and urban environments with regards to:

- Forms of vulnerability: the shocks and stresses that affect urban environments may not apply to rural environments;
- Capital assets: the important assets that might apply to urban environments will not be the same for rural environments (i.e. urban may be greatly dependent on social assets, whereas rural will be dependent on natural assets);
- Access to assets for the poor: their access may be culturally and environmentally orientated;
- Patterns of access: rural people may have to access their assets through a governing body, whereas for urban people their access to entitlements would be based on senior citizenship;
- Policies, institutions and processes: rural poor may co-operate with government and the public sector, whereas the urban people would be closer to the private sectors; and
- Livelihood outcomes for the rural and urban people (Source : Farrington et al. 2002 p.III).

Despite these differences, the SL approach can still be applied to both urban and rural environments. Indeed, the most significant principles remain the same, and are addressed through the following questions:

- What forms of vulnerability or risks do the poor people face?
- How do households vary in their vulnerability to external conditions?
- How do they manage their assets and which specific assets are important to them?
- How do they access assets that they do not own?
- What are their rights and entitlements? What threats do they face in accessing their rights?
- What livelihood outcomes do they seek to obtain, how, and against what shocks and stresses? (Source: Farrington et al. 2002 p.VI)

Within the context of rural areas, the SL approach employs the rights based approach to increase our understanding of how the people in the rural areas access their capital assets and the supplies that governments and public and private organisations provide for them and what rights they are denied (Farrington et al. 2002 p.32). When it comes to building development in rural people's livelihoods, it cannot be assumed that the government will be the leading player. NGOs and other private sectors are also leading partners, especially when the government does not have the full capacity (Farrington et al. 2002 p.vi). The advantage of applying the rights based approach with respect to access and assets is that it creates gaps or positions that the private sector could fill in creating development. The private sector can support the rights based approach in the redistribution of assets, particularly with natural assets and improve the livelihood quality of the rural people (Carney 2002 p. 23). For this study, the right based approach acts as a guideline in applying the SL approach, however, the SLAF was used in analysing and understanding how the decline in water availability reduced the communities access to water and how it played a role in their livelihoods. The next section discusses and describes the theory and principles of vulnerability within the context of sustainable livelihoods.

2.4 Vulnerability

This section explains and discusses in detail the works that were done by those leading authors who conceptualised vulnerability – Dow (1992), Cutter (1996), Adger (2006), Gallopin (2006), Cannon (2008), McEntire (2012) and others. The next section begins by defining the concept of vulnerability.

2.4.1 Defining the concept of vulnerability

Alexander (2006 p.1) describes vulnerability as a great basis of determining disasters other than the hazards themselves. Vulnerability is known to be critical if the disaster is in proximity with humans and their infrastructure (Alexander 2006 p.1; Cannon 2008 p.351; McEntire 2012 p.206). For example, if a drought occurs in an uninhabited and remote area, it will not automatically lead to human disruptions, regardless of the scope and magnitude. However, if the drought occurs in the area that includes people and their natural resources, then a disaster is likely to occur. In addition, Perrow (2007 p.25) explains that hazards cannot be prevented or mitigated. For instance, there is no way to prevent droughts, hurricanes, floods or earthquakes (Trenberth 2012 p.284; McEntire 2012 p.206). Even anthropogenic hazards such as wars cannot be alleviated, especially if individuals are unconcerned with risks and safety precautions (McEntire 2012 p.206; Shameem et al. 2014 p.79). Essentially, the presence of people determines the degree and vulnerability of a region in the disaster calculation (McEntire 2012 p.207).

Vulnerability has been outlined in several ways by both scholars and practitioners (McEntire 2012 p.207), thus there are several definitions to the concept of vulnerability. For instance, Cutter et al. (2003 p.244) view vulnerability as the ‘probability of individuals experiencing losses’. Bolin and Stanford (1998 p.22) defines it as the ‘probability of individuals and groups being affected by environmental hazards that will negatively affect their ability to counter with the adversities of disasters that come along at household level. Dow (1992 p.418) expresses vulnerability ‘as the capability to be wounded’. Haalboom and Natcher (2011 p.184) explain the phenomenon as the community’s inability to plan or adapt to risks or hazards. Other authors such as Naude et al. (2009 p.185), McEntire (2012 p.208) and Bankoff (2015 p.431) conceptualise vulnerability in relation to capabilities and abilities, by explaining that people are predisposed to

hazards and their resistance to deal with the effects is purely dependent on their capacity. Kelly and Adger (2000 p.327) refer to vulnerability as ‘the capability of people and social groups to react to, cope with, recover from and adapt to any external stresses placed on their livelihoods and wellbeing’. Renaud and Perez (2010 p.155) write that it is ‘the vulnerability of communities to natural and anthropogenic hazards that integrates vulnerability, exposure with coping and adaptation abilities’.

Other authors such as Chambers (1989 p.2) refer to vulnerability as a dual concept, including ‘exposures to contingencies and pressure and exertion in coping with them’. McEntire (2012 p. 207) writes that this concept has two sides: the external sides of risks, shocks and stresses to which a household is subject and an internal side that is defenceless, with the lack of ability to cope without incurring loss. These are the factors that determine the liabilities and variables related to limited capacity (McEntire 2012 p.208). In other words, vulnerability is often viewed to be a measurement of ability along with the capability to endure or react to hostile consequences.

After understanding the different definitions that describe vulnerability, it is important to gain a better understanding of vulnerability by comprehending the theory that surrounds it. The idea is to present the breadth and complexity of the concept of vulnerability in terms of the extensive literature behind it.

2.4.2 Understanding the theory of vulnerability

The theory behind vulnerability has been a powerful analytical lens for analysing the different states of susceptibility to harm, powerlessness and marginality of both physical and social systems (Adger 2006 p.269). It is also a lens in regimenting the analysis of actions to establish the wellbeing of a system through the reduction of risks (Adger 2006 p.270; Renaud and Perez 2010 p.155). The current research on vulnerability has contributed to the evolving understanding of resilience through its methods and conceptualisation of the stresses and processes that produce threshold changes (Adger 2006; Barsley et al. 2013), which are changes that are involved in the institutional and social dynamics of socio-ecological systems. While some scholars regard the

theory and assessment of vulnerability as an endpoint, others view it as their centre point, and yet others may consider it as a preliminary point (Kelly and Adger 2000 p.328).

The phenomenon of vulnerability is usually depicted in negative terms as the ‘susceptibility to be harmed’ (Gallopín 2006 p. 294). In context of livelihoods, it looks at the probability of a community’s household economy being injured by severe threats. Once the probability of the community’s household economy is determined, the level of vulnerability can be identified. Vulnerability is an important component in examining the magnitude and frequency of the threat (Gallopín 2006 p.294; Jalayer et al. 2015 p.78), through which the extent of the threat can be determined. It is at this point that the construction of assets needs to be considered, as well as the economic, social and institutional factors that could influence the vulnerability of communities. The aim is to develop interventions that could promote remedial actions that can limit the negative impacts (Kelly and Adger 2000), and once these factors have been identified, it is easier to reduce the severity of the threat.

The key parameter of vulnerability is the stress to which the system (i.e. livelihoods) is exposed, and includes sensitivity and adaptive capacity (Adger 2006 p.270 and Gallopín 2006 p.296). When it comes to understanding vulnerability and resilience, they share common elements regarding the shocks and stresses experienced by people’s livelihoods and their methods of coping (Madhuri et al. 2014 p.2). It is only in human-environment relationships in which vulnerability has a heavily challenged meaning. Nevertheless, together with understanding the notion of livelihoods in relation to human geography and ecology, vulnerability has commonly been conceptualised and theorised within the perspective of climate change (Kelly and Adger 2000; Adger 2006; Madhuri et al. 2014). Understanding vulnerability within community livelihoods has contributed to the current understanding of the interactions between the social and ecological aspects against the background of climate change, and has led to the identification of potential threats that could be affecting those forms of interaction.

Macklin (2012 p.70) believes that the theory of vulnerability has elements that need to be considered when analysing vulnerability in social systems. These are:

1. It starts with the basic idea of vulnerability as the relative liability to guard one's interest (relative to the capability of others to guard their own interests). The descriptive of the theory draws on logical facts and circumstances to explain why some communities or systems are more susceptible to injury than others.
2. It draws on the idea that we need to identify specific circumstances that make communities, systems or individuals vulnerable, and assess the potential austerities of their vulnerability.
3. The theory then proposes the question of what should be in the intervention and appropriation strategy in mitigating or preventing the damage or negative changes to those who are vulnerable in those applied circumstances.
4. A proposal is drawn up determining which institution or actors should have the overall responsibility to mitigate or prevent these negative changes to the communities or systems that are vulnerable (Source: Macklin 2012 p.70).

This framework is a good starting point for analysing the social systems' state to injury and harm, because it allows us to then develop vigorous strategies that can build up the system's resilience to shocks and stresses. Adger (2006 p.272) explains that the 'drivers of vulnerability' are human actions that are developed with unintentional actions that reflect self-interest with the provision of power, which interact with physical and ecological systems. Adger (2006 p.274) highlights that the theory of vulnerability is most commonly conceptualised by elements that include exposure, sensitivity to external stresses and the capacity to adapt. Exposure in this context is defined as 'as the nature and degree to which a livelihood experiences environmental or socio-political stress' (Adger 2006 p.270 and Gallopin 2006 p.298). Relevant elements include the duration, regularity and the magnitude of the hazard. Sensitivity is defined as 'the magnitude to which a livelihood is altered or affected by external stresses', and adaptive capacity is 'the capability of the livelihood to evolve whilst dealing with environmental and social stresses and to increase the range of unpredictability with which it can cope' (Chang and Martens 2010 p.4). It is important to note that these elements can overlap one another; it is not safe to assume that the system will only apply to one element, because there are circumstances in which some systems apply to all the elements (Gallopin 2006 p.298).

Adger's (2006) and Macklin's (2012) theories on vulnerability are two connected theories that address livelihood use of environmental assets, and determine environmental threats by looking at the vulnerability of communities and the ecological systems. Cutter et al. (2003) explain other views regarding the traditions of vulnerability, especially in scientific research. Cutter et al. (2003 p.243) write that vulnerability in the form of exposure clarifies the circumstances that make people vulnerable to a specific hazard. They further clarify that 'vulnerability in scientific research, is reflected as a social condition, which we can identify and measure the resilience of people's livelihoods or systems to the specific hazard' (Cutter et al. 2003 p.244). Assessing vulnerability should underline the potential exposures and the societal resilience.

The next section discusses water vulnerability in livelihoods through the perspective of entitlements.

2.4.3 Vulnerability in Livelihoods: 'Entitlements'

Adger (2006) and Ribot (2014) examine vulnerability through what they term 'entitlements'. In livelihoods, entitlements are defined as the basic assets available to communities based on their own method of production, other types of assets available and established mutual arrangements within institutions and organisations (Adger 2006 p.270; Ribot 2014 p.668). Entitlements also facilitate in providing livelihood outcomes such as income, food security and increased human welfare (Kelly 1992 and Chomba et al. 2015). They are a basic form of necessity that a community commands and uses within society, using its rights as well as opportunities that that community may come across (Adger 2006 p.270). Within the context of water security, entitlements such freshwater ecosystems are considered a basic entitlement that communities rely on for their capability to adapt to water-related hazards. Vulnerability in livelihoods stems from the insufficiency or total collapse of entitlements (Kelly 1992 p.323; Adger 2006 p.271). This concept is a key point in research, especially when investigating the probability of communities' livelihoods being vulnerable to natural hazards, regardless of whether the subjects have yet experienced the stresses that the hazards impose.

Vulnerability occurs when the entitlements fail to prevent the community's livelihoods from being affected by hazards, and usually happens to communities that have entitlements that are natural resource-based such as rivers, forests and biodiversity (Chomba et al. 2015). This phenomenon is mainly derived from the perception of insecurity. Insecurity in livelihoods at its most basic level does not only denote lack of water, food and economic wellbeing, but the lack of freedom from poverty, indebtedness, hunger, diseases and conflict (Moser et al. 1997 p.22; Adger 2006 p.271; Oluoko-Odingo 2011 p.3). Studies have shown that vulnerability in livelihoods has been an immediate consequence of entitlement failure (Adger 2006 p.271). However, there has been little research done on how to improve the flow and sustainability of entitlements such as food and water, which is a core component in resilience research, particularly for intervention strategies that enhance adaptive capacity within social and physical systems (Chang et al. 2010 p.5).

2.5 Resilience

This section explains and discusses in detail the works that were done by the leading authors that have conceptualised resilience, including Holling (1973), Allison and Ellis (2001) and others. Resilience in this section has been addressed within the context of water vulnerability and livelihoods. The next section begins by introducing the definition of resilience.

2.5.1 Defining the Concept of 'Resilience' within the Context of Water Vulnerability and Livelihoods

According to Allison and Ellis (2001 p.378), resilience is defined as 'the ability of an individual or communities' livelihood system to bounce back to its normality after being hit by a shock and stress'. The capacity of a livelihood system to absorb shocks and stresses and maintain its functionality primarily indicates the robustness of the system, such as high resilience and low vulnerability to hazards (Allison and Ellis 2001 p. 378; Bonß 2016 p.10). The concept of resilience is an important element of the current study, and although it is not the central focus, it needs to be understood.

Resilience is the probability of whether the community's livelihood system would have the potential to mitigate against the hazards posed on their water assets for the short or long term. In simpler terms, it gives an indication on the stability of the community's livelihood system. Holling (1973 p.8), who first introduced the concept of resilience within ecological systems, defined ecological resilience as 'the ability of the system to absorb changes of state variables, driving variables and parameters and still continue to persist'. By comparing Holling's (1973) and Allison and Ellis's (2001) definitions, a significant point about resilience is made clear: resilience within livelihoods is the power of resistance within an environment of conflict, endurance and change. Lorenz and Dittmer (2016 p. 25) explain that resilience would imply that when the livelihood is attacked, it would avoid suffering the conditions that the hazards poses due to internal reasons. However, one cannot assume that the catastrophes will be avoided and mitigated through preventative planning, because the conditions can still occur within a community's livelihood at any given time.

Resilience as a concept within the context of water vulnerability and livelihoods, is usually recognised because of large-scale damages that have been unforeseen and abrupt in communities' livelihoods. Major hazards and their effects on a community's water assets are unavoidable and at times unanticipated (FAO 2013 p. 3). Thus, community's resilience stems from its entitlements, which are what the community would manage and use in the face of hardships (Adger 2006 p. 271). In terms of water management, the security of the community's water assets facilitates resilience through their strategies, capabilities and outcomes. A decline in a community's water assets increases its vulnerability to natural hazards and reduces its ability to resist and cope, because the structure would have altered in the transformation of its assets. Therefore, if water assets are secured, the community's livelihoods develop resilience.

FAO (2013) and Collins (2014) explain that insecurities are periods that bring about extreme stress, and affects the community's capability to use its water assets because of the intense pressure that is placed on its livelihoods. To resist the pressure, the authors have discussed different responses that communities use to mitigate the stresses. To be adaptive to the stress, livelihoods are thought to adapt through reactive and proactive reactions that facilitate the

continuous longevity of resilience in the rural context (Collins 2014 p. 290). Other authors such as Osbahr et al. (2008 p.1952) highlight resilience within the context of coping and adaptation, while yet others point to reactive responses, or combating the hazards using survival techniques. However, the techniques do not often integrate long term solutions that will prevent the next future shock that arrives (Collins 2014 p 291.). Reactive techniques would be classified as coping against the stresses for the short term (Osbahr et al. 2008). Proactive techniques, in contrast, focus on adaptation for the long term, addressing the risk through practical learning to adapt to hazards and stresses that are beyond the community's control (Osbahr et al. 2008 p.1952).

Reactive techniques reduce vulnerability in the household system by trying to sustain food and water security during the period of insufficiency, whilst also trying to increase survival options for those that have limited capability in withstanding the hazards (Osbahr et al. 2008 p.1953; Collins 2014 p.291). The foundation for this approach stems from the ability to invent and experiment with livelihood outcomes (i.e. income generation) and pursue activities that pose less risks and uncertainties (Ellis 2000). On the other hand, proactive techniques stem from livelihood diversification – a term that is used to highlight how communities create a portfolio of their livelihood activities and find social support that enhances their capabilities in their struggle to improve their basic standard of living (Collins 2014 p.292). If resilience is built within communities' livelihood structure and their water assets, not only does it facilitate adaptation for the long term, but it also increases the overall water security for their livelihoods as well.

2.6 Water Security

This section discusses the works of those authors that conceptualised water security, including Fraiture et al. (2010), Cook and Bakkher (2012), Bakkher and Morinville (2013), Naik (2016) and others. Water security is an important concept in this study, and thus understanding its definition and principles will help contextualise the phenomenon being investigated. The next section below begins by defining the term water security.

2.6.1 Defining and Understanding the Concept of ‘Water Security’

Water security is an important concept in this research because it refers to securing water assets for human needs (Cook and Bakkher 2012; Kumar et al. 2016), which is an essential objective of sustainable livelihoods. It also relates to the issue of vulnerability by reflecting on the security and sustainability of the community’s water assets against slow hazards such as drought. Water security additionally looks at resilience within social and physical systems. Although resilience is not the central focal point of the study, it touches on the context of water vulnerability by highlighting the coping and adaptation methods that communities employ to reduce vulnerability and increase water security.

Bakkher and Morinville (2013 p. 1) define water security as ‘an acceptable level of water related risks to humans and ecosystems – coupled with the availability of water, of sufficient quantity and quality to support livelihoods, national security, human health and ecosystem services’. Water security looks at all aspects of human security applying to the utilisation and administration of water (Jansky et al. 2008). UN-Water (2013 p. 2) also defines water security within the context of human needs, stating that it is ‘the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods and human wellbeing, and socio-economic development for ensuring protection against water borne pollution and water related disasters and for preserving ecosystems in a climate of peace and political stability’. Although there is an element of anthropocentrism with regards to the framing of water security, the importance of freshwater ecosystems is not neglected, because they are an integral component of both human and water security (Cook and Bakkher 2012 p.39).

The definitions above imply that water should be sustainably managed throughout the water cycle and prepared by means of an inter-disciplinary approach so that it facilitates support towards socio-economic development (UN-Water 2013 p.3). In addition, it should aim to strengthen the collective resilience to environmental effects and waterborne diseases without jeopardising the present and future health of the population and the ecosystems (UN-Water 2013 p.3). As highlighted by Grafton et al. (2013 p.11), Plummer et al. (2013 p.750) and Sun et al. (2016 p.857), water is an essential asset that every livelihood is dependent on, and the security of

people's livelihoods is dependent on the security of their water assets. If there is a decrease in the security of water assets, then the community's livelihood may be subjected to low levels of water security, which is why the water security definitions provided by Bakkher and Morinville (2013) and UN-Water (2013) apply to the context of water vulnerability and livelihoods. A great deal of the academic literature and policy in the past decade has been drafted based on the themes indicated in the definitions above.

Water security is about handling water risks, which include risk of water shortage, excess, pollution and risks of declining freshwater assets – of the water that society and the environment depend on (OECD 2013 p.13). The approach to water security considers the frequency and magnitude of the water risks and uncertainties. OECD (2013 p.14) suggests that to achieve water security, there is a need to maintain four acceptable levels of risk. These are:

- Risk of shortage (inclusive of droughts): lack of sufficient water to meet demand (in short and long term) for all favourable users (i.e. households, agriculture and the environment);
- Risk of inadequate quality: lack of suitable water quality for a particular use;
- Risk of access (inclusive of floods): destructive build-up of water in areas that do not normally submerge; and
- Risk of undermining the resilience of freshwater ecosystems: looking at the status and coping capacity of both surface and groundwater bodies (i.e. rivers) and analysing the extensive damage of the ecosystems hydraulic and biological functions.

Achieving these four levels requires allocation of water amongst users to be adequate, effective and transparent. It implies having enough water that meets human needs, which is accessible and affordable to the user, and that water from the ecosystems and the water cycle is protected from degradation (OECD 2013 p.14). In addition, it implies that there are fair integrative mechanisms and methods that are applied to address or resolve any future conflicts that should arise regarding availability, affordability and scarcity (UN-Water 2013).

This extended use of the term water security is quite recent, and is categorized by rapid cumulative change (Cook and Bakkher 2012). There are also other water security guidelines that apply, which are different and encompass their own range of problems, and differ within

disciplinary perceptions on water use and context (Cook and Bakkher 2012 p.96). For example, prevention and protection against floods and droughts (water-related risks) are generally considered as key elements of water security from an agricultural and livelihoods perspective. The various context and disciplinary viewpoints in defining water security and understanding the diversity between the guidelines further scientific knowledge to the policy and literature. For instance, in the 1990s, dimensions of water security were used to highlight the significance of human security issues such as environmental security, food security and livelihood security (Cook and Bakkher 2012 p.97). In 2000, the Global Water Partnership (2012 p.22) (GWP) presented the integrative meaning of water security that measured access and affordability along with human needs and ecological health. Since the GWP, policymakers, scholars and researchers have taken up the term and some have developed their own discipline-based definition, whilst others created an integrative interdisciplinary approach.

Several individual securities need to be met to achieve human security (UN-Water 2013 p.3). Water security ensures that all human securities are met, and this includes having access to water and the benefits it promotes (UN-Water 2013 p.4). Numerous studies have shown that improved water security -with regards to access to water, levels on the use of water, overall health of the ecosystem environment and increasing the technological and institutional capacities to counter with sectoral challenges- facilitates better livelihood outcomes such as human health and food security (Kumar et al. 2016 p.22). Water security affects all facets of community livelihoods, reducing tensions and conflicts and facilitating social development and economic and environmental benefits on a large scale (Bhattarai et al. 2007; UN-Water 2013).

