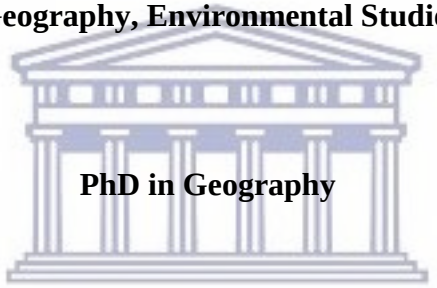
UNIVERSITY OF THE WESTERN CAPE

Faculty of Arts

Department of Geography, Environmental Studies and Tourism



PhD in Geography

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Thesis title:

Unusual waterscapes and precarious rural livelihoods: Occurrence, utilisation and conservation of springs in the Save Catchment, Zimbabwe

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ABSTRACT

Springs are an important natural resource in many rural spaces which, if utilised sustainably, can be an important source of livelihoods for rural communities. In Zimbabwe, the social aspects of springs and their waterscapes remain understudied. This includes an in-depth understanding of how communities have shaped their livelihoods around springs, the extent to which they have contributed to sustainable rural livelihoods, especially in water stressed parts of the country and the institutional framework shaping their access and utilisation. Using the sustainable livelihoods framework of analysis, the goal of this study was to investigate the role that springs and their resultant waterscapes have played in securing livelihoods for rural households in the Save Catchment of Zimbabwe. Methodologically, the research adopted the socio-hydrological approach which is a new and emerging discipline that aims at understanding the interactions and feedbacks between the human and natural processes that give rise to community water sustainability challenges. The socio-hydrological approach is informed by both the qualitative and quantitative research techniques of data collection and analysis. Two rural communities (Nyanyadzi and Maturure) of the Save Catchment were randomly selected for an in-depth study. The snowball sampling technique (non-probability) was utilised in the selection of the 100 participants for the questionnaire survey. Purposive sampling was used to select nine key informant interview participants. Secondary data collection was done through a systematic review of scholarly and policy literature. Qualitative data generated from primary and secondary sources were processed and analysed using qualitative techniques such as thematic ordering, systematisation and fine grain analysis. For quantitative data, descriptive statistics, such as frequencies, were used to summarise and analyse questionnaire data.

Rural communities in the Save Catchment of Zimbabwe were observed to have developed livelihood strategies that were anchored on springs and their waterscapes. In the studied communities, springs were utilised for both commercial and subsistence purposes and livelihoods constructed around springs included; gardening, tourism, livestock production, brick kilning art and craft making. In the study, springs were also shown to be a very important component of sustainable rural livelihoods. However, most of them were perceived to be declining in both water quality and quantity, imposing complex livelihood conundrums for the rural communities and threatening the sustainability of livelihood strategies that they are supporting. Practices observed to be threatening the integrity of springs were encroachment of settlements, natural environmental changes, soil erosion and population pressure. Limited environmental awareness, poverty, poor implementation and enforcement of conservation laws has resulted in the adoption of practices that degraded springs. Institutions shaping spring utilisation were observed to be ineffective to a large extent due to lack of capacities and conflicting mandates but local traditional leadership and water committees were observed to have deeper community penetration and were the most effective in influencing access and effective management of springs and their related waterscapes.

Key words: spring waterscapes, rural livelihoods, spring conservation, socio-hydrology, sustainable livelihoods framework, Save Catchment.

DEDICATION

This work is dedicated to my family for the steadfast and endless inspiration they gave me during my studies. These are Anashe and Wenyasha; mother, Lorin Chipato; brother, Robinson; sisters, Rose and Lynette. May God bless you all.

ACKNOWLEDGEMENTS

I wish to express appreciation to Professor D.S Tevera, my study supervisor and Professor D. Mazvimavi, my co-supervisor, for their dedicated, untiring and invaluable guidance, during the preparation of this thesis. My sincere thanks are also extended to the entire staff in the Department of Geography, Environmental Studies and Tourism at the University of the Western Cape, for all the contributions they made during my studies.

DECLARATION

I, David Chikodzi, hereby declare that this thesis for a PhD degree at the University of the Western Cape, hereby submitted by me, has not been previously submitted for a degree at this or any other university, and that it is my own work in design and execution and that all reference materials contained therein have been duly acknowledged.

Signature.....Date.....

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AGRITEX	Agricultural Technical and Extension Services
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CARE	Cooperative for Assistance and Relief Everywhere
DBI	Dragonfly Biotic Index
DDF	District Development Fund
DFID	Department for International Development
EMA	Environmental Management Agency
FAO	Food and Agriculture Organisation
GIS	Geographic Information Systems
GPS	Global Positioning System
IAHS	International Association of Hydrological Sciences
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
IWSD	Institute of Water and Sanitation Development
LIDAR	Light Detection and Ranging
NASA	National Aeronautics and Space Administration
NGO	Non-Governmental Organisation
OECD	The Organisation for Economic Co-operation and Development
OXFARM	Oxford Committee for Famine Relief
RDC	Rural District Council
S.I	Statutory Instrument
SASS	South African Scoring System
SLA	Sustainable Livelihoods Approach
SLF	Sustainable Livelihoods Framework
SPSS	Statistical Package for the Social Sciences
UNDP	United Nations Development Programme

USA	United States of America
USGS	United States Geological Survey
VIDCO	Village Development Committees
WADCO	Ward Development Committees
WCED	World Commission on Environment and Development
WFP	World Food Programme
Zimstat	Zimbabwe National Statistics Agency
ZINWA	Zimbabwe National Water Authority
ZRP	Zimbabwe Republic Police

DEFINITION OF KEY VARIABLES

The key concepts that were frequently used in the study need to be explained so that ambiguity is removed. This section operationally defines and explains the key terms and concepts as they were applied to guide discussions in the study.