The main challenge with increasing water security in livelihoods, especially within the agricultural sector, is the poor water management practices that incur social and environmental costs (Fraiture et al. 2010). For example, common pool water resources such as rivers and wetlands that have been polluted have both environmental and social costs, because the pollution of freshwater ecosystems creates symptoms of water scarcity (Fraiture et al. 2010 p.496). Water scarcity is a product of water and food insecurity in livelihoods (Rijsberman 2006 p.6; Wutich and Ragsdale 2008 p.2116), and water and food insecurity occurs when the available water resources are inadequate to meet the food and water demands of the community (Falkenmark

2001 p.540). For example, majority of the world's poor -1.7 billion people (as cited by Fraiture et al. 2010 p.497) live in South Asia and Sub-Saharan Africa. Five hundred and ten million of the people are food and water insecure (Fraiture et al. 2010 p.497). For Sub-Saharan Africa, the severity of the situation continues to double up from one hundred and twenty-five million people in 1980 to two hundred million in the year 2000 (Fraiture et al. 2010 p.497). As indicated above, water and food scarcity is very difficult to eradicate, especially in areas that are prone to water-related hazards such as drought.

In such circumstances, economic water scarcity and physical water scarcity become critical factors that need to be addressed and national and local level. Financial investment is needed to maintain the communities' livelihood outcomes, whilst battling with the increasing water demand (Naik 2016 p.3). For example, several poor small-scale farmers operate in conditions of both physical and economic water scarcities. About seventy-percent of the rural populations in Africa and Asia live in areas with few immediate options for employment outside of agriculture (Fraiture et al. 2010 p.497). In these circumstances, drought and arid areas need heavy investments and policies that can improve the rural farm-level access to irrigation water to both enhance agricultural productivity and preserve the remaining freshwater resources. In that way, communities' livelihood outcomes are met and their overall water security within their livelihoods is sustained.

Another important factor is the protection and restoration of freshwater ecosystems (Falkenmark et al. 2007 p.3; Fraiture et al. 2010 p.497). Fraiture et al. (2010) and Namara et al. (2010) explain that securing freshwater ecosystems is not only linked to the enhancement of water security, but also to the reduction of water poverty within community's livelihoods. Namara et al. (2010 p.522) highlighted that access to water supply, provides key inputs such as high yielding varieties that formulate higher output levels, which cut down on poverty and improve on farm income. For instance, two hundred and seventy-five varieties of rice have been shared amongst Latin American countries during the past decades (Namara et al. 2010 p.522). Ninety-percent of their varieties come from rain-fed and irrigated wetlands. The average yields increased from 2.8tha^{-1} in the mid-1960s to 4.4tha^{-1} in the mid-1990s (Namara et al. 2010 p.522). The average yields in rain-fed regions showed little change in the last four decades (Namara et al. p.522).

However, productivity differs broadly across agricultural systems and it depends on factors such as policy and local conditions (Namara et al. 2010). But based on the outputs of irrigated agriculture, it is critical to secure the remaining freshwater ecosystems to ensure not only food security, but human security.

Nicol (2000), Fraiture et al. (2010) explain that the principles of water security and poverty reduction in livelihoods are not very different from one another. Firstly, they state that there should be an insurance on the security of rights regarding access to water for the poor people. Such security can be achieved through water rights, investments in water storage and delivery and provision of water infrastructure when in demand (Cook and Bakkher 2012; Fraiture et al. 2010 p.498; Allan et al. 2013). Secondly, the rural poor should be empowered to use water supply more efficiently. Thirdly, there is the need for effective governance of freshwater ecosystems, and lastly, there should be external support in the variegation of livelihoods (Fraiture et al. 2010 p 498. and Namara et al. 2010 p.523). Several developing countries have failed to develop long term intervention strategies that could counter the decline and degradation of freshwater ecosystems (Naik 2016 p.3) and thus, policies that are drafted need to initiate a transition towards more stratified practices with more attention dedicated to trade-offs and the sustainability of freshwater ecosystems. In the context of trade-offs, the organisations and farming communities would have to choose the type of robustness that promises investment in the long term (Janssen and Anderies 2007). For instance, a social system such as agriculture will trade off a surface water ecosystem that has transformed, for a groundwater system to maintain yields in crop production or they take the initiative of resorting to crops that are more drought resistant. However, not all trade-offs are present to eradicate vulnerability and this is why certain social systems go through a collapse phase.

2.7. Conceptual Framework

This section will discuss in detail the SLAF and link the key concepts of vulnerability, water assets, livelihoods capabilities, strategies and outcomes that will be scientifically investigated in the study. It will discuss the purpose of the SLAF.

2.7.1 The Sustainable Livelihoods Analytical Framework (SLAF)

The SLAF has been used in understanding the current realities and concerns of poor men and women – what do they do to earn a living, the assets on which they capitalise and the shocks and stresses that they face in doing so (Scoones 1998 p.5). It provides a starting point for understanding how individuals or communities manage their livelihoods during a crisis (Solebury 2003 p.6). The main objective of sustainable livelihood, besides eradicating poverty, is to ensure that there are improvements in peoples' livelihoods. The core of SL approach lies deeply in the analytical framework, directing attention to the type of assets that the rural poor utilise and the strategies and capabilities they employ to earn a living.

2.7.1.1 Vulnerability

As highlighted in the theoretical framework, vulnerability looks at the insecurity of communities in the face of changing environments, whether they be social, political, environmental and economic. These either come in the form of sudden shocks, long term trends or seasonal shocks (Rakodi 2002; Moser and Dani 2008). In the context of this research, the study focuses on drought as the seasonal shock that indirectly induces vulnerability in a farming community's livelihood. Vulnerability is induced when the shock slowly weakens the security of the community's assets (Adger 2006 p.270) -which in this context the reduction of water availability of the Kafue River reducing the Kaleya farmers bulk water supply. The degree of the vulnerability relates to the local level of the outward hazard to a household community's welfare and to its ability to resist and cope (Farrington et al. 2002 p.3).

2.7.1.2 Assets

The SL approach that is taken from the current existing literature is the starting point for understanding how communities utilise and manage their livelihood assets in a crisis (Scoones 1998 p.6; Morse et al. 2009 p.4). In understanding how the people manage a crisis, one firstly

needs to comprehend the status of their livelihood assets. The SLAF framework (Figure 1) points to five significant livelihood assets in a livelihood. These are namely:

1. Human Capital – e.g. health status, skill levels, household size, leadership;
2. Natural Capital – e.g. natural resources such as water, land, farming, grazing;
3. Physical Capital – e.g. household infrastructure, irrigation schemes, tractors, roads;
4. Financial Capital – e.g. household income, remittances, savings, credit; and
5. Social Capital – e.g. informal and formal institutional associations i.e. markets and water users. (Source: Scoones 1998 p.7; Morse et al. 2009 p.5)

This study focuses on natural capital with specific reference to the Kafue River in the Kaleya rural farmers' livelihoods. The idea is to understand how the insecurity of the Kafue river indirectly induces vulnerability in their livelihoods. Natural capital is not just an asset that helps the farming community in getting by with life; rather, it helps them in creating a living that is of significance (Bebbington 1999 p.2022). Essentially, natural capital to some extent develops reflections and mechanisms of meaning, which a community creates to establish components such as their livelihood strategies (Bebbington 1999; Lawal et al. 2011)

Assets are therefore not just resources that individuals utilise in creating their own livelihoods; they are resources that provide the platform for individuals to have the capability to be and to act (Chambers and Conway 1991 p.4; Scoones 1998 p.6; Bebbington 1999 p.2023). Demonstrated in the framework in Figure 1, assets provide mobility to make a living and it also provides mobility to make life meaningful (Bebbington 1999 p.2022). Assets are not only resources that allow communities to survive from poverty (Lawal et al. 2011 p.4), but they are also the basis for the community's power to act, change, reproduce and challenge the rules that govern the control of use and conversion of their resources (Bebbington 1999 p.2022; Adato and Meinzen-Dick 2002 p.4).

External symptoms of vulnerability such as drought can affect the security of a community's livelihood assets (Chambers and Conway 1991). For instance, when the conditions of drought transform the community's natural capital, the effect is reflected within their capabilities and

outcomes. Bebbington (1999 p.2023) further states that the rural poor have not been able to enhance their livelihoods, purely from their inability to defend their assets from shocks. Livelihoods are termed ‘successful’ when communities can enhance their access to different resources, it creates an asset base that can enhance their livelihood (Scoones 2009 p.174). In simple terms, livelihoods are successful if the community has increased the number of ways in which they can sustain their resources (Scoones 2009).

2.7.1.3 Capabilities

The term ‘capabilities’ is defined as the ‘ability of individuals to perform certain basic functioning’s, which is essentially ‘what an individual is capable of doing or being’ (Chambers and Conway 1991 p.7). It is inclusive of several attributes, for example, having the ability to irrigate, harvest and plough -within the agricultural context-, put on clothes or visit friends within the social context, and keep track of the surrounding environment (Robeyns 2005 p.94). In this study, the research investigated the community’s capabilities within the agricultural context. It implied assessing the Kaleya rural farmers’ capability to perform infield irrigation as well as the social context, which implied looking at the Kaleya rural farmers’ capability to provide for their households. The aim is to establish whether the community could perform these functions whilst being affected by the reduction in bulk water supply from the Kafue River.

Chambers and Conway (1991 p.7) and Robeyns (2005 p.94) argue that these types of capabilities highlighted above would be a subset of capabilities that provides a platform for a household to cope with the stresses and shocks, whilst having the additional ability to manipulate their livelihood opportunities. Robeyn’s (2005 p.94) capability approach also characterises the welfare of a household, including the strengthening or the preservation of real freedoms available to the household, for them to create a valuable life. The principles of capability and sustainable development aim to address two significant questions: ‘how to sustain’ and ‘what to sustain’ (Lienert and Burger 2015 p.2). Both concepts characterise the communities as active agents of change, which possess the capability to introduce change within their livelihoods (Lienert and Burger 2015). It reviews the discussion on what activities for households would count as ‘valuable’ and the need for it to be supported by social changes.

It is important to understand that capabilities are a significant component in livelihoods, because they directly help the household in performing functioning's that create livelihood strategies and livelihood outcomes, which ultimately create their quality of life (Adato and Meinzen-Dick 2002; Robeyns 2005; Lawal et al. 2011). Without capabilities, it is difficult for communities to capitalise on their livelihood outcomes (Robeyns 2005). The next section below further discusses the role institutions and processes in communities' livelihood systems.

2.7.1.4 Institutions and Organisations

Institutions and organisations are other important components in people's livelihoods, and determine influence and access to assets (Dorward et al. 2003 p.321). Although it is not the primary focus in this study, it is important to understand the role institutions and organisations play in SLAF. Importantly, policy and institutional responses to enhancing a livelihood may limit or improve the accessibility of livelihood assets to the community (Scoones 1998; Dorward et al. 2003). For example, institutional relationships such as the private and public sectors may affect the community's access to livelihood assets (Krants 2001 p.10; Larson et al. 2007 p.253). This can occur in the decision making of managing common pool resources such as rivers and wetlands. In many cases, communities are marginalised because of their lack of social capital to increase their influence (Bebbington 1999 p.2023) and therefore there is a need for the right decisions to be made regarding opportunities that improve people's livelihoods and reduces any symptoms of poverty from evolving (Scoones 1998 p.11; Carney 2002 p.30; Larson et al. 2007 p.253). Especially within the context of socio-ecological systems, there is a need to recognise the influence that institutions have on communities' livelihoods, to comprehend and categorise the different asset uses and users that are in place, and pay attention to the different arrangements and responsibilities that surrounds them (Bebbington 1999; Carney 2002). It is important to note that access is primarily determined by the relationships of the people and the organisations, because as people try and access resources, they engage with actors and institutions that have the same interests in the use and conversion of those resources (Bebbington 1999 p.2024). Access is defined as the 'ability to derive benefits from things' (Ribot and Peluso 2003 p.153) and thus without access, the farming community would be unable to capitalise on the benefits that access

brings to their capabilities and outcomes. Institutions may either be physically present or absent, but their influence still has a significant impact on the community's access to natural resources (Carney 2002).

2.7.1.5 Outcomes and Strategies

The objectives of SLAF framework is mainly directed towards providing the desired outcomes of an individual's livelihood. These desired outcomes are viewed as positive benefits that facilitate sustainability and reduce poverty within a household (Rakodi 2002 p.16; Ming'ate 2016 p.330). Some of these desired outcomes include income, reduced vulnerability, increase in welfare, water and food security, employment and more sustainable resource use (Chambers and Conway 1991 p.9; Scoones 1998 p.12). Livelihood outcomes are the end goals of a community's livelihood, and it forms the final component in a framework that creates the means of living for which communities strive for (Rakodi 2002). Within the context of the study, the outcomes that will be assessed in the framework will be crop production, income and employment.

Livelihood outcomes are particularly dependent on the individuals' livelihood capabilities and strategies in managing their livelihood assets (Rakodi 2002). Livelihood strategies form as mechanisms that communities utilise to protect their current assets and structures within the livelihood system (Krants 2001). Their strategies are also determined by institutional and organisational structures. For example, the management and use of common pool resources such as land and water are settled through property rights (Schlager and Ostrom 1992 p.249). These social structures may either increase or decrease vulnerability for the communities' livelihoods.

If organisations and institutions were to aid in enhancing communities' livelihood diversification, and prevent them from being vulnerable to socio-economic changes and environmental changes, then the probability of the communities having the ability to cope will increase, resulting in effectiveness and sufficiency (Rakodi 2002 p.16; Niehof 2004). This study focuses on the livelihood strategies that the Kaleya rural farmers had in place to defend their access to bulk water supply from the Kafue River, and aims to establish whether their livelihood strategy against the reduction in water availability was adaptive for the long term.

By understanding the dynamics and challenges with regards to rights and accesses to livelihood assets, it increases the likelihood that the farmers will achieve better outcomes for his or her household in the long term (Niehof 2004 p.328). Figure 1 below demonstrates the relationships between the components (assets, vulnerability, capabilities, institutions, outcomes and strategies) of the SLAF.

2.8 Summary

This chapter has introduced the theoretical foundation of this study, describing and explaining nature of water availability and its influence on community livelihoods and the theories of sustainable livelihoods, vulnerability, resilience and water security. The chapter also addressed the SLAF conceptual framework, not only linking the theoretical concepts, but also describing the livelihood elements of assets, access, capabilities, strategies and outcomes.

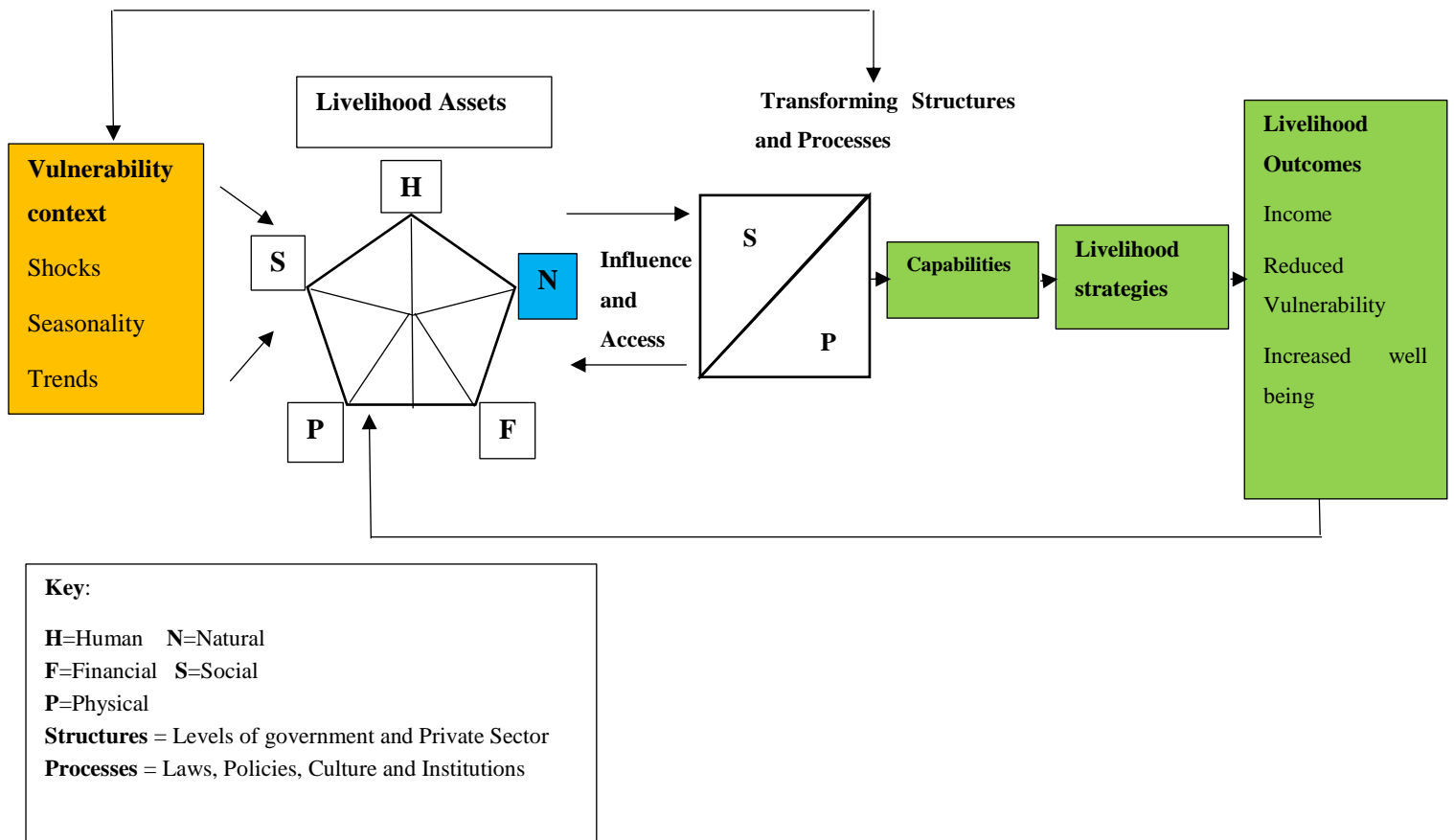


Figure 1: The Sustainable Livelihood Framework (SLAF). (Source: Adapted from Morse and McNamara (2013 p.106) and Farrington et al. (2002 p.2))

3. Chapter Three: Research Setting and Research Methodology

3.1 Introduction

The chapter outlines the research approach, research type and research paradigm followed by the techniques of data collection and data analysis that were applied in the study. The chapter also discusses the parameters that were used in guaranteeing validity and trustworthiness before during and after data collection. Lastly the chapter reviews the ethical considerations that were applied throughout the research. Because it is important to understand the context in which the research takes place, the chapter begins by describing the background of Mazabuka as the research setting, the nature of how water availability is conducted on the Kafue River, the establishment of the Kaleya smallholder scheme-as the main case study as well as how the Kaleya rural farmers and KASCOL management perform irrigation.

3.2 Research Setting

The research focuses on the Kaleya smallholders scheme, paying attention to the Kaleya rural farmers and their livelihood structures within the irrigation scheme. The scheme is in Mazabuka district in Zambia, which is 130km south from Lusaka and 2km out of Mazabuka town (Bangwe and Van Koppen 2012 p. 13). The geographical co-ordinates for the district is 15.8667°S, 27.7667°E (Source: Google Earth). Mazabuka is surrounded by Lochinvar National Park and the Kafue Gorge Dam illustrated in Figure 3. The surrounding geography of Mazabuka and the location of the Kafue River basin are illustrated in Figure 2, followed by a close-up of Mazabuka and the Kafue River basin with its surroundings in Figure 3.