Institutions

As given within the sustainable livelihoods framework, institutions are part of processes and organisations that produce and implement policies, deliver the needed requirements for access, utilisation and management of springs. Institutions also provide services important for gaining access to livelihood assets, trading them, and benefiting from their utilisation. According the Chuma et al. (2012), it is through institutions that policies, norms, rules and laws governing resource use, control and management are shaped. Institutions also provide frameworks for policy and legislative action. Studies have revealed that successful use and management of resources can be achieved if the resource users, planners and policymakers understand the relationships between springs, people and existing human institutions. Dixon et al. (2013) have observed the utilisation of springs to be influenced by dynamic institutional arrangements peculiar to each place. The study of human institutions in spring management is crucial in maintaining and restoring spring integrity as appropriate measures can be taken to improve and perfect the existing institutional structures. In Zimbabwe, the ability of a given institution to fulfil its mandate depends on power relationships, source of mandate and political 'rightness or acceptability' and on the capacities of the individuals representing the institution.

Livelihoods

As adopted from Scoones (1998) a livelihood comprises the capabilities, assets, including both material and social resources and activities required for a means of living. Chambers and Conway (1991) observed a livelihood to be sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities while not undermining the natural resource base. They maintain that a livelihood is environmentally sustainable when it can maintain or enhance the local and global assets on which livelihoods depend and has net beneficial effects on other livelihoods. A livelihood can be socially sustainable if it can cope with and recover from stress and shocks, and provide for future generations. Economically, a livelihood is sustainable if it is resilient and adaptive to shocks, to markets, price risks, and variability in economic scenarios (Nikolakisa and Grafton, 2015). Kollmair and Gamper (2002) highlighted livelihoods to be classified as sustainable, if they are independent from external support, if they maintain the long-term productivity of natural resources and if they do not

undermine the livelihood options of others. The contribution of spring waterscapes to the sustainability of rural livelihoods of the Save Catchment was studied through the lens of the Sustainable Livelihoods Framework.

Small natural features

Springs in the study area were analysed as *Small Natural Features*. A *Small Natural Feature* is a site with ecological importance that is disproportionate to its size, sometimes because it provides resources and processes that influence a much larger area, sometimes because it supports unusual diversity, abundance, or productivity. The collective ecological role of all the small springs on the Save Catchment can be greater in impacting on the livelihoods of rural populations than the impact of the relatively few large springs. Management of these *Small Natural Features* needs a dynamic approach to the conservation of their associated biodiversity and ecosystem services because they are too small to be conserved efficiently with some of the conventional large-scale tools of conservation, like designating a sizable protected area.

Socio-hydrology

In the study, the definition of socio-hydrology is adopted from Elshafei et al. (2015). They define socio-hydrology as a transformative discipline aimed at uncovering the dynamic cross-scale interactions and feedbacks between the natural and human processes that may give rise to water sustainability challenges. It aims to explain and interpret socio-hydrologic responses in terms of outcomes relevant to human well-being, and discern possible future scenarios of their evolution. Socio-hydrology also aims to understand the meaning and value of water as a culturally, politically, and economically embodied resource necessary to human life.

Springs

Springs are hydro-geological features formed when groundwater discharges on to the land surface. This natural outflow of groundwater creates waterscape environments such as diffuse zones, a lotic, lentic or wetland environment. Springs and their resultant waterscapes have a multi-dimensional value to ecologists, geographers, biologists, anthropologists, and sociologists. Springs, together with the resulting waterscapes, are the main focus of this study in terms their utilisation patterns, contribution to rural livelihoods, conservation challenges and institutions that shape their access and use.

Practice

As observed by Mabiza (2013), institutions, as rules of the game, cannot be observed because they are abstract; however, their effect on spring water utilisation manifests in what the users do, which is observable. Practice is the routinised type of behaviour which consists of several

elements, interconnected to one another including forms of bodily and mental activities, things and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge (Reckwitz, 2002).

Waterscapes

As used in the study, waterscapes are unique hydrological, geological and biological features that are created as a direct result of the presence of water produced by springs. In the study, spring waterscapes and how rural communities have constructed their livelihoods around them are the subjects of analysis. These waterscapes can be in the form of different wetland and biological environments created directly from spring water and from these, rural communities obtain their livelihoods and other ecosystem services. Other wetlands, such as vleis (*dambos, mapani*), flood plains and pans though referred to, were not the subject of analysis of this study.

Wetlands

As used in the research, wetlands refer to any moist environment with either flowing or stagnant water, created from mainly spring water. Wetlands are one of the main waterscapes that are generated by spring water.

CHAPTER 1 : ORIENTATION TO THE STUDY

1.0 Introduction

The chapter gives a background and introduction to the research problem. It also explores the spring waterscape question in Zimbabwe which looks at the debates around issues of access to, utilisation and conservation of springs in relation to the ecosystem functions and livelihoods that they support. The research questions, objectives and problem are also presented in this chapter. It also includes the introduction and rationalisation of the conceptual pivot used in the analysis of the research problem.

1.1 Background

Water resources are an important factor in the development, transformation and sustainability of rural livelihoods. Water is also at the centre of sustainability challenges facing rural communities in the modern era (Sivapalan, et al. 2014). During their assessment of spring water quality for drinking in Morocco, Barakat et al. (2018) posit that the knowledge of a country's water resource base and the potential of this water to be exploited for different uses are prerequisites for informed spatial planning and sustainable development of rural communities. In their study of spring waterscapes and groundwater diffuse zones in East Africa, Dixon and Wood (2003) concluded that they were highly valued by rural communities because of the functions that they provided, such as, reliable sources of water for a variety of household livelihood activities like mining, gardening, irrigation and domestic water supply. Davis et al. (2017) argue that in some arid to semi-arid regions of the world, springs may be the only reliable source of fresh water for communities and wildlife consumption. Springs therefore become a valuable and key resource to the development of these communities and needed to be protected from over-use.

Internationally, the International Centre for Integrated Mountain Development (ICIMOD) (2015) defined a spring as being a natural outflow of groundwater that may create a lotic, lentic or wetland environment. This means that at their point of occurrence, springs are directly associated with different waterscape environments that are either related to flowing or still fresh water. The United States Geological Survey (USGS) (2014), has noted springs to result from an aquifer filled to the point that the water overflows or diffuses to the land surface. The

USGS (2014) also maintain that springs vary in size from large pools with high flow rates of millions of litres of water a day to intermittent seeps that flow only after heavy rainfall.

In Zimbabwe, springs are not well defined and imbedded in the law. The Environmental Management Act (2002), which is the main law that is used to protect natural resources like springs in Zimbabwe, just acknowledges springs as being part of a list of wetlands that occur in the country. Wetlands are defined in the Environmental Management Act (2002) as "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including riparian land adjacent to the wetland.*" Zimbabwe's Water Act (1998) also does not specifically define what a spring is but classifies them as part of surface water resources together with marshes, swamps and vleis. The Water Act (1998) prohibits the utilisation or interference of any springs by any person without a permit. With no detailed recognition of springs at law due to the absence of a clear local definition, their effective wise use and protection becomes difficult. Narasimhan, (2009) state that that in many countries where springs occur, groundwater extraction was historically unregulated and the interactions between surface and groundwater were poorly embedded in law.

Springer and Stevens, (2009) postulate that the geological characteristics of the containing aquifer allows some springs to support a wide variety of aquatic, terrestrial animal and plant species as well as human settlements. This means that the ability of springs to support different ecosystem services and human livelihood activities depends on the physical characteristics of the aquifer supporting the spring flow. Eggenkamp and Marques (2013), followed by the USGS, (2014) posit the physical environment of a spring to be mainly determined by its geomorphological setting with the aquifer material dictating its discharge, dissolved oxygen concentration, substrate, temperature and water chemistry. Barakat et al. (2018), argue that at their point of convergence with the ground surface, springs create different waterscapes such as wetland environments. These waterscapes can potentially support unique ecosystems services to both the environment and nearby human communities as well as supporting a diversity of their livelihoods.

As argued by Finlayson and Davidson (1999), hydrogeologists have traditionally studied and classified springs using their physical and chemical parameters up to their point of discharge, paying little attention to other aspects of springs. After their point of discharge, springs become more interesting to the ecologists, geographers, conservation biologists, cultural

anthropologists, and recreation sociologists. This means that interest in the study of spring waterscape environments is multi-disciplinary and multi-dimensional. However, not all aspects of springs have been well studied in literature, especially the understanding of rural livelihoods that have been constructed around springs in the Global South. Barakat et al. (2018), highlighted that biologists in studying springs were more interested in the microhabitats, ecosystems that they support and the factors that may influence biodiversity of spring fauna. These factors include the stability of the spring conditions, the nutrient status of the spring waters, transport of living organisms through the subsurface and the effects of groundwater contamination. Hydrogeologists, on the other side, when they study springs will be more concerned with the relationships between groundwater and underlying geological formations (rock-water interactions, transit time), recharge zones of and quantification of water resources for their effective management. They are also interested in the hydrological links between aquifers and springs, and in understanding how groundwater extraction affects spring flowrates (Finlayson and Davidson, 1999). Ecologists are seen to be interested in the '*Small Natural Features*' phenomena of springs. Here ecologists explore the disproportionate ecological importance of springs in maintaining biodiversity, providing important ecosystem services to humans and the environment than their size suggests. Ecologists are also interested in the management challenges facing springs and the ecosystems that they support and in devising innovative approaches to conserving them (Faulks et al. 2016; Davis et al. 2017).

Geographers, on the other hand, are more interested in studying the spatial distribution and inventory of springs based on mapping systems that identify their location, size and extent of groundwater resources that sustain them (Ozdemir, 2011; Zandi et al. 2016). Techniques used by geographers to map springs include; the use of satellite remote sensed imagery, GPS field surveys, aerial photographs and LIDAR (White and Lewis, 2011). Sociologists, on the other hand, are more interested with the important social, cultural and economic value of springs and how they impact on societal norms and wellbeing.

Springer and Stevens (2009) posit the classification of spring types to be an important process because it offers a universal understanding of spring forms which then would provide guidance for spring management, ecosystem preservation and restoration. However, springs have been observed to be too varied over space and time such that it has been difficult to develop any universally accepted classification system that is consistent or comprehensive. As mentioned by Lambrakis et al. (2013), springs have been classified differently by different researchers,

for example, according to their hydrogeology, physico-chemistry, fauna and source characteristics. Classifications based on hydrogeological parameters incorporate the aquifer type or bedrock structure which channels groundwater flow to the surface (Smith, et al. 2003). Physicochemical classifications consider the prevalent defining characteristics of water at the spring source, such as, temperature in thermal (Eggenkamp and Marques et al. 2013), cold (USGS, 2014) and variable (Smith, et al. 2003) springs. Even though there is still no universally accepted spring classification system, Springer and Stevens (2009) advocated for an integrated spring classification system which includes major physical, biological, and socio-cultural variables associated with them. Such an integrated and all-inclusive classification system would be desirable because it would allow improved assessment of the distribution of different forms of spring ecosystems and services that they provide. Such a classification system has an effect of improving spring inventory and development of robust conservation and restoration strategies.