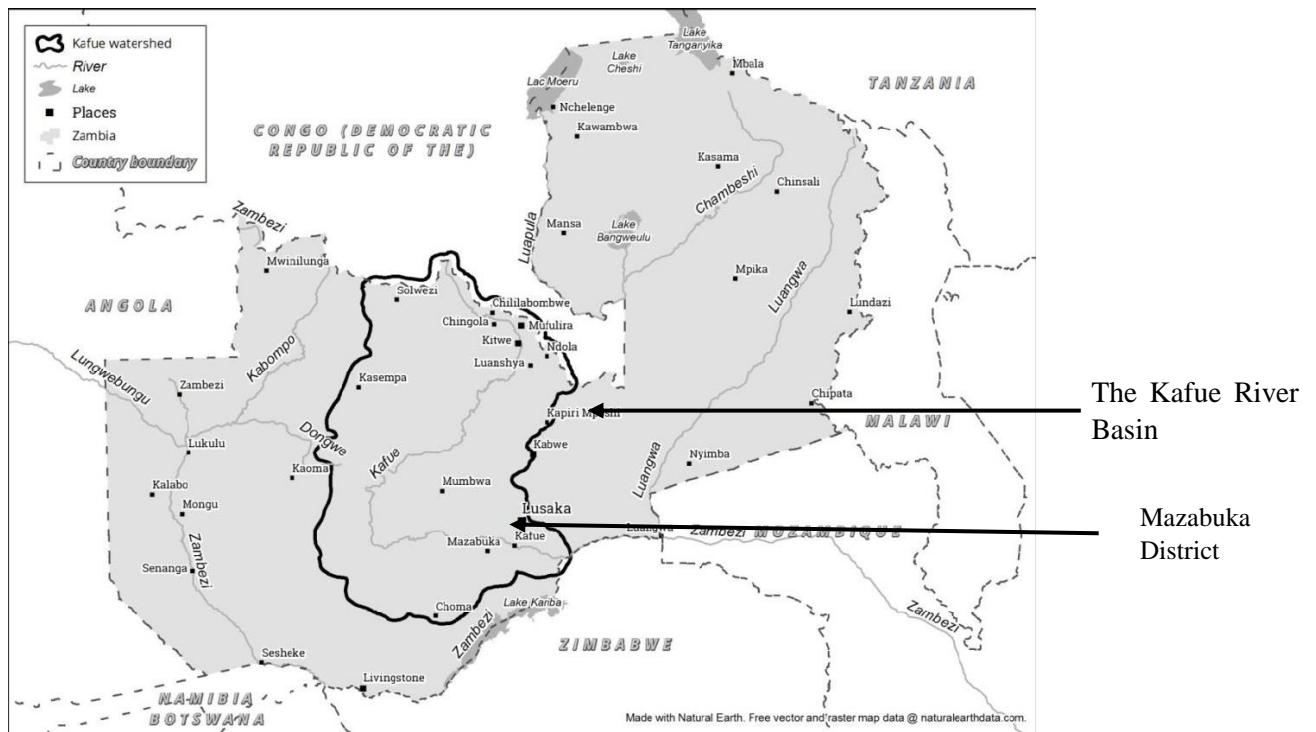


Figure 2: Location of Mazabuka in South-Western Zambia and the nearby Kafue River Basin (Source: Chomba and Nkhata 2016 p.4)

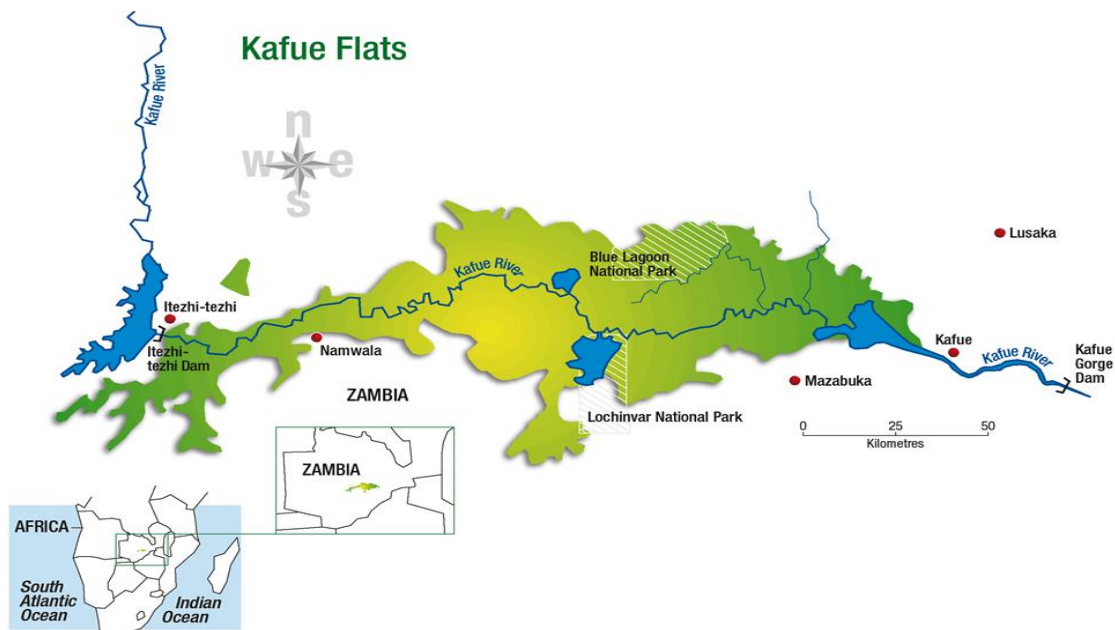


Figure 3: Location of Mazabuka town and its surrounding rather in the context of the Kafue River Basin (Source: World Wildlife Fund)

The Kafue River basin is a primary sub catchment of the Barotse sub basin (Zambian Ministry of Finance 2013 p. 5). It receives most of its water from the Zambezi River. The Kafue River flows from the north-western part of the basin, south to the Itezhi-tezhi storage dam (Schelle and Pittock n.d. p.2). At the Itezhi-tezhi (ITT), the river moves eastwards towards the Kafue Flats, after which it reconnects with the Barotse sub-basin to flow back into the Zambezi River (Schelle and Pittock n.d. p.2). It is a large basin that services the mining, industrial and agricultural sectors, and approximately 50% of the Zambia's population is concentrated within the catchment area (APFM 2007 p.16). The Kafue River extends to a total distance of 1,200km, starting in Zambia's North Western Province and draining southwards through the Copperbelt, Central and Southern provinces before reaching the Zambezi River (Chomba and Nkhata 2016 p.4).

3.2.1 Topography

The basin is centred in the African plateau, with rock minerals characteristic of the Katanga sediments of the upper Precambrian age. The river is one of the major tributaries of the Zambezi River, with a total area of 155,948km² (Chomba and Nkhata 2016 p.4), covering 20% of Zambia.

3.2.2 Seasonal Variations

The Kafue River basin has two tropical seasons: a rainy season from November to April (summer) and the dry season from May to August (winter) (APFM 2007 p.17; Chomba and Nkhata 2016 p.5). It is sub-divided into a cool and dry season from May to August and its gets warmer and hotter from September to October. Annual rainfall differs from 1300mm in the north to 700mm in the south (APFM 2007 p.17; Chomba and Nkhata 2016 p.5). Natural variations are more prominent in the south and west where frequencies of dry seasons increase, owing to the inter-annual changes in the southern extent of the Inter Tropical Convergence Zone (ITCZ), along with the El Nino/La Nina Southern Oscillation phenomenon (Chomba and Nkhata 2016 p.5). The average temperatures range from 15°-16°C in June/July and to 24-25°C in October (Chomba and Nkhata 2016 p.5).

3.2.3 Water availability on the Kafue Flats

Measuring water availability on the Kafue flats is calculated with the following measurements- using a hydro-meteorological networks backing up the water system; inflow of water in to the systems: return flows in to the system and evaporation rates (Chomba and Nkhata 2016 p.iv). In Zambia it is a requirement from the government to have meteorological stations established and at present, there are thirty-three stations that are functional in the Kafue River basin and six of them are registered at the Kafue Hook, Nyimba, Namwala Pontoon, Kasaka, Chiawa and Nanzila (Chomba and Nkhata 2016 p.v).Water Resources Management Authority (WARMA) collects and gathers all the runoff data through the hydrometric network, along with The Zambia Electricity Supply Corporation (ZESCO) that also gathers from Magoye, even though there are no gauging stations that are fully established on the tributaries such as Nanzhila, Mwembeshi and Nangoma (Chomba and Nkhata 2016 p.v). This is because there is difficulty in acquiring data regarding the actual contributions of these tributaries flow in the main river channel. In addition, Zambezi River Authority (ZRA) co-ordinates the network downstream (Chomba and Nkhata 2016 p.v). Data regarding inflows and outflows are also collected at the Itezhi-Tezhi (ITT) and the Kafue Gorge Dam (KGD) (Chomba and Nkhata 2016 p.v). The most important gauging station that gathers data on inflows at ITT is the Kafue Hook Bridge. Measuring average flows for the past 20years estimated at 224m³/s. Data regarding the outflows has been difficult to obtain because of the limited monitoring capacity of the Department of Water Resource Development (Chomba and Nkhata 2016 p.v). Although return flows for the middle basin are estimated at approximately twenty-seven million cubic metres per year from, urban, industrial, agriculture and mining water use (Chomba and Nkhata 2016 p.v).

Evaporation plays a big role in determining the water availability on the Kafue River. Research has shown that there has been estimate water losses from evaporation between 1605mm and 2166mm compared to the national average which stands at 2061mm. Evaporation rates are relatively higher in areas that have invasive species (Chomba and Nkhata 2016 p.v). There are other stations that measure inflows such as Iolanda Lusaka Water Sewerage Company Pumping station and The Kafue Gorge Dam and outflows in the Kafue Gorge Dam were approximately measured at 289m³/s in the year 2015 (Chomba and Nkhata 2016 p.v).

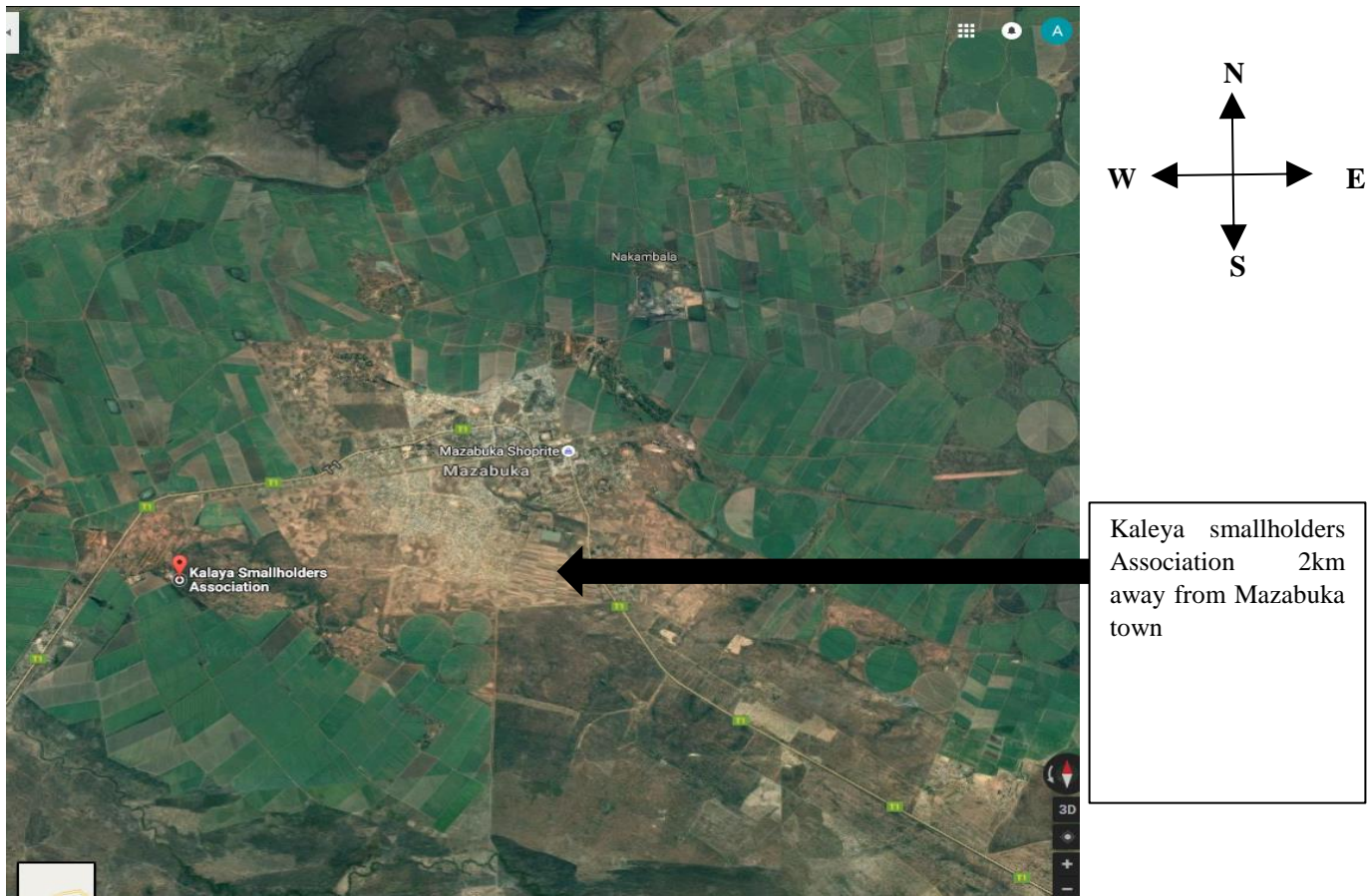
3.2.4 Socio-Economic Setting of Mazabuka and the Kafue River Basin

The overall population within the Kafue River basin is estimated at 6,610,594, or reflected as 50% of the Zambian population (Chomba and Nkhata 2016 p.7). Mazabuka is a district that is characterised by agricultural farms, with small service areas and a few administrative centres (Nchito 2010 p.92). The district is heavily invested in fishing and commercial and subsistence agriculture, mainly sugarcane, maize, millet, soybeans, wheat, cotton, tobacco, coffee and other cash crops (APFM 2007 p.24; Zambian Ministry of Finance Report 2013 p.5; Chomba and Nkhata 2016 p.7). The population comprises of smallholder farmers that are heavily invested in subsistence farming, cultivating areas of about two hectares and utilising traditional methods of farming categorised by low input and low production (Zambian Ministry of Finance Report 2013 p.5). Sugar cane farming is most predominant within this area.

The population is racially characterised as Black African with the ethnic tribes such as the Tonga, Ila, Mwanachingwala, Hamosonde, Nalumbamba, Musungwa, Mukobela, Chiliabufu, Shimbizi, Skakumbila, Mungaila and Muwezwa (Anthony and Uchendu n.d. p.217; Nchito 2010 p.92; Chomba and Nkhata 2016 p.7). A great majority of these settlers are low-income earners or unemployed (Bangwe and Van Koppen 2012 p.14). The farmers are heavily dependent on rain-fed and irrigated agriculture, using the Kafue River as their main source of water and family labour (Chomba and Nkhata 2016 p.7).

3.2.5 Establishment of the Kaleya Smallholder Scheme

The Kaleya smallholder scheme was founded by the Zambia Sugar's expansion program at Nakambala Sugarcane Estate (Shumba et al. 2011 p.6). The venture was initiated in the early 1970s with a World Bank investment loan, with the Zambian government as majority shareholder (Shumba et al. 2011 p.7). More than 22,000 people live in Nakambala Estate and depend on the agricultural industry for their sustainable livelihoods and household income (Bangwe and Van Koppen 2012 p.15). Figure 4 illustrates the location of Kaleya smallholder scheme in the district of Mazabuka, Zambia.



**Figure 4: Map showing the location of the Kaleya Smallholder Farms in Mazabuka
(Source: Google Earth)**

The objective of the scheme was to develop subsistence farmers that were living in poverty, with low food security. The smallholders' outgrower links with Zambia Sugar were implemented through the Zambian government's willingness to invest in public water and infrastructure (Bangwe and Van Koppen p.15). A loan of \$27 million dollars was granted by African Bank Development and 4000ha was provided by Zambia's government to start the scheme (Shumba et al. 2011 p.8). The Kaleya Smallholder Company is the oldest among the smallholder schemes. It began in 1981 and it has 160 farmers (Cotula 2011). These farmers were gathered from the surrounding communities that had lived on a household income of one Zambian kwacha a day (Bangwe and Van Koppen 2012 p.16).

3.2.5.1 Distribution of Irrigation Water for Kaleya Smallholders

KASCOL has 4000ha available, 1430 ha is a nucleus estate and 1070ha is under smallholders, with the remaining balance being occupied by infrastructure support, housing and other services for employees and undeveloped land (Bangwe and Van Koppen 2012 p.15). Each smallholder has 6.0-7.5 ha under a fourteen -year renewable lease agreement (Bangwe and Van Koppen 2012 p.15). Training and extension services, agricultural inputs and mechanical services, meetings for cane harvesting, haulage and distribution of irrigation water is managed by KASCOL on behalf of the smallholders (Bangwe and Van Koppen 2012 p.15). Family labour is used for the infield irrigation, weed control, crop harvesting, fertiliser application and removal of diseased cane stalks. Water is distributed from the Nakambala Sugar Estates and is channelled through a pipeline to KASCOL. Nakambala supplies water to KASCOL and it is pumped through a secondary pipeline canal to six-night storage dams from the Kafue River. This is illustrated in Figure 5 below. Kaleya Smallholder Company is entitled to its own water up to 1,600m³ per day from the Kafue River, but is not directly abstracting from the source, due to high infrastructure costs entailed in laying its own conveyance system (Chomba and Nkhata 2016 p.v; Bangwe and Van Koppen 2012 p.16). Kaleya draws a total of 13,000m³ during peak periods from Zambia Sugar (Chomba and Nkhata 2016 p.v). The water is tapped from tertiary canals in to the fields for flood irrigation (See Figure 5). In some cases, smallholders depend on rainwater to grow other field crops as rain fed crops, however it is a small percentage.

An average sum of 6.5 ha per farmer requires 52 tonnes of sugarcane seed for crop production (Bangwe and Van Koppen 2012 p.16; Shumba et al. 2011 p.8). The capital investment for crop production and infrastructure was mainly financed by CDC, AFDB, DBZ and Barclays Bank at about fifteen million British pounds (Bangwe and Van Koppen 2012 p.16). A smallholder can only grow sugarcane using irrigation water and they can grow other crops and keep livestock in the residential plots they are provided. Before they become official smallholders for Kaleya, farmers sign a Cane Farmers Agreement (CFA) in Appendix VII, that binds them to certain rules of behaviour and standard (Bangwe and Van Koppen 2012 p.16). A Cane Purchase Agreement (CPA) is negotiated between Zambia Sugar Company and the Cane Growers Association allowing the sale of sugar and it distinguishes the pricing method (Bangwe and Van Koppen

2012 p.16). Sugarcane grown by smallholders is all collected by KASCOL, bulked with the estate cane and sold to Zambia Sugar under the Cane Purchase Agreement.

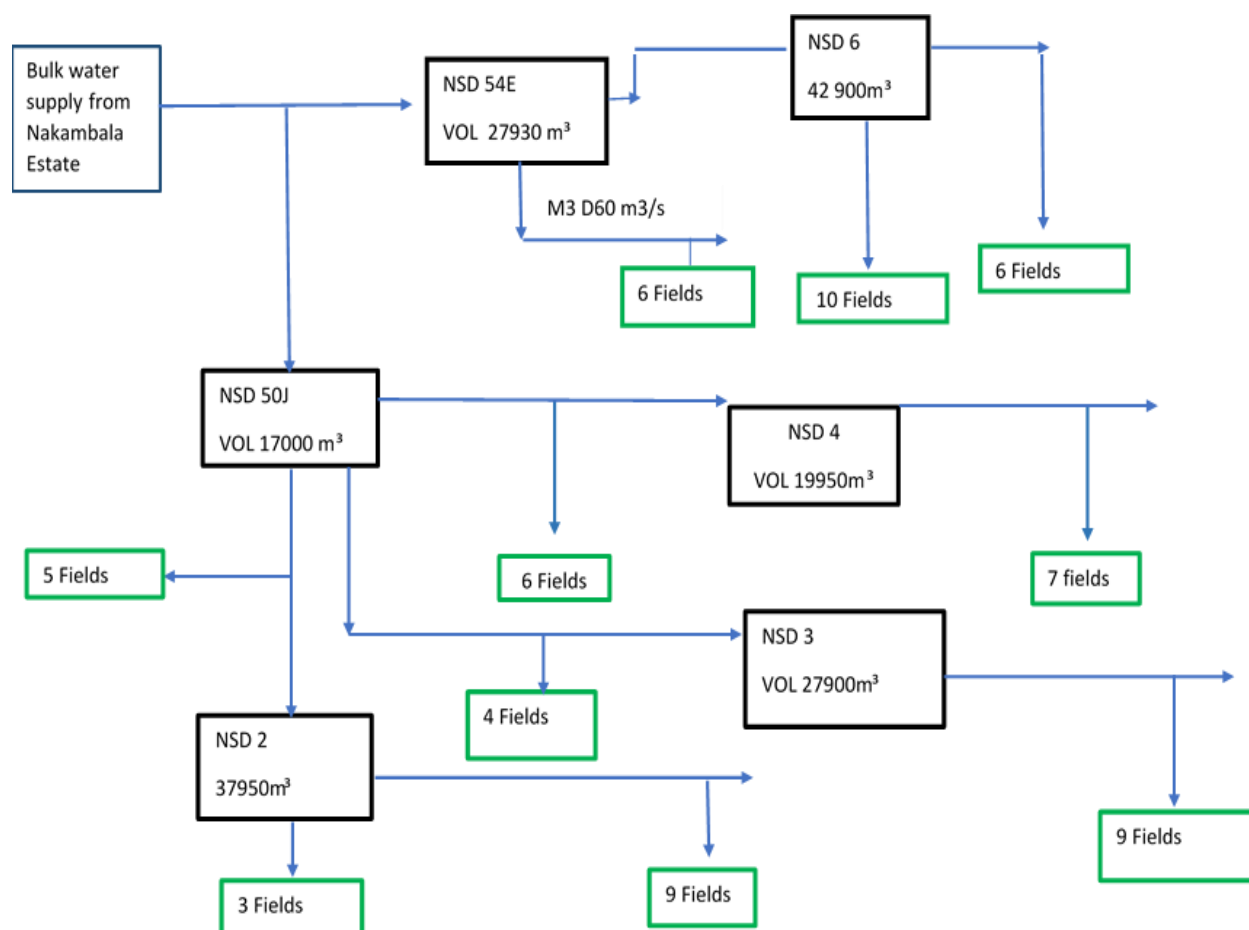


Figure 5: Zambia Sugar and Kaleya Irrigation Supply Network Diagram (Source: Acquired from KASCOL Management 2016)

3.2.5.1 KASCOL and Kaleya Management

KASCOL is managed through the Board of Directors, in which KASFA is represented. KASFA is a team that has been elected to monitor the farmers' associations. Figure 6 below illustrates the administrative structures within the Kaleya smallholder system.