Management and conservation of spring waterscapes and the services that they provide such as biodiversity have been argued to be an important area for intervention at key international conventions and in regional and national policies (Webb et al. 1998; Cantonati, et al. 2005). The importance of sustainable management of springs and their services though still at its infancy, has being increasingly recognised in the wide ranging debate on managing the world's water resources (Finlayson and Davidson, 1999). Several initiatives have been implemented worldwide to ensure protection and sustainable management of spring resources. However, these initiatives have mostly been from the Global North where the pattern of access and utilisation is different when compared to the Global South. In the United States of America (USA), for example, the Florida springs task force developed steps that can be followed during the protection and restoration of local springs and underground aquifers (Hartnett, 2000). The Bureau of Land and Management of the USA, has developed a manual that provides a guide in managing and preserving freshwater springs in western USA (Sada, et al. 2001). In Germany, as observed by Scarsbrook et al. (2007), the Society of Spring Ecology and Conservation has been active in the development of key information related to spring habitats with the creation of an academic journal called *Crunoecia*. The society also organised the first European symposium on spring ecology and conservation. In Australia, Fatchen (2000), observed the existence of a focus group of researchers known as the Great Artesian Basin that meets annually to discuss issues related to the management and protection of springs. Most of these initiatives have tended to be focused on mainly improving the conservation and rehabilitation of springs

and the ecosystems that they support. Little attention has been given to understanding the nexus between spring waterscapes and livelihoods that they support which is also important to their utilisation and management, especially in the Global South, where Dixon (2008) has highlighted the growing recognition of the value of springs in supporting rural community livelihoods.

According to the Millennium Ecosystem Assessment (2005), springs provide a range of goods and services and possess a variety of attributes of value to human society. Turner, et al. (2000), argued that springs offer provisioning, regulating, cultural, and supporting services that generate economic value from their direct, indirect, or potential use. Scarsbrook et al. (2007) advocated for the understanding of livelihoods supported by springs as being crucial when deciding on conservation and development priorities related to land use and the allocation of scarce water resources. Lannas and Turpie (2009) highlighted that, assessing the value of natural resources like springs to poor communities was a critical consideration in the management of resources because there was a need to strike a balance between livelihoods and conservation. In South Africa, Sattler (2010) followed by Nkuna et al. (2014) concluded in their studies of rural springs that they were an important natural capital in many rural settings which, if developed and utilised sustainably, could generate economic and social benefits for local communities and could contribute to the sustainability of rural livelihoods. As discussed by Quaddus and Siddique (2004), sustainable utilisation of spring resources that are key to rural livelihoods involved improvements in the quality of human life while living within the carrying capacity of supporting ecosystems. This means that, while utilisation of springs was essential in satisfy household needs and improving their livelihood base, it also needed to be based on efficient and environmentally responsible use of the society's natural, social and economic resources (Petroman, et al. 2010).

Elshafei, et al. (2015) have called for more worldwide research that focuses on how communities interact with springs (water) and related waterscapes to support their livelihoods. Studies of the interrelationships between human society and water resources is the main focus of a relatively new multi-disciplinary field of study called socio-hydrology. Socio-hydrology was defined by Di Baldassarre et al. (2015) as a discipline aimed at unpacking the dynamic interactions between the natural and human processes that give rise to water sustainability challenges. Sivapalan, et al. (2014) noted socio-hydrology to be the science that focuses on people and water, and aimed at understanding the dynamics and co-evolution of coupled

human-water systems. Hydrologists and natural scientists in general have for too long ignored the human factor in their studies and modelling. In traditional hydrology, for example, human-induced water resources management activities are prescribed as external forcings in the water cycle dynamics, under the assumption of stationarity (Montanari et al. 2013). This has led to limited understanding of the interplay between physical and social processes that may bring sustainability challenges in the water sector. In socio-hydrology, on the other hand, humans and their actions are considered part and parcel of the water cycle dynamics with the aim of predicting the dynamics of both. Socio-hydrology has been argued by Di Baldassarre et al. (2015) to be an interdisciplinary but quantitative science of people and water, having the objective of making predictions of water cycle dynamics for the purpose of underpinning sustainable water management.

Montanari et al. (2013) observed the rise of socio-hydrology as having been inspired to a large extent by the International Association of Hydrological Sciences scientific decade 2013–2022 known as *Panta Rhei.* This decade was dedicated to better understanding the interactions and feedbacks that exist between water and societal systems. In line with this, the study therefore, adopted the socio-hydrological approach in understanding and unpacking the ways in which rural communities were utilising groundwater springs to support their livelihoods on the Save Catchment of Zimbabwe.

1.2 The spring waterscape question

Matshel, et al. (2013), suggested water availability as influencing rural livelihood sustainability due to the direct link between household access to water resources and material poverty in many rural areas of the Global South. Thus, in order to ensure water security in rural areas, Dlamini (2007) argued that it was paramount to gain an understanding of the livelihood strategies of rural people and the role that water plays in ensuring their sustainability. It is, therefore, essential that more research is directed towards understanding the complex relationships between water scarcity and its influences on the livelihood options available to rural dwellers. It is also critical to appreciate how various institutions intervene to influence this relationship. According to Quin et al. (2011), rural populations were the most affected by water scarcity due to their direct reliance on water for livelihood purposes. They also maintain that the various livelihood activities that rural dwellers utilised water for were often not fully

realised due to the limited availability or access to the resource. Springs are one of the major sources of rural water and as such, in many water stressed rural communities of the Global South, Derman and Ferguson (2003) observed springs to be sites of perpetual disagreement because they were a fundamental resource that supported ecosystem services and also sustained livelihoods. Disagreements around springs occur because they support different uses and those with interests in the springs disagree on the best use leading to the development of the spring waterscape question.