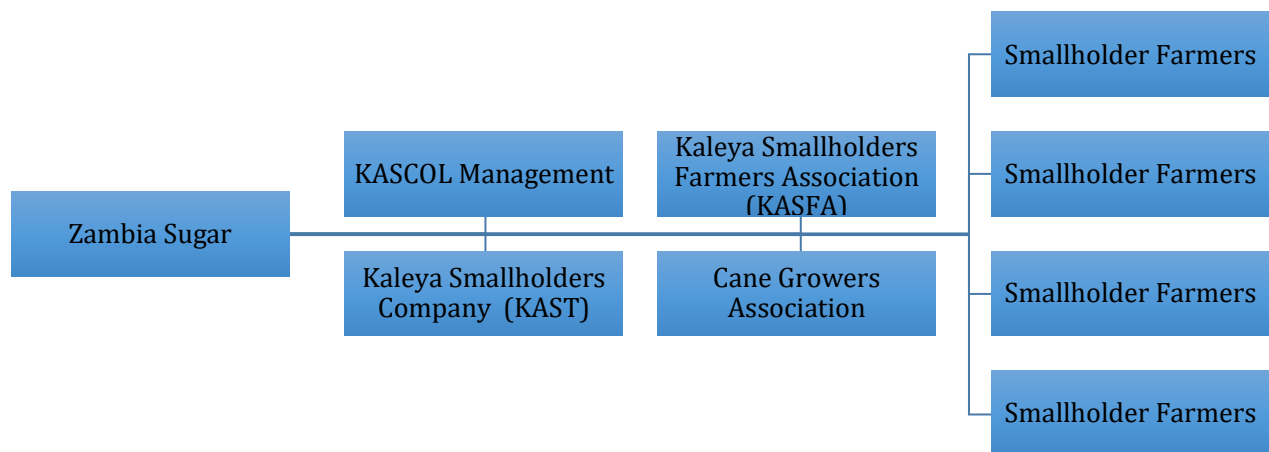


Figure 6: Administrative Structures of the Kaleya smallholder Farmers and KASCOL management (Source: Adapted from Bangwe and Van Koppen 2012 p.14)

3.2.5.1.1 Social Analysis

There are 160 smallholder farmers, comprising 60 females and 100 males who farm 1070 hectares of farmland (Munjenja n.d p.29 and Bangwe and Van Koppen 2012 p.17). There are many positive impacts of this scheme, in terms of the development of social services for the farmers (Bangwe and Van Koppen 2012). The social services allow their farmers to send their children to schools and provide them with access to acquire medical services.

3.3 Research Approach: Qualitative Methodology

Qualitative research is positioned towards examining personal and interpersonal subtleties and shedding light on the phenomenon that is under study to make it comprehensible for those who are not participants (Cleary et al. 2014 p711). It focuses on experiences that cannot be numerically expressed (Hancock et al. 2007). This approach allows for rich, in-depth data to be

collected from the complicated and all-round phenomena under study in a specific context (Richards and Morse 2013). The objective of qualitative research in this study is to collect all the facts of the social setting in a comprehensive description, expressing in detail the nature of the setting and the livelihoods of the participants involved and analysing all the meanings, values, relationships and experiences from that setting (Rosetto 2014 p.483). For the context of the study, it is to understand the ‘why’, ‘what’ and ‘how’ of the water vulnerability in the livelihoods of the Kaleya rural farmers.

3.4 Research Paradigm: Interpretivist

The interpretivist approach suggests that human beings are different from objects in the way that they behave and react to situations (Du Plooy-Cilliers 2014 p.27), because humans are influenced by many factors in the environment. From an epistemological approach, the aim is to understand human behaviour and capture people’s interpretation of a specific phenomenon (Mason 2002 p.2; Du Plooy-Cilliers 2014 p.27). The aim in this study is to interpret the Kaleya rural farmer’s perceptions of how they view water vulnerability.

Because what can only be termed as factual depends on the setting and the participants’ interpretation of information (Denzin and Lincoln 2011; Babbie 2014); only individuals can give social meaning to an act, considering the social setting in which the act occurs (Schnelker 2006 p.42). From an ontological position, reality is socially constructed and it is conditional on the meanings that individuals assign to their own experiences and feelings (Schnelker 2006). From a metatheoretical position, this study was interested in the meanings and values that were of importance to the farmers. The methods employed were therefore specific to the context. However, because meaning is dependent on the circumstances and experiences, not all the individuals experience phenomena in the same way (Cunliffe 2011 p.649). From an axiological position, the study values the unique complex of realities, and is inclusive of the researcher’s interpretations as well as those of the participants.

3.5 Case Study Approach

According to Strydom and Bezuidenhout (2014 p.179), a case study is required when there need to examine a phenomenon in-depth and within its natural setting. It is an approach that is widely used in a broad range of social disciplines (Amerson 2011 p.427). The case study method aids in providing a thorough understanding of the phenomenon through the experience of the participants and the advantage of the case study method is that it is a good method to use in challenging theoretical assumptions (Crowe et al. 2011 p.1). However, the limitations are that there is difficulty in drawing definite cause-effect conclusions and it is hard to generalise from a single case (Crowe et al. 2011 p.1). In applying this technique, this study analyses water vulnerability, through the decline in water availability in the Kafue River and how this transformation brought changes to the Kaleya farmers' capabilities and outcomes. These results were used to compare and contrast with other results from other case studies that had looked at water vulnerability. The aim of the case study approach is to display the case legitimately and, in the process, determine the symbolic, unique realities of the participants in terms of their perceptions of water vulnerability, their perceptions of their capabilities, outcomes and strategies. In this regard, the study of the Kaleya outgrower scheme is an exploratory case study.

3.6 Unit of Analysis

The unit of analysis is the 'what' or whom' that is being studied (Babbie 2014). In this research, it is water vulnerability and its influence in the Kaleya rural farmers' farming livelihoods. The participants in the study were the Kaleya rural farmers and the people from KASCOL management. These are the participants who aided in the answering of the main research question, and thus formed the population of this study.

3.7 Data Collection Techniques

This section discusses the data collection techniques – both primary and secondary, beginning with the primary data collection techniques.

3.7.1 Primary Data Collection Techniques

Specifically, the information acquired was used to understand how the rural farmers viewed the reduction in water availability and the changes they experienced in their capabilities and outcomes and whether they formulated a strategy to mitigate the changes. Data methods such as in-depth interviews, focus group discussions and secondary data were used to collect and validate the data against one another. According to Hox and Boeje (2005 p.594), triangulation of methods employed helps in trying to implement validity and trustworthiness within the data. Any research bias demonstrated in the process was countered by the information generated from the in-depth interviews, focus group discussions and secondary data.

The field notes include practical observations of the rural farmers' livelihoods and their perceptions of the Kafue River. It gave the researcher an in-depth understanding of how the rural farmers' livelihoods were socially constructed in terms of how their livelihoods benefited from using bulk water supply from the Kafue River.

3.7.1.1 In-depth Interviews

According to Boyce and Neale (2006 p.3), interviews are a qualitative data collection method that allows one to pose questions to the participants with the aim of learning more about their views, opinions and beliefs about a specific phenomenon. In this study, an informal conversational and general interview approach were used, in which the interviews could progress as the participants spoke, following a conversational approach with predetermined questions. The interview technique was chosen for its benefits of flexibility and adaptability (Legard et al. 2003). Face-to-face interviews allow for an opportunity to observe the participants' responses. The researcher was equipped with the necessary skills and experience needed to conduct the interviews effectively.

The interview guide with the farmers of the Kaleya smallholder scheme is included in appendix VI. These interviews provided insight into substantive matters regarding drought, access to bulk

water supply from Nakambala Estate, infield irrigation, sugarcane production, household income and employment- under the study. These factors were used to provide the direction and line of questioning in the next phase of the interview. Both male and female participants were interviewed. The members were interviewed based on their availability to participate. Thirteen (13) Kaleya smallholder farmers were interviewed in the first set of interviews.

Appendix VI was also used with the participants who held some position of power, and was also used to obtain extensive information about the Kafue River and the company and farmers concerns. Participants included four (4) members from KASCOL management, including the agronomist, a water specialist, the water co-ordinator and the KASFA chair person. This approach was only adopted with the agreement of the participants. The interviews enabled the study to obtain a rich account of data, which aided in understanding the participants' structure of their knowledge and social reality within the context of their management positions.

Together with the farmers, there was a total of seventeen participants (17) who were interviewed face-to-face. The interviews were in some instances conducted with the aid of a local translator, as the researcher was a foreigner that did not understand the local language spoken in that area. Several of the participants could, however, speak to the researcher in English.

3.7.1.2 Focus Group Discussions

Focus group discussions were also employed in the study, based on the availability of the participants. Some participants were not available due to personal, family and business matters that they had to attend. Based on availability the discussion comprised of six (6) farmers. This technique was used to determine the participants' experiences regarding changes in their households, farming activities and the strategies they employed in managing water. The discussion was conducted in a natural and unstructured way, where the participants were free to express their views and opinions about the subject at hand. Open-ended questions were employed to encourage the participants to express their views and opinions. The advantage of this method was that it allowed the farmers to share their feelings and opinions about similar situations they had experienced (Colucci 2007). In addition, it provided the researcher with

different perspectives of how the farmers perceived their situation regarding their livelihoods and access to bulk water supply.

3.7.2 Secondary Data Techniques

3.7.2.1 Document Analysis

Document analysis is a systematic assessment of the existing literature that does not include methods from the original data collection (Bowen 2009 p.27). The literature consists of documents, which were both textual and visual, within a specific content. Document analysis is the use of data that was collected by an individual other than the researcher. As a method, it focuses on all types of written communication and other forms that may give input to the study (Bowen 2009 p.27).

Document analysis aided the researcher in accessing the information that was already processed and thought out (Bowen 2009 p.28). Documents that were used in this study included a variety of published sources (books, journal articles, government publications, statistical records, newspapers, annual reports and archival data) and unpublished sources (agenda, minutes and memos). The primary data was acquired from KASCOL management and Iolanda River station and the secondary data was sourced from the Monash South Africa library.

The data from the document analysis helped the researcher to complete the information, and it verified specific aspects of the primary data. It also allowed the researcher to make comparisons and identify the advantages and disadvantages of the different approaches that were employed in the study. However, the application of secondary data had its own limitations. Flick (2009) suggests that during a qualitative study, the researcher needs to be aware of the purpose of the documents, as they may have no relevance to the study being carried out. Some of the information gathered did not inform the researcher of its purpose, therefore those documents may have had no relevance to the current study.

3.8 Selection of Participants

Non-probability sampling, which looked at the selection of the participants and secondary documents, was used in this study. In accordance with the case study approach, the purposive sampling method was used, and participants were recruited from the Kaleya smallholder scheme. The Kaleya smallholder farmers were Zambian subsistence farmers, who were specifically recruited into an outgrower irrigation scheme and primarily practiced the growing of sugarcane. These participants were selected based on the characteristics that met the criteria of the study, to ensure that the participants would be to assist in the study as they fall within the population parameters. Based on these parameters, referrals were obtained from the KASCOL management team.

3.9 Data Analysis

The aim of qualitative data analysis is to bring order, structure and meaning to vast data (Bezuidenhout and Cronje 2014 p.229). The process typically involves cutting down volumes of raw data, identifying the significant patterns and developing a framework for communicating the depth of what the data revealed (Thorne 2000 p.1). In the application of a case study approach, the researcher becomes the research instrument of the research procedure and, as such, the data analysis was dependent on the researcher's analytical skills of reduction, organisation, interpretation and substantiation. In this study, the researcher collected and analysed the words from the recordings and documents to define their meanings, then transcribed all the data from all the raw information that was collected from in-depth interviews, focus groups and notes from field research. The transcripts were read and reviewed, and notes were made about the key themes that evolved. This approach enhanced the validity of the study, helping the results reflect the original data.

This analysis was used to explore and identify evident and covert themes and patterns ingrained in texts (Barbour 2008). Thorne (2000 p.2) and Berg (2004 p.199) suggest that applying a qualitative content analysis means paying close attention to the different themes that typify the

range of meanings of the phenomenon, rather than the numerical significance of the occurrence of texts and concepts. Within this study, the researcher used the raw data to develop the themes using a pre-defined conceptual analytical framework, as illustrated in Chapter Two. The themes of water vulnerability in rural farmers' livelihoods emerged from the data through the study's careful examination and constant comparison against other studies that have similarly researched on water vulnerability.

3.9.1 Thematic Coding

Thematic coding was applied by grouping the categories together. It made the process of analysis more manageable and thus was applied to all the texts, including written notes from the interviews, focus group discussions, written texts and notes from the diary. The aim was to group the words into codes and concepts and reposition them into meaningful categories. The categories consisted of titles and definitions relevant to the categories. The categories were then conceptually organised based on their similarities and differences as well as their relationships with one another. Lastly, the categories were then applied within the SLAF framework in Figure 1.

Table 1: Thematic Coding Scheme

Themes	Codes
Shocks	Recurrence of droughts in Mazabuka and reduction in water availability from the Kafue River
Stresses	Water Shortages
Water Assets	Kafue River basin
Livelihood Capabilities	Irrigating, harvesting and cultivation
	Taking care of their children and extended families
Livelihood Outcomes	Sugarcane production, household income and job security
Livelihood Strategies	Water Management Strategy

3.9.2 Consistent Comparative Analysis

In the study, the emerging themes and patterns were compared to other scholars' findings. Some of these scholars included Reid et al. (2006) and Sallu et al. (2010). The purpose was to evaluate whether there were similar patterns and themes that arose from understanding water vulnerability and livelihoods, which assisted the researcher in avoiding bias as the researcher checked for new concepts that evolved from the data.

3.10. Validity and Trustworthiness of the Study

In qualitative research, researchers apply trustworthiness to measure the validity within their studies. Applying trustworthiness and validity helped the researcher in obtaining a better understanding of water vulnerability and community's livelihoods within a specific context, and not to generalise the results for the broader population. Trustworthiness was used in this to study to ensure credibility, transferability, dependability and confirmability. The researcher spent long periods with the participants and employed member checking during the scoping exercise. Then,

the interviews and focus group discussions were used to validate the credibility of the information gathered at data collection.

The triangulation of data sources was used to validate the information gathered (Koonin 2014 p.253). The interviews, focus group discussions and the document analysis were used to check each other. Validity was ensured through the reading and review of the transcripts and comparison with the main findings of the research. The purpose was to check that what was observed and written reflected the ‘truth’ to what the participants had articulated, and this added confirmability to the study.

3.11 Ethical Considerations

When carrying out research, ethical considerations need to be taken in to account to protect the participants from potential harm (Louw 2014). According to Louw (2014 p.263), the problems that might affect the research include the relationship between the participant and the researcher, because of the researcher’s subjective interpretation of the data and the process itself. Thus, to avoid the problem, ethical matters were addressed in the study. The data collection for the study only began once ethical clearance had been granted by Monash University Human Research Ethics Committee (MUHREC) (Appendix I). Before the research was conducted, an explanatory and consent form (appendices II and III) were handed out. The study only commenced when the participants gave their consent. The information gathered during the study remained confidential and it was kept in a secure location, both during and after the research. Only the supervisors and the researcher had access to the study data. All the names of the participants interviewed were represented by codes to ensure anonymity. All the findings and results presented were of the facts stated from the focus groups and interviews.

3.12 Summary

The chapter presented the research setting and the research methods that were employed to examine water vulnerability in a community’s livelihood. The approach, the research type and

research paradigms were also outlined. Lastly, data collection techniques and the parameters that were used in guaranteeing the validity and trustworthiness were addressed, together with the ethical considerations.

4. Chapter Four: Research Findings

4.1 Introduction

The purpose of this study was to explore how water vulnerability influences community livelihoods associated with small-scale sugarcane farming. It should be noted that the case study presented herein focuses on the implications of frequent droughts for livelihoods to illustrate the influence of water vulnerability on community livelihoods. It is neither meant to be comprehensive nor exhaustive; rather it is only designed to be exploratory and illustrative. While the inclusion of climate focused data could perhaps have provided valuable insights, time and logistical constraints limited the study to drought related data and its association with livelihoods. Nevertheless, the case study is still instructive particularly in illustrating why and how changes occurred in the livelihoods of the Kaleya rural farmers.

The chapter begins by highlighting the changes that water vulnerability brought to the Kaleya rural farmers' capabilities, outcomes and strategies. It shows the changes that had occurred to the Kaleya rural farmers' livelihood capabilities, outcomes and strategies. These changes had occurred to the farmers' irrigating and harvesting capabilities and livelihood outcomes including sugarcane production, household income and job security. In addition, there were changes to the farmers' water management strategies that were epitomised in the efforts of the farmers to formulate an informal water regulation policy to defend their water asset. The evidence provided suggests that these changes were linked to the recurrence of droughts in Mazabuka. The droughts (herein referred to as a shock), it is contended, have brought about significant changes to both the Kafue River as well as the farmers who are reliant on the river for the generation of their capabilities, outcomes and strategies.

4.2 Contextual Background

This section provides contextual information that depicts how water vulnerability influenced the livelihoods of the Kaleya farmers (Figure 7). The depiction is particularly necessary if we are to appreciate where we currently are in terms of the theory and practice of water management and livelihoods in the Kafue River system. It is also essential to appropriately bound the issues and concerns surrounding water vulnerability. The section aims at exposing the context within which

the Kaleya farmers operated. It is argued that these farmers operated within a complex context, which could have been a major source of external stimuli with the capacity to trigger major changes in their livelihoods. Therefore, by positioning water assets into an appropriate complex context, we are able to determine the depth and range of factors that could have mediated the relationship between water vulnerability and livelihoods. To expose the complex context of the Kaleya small-scale sugar farming system, Figure 7 presents a model that illustrates the relationships among recurrent droughts, water assets and livelihoods associated with the water vulnerability of the Kaleya rural farmers

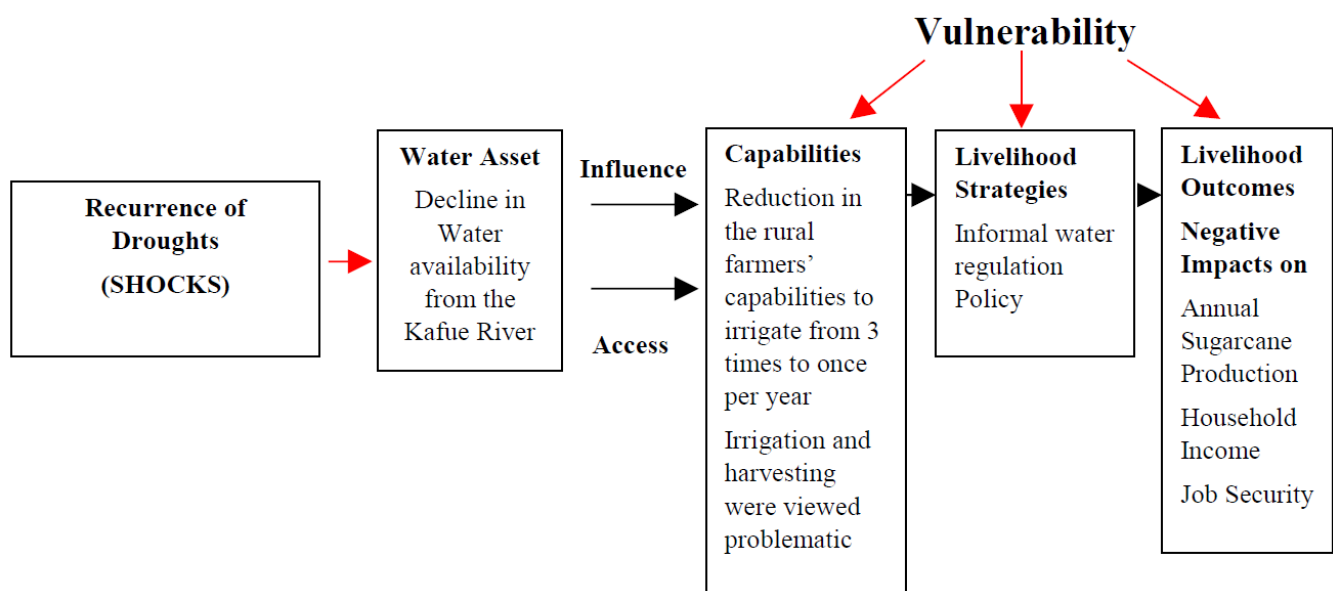


Figure 7: Diagram illustrating the relationships between the recurrence of droughts, reduction in water assets and livelihood components within the context of water vulnerability in the Kaleya farmers' livelihoods

The Kaleya smallholder scheme is located in Mazabuka district in the south-western part of Zambia (see Figure 2 in Chapter 3). It is an established outgrower irrigation scheme that is specifically specialised in the growth and development of sugarcane farming (Bangwe and Van Koppen 2012). The rural farmers rely on water from the Kafue River to support irrigated agriculture. Although the water used by these farmers comes from the Kafue River, this water indirectly comes through the bulk water supply system which is operated by the Zambia Sugar Company. The supply of water to the Kaleya farmers is based on an existing contractual

arrangement between KASCOL management and Zambia Sugar (Bangwe and Van Koppen 2012). While some cases exist in which some of the farmers partially rely on rainfall, the main water asset for the Kaleya smallholder scheme is the Kafue River.

This study postulates that the dependence of the Kaleya farmers on the Zambia Sugar Company's bulk water system exposed them to various external shocks such as frequent droughts. Based on a documentary analysis conducted for this study, it was suggestive that the frequency of droughts threatened the water availability for the Kaleya scheme. Using rainfall data from the Zambia Central Statistical Office, the study was able to establish that there were several drought periods that occurred in Zambia between 2002 and 2016 (Bwalya, 2010; Phiri et al., 2013; Mubanga and Umar, 2014). The implications of the frequent droughts for water availability were evidenced in the data on water levels of the Kafue River collected at the Iolanda monitoring station by the Lusaka Water and Sewerage Company (Iolanda River Station Records 2016). The data showed that there was a decline in the water levels of the Kafue River which dropped from 975.0418MASL in 2007 to 973.5875MASL in 2016.

Cognisant of the complex context of the Kafue River system, it is tempting to suggest that the dropping water levels in the Kafue River most likely could have affected the water availability for the Kaleya farming scheme. Because the Kafue River was considered a freshwater asset that the rural farmers depended on for the security of their livelihoods, the SLAF that was highlighted in Chapter Two (Figure 1) was used to explore how the frequent droughts could have generated negative changes in the Kaleya rural farmers' capabilities, outcomes and strategies. The next section of the results presents an account of the changes that occurred to the Kaleya rural farmers' capabilities.

4.3 Livelihood Capabilities

As indicated in Chapter Two, the term 'capabilities' is defined 'as a community's ability to perform basic functions' (Chambers and Conway 1991 p.7). These functions are considered as activities that the community does to obtain its livelihood outcomes (Robeyn 2005), and they are mainly determined by the status of the underlying assets (Adger 2006). Based on the SLAF

conceptual framework, it is expected that changes within a community's water asset would be reflected in its capabilities. It is important to note that the use of livelihood assets can create a dependency, because it facilitates the development of resource-based activities that yield the communities' means of living (Slater and Twyman 2003). This dependency is interpreted as a positive relationship because of the enhanced benefits obtained in the long term. However, it becomes problematic in a community's livelihood when there is increased dependency on assets and decreased capabilities in resource-based activities (Ming'ate 2016). This situation is set to happen when assets are reduced and, as an ongoing consequence, changes are created in the community's livelihood outcomes in the long term (Slater and Twyman 2003; Ming'ate 2016). The study found that indeed there were changes that occurred to the Kaleya rural farmers' capabilities due to reduction in water availability. The interviews conducted for this study indicated that these changes mainly manifested in the capability of the farmers to successfully operate the irrigation scheme. This issue was first highlighted by a respondent who had participated in the irrigation scheme since 1984:

‘Having no water is a major thing, because like this year, we have this problem because there is no water in the Kariba Dam, so for us to get water from the Kafue River, coming this side, the water supply was not sufficient for us to irrigate our cane and that is the problem we are facing’ (KSF1).

This response suggests that these farmers were experiencing reductions in water availability, a situation which could probably be attributed to the trends in frequent droughts. The reductions in water availability were not only felt in the river, but also in the Kaleya farmers' capabilities to irrigate. It is indicative the available water was not sufficient for them to irrigate their sugarcane. This problem was further noted by other respondents who were also experiencing the stress of reduced water availability:

‘They had informed us of the problem, before we noticed that it was drought and they told us that we would experience such a problem because of the Kafue River. The farmers complained about the shortages of water, but they could not help it because it was not a problem with Zambia Sugar’ (KSF2).

‘The water supply for irrigation was reduced, the field is small and if the challenge continues, it comes on to the field and the yields go down. We were told that the water levels in the Kafue River were reduced and insects came and attacked our crops’ (KSF3).

There are a number of key points that can be deduced from these responses. The on-going water availability reductions were symptomatic of an external stress that these farmers could not control. Most likely these farmers viewed the water from the Kafue River as an entitlement that they could not command and use to their own advantage. Not having sufficient water not only affected their capabilities to irrigate, but also to harvest, as observed by a respondent who had experienced an outbreak of pests. The interviews indicated that the Kaleya farmers’ capabilities to irrigate were reduced from being able to irrigate two times per year to only once a year. One of the farmers explained why performing the associated roles of irrigation and harvesting were problematic:

‘Irrigation is still a problem. Sometimes this time, you can irrigate just once per year or twice per year, because of the shortage of water. As a result, the yields go down. That is why we would want to see ourselves with our own source of water, in that can help us and the company also’ (KSF1).

The reductions in water availability had given rise to problems with regards to how much water the farmers could receive on a monthly and seasonal basis. There were additional risks with regards to whether the farmers would have the capability to perform key tasks.

The next section discusses the changes that reductions in water availability brought to the Kaleya rural farmers’ livelihood outcomes, which in this study was their sugarcane production, household income and their job security.

4.3 Livelihood Outcomes

Livelihood outcomes are the desired benefits that facilitate long-term sustainability within a community's livelihoods (Chambers and Conway 1991 p.9; Scoones 1998 p.12). The community's outcomes are particularly dependent on the protection and security of its livelihood assets. Therefore, based on the SLAF conceptual framework, if the security and protection of its water assets are weakened, this could lead to dire consequences for the community's livelihood outcomes. This was indeed the case with the Kaleya rural farmers' sugarcane production, household income and job security.

4.3.1 Sugarcane Production

Sugarcane production is recognised as an important livelihood outcome for the Kaleya rural farmers in the context of the use of water from the Kafue River. It is estimated that for optimal sugarcane production to take place, based on appropriate capitalization of sugarcane land, it requires at least the cultivation of 6.7.5ha of land by one farmer (Shumba et al. 2011 p.8). A documentary analysis conducted for this study revealed that, however, due to the reductions in water availability, the sugarcane production capability of the farmers was operating inconsistent with expected performance. As shown in Figure 8, sugarcane production was inconsistent from 2002-2015 owing to the variations in water supply on an annual basis. While arguably there could have been other factors that affected production, it is tempting to suggest water availability could have been the key decisive factor.

As shown in Figure 8, there was a general increase in tonnage over the years, with the highest being 138441 tonnes in 2014 and the lowest 77944.84 tonnes in 2002. However, what is interesting to note is the gradual decrease in water supply from 2002-2008 and thereafter an increase in 2009. The lowest was 9788920m³ in 2008 and the highest was recorded at 22798022m³ in 2013. It is important to note that the annual water supply did not directly impact the sugarcane production of that same year. The Kaleya smallholders and KASCOL management only measured the amount of water they would receive at the end of each year. It is suggestive

that certain years would have benefitted from the leftover water supply from the previous year. For example, there was an increase in water supply in 2013, which benefited the sugarcane production in 2014. The increase in water supply was primarily from the increased water demand from the Kaleya farmers owing to the fact that their fields were exposed to dry out periods and the outbreak of pests.

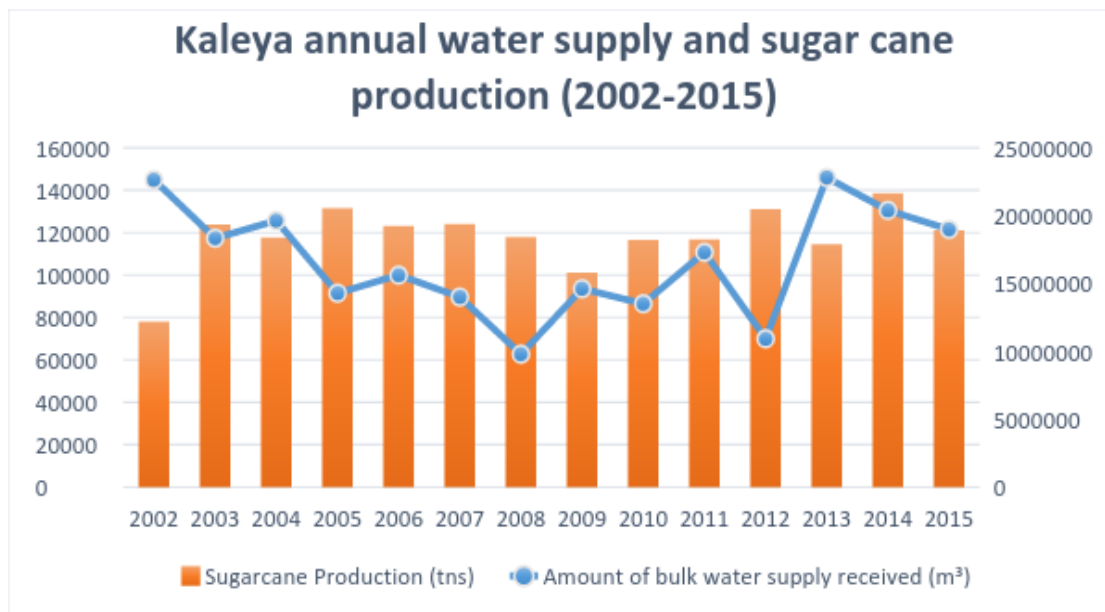


Figure 8: Annual Water Supply for the Kaleya Scheme and the Annual Sugarcane Production (2002-2015) (Source: KASCOL Sugarcane Production records 2016).

The documentary analysis additionally suggested that there were phases in which although water supply was low, sugarcane production was still high (Figure 8). This can be seen in the years between 2005 and 2006. Again, in this case, because there was low surplus of water supply from the Kafue River in that year, the Kaleya farmers used the water that was preserved from the previous year. This was possible because of the scheme's management and conservation of water in night storage dams. Interestingly, due to the dip in water supply in 2008, the sugarcane production levels were lower in 2009 than in 2008, showing that each time there was a decline in water supply, the effects of sugarcane production was prolonged from one year to the next.

The documentary analysis showed that sugarcane production dropped approximately six times within a space of fourteen years: in 2004, 2006, 2008, 2009, 2013 and 2015. This decrease in

production was probably due to the fluctuations in water supply. The interviews conducted for this study suggested that the majority of the farmers' households had difficulty determining in advance whether they would make a profit or loss, because of the uncertainty regarding the amount of water they would acquire at the end of each season.

Regardless, it is not safe to assume that the fluctuations in water supply could have been the major factor that affected the sugarcane production for the Kaleya rural farmers. Several variables such as land suitability, water infrastructure and cane management should not be ruled out. However, the main emphasis in this study is that the constant fluctuations are suggestive of the changes that occurred in these farmers' livelihood outcomes. Sugarcane production was not the only livelihood outcome that experienced changes with respect to water vulnerability. This study showed that it influenced the Kaleya rural farmers' household income as well, which is addressed below.

4.3.2 Household Income

Household income is an important livelihood outcome for communities with backgrounds of poverty and hunger. Thuronyi (1990) defines income 'as the increase over the period in an individual's power to consume, as an appropriate measure of economic wellbeing'. The consumption would be of goods, services and leisure (Thuronyi 1990). Within the context of the Kaleya rural farmers, household income was a livelihood outcome that they would obtain from the use of water from the Kafue River. However, the changes that the shock had created on the Kafue River had a significant effect on the community's economic wellbeing.

Analysis of the interviews suggests that several of the Kaleya rural farmers' households did not have sufficient household income to maintain their household needs. The majority of these responses came particularly from female-headed households. It was interpreted that the farmers desired more income to do four things that were viewed as a priority, namely to adequately feed their families, take care of the children, pay for education, and maintain their farms and buy livestock. This information is summarised in Table 2 below.

Table 2: Selected Comments on the Farmers Needs for Household Income

‘The challenges that I have is, those with a reasonable size family are doing better than those with a big family size, better than ourselves, because I have a big family and the land I have is very limited for me to take my children to school and to feed them’ (KSF4).
I need to look after the children, since they are young, because they are my responsibilities. I need to take them to school and look after the farm. I use the money to also maintain the farm, like paying for water and fertiliser and it helps me look after my extended family. Having an income is one of the benefits I received when I joined this scheme’ (KSF2).
‘With my limited resources, I need to at least plan, I have to plan and see where my money goes, so that I can take my own children to school, I also have people that I need to feed from me, and also important family members from my extended family’ (KSF3).
‘I need money to invest in to another farm, so that I can at least buy animals, as you know that we are not allowed to keep animals on this farm’ (KSF5).

Several farmers were dependent on household income, because for some farmers it was their only source of income to sustain their families’ livelihoods for the whole year. Several farmers indicated that they would sustain themselves with other businesses, such as a tuck-shop they owned within the community, sending their own trucks for business and doing other farming activities at other farming schemes, as shown in the responses below:

‘I was able to buy a plot with the money, to make this tuck shop here and it is where I had started my business in the farm’ (KSF2).

‘I managed to buy some fields, like I have a farm at KASCOL with a number of vehicles so that I am at least able to take my children to school’ (KSF3).

However, all the farmers in the Kaleya scheme earned their household income from this project once a year, and they indicated that they would only be able to generate a high household income if their water from the Kafue River was sufficient for them to increase their sugarcane production. The results of decreased sugarcane production and household income in represented Figure 9, showing that there is a direct correlation between a farmer’s household income and the

amount of tonnage produced in sugarcane. It was found that the Kaleya rural farmers' household income had dropped six times within the space of fourteen years.

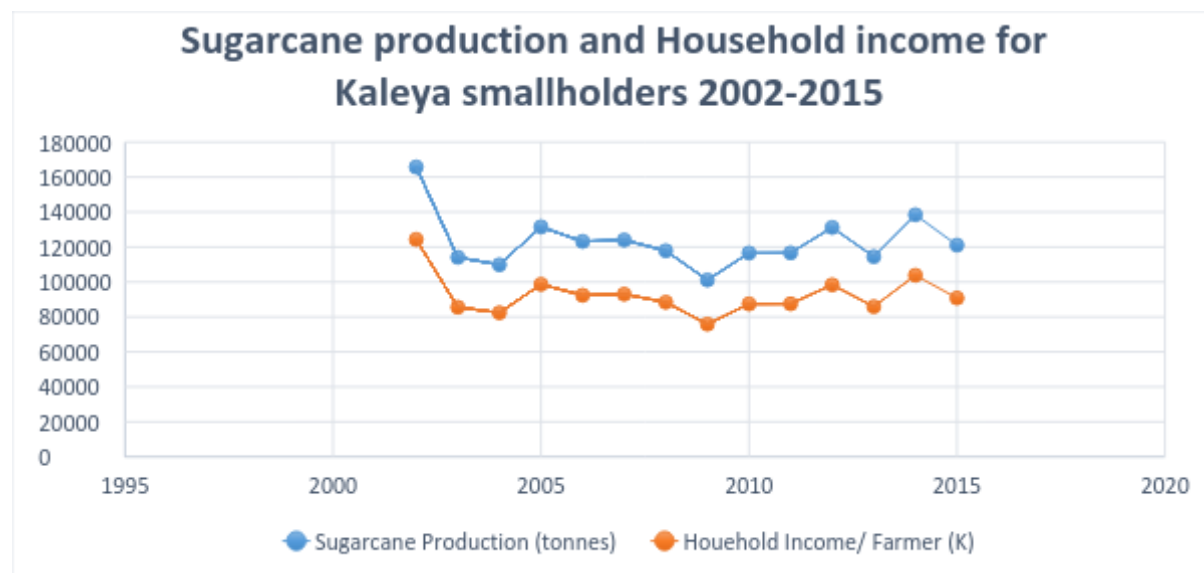


Figure 9: The relationship between sugarcane production and household income for the Kaleya smallholders (2002-2015) (Source: KASCOL management sugarcane production records).

The calculation was based on the selling price of the sugarcane, which was K240.00 (kwacha) in 2016. The sugarcane price is split; fifty percent goes to KASCOL Company and the remainder goes to the Kaleya smallholder farmers, making it K120 in total. The farmers' household income had dropped six times, in the years 2004, 2006, 2008, 2009, 2013 and 2015. The lowest income was recorded in 2009 at K75837 per farmer. Such variations lead to uncertainty regarding the stability of the farmers' household income. The fact that there are constant fluctuations suggests that there will be periods where the farmers will have difficulties meeting their household needs, because the low phases in sugarcane production could re-occur in the next years to come.

In addition, Kaleya rural farmers' households experienced not only a decline in household income but also an increase in expenditures. Understanding the effect that water vulnerability has on the farmers' livelihood outcome helps one to see how poverty is viewed by the Kaleya rural farmers, as well as understand the conditions in which the Kaleya rural farmers live and the

status of their livelihood outcomes. The data provided in Table 2 and Figure 9 suggests that water vulnerability generated negative changes in their household income.

Furthermore, water vulnerability influenced the farmers' job security as another livelihood outcome, which is discussed below.

4.3.3 Job Security

Besides income, employment is one of the main livelihood outcomes that poor people strive to obtain (Silva et al. 2015). In fact, employment is one of the significant livelihood outcomes that is automatically generated from the application of water from the Kafue River. It is recognised as an outcome that aids in the sustainability of the Kaleya rural farmers' sugarcane production and household income. The decline in water from the Kafue River therefore indirectly affected the security of their employment, because the farmers had to maintain their performance through irrigation with insufficient water.

Some of the farmers feared losing their farming jobs, especially to poor performance because of problems with irrigation. It was important for the farmers to perform well within the scheme to secure their employment for the long term. Although their farming jobs were secured in the form of a land lease agreement, which stipulated the amount of years the farmers could farm on their land (Shumba et al. 2011; Bangwe and Van Koppen 2012), the change in water availability in the Kafue River indirectly threatened the status of their job security. Several of the participants explained that to maintain their job security, KASCOL management had to increase the number of years they could farm on their lease agreement, as indicated below:

‘We had no KASFA by then, we were tired of farming the lands for one year, because it was not easy, after one year they would say you are not performing well and once you have made that slight mistake, you are fired’ (KSF1).

Water vulnerability had created risks to their performance and uncertainties regarding their jobs. Indeed, although there was no direct change to this livelihood outcome, the insecurity of the Kafue River increased the probability of the farmers losing their farming jobs. It was further

added that there was a penalty for the farmers, especially if they lost the opportunity to irrigate their fields during the times when water from the Kafue River was uncertain and limited. This was captured below from a farmer that feared losing his livelihood outcome.

‘If I know that I am not prepared to irrigate, I will tell my neighbour to irrigate his/her field, but if that one starts irrigating, that means the whole block will finish, they will not supply me with water, it will not come back, that will be your own penalty. If you say that you are not ready to irrigate, they will go on to the next farmer and you will not get the water, because they have to finish all the other farmers as well and you will end up irrigating last’ (KSF7).

Infield irrigation was a priority that had to be performed regardless of the conditions the farmers were in otherwise, they would pay the penalty for it. The statement just gives an indication that the farmers feared losing their jobs and for them to keep their employment, they had to perform their farming duties and excel in their crop production regardless of the water shortages that they were experiencing. However, it is not safe to say that water vulnerability was the main reason why the farmers feared losing their jobs, other factors such as rules and conduct of infield irrigation and land lease agreements could have played a role.

The changes that took place in sugarcane production, household income and job security highlights the severity of the changes that water vulnerability can generate within this community’s livelihood. Furthermore, job insecurity and instability in their sugarcane production and household income suggests an acute peak of vulnerability for the Kaleya farmers, because they are dependent on their livelihood components to obtain a means of living.

The design of the Kaleya smallholder irrigation scheme was an economic platform that facilitated empowerment for the rural farmers in enhancing their ability to consume and provide for their extended families and household needs such as food and electricity, and water from the Kafue River was key. This situation supports Ashley and Carney’s (1999) explanation in that in certain circumstances, the developers and institutions of such plans need to identify the priorities and concerns that are specific to the community and identify strategies that could aid them

reducing vulnerability. Identifying the community's concerns and developing strategies for their livelihoods meets the objectives of sustainable livelihoods.

As it stands, the change in the Kafue River has brought about negative changes to the Kaleya farmers' livelihood outcomes and will facilitate an increased exposure to the conditions of poverty in the long term. The only way the farmers can reduce their exposure is their ability to defend their current water asset. This next section discusses how water vulnerability had acted as a catalyst for the farmers in formulating their livelihood strategies.

4.4 Livelihood Strategies

Livelihood strategies are mechanisms that communities use to protect their current existing assets and structures within their livelihood systems (Krants 2001 p.12). Livelihood strategies are mechanisms that are practically used to secure the necessities of life (Rakodi 2002 p.16). When there is insecurity in a community's asset, mechanisms will be drafted and strategised to defend the asset, and protect its livelihoods. Livelihood strategies also comprise coping and adaptation (Osbaahr et al. 2008). The distinction is often viewed in terms of the time scale it follows: shorter time scales are presented as 'coping' with change, whilst longer time scales are presented as 'adaptation' to change (Osbaahr et al. 2008 p.1952; Collins 2014 p.291). Moreover, coping is viewed as a group of responses that take place in short and long term decision making, depending on the shocks that have affected the community's livelihood and assets (Saldana-Zorilla 2015). Within the context of Kaleya, water vulnerability had caused changes in their strategies regarding how the rural farmers would distribute water amongst themselves. It was found that the reduction in water availability from the Kafue River had prompted KASCOL management and Kaleya smallholders to formulate an informal water regulation strategy, which is discussed in the section below.

4.4.1 Water Management Strategy

KASCOL management and the Kaleya smallholders implemented an informal water regulation strategy that would ensure that all the farmers in the scheme would have equal access to water to

perform irrigation. The strategy was based on the objective of reducing the on-going stresses of water shortages that were affecting the rural farmers' capabilities and livelihood outcomes. For instance, the scheme tried to reduce the number of dry outs periods that each farmers' sugarcane field would undergo. When the farmers within the community saw that one farmer's land had more dry-out periods than the others, the scheme would initially supply the farmer with water for irrigation to reduce the effects of vulnerability.

The Kaleya rural farmers would follow this plan according to each farmer's irrigation cycles, and ensure that each farmer had a chance to irrigate when water was present. A participant that adopted the water regulation strategy to defend the amount of water they could access for irrigation summarised:

‘They told us to maintain the water that is supplied, if you are given water use that opportunity carefully, irrigate your field within three days, because then it is possible, then you give it to the other farmer. You cannot irrigate for more than a week, after twelve hours you knock off, we have got our own problems, if you are given water, use that water for the whole day for you to accommodate your friends as well. Every day when the dam checkers give me water, they have to go and sign how many lines I have irrigated from the previous day to the end. So it means they have to count the numbers I have in my field and counting the numbers in their books on what they have registered and verify that I have made a circle. I have to go there early in the morning to monitor those who are irrigating, after that it is when I come back here’ (KSF2).

The farmers would defend their water by reducing the number of hours they could irrigate in their sugarcane fields, ensuring that other farmers had an equal chance to irrigate their fields, whilst capitalising on the available water that was provided. Each farmer had to ensure that each time they received water, they would use the water wisely and ensure that other farmers were given the same chance, as explained by the participants' responses captured in Table 3.