The spring waterscape question explores the conceptual debates around issues of access to, utilisation and conservation of springs in relation to the ecosystem functions and livelihoods that they support. The spring waterscape question in the Global South is dominated by two diametrically opposed views. One view advocates for the complete protection of springs as a fragile *Small Natural Features* facing multiple threats. According to Davis et al. (2017), *Small Natural Features* are sites of immense ecological importance that are disproportionate to their size. This is because they provide resources that limit key populations or processes that influence a much larger area and they support unusual diversity, abundance, or productivity. The other view on spring waterscapes argues for their complete transformation and exploitation to support agricultural production and other socio-economic services in order to improve rural livelihoods (Knüppe, 2011). Dixon and Wood (2003) argued that some springs support fragile and transient ecosystems that were easily prone to erosion and degradation through natural processes and anthropogenic exploitative interventions hence the need to preserve them. Clare and Creed (2014) called for the utilisation of springs only if there was an approved management plan for their use. This was after observing that in Canada, springs that were being utilised without government permits were significantly degraded when compared to those that had approved management plans in place. They concluded that use of springs without clear environmental management plans could pose a threat to their wise use.

Knüppe (2011) observed that the decline in water quantity and quality together with the negative impacts of climatic variability have increased the demand for spring waterscape utilisation leading sometimes to their over use and eventual degradation. This degradation of spring waterscapes then directly impacts negatively on the livelihoods and ecosystem services that they support. Dixon and Wood (2003) posit that in many spaces of the Global South, there was disregard of the importance of ecosystems services provided by springs. This disregard coupled with the undervaluation of their significance to rural livelihoods, the shortages of

expertise and adequate data in the areas of spring utilisation and conservation were responsible for their continued degradation.

In Zimbabwe, like other countries in the Global South, social, legislative, historical, political, economic and environmental factors have interacted in complex ways to influence access and utilisation of spring waterscapes (Ferguson and Derman, 2004). In Zimbabwe, historical factors play an important role in the access and utilisation of spring waterscapes by contemporary societies. Mtisi (2011) observes that historically, in Zimbabwe early European settlers embarked on a wide scale forcible acquisition of fertile and well-watered land in natural agro-ecological regions I, II and III and the subsequent resettlement of Africans on marginal lands. These marginal lands were called the native reserves which were invariably located in the dry and semi-arid Lowveld regions IV and V. According to van der Zaag et al. (2001), the Africans were, therefore forced to occupy environmentally sensitive land that was of poor fertility, vulnerable to erosion and of limited water resources while the Europeans occupied the best land in terms of fertility and water availability. Hence Mabiza (2013), suggested that this colonial land acquisition did not only create a skewed distribution of land, but also an inequitable access to water. Since dryland agriculture was not reliable, Africans were therefore, forced in some areas to intensively utilise spring waterscapes as a basis of securing their agro-based livelihoods even if the practice was illegal.

Whitlow (1990) noted that before independence in 1980 environmental laws were preoccupied with the hazards of soil erosion and degradation of spring waterscapes in Zimbabwe. This preoccupation prevented a realisation of their full potential to support livelihoods through various prohibitive measures on spring waterscape utilisation enshrined in the legislature. Dermana and Hellum (2007) suggested that the ban on spring waterscape utilisation in general was actually intended to make it difficult for black Africans to compete with whites in agricultural production. This was because springs on white owned commercial farms could be legally utilised while as those on black communal lands were prohibited. Manzungu (1999) also argues that the actual reason behind the ban on spring utilisation was the fact that black manpower was required on the commercial farming areas so if they became self-sufficient, then there would be no demand for employment at the commercial farming areas. Africans, therefore, had to deal with the capriciousness of the rains with no option for irrigation. The ban on spring use, as stated by Mharapara (1995), was made based on a largely uninterrogated assumption that land degradation will occur if Africans were allowed to utilise the springs.

Mabiza (2013) disputed this by highlighting that erosion and desiccation of spring waterscapes were the products of a complex chain of anthropogenic events including the enforced relocation and concentration of the indigenous population and the historical lack of investment in the non-commercial rural sector not just their utilisation. Mutekwa and Gambiza (2017) also viewed the ban as a mechanism for subjugation, deprivation and marginalisation of local communities to disempower them and generate near free labour for the benefit of colonial authorities. As argued by McGregor (1995), through discriminatory pieces of legislation such as the Natural Resources Forest Produce Act of 1928, the Natural Resources Act of 1941 and the Native Land Husbandry Act of 1952, the colonial government centralised natural resources management. This gave government agents the power to intervene at the local level to enforce resource conservation. The situation created tension between the government and local actors because this approach to conservation jeopardised the livelihoods of Africans and to a large extent explains why resisting resource conservation measures came to be part of the struggle for independence.

After independence, the new post-colonial government inherited colonial legislations and maintained the complete ban on the utilisation of springs by rural communities. However, despite these embargoes, Dermana and Hellum (2007) observed that spring wetland utilisation continued unabated in most communal areas of Zimbabwe. This was because they were one of the major sources of secure livelihoods and the government lacked the means to monitor and stop this practice. Derman et al. (2007) postulate that Zimbabwe's legislative restrictions had seriously retarded the implementation of organisational reforms to support sustainable wetland utilisation. The restrictions also made it difficult to integrate conservation and development goals at a local level and pushed wetland utilisation away from the open agenda as the communities and supporting institutions maintained the perception that it was illegal to use them.

The reform of the water sector in Zimbabwe was done in 1998 with a new Water Act that created participatory structures in the management of water resources. The new Water Act (1998) continued with the protection of springs because they were deemed to be an important source of water that could not be utilised unless one obtains an official permit. Despite this new Act and its provision for legal utilisation of springs, problems associated with spring degradation continue to manifest and utilisation without official approval still persists. The Environmental Management Act, (2002) also maintained a prohibition on the utilisation of

springs without a permit from the Environmental Management Agency (EMA), hence the Act gives a provision for their wise use. However the process of getting a written permit is still not well understood by the local communities and local institutions who interact with the springs on a daily basis with Sibanda (2005) arguing that very few springs were being utilised under permit in Zimbabwe. The Environmental Management Agency is as key institution that was created by the Environmental Management Act of 2002 to protect and manage Zimbabwe's natural resources on behalf of the government. Most authors contributing to the debate on spring utilisation, for example, Marambanyika and Beckedahl (2016), Dixon (2003), Dermana and Hellum (2007) and Whitlow (1990) continue to advocate for the utilisation of spring wetlands to sustain rural livelihoods. They call for utilisation in a manner that balances households' right to a livelihood and sustenance of natural ecosystem services provided by the springs. Further studies on spring waterscapes are, therefore, justified due to the outstanding questions and contemporary concerns about their utilisation in supporting rural livelihoods and the lack of conclusive empirical data on the environmental consequences of this utilisation.

1.3 The problem

Springs create waterscapes of fragile ecosystems which require careful management if they are to continue providing their range of functions and benefits to the environment and local communities (Frenken and Mharapara, 2002; Dermana and Hellum, 2007; Marambanyika and Beckedahl, 2016). Dixon (2003) observed that in most rural communal areas of eastern and southern Africa, many springs have either dried up while others were shrinking due a multiplicity of factors. Brocx and Semeniuk (2007), observed that as this degradation continues, it comes with implications such as loss of livelihood options for local communities and also loss of important biological and geological diversity. Due to shortages of both domestic and productive water supplies in many communal areas of the semi-arid parts of Zimbabwe (Davies and Burgess, 2015), springs have become a key resource providing reliable water supplies. Comprehensive knowledge on utilisation and how communities have constructed their livelihoods around spring waterscapes becomes a prerequisite for their informed management especially for rural communities with perennial water shortages (Lannas and Turpie, 2009). In Zimbabwe there is a paucity of literature with a deep understanding of the country's springs (especially their social aspects). Studies from other countries show that understanding of the social context of springs as well as organised spring utilisation and

management can make a considerable contribution to the socio-economic transformation of people living in the poorer and water stressed rural communities of a country (Tshibalo, 2011) by offering economic alternatives to traditional subsistence agriculture (Nkuna, et al. 2014). Also limited in literature is an in depth understanding of rural communities' perspectives on access and utilisation of springs to sustain their livelihoods in the context of both internal and external variables such as cultural and traditional norms, legislation and climatic variability. Equally lacking, is an in-depth understanding of the institutional challenges in the utilisation and management of springs by rural communities in Zimbabwe. Any utilisation and conservation plans for springs in Zimbabwe aimed at improving rural livelihoods designed from this inadequate knowledge and understanding of springs are likely to yield limited results.

In Zimbabwe springs as natural capital were generally overlooked in matters of management and little is known about how they are being conserved and managed over time, hence the need for a study that investigates the utilisation and conservation of springs as well as threats to their sustainability. This study seeks to contribute to knowledge on the utilisation of springs that can bring about socio-economic transformation that is institutionally, socially and economically sustainable and able to produce genuinely positive livelihoods in Zimbabwe.

1.4 Aim and specific objectives

The research aims at investigating access, utilisation and conservation of springs and their impact on rural livelihoods in the Save Catchment of Zimbabwe.

The research specifically aims:

1. To determine the utilisation of springs and how they have contributed to rural livelihoods in the Save Catchment.
2. To investigate the management and key threats to springs on the Save Catchment.
3. To examine the institutions influencing access to and utilisation of springs on the Save Catchment.

1.5 Research questions

1. How are springs being utilised and to what extent do they contribute to the sustainability of rural livelihood strategies on the Save Catchment?

2. How are springs being managed and what challenges do rural communities in the Save Catchment face in their management?

3. How do institutional factors influence the access, utilisation and management of springs on the Save Catchment?

1.6 Conceptual pivot

To help conceptualise the research problem, the sustainable livelihoods framework was adopted as advocated for by the Department for International Development (DFID), (1999). In the research, the sustainable livelihoods framework was used to connect the utilisation of springs by rural communities in the Save Catchment to their contribution to rural livelihood outcomes in the context of inter-connected capital domains, vulnerability context and transforming institutions. As observed by Carney (1998), the framework offers ways of assessing how organisations, policies, institutions and cultural norms shape livelihoods, both by determining who gains access to which type of asset and defining what range of livelihood strategies are open and attractive to communities. The categories in the sustainable livelihoods framework were also used to guide data collection and analysis in the research.

The sustainable livelihoods framework was also adopted in the study because it provided an analytical framework that promoted the systematic analysis of the underlying processes that link spring utilisation with rural livelihood outcomes. The framework also permitted the merging of different approaches in understanding various issues, and how these issues shaped the livelihoods of the rural poor as advocated for by (Mazibuko, 2013). Most importantly, the framework provided an opportunity for the researcher to actively involve local people in the research, particularly through in-depth interviews, questionnaires and participatory impact assessments.

In the study, the sustainable livelihoods framework guided the research the on the type of data which needed to be collected in order to understand livelihoods supported by springs in the Save Catchment. On the other hand, the socio-hydrological approach as propounded by Di Baldassarre et al. (2015) informed the methodological approach used in the collection of data. Socio-hydrology advocates for a multi-disciplinary approach in the study of water issues and adopts both the natural science and humanist research methods.