Table 3: Farmers Comments on Water Sharing

‘Water sharing is done by KASCOL, as they are the ones that schedule fields for irrigation. They inform the farmers. Water is not for the individual, we work together. When water comes, the farmer is responsible for monitoring his or her own water usage by recording the number of cycles irrigated’ (KSF6).
‘With water challenges, we have to irrigate equally, because when the first one finishes, and the second farmer gets water, he or she will also irrigate until he or she is finished with their fields’ (KSF7)
‘There is a system which is set here, I am number one at first, the dam checker will come and give us the programme and tell me tomorrow that I start irrigation, I will go at 0600hrs and the dam checker will open the water, then I irrigate and irrigate until 1800hrs, he closes the water and then I knock off. I cannot irrigate at night and I cannot irrigate on my own’ (KSF1).

Based on the comments above, it is evident that water vulnerability had resulted in changes in their strategies to accommodate all the farmers’ fields that were vulnerable to the shock. However, there were complications within their strategies, which are discussed in section 4.4.2 below.

4.4.2 Complications in the Kaleya Rural Farmers’ Livelihood Strategy

There were complications identified within the Kaleya rural farmers’ livelihood strategy to mitigate the effects of water vulnerability in their livelihoods. The complications can be categorised into two issues: firstly, some of the farmers would irrigate more often than the others and, secondly, some farmers had poor water management practices. One of the participants of the focus group explained how the farmers chose a third, alternative form of water such as the digging up of commercial boreholes, to ensure that they had their own fair share of water. Nonetheless, the creation and use of commercial boreholes was not financially viable for the whole scheme, and it was suggested by the participants that the farmers would cope better with

the water shortages if they had financial assistance in establishing such boreholes within the scheme.

‘We dig boreholes, but we need commercial boreholes. Now that the shortage of water is from the source, our appeal is that let the available amounts be shared equally by regulating it. So that the scenarios where some farmers are given more than others use. If a farmer irrigates before the next farmer does the irrigation, the same farmer who irrigated is given again water to irrigate. This scenario does happen. Sharing equitably is needed; given that it is the source with the problem, drilling commercial boreholes would be the best option’ (KSFG1)

Another participant further added that some of the farmers of the scheme were poor with water management practices, as they would throw the irrigation water down the roads.

‘Some of the farmers are careless with water, they pour the water down the roads, particularly water that is meant for irrigation’ (KSF2).

Based on the comments above, it is evident that the Kaleya rural farmers’ livelihood strategy was altered owing to the vulnerability of the Kafue River and, in this context, their reaction can be viewed as reactive strategy (Collins 2014). Their informal water regulation strategy only contributes to the sustainability of the farmers’ livelihoods for the short term, because their livelihoods will remain susceptible to the negative changes that affect the Kafue River. Therefore, in the context of water vulnerability and resilience, the community’s livelihoods will be susceptible to the recurring changes that affect Kafue River, regardless of the approach that the scheme and the farmers implemented. These strategies are therefore flawed, as some of the farmers were using other farmers’ water and some of the farmers were poor with water management practices.

It is evident that water vulnerability generated changes to the Kaleya rural farmers’ strategies to defend their access to water for irrigation and reduce vulnerability within their livelihood

outcomes and capabilities. Therefore, based on the research findings, it is safe to suggest that water vulnerability played a key role in formulating the Kaleya rural farmers' livelihood strategy.

4.5 Summary

This results chapter has examined the changes that water vulnerability generated within this community's livelihood. It was shown that the vulnerability of the Kafue River, the Kaleya rural farmers' water asset, caused significant changes in their capabilities, outcomes and strategies. The decline in water from the Kafue River created the stress of water shortages, which negatively affected the rural farmers' capabilities to perform irrigation and harvesting.

Water vulnerability additionally brought about negative changes to the Kaleya rural farmers' livelihood outcomes. The changes in water availability affected the rural farmers' sugarcane production, as analysis thereof showed that production was unpredictable, owing to the inconsistency in water supply from the Kafue River. This water vulnerability also affected their household income. The rural farmers' household income had gradually dropped six times within a space of fourteen years, affecting their ability to provide for and sustain their families' household needs. Lastly, the changes in the Kafue River increased the probability of the rural farmers losing their farming jobs. They could not afford to underperform in their farming activities, even though water was limited. All these problems were created regarding their capabilities, outcomes and strategies because of the effect that the recurrence of droughts on the Kafue River.

Furthermore, water vulnerability influenced the Kaleya rural farmers in formulating a livelihood strategy, not only to defend their water but their livelihood components as well. The farmers and the KASCOL management implemented an informal water strategy to ensure that all the farmers had equal access to water for irrigation, reducing the number of extended dry outs that each farmer's sugarcane fields would undergo. However, the Kaleya rural farmers' strategy was recognised as short term coping strategy that was not adaptive for the long term, because analysis suggests that the farmers do not have the capability to mitigate the future changes that the shocks will continue to create on the Kafue River. The rural farmers will therefore still be susceptible to

the changes that take place in the Kafue River. Furthermore, there were insecurities amongst the rural farmers with respect to their informal water regulation strategy. Some farmers had poor water management practices and some farmers had more access to water than others.

To conclude, water vulnerability did play a key role in the Kaleya rural farmers' livelihoods, with respect to their capabilities, outcomes and strategies. There is a need for financial and institutional support to improve the Kaleya rural farmers' critical water asset, and improve their livelihood structures, with respect to their capabilities (irrigation and harvesting), outcomes (sugarcane production and household income) and strategy. Such improvements would ensure that their farming livelihoods are sustainable and resilient against the external effects of the recurring shocks in the long term. Importantly, the Kaleya smallholders' scheme needs to maintain its functionality, because the scheme is a form of empowerment for the rural farmers. The majority of the individuals come from a poor background of poverty and hunger, thus reducing their susceptibility and raising their resistance to the external effects of the shocks can shield the rural farmers from the long-term effects of poverty, ultimately increasing resilience in their livelihoods.

5. Chapter Five: Discussion

5.1 Introduction

This chapter discusses the results in relation with the key question of the study given in Chapter One. It discusses the influence of water vulnerability on community livelihood in small-scale sugarcane farming, with specific reference to the Kaleya rural farmers in Mazabuka, Zambia. In addition, the chapter discusses water security in community livelihoods. The next section begins by discussing the decline in water availability and its influence on community's capabilities and outcomes.

5.2 Livelihood Capabilities

Capabilities support communities in acquiring livelihood outcomes such as income and employment, which in turn help them in building resistant to stresses and shocks (Chambers and Conway 1991 p.4). With reference to this study, the Kaleya farmers were trained by Kascol management to enhance their capabilities to perform infield irrigation, weed control, fertiliser application, crop harvesting and removal of diseased cane stalks. This scheme supported the farmers in improving the quality of life for their families. Importantly, it assisted them to devise mechanisms for coping with the effects of water vulnerability. However, the reduction of water availability influenced changes in their capabilities to perform infield irrigation, which saw an increase in water shortages that had a knock-on effect on crop production and household income.

This study illustrates that a farming community becomes vulnerable when its access to water is limited. As evidenced in the Kaleya scheme, the development of capabilities and outcomes was shaped by the nature of access to bulk water from the Kafue River. The resultant water shortages brought about significant changes to crop production and household income generation. The farmers feared that these changes could diminish their livelihood outcomes. Due to uncertainty

and fears, the farmers had to adjust their capabilities and strategy to counter the water shortages. The farmers' capabilities were reduced from being able to perform infield irrigation two times per year to once per year. This adjustment influenced crop production and household income.

This case example supports Adger's (2006) and Ribot's (2014) theory in that vulnerability in livelihoods stems from limited access to entitlements. Entitlements are the forms of necessities that the community uses along with the associated rights and opportunities that come (Adger 2006 p. 269). In the context of this study, the Kaleya farmers' entitlements were embodied in the bulk water supply from the Kafue river that guaranteed livelihood outcomes based on the the Cane Farmers Agreement in appendix VII. Vulnerability occurred to the farmers' livelihoods when they started experiencing water shortages and changes in their household income and crop production. As highlighted in the study, this situation particularly happens when access to an asset that is natural resource based is limited (Khanal et al. 2014 p.2). Poor rural people often depend on water and land to enhance their capabilities and to execute activities that support livelihoods (Dorward et al. 2001 p.322). But when there is a reduction or transformation in their assets, this leads to alterations in their capabilities and activities. Such negative transformation is recognised as a symptom of vulnerability (Dorward et al. 2001 p.323).

5.2.1 Livelihood Outcomes

Water and freshwater ecosystems cannot be reproduced by human societies once they are modified. When this happens, there is usually no substitute and it is difficult to rehabilitate the degraded systems (O'Connor 2000 p.4). The fact that if there is no substitute means that communities that depend on water for crop yields, employment and income will have insecurities within their livelihood structure (Sivakumar and Hansen 2007). As was illustrated in the Kaleya scheme, sugarcane production was an important source of income for the rural farmers. It underpinned the livelihood outcomes of the community by providing secured household income. This was evidenced in the extra capabilities that were yielded to cater for family needs. But the

decline in water availability brought changes to sugarcane production, which had a knock-on effect on their income. As highlighted in Chapter 4, one could argue that at the core of these changes were the water shortages, which were compounded by other factors such as an outbreak of pests, poor cane management and land infertility. Thus, it is tempting to suggest that the build-up of water shortages played a role in the outcomes of sugarcane production and household income generation.

The Kaleya farmers witnessed decreases in sugarcane production each year with no substantial stability within the trends. The lack of stability reflected in the sugarcane production trends had an impact on the Kaleya farmers' household income. This finding supports Chambers and Conway's (1991 p.4) explanation in that the reduction in assets alters the individual's outcomes, owing to the influence that assets have on an individual's livelihood outcomes. In other studies (Moser et al. 1997), it has been observed that when such capabilities are diminished, the negative consequences are reverberated in other social capabilities such as the ability to take children to school, pay for medical services, and pay for electricity and water. When there is a build of expenses, this exposes households to symptoms of poverty and hunger due to low financial capacity. This supports Adger (2006 p.270) who claims that insecurity in livelihood outcomes does not only imply the lack of economic well-being, but also the lack of freedom from poverty, indebtedness, hunger, conflict and strife.

That is why, in the context of the Kaleya scheme, having access to water was critically important to enhancing farming livelihoods. The limited water supply meant that performing infield irrigation was critical in a sense that the farmers had to maintain their performance regardless of the water shortages that took place. The Kaleya farmers could not afford to forgo infield irrigation, even if they were not ready. This suggests that water availability played a key role in the maintaining job security. Clearly, water supply was not always guaranteed under the contractual arrangement the Zambia Sugar Company. Given that the farmers could not negotiate a secured supply water, this had major implications for employment and income required to sustain livelihoods. As such, their ability to adapt to changing environments compromised because of their over-dependence on agriculture for their daily survival (see also Ijang and Ndikumagenge 2013).

5.2.2 Livelihood Strategies

People adopt strategies to defend their assets (Krants 2001 p.9). Strategies act as procedures that communities employ to protect their natural assets, which in turn are normally shaped by environmental, institutional and organisational factors (Krants 2001 p.8). In the context of the Kaleya scheme, the farmers implemented an informal irrigation strategy to counter the water shortages. Their strategy was shaped by institutional, environmental and economic factors. The farmers employed the strategy to safeguard their access to water supply from the Kafue River. This situation is set to happen when there are unconventional falls in resource supply (Grafton et al. 2013 p.178) and thus people come up with strategies to balance the availability and the anticipated demand. The Kaleya farmers adopted an irrigation strategy to ensure that each farmer had at least an equal chance to perform infield irrigation, which meant cutting down on the dry out periods that their fields were experiencing. This was a coping strategy that would aid the farmers in countering the water shortages and the effects that the decline in water availability had on sugarcane production and household income. However, the farmers' strategy can only be viewed as a coping strategy that was effective in the short term. This is because the sugarcane production and household income generation activities were still susceptible to changes that could occur to the Kafue river. For instance, if the river's water availability continued to decline, their irrigation strategy would not be effective in mitigating the risks imposed on crop production and income. It would only be effective, if the farmers and the scheme had a trade off or financial assistance in securing other alternatives of water supply other than the Kafue river. As highlighted in Chapter 4, however, the farmers did not have the financial capacity, which complicated the implementation of the strategy. Several of the farmers were gaining more access to water supply than the others and some of the farmers were careless with irrigation water. The farmers additionally wanted to experiment with other water alternatives such as commercial boreholes that posed fewer risks; however, they lacked the financial capacity to implement them. Thus, they opted for other alternatives such as buying other farms, investing in tuck-shops and buying extra transport to support their household. Strategies in those circumstances stem from the ability of the community to transform and experiment with their livelihood outcomes and practice other activities that bring them more security (Collins 2014 p. 291). The rural farmers may be coping in the short term, but it is not safe to assume that the disasters will be avoided and

mitigated through pre-emptive planning, because the changes can still occur at any given time (Sullivan 2011 p.628).

5.3 Water Security in Community Livelihoods

Management of water resources is indeed crucial to human development and it has been since the establishment of human civilisation (Sullivan 2011 p.628). Water is a basic asset that impacts all human existence and it contributes to human security (Sullivan 2011 p.628). Securing the benefits of water supply for the Kaleya farmers contributed to meeting the objective of water security, which is to ‘safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods and socio-economic development for ensuring protection against water borne pollution and water related disasters and for preserving ecosystems in a climate of peace and political stability’ (UN-Water 2013 p.1). Bulk water supply from the Kafue river ensured that the farmers were water secure. In this context, the Kafue river is seen to be crucial asset to the Kaleya farmers farming livelihoods, without bulk water from the Kafue river, the farmers would have not been able to perform their farming and social capabilities and earn an income. The protection of the Kafue river secures access to water, which facilitates better human health, food and water security for the farmers. For instance, when the Kafue river had abundant water, it would guarantee the Kaleya farmers to receive water from the Zambia Sugar Company. This helped them in performing their daily activities and securing their families’ livelihoods in the long term. But because there was a decline in water availability, this imposed restrictions on their water supply and brought changes to their daily activities and outcomes. Ultimately, these changes subjected the farmers to low levels of water security (see also Grafton et al. 2013).

This study demonstrates that water is an important entitlement that is needed to ensure all human securities. Human security is reliant on an individual’s sense of wellbeing, which is closely tied to the individual’s needs for water and the benefits it provides (UN-Water 2013 p.2). Not meeting the objectives of water security in livelihoods, results in a loss of livelihood opportunities for poor people (Fraiture et al. 2010 p.495), particularly because the decrease in water security invites the presence of water scarcity, which is difficult to mitigate, especially in areas that are already prone to water-related hazards such as droughts. Water security for the

Kaleya farmers means securing the amount of water that is left in the Kafue river, if their water is not secured, they will start to gradually experience symptoms of water scarcity through the presence of water shortages and they will continue to experience symptoms of water scarcity because they reside in a drought prone area. In addition, the farmers will further lose farming opportunities by failing to provide sugarcane for Zambia Sugar, generate income for their household and ensure employment-factors that keep their livelihoods resilient. Governments have failed to establish long term intervention strategies that could counter on the reduction of freshwater ecosystems and this has forced several small-scale farmers to operate in conditions of physical and economic water scarcities (UN-Water 2013 p.3). There is thus a widespread need for heavy investment and policies that can improve rural farm-level access to irrigation water to enhance agricultural productivity (Calow et al. 2006).

5.4 Revisiting the Sustainable Livelihood Framework

Applying the SLAF framework was useful in understanding the complex system of interactions (La Flamme 2001). Several researchers have shared their observations in developing conceptual knowledge of comprehending the human-environment system. In practice, we use the SLAF framework to comprehend the characteristics of what a good livelihood entails (La Flamme 2001). The framework is also applied to understand how a livelihood copes and adapts to the environment it lives in using the five capital assets (Chambers and Conway 1991). For instance, by applying the SLAF framework, this study managed to understand the nature of the Kaleya farmers' livelihoods in Mazabuka and to comprehend how they were using water as a capital asset in coping with environmental changes. It is understood why water as a natural asset was of significance to the farmers and how the asset influenced their capabilities, strategies and outcomes. Applying the framework was useful in seeing how livelihood components influence one another. For instance, Newton and Franklin (2011) found that applying the SLAF framework was effective in understanding the linkages between strategies, capabilities and assets. The authors used it as a starting point in identifying research questions. In the same way, the framework aided in formulating research questions for this study.

However, there were certain drawbacks in applying the SLAF framework:

- The framework does not fully define the existing relationships between the shocks livelihoods experience, the type of assets farmers use and the effects that the shock could have on livelihood capabilities, outcomes and strategies for the long term. This is because relationships change over time, depending on the nature of the interactions. It only provides the potential relationship that exists for that current time.
- Secondly, it does not fully highlight the future vulnerabilities that could occur within livelihoods, it just provides us with possibility of what vulnerability a livelihood may encounter. But it does not also indicate whether a livelihood will undergo those vulnerabilities in future.

5.5 Summary

In conclusion, the chapter has discussed water vulnerability in a community's livelihood through the analysis of capabilities, outcomes and strategies. In addition, it has provided an overall discussion on water security in community livelihoods and the effectiveness of applying the SLAF framework. Using the Kaleya rural farmers as a case study, this discussion considered the existing literature that was provided in Chapter Two. The next chapter offers recommendations of what is needed for policy and further investigation, together with the implications of the study and final conclusions.

6. Chapter Six: Conclusion and Recommendations

6.1 Introduction

This chapter provides a summary of the research findings along with the conclusions that have been drawn from the research. It also addresses the implications of the study as well as the recommendations for policy and future research. The next section provides a summary of the research findings.

6.2 Summary of the Research Findings

The objective was to investigate how water vulnerability generates changes in community livelihoods associated with small-scale sugarcane farming, using the Kaleya rural farmers in Mazabuka as a case study. Based on this case study, it can be argued that indeed water vulnerability does generate changes to a farming community's livelihood through their capabilities and outcomes. The decline in water availability in the Kafue river generated water shortages, which brought changes to farming capabilities to perform infield irrigation. The farmers' performance in infield irrigation dictated the outcomes of sugarcane production and household income. Some of the farmers experienced poor performance their infield irrigation activities that brought in inconsistency in sugarcane production and household income. The inconsistency in sugarcane production meant that some of the farmers had difficulties in maintaining families livelihoods because the inconsistency reverberated to household income as well. These three elements -infield irrigation, sugarcane production and household income- of the Kaleya farmers' livelihood structure are what would under normal circumstances reduce their vulnerability.

Evaluating water vulnerability has shown that this phenomenon acted as a stimulant that compelled the community to defend their access by formulating the informal irrigation strategy to counter the water shortages and outbreak of pests. However, their strategy only aided the farmers in coping against the current water shortages in the short term and not in the long term.

Their capabilities and outcomes were still susceptible to the future transformations that could occur on the Kafue river. The research findings provide an indication of how water vulnerability brings about changes in a community's livelihood and raises questions on what intervention strategies or external support should be provided to other communities that experience a similar phenomenon to the Kaleya rural farmers in the rural district of Zambia.

6.3 Conclusions Drawn from the Research

There are five possible conclusions that can be drawn, and these are:

1. Water vulnerability does generate changes to a community's capabilities and outcomes. There is a need for intervention strategies that do not only reduce the current stresses that are experienced, but the future stresses as well.
2. Water vulnerability does play a part in shaping the status of water security in a community's livelihood. There is a direct relationship between water vulnerability and water security, in that when water vulnerability is reduced within a community's livelihood, the status of their water security increases, and vice-versa.
3. The protection and security of the Kafue river is of critical importance, especially for an ecosystem that had so many stakeholders depended on it. Protecting the Kafue river increases the community's chances of surviving water-related disasters such as droughts and reduces their risks to symptoms of poverty and hunger.
4. There is a need for external support from institutional actors, government or organisations that can contribute to the structure and wellbeing of communities. The actors need to recognise the priorities and concerns of the community and help provide solutions that can improve on empowerment.
5. There is a need to strengthen the status of the community's other assets, such as financial, physical, human and social assets. Communities can cope and adapt against drought using the status of these other assets, which not only reduces the

dependency on water, but strengthens the stability of their livelihoods against potential future vulnerabilities.

6.4 Study Implications

There are some study implications that need to be highlighted:

- It cannot be assumed that the findings of water vulnerability in the community's livelihood in this case study will apply to another case study, because each community's livelihood is different based on the type of assets, capabilities, outcomes, strategies that comprise its livelihood, as well as the type of shocks and stresses that are found within. The situations may be similar, but contexts may be different.
- A deep qualitative study of water vulnerability in livelihoods requires an investigation of the case study for a longer period, which implies a longitudinal study. Conducting the study for a shorter period provides an indication of the current picture. It does not reflect the future reality, and not all data can be collected within a shorter period.
- Examining water vulnerability in livelihoods allows for a direct understanding of how rural communities can be easily susceptible to the symptoms of poverty and hunger, especially when their livelihoods are dependent on water for the generation of their daily activities. It is not safe to assume that the communities will remain vulnerable to the symptoms in the future, because the implication is that we are unaware of the possible circumstances that could promote the status of their resilience. A deeper analysis and monitoring of their livelihoods and water assets for a longer period is therefore required.
- It is difficult for a community to build resilience to sustain its livelihoods, especially when it is only reliant on one form of water. Without a substitute, the community cannot pursue its daily activities for survival means. It is for this reason that developers and organisations need to support the community in providing alternatives that can increase water capacity, enhance agricultural productivity and in the process, improve the well-being of the community's livelihood.

6.5. Recommendations for Policy

This section offers the following recommendations that are likely to reduce water vulnerability and enhance water security in a community's livelihood.