1.7 Rationale

Very little is known about the effect of lack of access to spring water on rural community survival and livelihoods in water stressed places of the Global South. As noted in Marambanyika and Beckedahl (2016), a deeper understanding of the circumstances under which springs become critical to the survival and sustainability of rural community livelihoods in water scarce parts of Zimbabwe is little known. It is therefore, important that studies be carried out to improve our understanding of the rural livelihoods developed around springs in Zimbabwe. Nkuna et al. (2014) argued that springs were generally overlooked in issues of management and protection and little is known about how they were being conserved and managed were they occur. This study therefore becomes key because it investigates the utilisation and conservation of springs as well as threats to their sustainability. The study is also necessary because it gives a detailed appreciation of spring waterscapes in Zimbabwe which may help in improving the quality of life of communities that have constructed their livelihoods around springs.

A challenge, remains whether the development and exploitation of rural springs for various uses can effect substantial socio-economic transformation in areas that they occur. The research therefore seeks to unravel the circumstances under which springs become a key natural asset supporting rural livelihoods as well as the social arrangements impacting on access and utilisation of springs. The research will also show the extent to which the institutional arrangements are a key component to the sustainable development of livelihoods by communities living around springs in the Save catchment of Zimbabwe.

1.8 Thesis outline

Chapter 1: Orientation to the study

This chapter presents introductory issues in order to provide a contextual background to the research and insights into the main research theme. Consequently, the research questions, problem statement, aim, objectives and the rationale of study are outlined. The chapter concludes by outlining coherently, the thematic structure and arguments of the research.

Chapter 2: Literature review

This chapter discusses bodies of relevant and contemporary scholarly literature that focuses on spring utilisation and their contribution to rural livelihood sustainability. The chapter also explores the debates around spring utilisation and changes that have occurred in their study as

well as an analysis of institutions that are involved in the management of springs in Zimbabwe in terms of their influences and weaknesses. The convergences and divergences observed in literature on the main themes are also discussed in this chapter.

Chapter 3: Conceptual framework

This chapter shows the focus and lens through which the problem was conceptualised and linkages investigated. It is concerned with the underlining theoretical perspectives that try to explain the existence of the research problem. The chapter details the sustainable livelihoods framework as adopted in the study, why it was adopted and how it informed the study. A critique of the framework is also done and modifications implemented.

Chapter 4: Study Area

This chapter gives a detailed description of the physical and anthropogenic characteristics of the Save Catchment in order to give the context in which spring utilisation and associated challenges are occurring.

Chapter 5: Methodology

This chapter gives insights into the research design and methods that were used in the study to answer the research questions. The chapter details the tools, sampling procedures and methods that were used in the data collection process and the reasons these were the best to use. The chapter also summarises the methods that were used in the data analysis and presentation process.

Chapter 6: Utilisation of spring waterscapes and rural livelihoods in the Save Catchment

The chapter gives detailed insights into how rural communities in the Save Catchment were utilising springs as well as how they have shaped their livelihoods around springs. The extent to which springs were important in sustaining rural livelihoods as well as how access and exclusion to springs were enforced is also analysed in the chapter. The chapter also gives a detailed analysis of the demographic profile of participants in the research.

Chapter 7: Management and threats to spring waterscapes

The chapter investigates the management of springs and the key threats that they are facing on the Save Catchment. In particular, it analyses the state of springs, practices degrading springs, management challenges facing springs and how the community can overcome them.

Chapter 8: Institutional framework in spring waterscape livelihood development

This chapter examines the key institutions influencing access and utilisation of springs on the Save Catchment. The role played by each institution and the frequency with which each institution takes part in spring management was analysed.

Chapter 9: Conclusion and Recommendations

This chapter provided a synopsis of the research and how it was done. It also highlights the main findings of the research and their possible impact on the study area. Recommendations and concluding remarks are also made in this chapter.

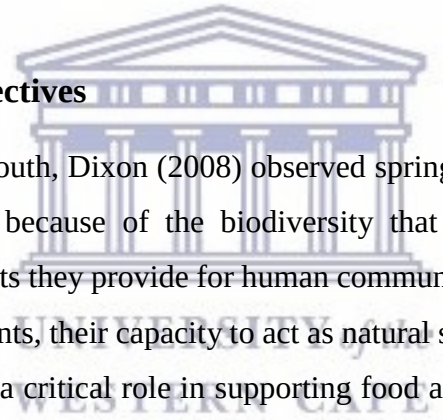
1.9 Chapter summary

The chapter gave a background to the research problem including the major debates around the utilisation of spring waterscapes, presented the research questions, objectives and statement of the problem. It also introduced and rationalised the conceptual framework that informed the research. The chapter looked at the spring waterscape question which explored the conceptual debates around issues of access, utilisation and conservation of springs in relation to the livelihoods and ecosystem services that they support. The aim of the research was also presented in the chapter and it aimed at investigating the issues of access, utilisation and conservation of springs and their impact on the livelihoods of the rural communities of the Save Catchment in Zimbabwe. In conceptualising the research problem, the sustainable livelihoods framework was adopted. The sustainable livelihoods framework was used to connect the utilisation of springs by rural communities in the Save Catchment to the contribution that they made to rural livelihoods outcomes in the context of inter-connected capital domains, vulnerability context and transforming institutions. The research outcomes were noted in this chapter to help improve our understanding of how rural communities constructed their livelihoods around springs in water scarce communal areas of Zimbabwe. The chapter ended by giving a synopsis of the outline on the entire thesis from chapter 1 to chapter 9.