- There is a need for government, organisations and communities to have strategic and effective monitoring of the Kafue river, especially in Mazabuka- that is a drought-prone area. The protection of the Kafue river reduces water vulnerability and enhances water security, not only for people's livelihoods but for the region as well. If there is no consistent monitoring of the Kafue river, there will be more difficult challenges in the future with respect to water allocation and demand, owing to unforeseen damages that may have been prevented. Any organisation that works with smallholders and uses water as their main input should have a strict monitoring policy on the management of the Kafue river.
- Communities need to participate in the management of water supply from the Kafue river. They need to have their opinions and concerns heard by their institutions. Because the communities are the strategic managers of water, they can be very influential in the way water and ecosystems are managed. Such an arrangement would benefit the institutions as well, because it helps them identify problems that may be of significance to them and the communities. Furthermore, it also helps the communities develop and create strategies that can aid them in building up water security and reduce vulnerability against water-related hazards.
- Community assets, such as the financial, social, human and physical, need to be enhanced. This is because communities rely on other capital for livelihood security, especially when its natural assets are reduced. If their livelihood assets are not enhanced, the community is unable to mitigate the vulnerabilities occurring within its livelihood, because it has no other assets to trade off.
- Communities and organisations need to adapt to alternative water assets such as ground water, which is economically viable and sustainable in the long term. This does not mean that all water assets should not be sustainably managed and protected. However, communities do need to rely on other water assets so that it becomes an

ultimate trade-off for them, particularly when their primary source of water is vulnerable. This strategy not only improves water productivity, but also increases water security, especially during times of crisis.

6.6 Suggestions for Future Research

There are some possible recommendations for future research:

- Firstly, it is suggested that another study (particularly a longitudinal study) on water vulnerability in livelihoods be conducted, but this time by analysing anthropogenic factors (i.e. water pollution) as the main cause of water vulnerability. The purpose here would be to understand whether these effects and conditions of vulnerability are like those that are climate induced.
- Lastly, a study should analyse and evaluate the effectiveness of policies that are in place to secure freshwater resources from being degraded, and examine whether the principles of those policies are put into practice on the ground.

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Appendix I: MUHREC Ethics Approval



Human Ethics Certificate of Approval

This is to certify that the project below was considered by the Monash University Human Research Ethics Committee. The Committee was satisfied that the proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research* and has granted approval.

Project Number: CF16/286 - 2016000130

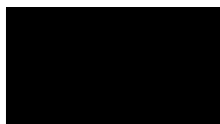
Project Title: Women's participation on Water Security Initiatives in the Zambian Small Holder Out Grower Schemes in the Kafue Flats, Zambia

Chief Investigator: Assoc Prof Bimo Nkhata

Approved: From: 23 February 2016 To: 23 February 2021

Terms of approval - Failure to comply with the terms below is in breach of your approval and the Australian Code for the Responsible Conduct of Research.

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, before any data collection can occur at the specified organisation.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must include your project number.
6. Amendments to the approved project (including changes in personnel): Require the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. Future correspondence: Please quote the project number and project title above in any further correspondence.
8. Annual reports: Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. Final report: A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. Monitoring: Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. Retention and storage of data: The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.



Professor Nip Thomson
Chair, MUHREC

cc: Ms Thandiwe Mpala

Monash University, Room 111, Chancellery Building E
24 Sports Walk, Clayton Campus, Wellington Rd
Clayton VIC 3800, Australia
Telephone: +61 3 9905 5490 Facsimile: +61 3 9905 3831
Email: muhrec@monash.edu <http://intranet.monash.edu.au/researchadmin/human/index.php>
ABN 12 377 614 012 CRICOS Provider #00008C

Appendix II: Explanatory Statement for the Kaleya Farmers



MONASH University

EXPLANATORY STATEMENT

(Women Farmers)

Project Title: Women's Participation in Water Security Initiatives in the Zambian Smallholder Outgrower Schemes in the Kafue Flats, Zambia

Project Number: CF16/286-2016000130

Chief Investigator's name: Prof. Bimo Nkhata	Student's name: Thandiwe Annastacia Mpala
Director of the Water Research Node	
Phone: +2711 9504453	
email: bimo.nkhata@monash.edu	

You are invited to take part in this study. Please read this Explanatory Statement in full before deciding whether to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The purpose of study is to explore women's participation in water security initiatives in the Zambian smallholder outgrower schemes in the Kafue Flats in Zambia. This is because there has been little research done on the phenomenon of women's participation on water security initiatives within the context of integrated water management in the Zambian Smallholder outgrowers' farms in the Kafue Flats.

The researcher will interview the women that work at the Kaleya and Manyoyo farms about their opinions on their participation and how they feel about gender equality in water management. Then the researcher will ask the women to show the researcher their work and responsibilities that they do on water management of the Zambian smallholder outgrowers' farms.

Why were you chosen for this research?

The participants were chosen for this research, because the women are part of the smallholder group farmers that work for the Zambian smallholder outgrower schemes, and their contribution would add value and knowledge to the subject of water security and integrated water management in the study that the researcher is exploring.

Consenting to participate in the project and withdrawing from the research

Participation in this study will allow you to participate in the interview and observations that the researcher will conduct. The interview will be conducted in the same line with the observations. The process should not take longer than 30mins per interview.

A consent form will be issued to the participants before the research is conducted. The consent form will allow you to indicate the terms and conditions that you are comfortable or not comfortable with. The consent form will then be collected by the researcher.

Your participation is voluntary and you may withdraw from the research without any repercussions. You may at any point in time refuse to answer specific questions that you may feel uncomfortable with. Your name shall not be mentioned in the report of the research findings to maintain confidentiality. Your responses will be audio recorded and once they are recorded the data will be difficult to withdraw. However, the researcher will be appreciative of the responses that will be provided.

Possible benefits to the participants

The benefits to be incurred from the implementation of this study include a raised gender awareness among women farmers and their positive effects on water governance and the arrival at an understanding of women farmers' interaction with water resources in irrigation schemes.

Their contribution will further add value to the understanding of the subject water security, which is one of the fundamentals being analysed in the International Water Security Network.

Confidentiality

All the names of the participants interviewed will be represented by aliases or symbols for the consideration of anonymity. All the findings and results presented will be that of facts stated in the interviews. The data that will come from the interviews and observations will be represented in the data analysis of the thesis.

Storage of data

The in-depth interview responses and observations will constitute the data and the information gathered during the study will remain confidential in secure location, during and after the research. The study will remain in the co-researcher's computer and it will be locked with a secure password that only the researcher and the chief investigator will have access to. After the study has been analysed, reviewed and published, the researcher will automatically destroy the data, if it is no longer required.

Results

The researcher will provide the participants with the internet link to the results when published. In addition, the researcher will also provide WWF Zambia with the links to the results, so that the participants can access the data through their direct contact.

Complaints

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the Research Coordinator at Monash South Africa

Ms Hester Stols

Monash South Africa

Tel : +27 11 950 4143 Email : hester.stols@monash.edu

Thank you

Prof Bimo Nkhata

Appendix III: Consent Forms



MONASH University

CONSENT FORM

(Women Farmers)

Project: Women's Participation on Water Security Initiatives in the Zambian smallholder outgrower schemes in the Kafue Flats, Zambia.

Chief Investigator: Prof Bimo Nkhata

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	Yes	No
To taking part in the interview for 30mins (approximately) and observations of the work I do at the farms	<input type="checkbox"/>	<input type="checkbox"/>
To an audio recording taking place during the interview process	<input type="checkbox"/>	<input type="checkbox"/>
To a visual camera capturing the participation process in the meetings and other places that I may show the researcher	<input type="checkbox"/>	<input type="checkbox"/>
The data I provide during this research may be used by the researcher in future research projects.	<input type="checkbox"/>	<input type="checkbox"/>

Name of Participant

Participant Signature Date :

Appendix IV: Explanatory Statement 2



MONASH University

EXPLANATORY STATEMENT

(Members of the Zambia Smallholder Outgrowers Committee)

Project Title: Women's Participation on Water Security Initiatives in the Zambia smallholder outgrower schemes in the Kafue Flats, Zambia

Project Number: CF16/286-2016000130

Chief Investigator's Name: Prof Bimo
Nkhata

Student's name: Thandiwe
Annastacia Mpala

Director of the Water Research Node

Phone: +27 11 950 4453

email: bimo.nkhata@monash.edu

You are invited to take part in this study. Please read this Explanatory Statement in full before deciding whether to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The purpose of study is to explore women's participation on water security initiatives in the Zambia smallholder outgrower scheme in the Kafue Flats in Zambia. This is for the reason that there has been little research done on the phenomenon of women's participation on water security within the context of integrated water management in the Zambia smallholder outgrowers' farms in the Kafue Rivers.

The researcher will interview the participants that are part of the management committee of the Zambia smallholder outgrowers' farms. The interview will be based on women's participation and gender mainstreaming. Then the researcher will kindly ask to sit in one of the supervisory meetings to perform the observations on how the committee and the farmers participate in the discussions, regarding water management.

Why were you chosen for this research?

The members of the Zambia smallholder outgrower schemes were chosen for the research because they represent the management team of the farms and they consult with the smallholder farmers on the farmers needs and concerns regarding water and make decisions on their behalf.

Therefore, their knowledge on participation and their opinion on gender equality and mainstreaming will add significant value to the study.

Consenting to participate in the project and withdrawing from the research

Participation in this study will allow you to participate in the interview and observations that the researcher will conduct. The interview will be conducted in the same line with the observations. The process should not take longer than 30mins per interview.

A consent form will be issued to the participants, before the research is conducted. The consent form will allow you to indicate the terms and conditions that you are comfortable or not comfortable with. In that process, the consent form will be emailed back to the researcher.

Your participation is voluntary and you may withdraw from the research without any repercussions. You may at any point in time refuse to answer specific questions that you may feel uncomfortable with. Your name shall not be mentioned in the report of my findings to maintain confidentiality. Your responses will be audio recorded and once they are recorded the data will be difficult to withdraw. However, the researcher will be appreciative of the responses that will be provided.

Possible benefits and risks to participants

The benefits to be incurred from the implementation of this study include a raised gender awareness among women farmers, the farmers in general and their positive effects on water governance and the arrival at an understanding of women participation and gender mainstreaming with water resources in Irrigation schemes.

Their contribution will further add value to the understanding of the subject water security, which is one of the fundamentals being analysed in the International Water Security Network.

Confidentiality

All the names of the participants interviewed will be represented by aliases or symbols for the consideration of anonymity. All the findings and results presented will be that of facts stated in the interviews. The data that will come from the interviews and observations will be represented in the data analysis of the thesis.

Storage of data

The in-depth interview responses and observations will constitute the data and the information gathered during the study will remain confidential in sure location, during and after the research. The study will remain in the co-researcher's computer and it will be locked with a secure password that only the researcher and the chief investigator will have access to. After the study, has been analysed, reviewed and published, the researcher will automatically destroy the data, if it is no longer required.

Results

The researcher will provide the participants with the internet link to the results when published. In addition, the researcher will also provide WWF Zambia with the links to the results, so that the participants can access the data through their direct contact.

Complaints

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the Research Coordinator Office at Monash South Africa
Ms Hester Stols .

Monash South Africa

Tel: +27 11 950 4143 Email: hester.stols@monash.edu

Thank you,

 **Prof Bimo Nkhata**

Appendix V: Consent Forms 2



MONASH University

CONSENT FORM

(Relevant Participant Group)

Project: Women's Participation on Water Security Initiatives in the Zambian smallholder outgrower schemes in the Kafue Flats, Zambia.

Chief Investigator: Prof Bimo Nkhata

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	Yes	No
To taking part in the interview for 30mins (approximately) and observations of the work I do at the farms	<input type="checkbox"/>	<input type="checkbox"/>
To an audio recording taking place during the interview process	<input type="checkbox"/>	<input type="checkbox"/>
To a visual camera capturing the participation process in the meetings and other places that I may show the researcher	<input type="checkbox"/>	<input type="checkbox"/>
The data I provide during this research may be used by the researcher in future research projects.	<input type="checkbox"/>	<input type="checkbox"/>

Name of Participant

Participant Signature Date

Appendix VI: Interview Guide



MONASH University

Interview Guide 2015-2016

Social Questions

- How did you become an outgrower?
- What are your roles and responsibilities on the farm?
- What are the benefits of being a smallholder?
- Are your basics provided within the scheme?
- Who helps you in managing the farm?
- How many children do you have?
- What are your household duties?
- What challenges do you face as an outgrower?
- Who addresses your social problems? and how are they addressed?
- What are development committees? And what do they do?
- How are development committees arranged within the scheme?
- Are your social problems always addressed by the development committees?

Water Management Questions

- Do you know where your water comes from?
- How do you receive your water for irrigation?
- How do you know when it is your turn to irrigate your field?
- How is irrigation performed in the scheme?
- What irrigation techniques do you use?

- What problems have you been facing with water?
- Where the changes in the allocation of water to the smallholder farmers?
- Was there a reduction in water supply? And why was the water reduced?
- Did you know about the drought when you started experiencing the effects? Or where you informed by the management of the situation?
- When you have water complaints, who do you report them to?
- Have your water issues been addressed?
- What other alternatives do you prefer other than receiving water from the Kafue River?
- What solutions do you propose in addressing your problems with water?

Appendix VII: Cane Farmers Agreement (CFA)

KALEYA SMALLHOLDERS COMPANY LIMITED

CANE FARMERS AGREEMENT

This agreement is made the ----- day of -----

BETWEEN ----- of Mazabuka Zambia (hereafter called “THE SMALLHOLDER”) on the one part and KALEYA SMALLHOLDERS LIMITED a company incorporated in Zambia having its registered office at Mazabuka (hereafter called “KASCOL”) of the other part.

1. INTERPRETATION

- 1.1** “Regulations” means the smallholders’ regulations and any reasonable modifications or additions that may be made to them from time to time by Kascol under clause 5, relating to all aspects of cane growing, the control of the dwelling areas and other related issues, referred to in this agreement.
- 1.2** “Sugar Cane price Agreement” means the Agreement dated the ----- day of -----200----- and made between Zambia Sugar Plc and Kaleya Smallholders Company Limited and any variation or renewal thereof.

2. SUBLETTING OF CANE FIELD AND DWELLING AREA

KASCOL hereby agrees to sublet to the smallholder the cane field and the dwelling area for the growing of cane and residence respectively at the rent of one maize cob per annum (if demanded) and subject to the terms and conditions set out in the Agreement.

3. OBLIGATIONS OF A SMALLHOLDER

During the term of this Agreement the smallholder shall:-

- i) Construct a residential house pursuant to the dully approved plans by KASCOL Management of which the minimum standard shall be KASCOL's "C" type house.
- ii) Pay KASCOL expenses incurred by it for:
 - (a) Supplying of fertilizers and other chemicals.
 - (b) Hiring of tractors, implements and operators;
 - (c) Supplying of irrigation water;
 - (d) Any other goods and services supplied and operators;
- iii) Deliver to or allow KASCOL to harvest and transport all the cane produced in the cane area;
- iv) Not assign, sublet or part with share possession of the cane field or residential area or part thereof without the prior written consent of KASCOL;
- v) Except for the residence referred in clause 3(i) not carry out earthworks on the cane field or dwelling area or any part of the project area without written consent of KASCOL;
- vi) Avoid anything howsoever, that would constitute a nuisance to KASCOL, other smallholders or occupiers of land in the vicinity;
- vii) Comply with all the terms of any Regulations made under the Agreement; Permit KASCOL and it's agents to enter the cane field and the dwelling area to view their condition and for the purpose of carrying out such operations as may consider necessary to compliance of the Agreement;
- viii) Grant KASCOL, its agents and other participants in the scheme:-
 - a) all rights of way as are used and enjoyed by KASCOL across the cane field and the dwelling area to and from other parts of the project area;
 - b) rights to all springs and other sources of water on the cane field and dwelling area;
 - c) access to and use of drains, water pipes, channels, cables and wires or any thing used in connection with irrigation systems (other than such items) shall be exclusively in connection with the cane field and dwelling area constructed or installed by KASCOL.

4. SMALLHOLDERS RIGHTS

The smallholder may, subject to Regulations under this Agreement cultivate crops, keep poultry and other acceptable animals as long as these animals are enclosed and neighbours and management have been consulted and have accepted.

The smallholder shall have the right to lawful assembly and association provide notification and approval to proceed has been granted by KASCOL management.

5. OBLIGATIONS OF KASCOL

- i) Allow the smallholder peaceable occupance of the dwelling area and peaceable use of the cane field subject to the terms and conditions of this Agreement;
- ii) Supply and deliver irrigation water to the cane area and repair and maintain irrigation equipment;
- iii) Make and publish the smallholder Regulations as set out in the second schedule and any reasonable modifications or additions to them relating to all aspects of sugar cane growing, the control of the dwelling area and any other matters connected to or incidental to foregoing;
- iv) Plough the cane field, plant the cane and provide all the necessary inputs and services necessary for proper growing of cane, unless the smallholder decides to carry out any of these operations himself with the approval of KASCOL management.
- v) Harvest and deliver cane produced in the cane field to Zambia Sugar mill; unless the smallholders decides to carry out this operation himself or herself with the approval of KASCOL management.
- vi) KASCOL shall pay the smallholder a sum calculated at an agreed percentage of the proceeds of the sale of the smallholders sugarcane, as per cane price Agreement entered between KASCOL and KASF as per Appendix 4 and amended from time and is payable in Zambian Kwacha.
- viii) The cane price as calculated in 5 (vi) above includes the price of molasses, therefore no separate payment is due for molasses.

6. CHARGES

KASCOL shall deduct any charges due and payable by the smallholder from any monies due and payable to the smallholders under the Agreement, including, but without limitation on the following charges:-

1. Fertilizers

2. Chemicals
3. Seed Cane for gapping/supplying
4. Irrigation water
5. Any other charges due as per cane price agreement or other approved charges as may be indicated on authorized stop orders from smallholders.

7. SUCCESSION TO AGREEMENT

The smallholder may by testamentary disposition devise the residue of the smallholder's interest on this agreement to a qualified member of his immediate family preferably spouse or own child, the heir or successor in title shall, if approved by KASCOL, be subjected to training for six (6) months.

However, in the event of the nominee failing to manage the farm, for whatever reason, KASCOL shall permit appointment of two more nominees successively, after which farm shall be repossessed if the third nominee fails to manage the farm.

8. DURATION AND RENEWAL

- (i) This Agreement shall subsist for a period of fourteen (14) years from

----- day of -----20-----.

- (ii) This Agreement may be renewed at the option of both parties for a further term of fourteen (14) years, provided that either party shall give the other one year's notice of its intention to renew or not to renew the agreement before the expiration of the lease.

9. DISPUTES AND ARBITRATION

- a) Any dispute, in regard to this Agreement, shall be referred to a registered arbitrator for arbitration in accordance with the Arbitration act (CAP 180 of the laws of Zambia).
- b) Differences between smallholders interest shall be referred to the disciplinary committee which will consist of four (4) members from management and three (3) members from smallholders' executive committee. The committee shall choose the Chairman and Secretary, this committee will develop a system of resolving disputes.

10. TERMINATION OF AGREEMENT

This Agreement shall terminate immediately;-

- a) If the Smallholder is proved or otherwise declared bankrupt;
- b) On the death of the Smallholder where no satisfactory person has been nominated to succeed the smallholder or a person's nomination has not been approved by KASCOL within one year;
- c) In accordance with the attached Disciplinary code;
- d) The Smallholder decides to resign from the project;
- e) If the smallholder is not building a good residential house (as described in clause 3(i);
- f) If the smallholder is suffering from infirmity of either body or mind and by virtue whereof unable to discharge obligations under this agreement, the nominated successor shall take over the farm;
- g) If the farmer's performance is below expected levels(if a farmer, for two consecutive seasons, gets yields below 75 % of the highest achiever in that block purely out of bad management, he he/she shall be handed over to the disciplinary committee.
- h) Absence from the project area for more than 30 days as per clause 7.4 under "CULTIVATION OF CANE".

11. COMPENSATION

Upon the termination of this Agreement KASCOL shall compensate the Smallholder, in accordance with the advice of an independent evaluation for;-

- a) The estimated value of any permanent buildings on the dwelling area at the time of termination;
- b) Any standing cane in the field
- c) any other improvement made by the Smallholder with the approval of KASCOL;
- d) In the event of termination of this agreement at the behest of the smallholder, the liability of KASCOL shall still be limited to the current market value of any standing cane in the smallholder's farm and any approved permanent building in the dwelling area.

e) In the event of legal suit, each party shall bear its costs unless the court of law determines otherwise.

12. KASCOL MAY DEDUCT FROM ANY COMPENSATION PAYABLE UNDER CLAUSE 11

- i. Any monies owing by the Smallholder to KASCOL;
- ii. Any loss or damage to any part of the dwelling area or cane field or to any part of the project area caused by the Smallholder or as a result of the Smallholder's negligence.

13. IN WITNESS HEREOF KASCOL has caused its common seal to be affixed

here and the smallholder set his hand and seal on-----20-----

ADDRESS:-----

OCCUPATION:-----

FIRST SCHEDULE

(Clause 1)

DESCRIPTION OF THE CANE FIELD

The field is related to tertiary canal no..... and shall commence at rowand end at row..... inclusive, these rows being as numbered along tertiary canal, and will approximate an area of hectares, shown for the purpose of identification but not delineation on the sketch plan annexed hereto and thereon coloured green and situated on.....However, this will depend on the new set up of lines every after each replanting .

DESCRIPTION OF DWELLING AREA

The dwelling area is the area KASCOL has allocated for the use by the Smallholder and his family shown for the purpose of identification but not delineation on the sketch plan annexed hereto and there on coloured red and situated on.....

SECOND SCHEDULE

(Clause 1)

SMALLHOLDERS' REGULATIONS

These Regulations are issued to ensure the proper operations of the KASCOL Scheme so that all Smallholders receive long-term benefits from their participation. They are issued by the Board of Directors of Kaleya Smallholders Company Limited and compliance with these Regulations is required under the terms of the KASCOL Smallholders' agreement of which this Scheme forms a part.

Amendments to these Regulations may be made by KASCOL.

1. CULTIVATION OF CANE

- 1.1 The Smallholders shall maintain the cane on the field to the standard required by KASCOL for sustainable cultivation of cane by following best environmental management practices. To this end Smallholders shall;-

- a. follow the fertilizer programme recommended by KASCOL and in respect of methods, rates and types of fertiliser and also be responsible for the charges relating to that programme;
 - b. maintain their cane fields in a weed-free condition either by hand labour or by the use of herbicides;
 - c. use only such herbicides at such rates and by such methods as may be recommended by KASCOL from time to time;
 - d. notify KASCOL of the occurrence of any disease and pests as listed in Appendix 1 to these Regulations.
 - e. take all steps to eliminate diseased cane by such methods as are directed by KASCOL;
 - f. apply only such pest control measures as KASCOL may recommend;
 - g. apply only such cane ripeners or any other chemicals to the cane as are recommended by KASCOL;
 - h. ensure that the areas outside the cane field are maintained weed-free with a cover of short grasses. The Smallholders' responsibility for this extends to the outside of the field road for the collection of their cane. For those Smallholders adjacent to secondary canals or drains this responsibility extends to the top of the secondary canal bank and the top of the secondary drain adjacent to the field;
 - i. maintain the tertiary drain taking drainage from their cane field with a cover of short grass and in proper shape and condition as directed by KASCOL.
- 1.2 KASCOL may under the terms of the Agreement enter the cane field and take any action as it may deem necessary for the control of weeds, pests and diseases. The cost of any such control measure shall be settled by the Smallholder. This action however, shall be at Kascol's discretion.

2. HARVESTING OF CANE

- 2.1 Smallholders shall utilize any harvesting facilities made available by KASCOL and allow KASCOL employees or their agents to burn and harvest their whole area of cane (or such part as KASCOL may decide) at one time in accordance with the harvesting programme notwithstanding that the actual date of harvest may differ to some extent from the initial programme published.
- 2.2 Smallholders shall be personally present on their cane field during the burning and harvesting operations, but KASCOL may carry out the burning and harvesting in the absence of a Smallholder.

- 2.3 Cane supplied to Nakambala Sugar Estate Mill of Zambia Sugar Company shall meet certain quality requirements to be classified as Standard Cane.” Smallholders shall be responsible for ensuring that these quality Requirements are met (in as far as they are able). These quality requirements are set out in Appendix II to the Regulations and the Smallholders accept these requirement as part of their acceptance of the Farmer’s Agreement.
- 2.4 Smallholders shall be personally responsible for carrying out all field Operations subsequent to harvesting and commencing with trash clearance.

3. REPLANTING OF CANE

- 3.1 To ensure long-term sustained yields of cane it shall be ploughed out and be destroyed at such times as KASCOL may direct and in accordance with replanting programme laid down by KASCOL having regard to disease control, pest control, drainage requirements, yield decline or other reasons. KASCOL shall provide a replanting service to Smallholders.
- 3.2 Pesticides or treatments to the seed cane or soil shall be applied as KASCOL may recommend.
- 3.3 Fertiliser or other treatments to the seed cane or soil shall be applied as KASCOL may recommend.
- 3.4 Only KASCOL approved varieties of sugar cane as listed in Appendix 1 to these Regulations may be planted and KASCOL will discuss the varieties for particular cane fields with Smallholders’ participation.
- 3.5 Only seed cane from a source approved by KASCOL may be used
- 3.6 Seed cane shall be planted at rates recommended by KASCOL
- 3.7 Smallholders shall maintain their plots even at times when those plots are being planted

4 DWELLING AREAS

4.1 Smallholders shall in their dwelling areas:-

- (a) control their livestock and ensure that all their animals are under proper control and not causing a nuisance;
- (b) refrain from growing any crops prohibited by Appendix I to these Regulations;

- (c) refrain from keeping any animals prohibited by Appendix I to these Regulations
- (d) maintain their dwelling area and buildings thereon to a proper standard;
- (e) practice only good soil conservation practices to prevent soil erosion on their dwelling area;
- (a) make proper provisions for the disposal of rubbish by composting, burning or such other method as KASCOL may recommend;
- (b) erect and maintain a suitable toilet and ensure that this is properly used and maintained to a proper hygienic standard.
- (c) provide proper water taps and ensure that water is properly used. Connections of pipes from the main lines will only be done with permission from KASCOL.
- (d) provide all required electrical installations and use electrical appliances ` properly.
- (e) control their children and dependants and ensure that they are under proper control and are not a nuisance.

5. MAINTENANCE OF CANE AND DWELLING AREAS

5.1 Smallholders shall take all steps necessary to preserve soil fertility at all times and shall observe any advice and instructions given to them by KASCOL for that purpose.

They shall in particular:

- a) use or hire for use only that machinery of which KASCOL approves in the manner that KASCOL recommends in order to avoid damaging the structure of the soil.
- b) adopt such soil conservation and erosion prevention measures as KASCOL directs;
- c) refrain from any excavations of the soil or removal of soil;
- d) refrain from applying to the soil any soil from any area, any organic fertiliser or any soil ameliorant except under the direction of KASCOL;
- e) carry out such drainage or soil ameliorant work as KASCOL may direct;

5.2 Smallholders shall ensure that any boundary beacons demarcating their Cane fields and dwelling areas are maintained in their places and are at all times kept visible at all time;

- 5.3 Smallholders shall remove at their own expense all stones and obstacles such as steel pipes, fencing materials, etc. On their cane fields and dwelling areas which may damage machinery engaged in cultivation, harvesting or other operations, and shall reimburse the cost of repair of any damage to machinery caused by their negligent failure to do so. Such disposal is to be in a manner approved by KASCOL.

6. IRRIGATION

- 6.1 KASCOL shall deliver water to the boundary of each cane field by means of a tertiary canal. Deliveries shall normally be made in 11 hour periods during daylight hours at intervals sufficient to provide proper irrigation of the cane fields as decided by KASCOL taking into account rainfall, evaporation, stage of growth, availability of water and other factors.
- 6.2 KASCOL shall notify Smallholders in advance of the days on which water will be delivered to them and Smallholders must accept water on those days;
- 6.3 Extraction of water from tertiary canal shall only be done by using the set of syphons supplied by KASCOL for that canal. These are to be shared among all Smallholders obtaining water from that canal who shall be jointly responsible for loss or damage to the syphons.
- 6.4 Smallholders shall irrigate their cane fields properly as advised by KASCOL and must avoid unnecessary waste of water.
- 6.5 Water supply gates may only be opened, closed or adjusted by KASCOL's employees or their agents.
- 6.6 Smallholders shall not damage or interfere with any part of the canal system, irrigation equipment or drainage system.
- 6.7 Smallholders shall, when domestic water is drawn from canals, use clean containers and shall not contaminate canal water with toxic chemicals, refuse or sewage.
- 6.8 Smallholders shall not plant anything except grass within 1.5 metres from the edge of any canal.
- 6.9 No Smallholder shall build a bridge over a canal except under the supervision of KASCOL.
- 6.10 Smallholders shall maintain drainage at the end of in-field irrigation lines to direct surplus water into drainage system.

- 6.11 All secondary canals and dams are out of bounds to children; the smallholders shall make sure that children are kept away from these premises.

7. RESIDENCE ON AND ABSENCE FROM THE PROJECT AREA

- 7.1 All Smallholders shall occupy the residence on their dwelling areas as their primary and usual place of abode, and shall normally be present at the cane field during normal working hours to ensure maintenance of high standard of crop husbandry. However, a smallholder can assign or employ someone to manage his/her farm with proper arrangements with management- i.e. with KASCOL's prior approval.
- 7.2 If a Smallholder intends to be absent from the project area for more than seven (7) consecutive days, he shall ensure that a competent adult person is present on the project area for the period during which the Smallholder is absent, who shall act on behalf of the Smallholder. The Smallholder shall register such a person with KASCOL. Any such person shall be deemed to have the Smallholder's full authority to request and sign for goods and services provided by KASCOL, and shall observe all instructions given to the Smallholder by KASCOL.
- 7.3 If a Smallholder is absent from the project area for more than seven (7) days for whatever reason, and if no competent substitute is present, then, KASCOL may do all such acts, at the expense of the Smallholder, which it shall reasonably consider necessary to ensure the proper cultivation and maintenance of the cane field and KASCOL shall not be liable for any damage caused by KASCOL's employees.
- 7.4 If a Smallholder is absent from the project area for a period of more than one month without having agreed with KASCOL's acceptable arrangements for the management of his/her plot, the Smallholder automatically forfeits the right to the continuance of his lease which will be terminated by KASCOL.

8. PROJECT AREA

- 8.1 KASCOL intends to manage the parts of the project area not allocated to individual Smallholders to ensure the best long term benefit for the project, Smallholders have no right over these areas without the prior written permission of KASCOL.
- 8.2 Firewood may be taken from the project area on designated areas and only with the specific permission of KASCOL.
- 8.3 No trees on the project area shall be cut without the prior approval of KASCOL.

9. PAYMENTS

- 9.1 Whenever a payment is due from KASCOL to a Smallholder, KASCOL will endeavor to make prompt payment.
- 9.2 Whenever a payment is due from a Smallholder to KASCOL, the amount will be deducted from the next payment due or the Smallholder may opt to pay cash.
- 9.3 KASCOL shall charge interest at the current Barclays Bank of Zambia Limited's prime overdraft rate, if the Smallholder does not effect payment at the agreed time.

APPENDIX I

APPROVED CROPS:

Cane area:	Sugarcane varieties approved by Management from time to time.
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PROHIBITED CROPS:

Cane area:	All crops other than cane.
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Dwelling area:	All psychotropic substances.
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NOTIFIABLE PESTS:

Cane area and Dwelling area:	Heteronychus beetle, thrips, Locusts, Army worms.
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NOTIFIABLE DISEASES:

Cane area:	Smut, Rust, Leaf scald, YLS, RSD
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Dwelling area:	Rabies, all communicable diseases.
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PROHIBITED ANIMALS:

Cane area and Dwelling area:	Cattle, sheep, Donkeys, and goats (any animal which is likely to be a nuisance to other occupiers).
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APPENDIX II

In accordance to Cane Supply Agreement:

1. All cane delivered to Nakambala Mill will be subjected to sampling for quality analysis.
2. All cane delivered shall also be inspected for extraneous materials which are generally divided into two groups:
 - a) Extraneous Materials of a General Nature e.g rocks. sand, metals or anything that is likely to damage machinery in the mill.
 - b) Extraneous Vegetable Matter i.e any vegetable matter other than just cane stalks that is likely to lower the purity standards of the sugar.
3. Minimum cane quality accepted for milling shall be per recommendation by the ERC Committee from time to time.
4. Cane found with excess extraneous materials and/not meeting the minimum standards shall be:
 - a) recommended for outright rejection or,
 - b) penalized as recommended by the ERC Committee. The cost of disposal of such rejected cane shall be borne by the smallholder.

APPENDIX III

SMALLHOLDER'S DISCIPLINARY CODE

INTRODUCTION:

The KASCOL Management and Smallholders do recognize that in any society, Orderly conduct within the frame work of rules and regulations laid out is essential for the well-being of society at large and for the successful achievements of all endeavours. At KASCOL, it is the function of both Management and the Smallholders' Trust Executive to maintain law and order, discipline and efficiency. Individual Smallholders who fail to maintain the required peaceful habitation on the project area should be dealt with appropriately.

The code of conduct will help maintain the necessary law and order. It should not be seen as a restriction or threat, but an effort to ensure the success of the Smallholders project which is only possible if all abide by the law of the land. The rules and regulations set out in the Cane Farmer's Agreement, of which this forms part, are rules that a good farmer should follow. Some rules and regulations must, of necessity, be enforced in the interest of peace, progress and maintained productivity. These vital regulations are highlighted hereunder.

Those who fail to observe these vital regulations will be dealt with in any one of the following ways;-

CODE OF CONDUCT

S/NO	OFFENCE	PUNISHMENT			
		1st	2nd	3rd	4th
A	Any absence from the project area of 30 days or more without having agreed with Kascol's acceptable arrangements for the management of his/her Plot.	4	-		
B	Insulting publicly or shouting at any time Without proper reason	3	4		
C	Assaulting or fighting, showing threatening Behaviour or using abusive language to any Company employee or any Smallholder	3	4		
D	Willfully damaging any company property	3	4		

E	Bribery of a company employee or any other Persons to the detriment of the company	3	4
F	Inciting a strike or "sit down" or any form of Riotous behaviour	4	-
G	Any other form or type of bad behaviour which is against the general interests of the company And is likely to jeopardise it's well being or Reputation	3	4
H	Lack of serious, conscientious and sustained Application or implementation of the Recommended sugarcane growing field Management practices	1	2 3 4
I	Failure to observe laid down channels in Resolving disputes.	2	3 4
J	Failure to take over irrigation in time and/or Failure to follow the recommended irrigation Schedule	1	2 3 4
K	Forgery or fraud	3	4
L	Theft of any description,including misdirection of fertilisers and chemicals meant for cane	3	4
M	Disclosing confidential campany information to any outsider which may have detrimental effect On the company	3	4
N	Found at an awkward place,at an awkward time and condition and loitering which may jeopardise the safety of others or Company property	4	-
O	Failing to turn up to fight fire by a smallholder and their dependants when called to do so (it is the duty of everyone in the project area to fight fire).	3	4
P	Refusing to obey company instructions or carry out a field operation or dwelling area operation as recommended by management.	3	4

Q	Insurbordination or blatant disrespect to another Smallholder or company employee	3	4
R	Publishing false information which would jeopardise the safety of the company	3	4
S	Taking information to the press or radio.	4	
T	Children found pulling cane from tractors or stealing cane.	2	3 4
U	Supporting and protecting indiscipline children or dependants who have been found guilt of an offence	3	4
V	Found to be in possession of psychotropic substances.	4	
X	Convicted of any criminal offence.	4	
Y	Careless lighting of fire or smoking in mature cane	3	4
Z	If the smallholder's performance is below expected levels (as in clause 10g)	3	4

Legend

- a) Verbal warning - 1
- b) Written warning - 2
- c) Final warning (appearance before a Committee of Management and Smallholders Executive) i.e. the Disciplinary Committee - 3
- d) Appearance before the Disciplinary Committee who alone can recommend a dismissal - 4.

Where a Smallholder has been given verbal warning or written for any offence, this warning will stand for a period of one (1) year. In case of a final warning, the warning will stand for two (2) years. Should the individual not commit any offence of similar nature within this period, then the warning will be deemed as having lapsed.

THE COMMON SEAL OF)
Kaleya Smallholders Company Limited)
Was hereto affixed
In the presence of:

OCCUPATION: -----

APPENDIX IV

KALEYA SMALLHOLDERS COMPANY LIMITED

This agreement is made today 20th October 2009 between

- A. Kaleya Smallholders Farmers Trust
P. O. Box 670519
Mazabuka (here in called the KAST)

And

- B. Kaleya Smallholders Company Limited
P. O. Box 670371
Mazabuka, a registered Company in Zambia (where in called KASCOL)

WHEREAS

The parties have mutually agreed to enter into this agreement on behalf of all the smallholders who are members of the TRUST and Kaleya Smallholders Company Limited to amend clause 5(vii) of the Cane Farmers Agreement that:-

With effect from 1st April 2009 (2009 season) the Smallholders' Cane Price split of 43%, of the cane price as per cane price Agreement entered between Zambia Sugar and KASCOL from time to time and is payable in Zambian kwacha is adjusted to a further percentage as follows:-

1. WATER CHARGES:

- I. **Water Charges**:- The irrigation cost to KASCOL contains water charges By Zambia Sugar water charges paid to Water Development Board, canal maintenance and amortization cost. It is agreed that the percentage of water charges (total water bills paid to ZS and water charges paid to Water Development Board) to the cane revenue incurred by KASCOL in a season will be added back to the following financial years' cane price split using the following formula:-

Percentage of water cost to cane sales: total irrigation bills paid to Zambia sugar and water right charges paid to Water Development Board divided by total cane sales expressed as a percentage.

$$W^3 = W/CS * 100$$

Where:

WP - Water Charge percent to be added to the cane split
W - The total water bills paid to Zambia Sugar plus water charges paid to Water Development Board.

CS - The total of estate and smallholders cane price.

APPENDIX IV

II. WATER CHARGES RECOVERY

The recovery of water charges to Smallholders will be based on total irrigation bills paid to Zambia Sugar plus water right charges paid to Water Development Board divided by Total number of hectares at Kascol divided by average number of irrigation cycles multiplied by number of irrigation cycles per farmer multiplied by total area for each farmer by using the following formula:

Irrigation cost per hectare:

$$WR = W/TH/AV * IC * HA$$

Where:

- | | | |
|----|---|---|
| W | - | The total water bills paid to Zambia Sugar water charges paid to Water Development Board. |
| TH | - | Total hectare (both estate and smallholders together) |
| AV | - | Total area wet (irrigated) divided by TH |
| IC | - | Number of irrigation cycles per farmer; |
| HA | - | Total area for each farmer |

Since there are no official records for the number of irrigations in 2008 season, it is agreed that an average rate based on the total area irrigated will be used for 2009 season's payments only, as follows:

total water bills divided by total area = per hectare water cost

$$W/TH = K/ha \text{ (per hectare water cost)}$$

2. Smallholder amenities:-

- i. The entire cost under this head is currently allocated to smallholders based on the hectare. Smallholders are of the opinion that they can bear only the cost of one extension officer and his associated cost like motor cycle maintenance, fuel ect whilst the rest of the cost like training, seminars and tours will be met out by fair trade funds or own arrangements.
- ii. The smallholders and management will work out the training programmes/tour & seminars for each year and will submit to the fair trade for support. Should the fair trade run out of funds, a temporary assistance by the company may be considered.
- iii. For the avoidance of any doubt, the issue of one extension officer will be reviewed every year based on the overall performance of the smallholders. Should the company feel that the extension support should be beefed up the company will do so, but will be adjusted from the one off split given.
- iv. The rest of the cost like water improvements/medical cost apportionment of the clinic cost will be met out of the remaining split retained by the company.
- v. It is agreed that a one off adjustment of 2% is added back to the current cane price split. The one off adjustment is calculated based on the actual percentage of smallholder

amenities cost to the cane price less the cost of one extension officer using the following formula:

SA/ASP *100 (rounded off to the nearest digit)

Where:

SA - Actual smallholders' amenities incurred in 2008 – 09 financial year (net of one extension officer cost)

ASP - Average smallholders cane price p/ha for 2008 – 09 (2008 season).

3. **Revised cane split**:- The revised cane price split after the above adjustments will be:

Current split	-	43%
Add: one off adjustment as per clause 2 (v) above	-	2%
Add: Water charge percentage as per clause (1) above	-	WP
Revised split	-	45% + WP

For the avoidance of any doubt, the split percentage is not fixed and will vary on a day basis as the water bill percentage will vary from year to year depending on the water cost

4. **Implementation plan**:- The new system will be effective from financial year 1st April 2009 (2009 season) for a period of four years (2012 season, financial year 2012 – 13) and will be reviewed thereafter based on the net surplus (deficit) on the split retained by the company. For the purpose of transparency and accuracy, the water percentages, water charges and fertilizer cost rates will be certified by the company's auditors and will be released to Smallholders before the beginning of the season affective from next season's payment (2010 season).

5. It is further understood that by signing this agreement, all smallholders have given to the Cane Pricing System and the agreement is irrevocable during the tenure of the agreement.

IN WITNESS WHEREOF the duly representatives of the parties hereto have set their hands here unto the date indicated below:-

Signed By:.....	Signed By:.....
TITLE: ESTATE MANAGER	TITLE: TRUST CHAIRMAN

DATE:.....	DATE:.....
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For and on behalf of

For and on behalf of

KALEYA SMALLHOLDERS COMPANY LIMITED	KALEYA SMALLHOLDERS
ARMERS TRUST	

Signature of Witness:.....	Signature of Witness:.....
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TITLE: COMPANY SECRETARY	TITLE: TRUST SECRETARY
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DATE:.....	DATE:.....
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APENDIX IV

EXAMPLE:

WATER CHARGES CALCULATION (2009 SEASON)

Water charge percent = $W/CS \times 100$

Where:

W - The total water bills paid to Zambia Sugar plus water charges paid to water

Development Board.

CS - The total of estate and smallholders cane price.

Percentage of Water cost to cane: Total irrigation bills paid to Zambia sugar and water right charges paid to water Development Board divided by total cane sales expressed as a percentage.

For 2009 season $(653,254,443/32,774,613,790.86) \times 100 = 1.99\%$.

WATER CHARGES RECOVERY: (2009 SEASON)

For example if the total area under irrigation was 2270 ha in 2008 and a farmer of 60 ha had 3 irrigation while the average irrigation cycles were 4, the cost for that farmer will be:

$653,254,443/2207/4 \times 3 \times 6 = K1,331,964.20$

SMALLHOLDERS AMENITIES ADDED BACK

$SA/ASP \times 100$ (rounded off to the nearest digit)

Where:

SA - actual smallholders amenities incurred in 2008 -09 (net of one extension officer cost)

ASP - average smallholders cane price p/ha for 2008 – 09.

$K336,010$ actual cost of S/H amenities per hectare in 2008-09) – $K52,903$ (cost of extension officer including motor cycle maintenance per hectare)/ $17,240.042$ (average small holder cane price per hectare for 08 -09) = 1.64% , rounded off to 2% .