CHAPTER 2 : LITERATURE REVIEW

2.0 Introduction

The goal of the chapter is to critically review both published and grey literature that addresses the major debates around trends in spring studies, multiple functionality, utilisation and management of springs, the importance of springs to the sustainability of rural livelihoods and the methodological approaches in the study of springs. Divergences and convergences in the literature will also be noted in the chapter. The chapter also analyses the role of institutions in the management and governance of water resources in Zimbabwe in general and specifically those having an influence on the access and utilisation of springs. Issues of property, the legal framework and multiple institutional involvement in water resources management with a bias towards springs are also analysed in the chapter.



2.1 Springs: Global perspectives

In many parts of the Global South, Dixon (2008) observed springs and related waterscapes to be important natural capital because of the biodiversity that they support, the range of functions, services and products they provide for human communities and the environment. In dry and sub-humid environments, their capacity to act as natural sources of good quality water means that springs often play a critical role in supporting food and livelihood security (Sada, et al. 2001). In Nepal, the International Centre for Integrated Mountain Development (ICIMOD) (2015) observed springs to be the life blood of the hamlets in mountainous area, but many were drying up, threatening a whole way of life of local communities. Wood et al. (2008) noted that the increasing reliance on springs for food production has prompted concerns regarding the environmental sustainability of their use, and the effectiveness of existing spring management strategies to continue providing the range of functions and benefits in the long-term.

In Zimbabwe, the National Water Policy (2013) declares water to be an important catalyst in sustaining life and the economy. The policy also affirms that the capacity of land to support an increasing population will in future be constrained by limited availability of water. The projected future water shortages will, therefore, limit agricultural, industrial, mining, and urban

development and will be a defining factor in rural poverty reduction and livelihood sustainability in Zimbabwe.

ICIMOD, (2015) defines a spring as a natural outflow of groundwater that may create a lotic, lentic or wetland environment. Springs occur where the geology allows natural outflow of groundwater to the surface of the Earth. Springs therefore, form an important link connecting the underground and the surface water circulation systems. Bascik et al. (2009) saw springs as being like a key hole that allowed hydrologists to have an in depth look into the groundwater circulation system, to gain the knowledge of this system and to prepare for its possible multi-dimensional utilisation. Springer and Stevens (2009) argue that at their point of origin, the geological structure of the place determines the extent to which springs can support human populations and large arrays of aquatic, wetland and terrestrial plant and animal species. As such, Eggenkamp and Marques et al. (2013) observed springs to have always been highly valued by human society.

Numerous processes have been observed to work either individually or in combination to determine the type and form of springs that occur at a certain place (Alfaro and Wallace, 1994; Chinnasamy and Prathapar, 2016). In most cases however, no single process can be observed to be responsible for the resultant spring waterscape, but the dominant force, whether thermal, chemical, or structural can often be recognised, hence, can be used as a characteristic for their classification. Fetter (1994) posits that since Meinzer's classification of springs in 1927, the classification of springs has improved as our understanding of their origin and our scientific knowledge of springs has increased. Currently, a cocktail of different classifications have been developed that concentrate on one or more specific characteristics such as size, mineral content, or temperature, tectonic conditions, geologic, flow rate and according to the origin of the water (Mahamuni and Kulkarni, 2012).

Historically, Alfaro and Wallace, (1994) highlight that prior to the 17th century, classification of springs was mainly an unwritten recitation of the location, taste, temperature, size and drinkability spring water. In the early 1900s, the documentation and classification of springs by scientists worldwide began with much of this early work being done by government agencies, such as, the United States (US) Geological Survey. The main criteria used by these government agencies were mainly the origin, rock structure or geologic setting, size or discharge rate, temperature, and variability of the flow rate of springs.

Mahamuni and Kulkarni (2012) observed current and contemporary spring classification systems as being based on much of the early classification systems. This is because many of the current classification systems borrow heavily from the works of Bryan (1919) and Meinzer (1923) but refine or expand portions of these works based on modern knowledge and quantification of springs. Distinctively, Chinnasamy and Prathapar (2016) maintain the current classification of the springs as having become more of an inventory of the springs. In this inventory, database information on location, ownership, water use, geology at origin, topographic, rock type, physical and chemical analyses, comments, and references are provided.

Ward and Tockner (2001) posit that springs occur at the interface between groundwater, surface water and terrestrial ecosystems, and as such they constitute a unique three-way ecotone. In particular, ecotones often comprise of substantial biodiversity values, including a varied mixture of cosmopolitan and endemic flora and fauna, and a range of ecosystem functions peculiar to that ecotone (Scarsbrook et al. 2007). The biodiversity values associated with springs are well recognised and often support a highly diverse community of animals and plants, and in some cases the biota may also exhibit high proportions of endemism (Witt et al. 2006). Given their distinct physico-chemical and biological properties, springs were also described by Odum (1957), as rich natural laboratories for ecological studies. Thus spring waterscape macro-vertebrates and riparian vegetation have been advocated for and used as valuable and cheap indicators of groundwater quality without the need for costly drilling operations. Cantonati and Ortler (1998), observed new techniques for monitoring spring water quality by means of observing present spring fauna and flora to have been developed and adopted the world over.

The observation of spring fauna and flora known as biomonitoring is a product of the assumption that the presence, reaction and type of biota can give substantial information about the health of the environment in which they live (Bonada et al. 2006). Biomonitoring uses resident biota such as plants, animals and microorganisms to evaluate effects caused by natural and anthropogenic stress on aquatic ecosystems. Stressed water bodies as highlighted by Rosenberg and Resh (1993) are often dominated by tolerant organisms with corresponding reduction in the number of sensitive ones. Biomonitoring uses the health or responses of biological organisms to evaluate changes in the environment that could provide indications of environmental stress, hence the need for remedial actions in stressed environments (Chutter,

1998). For example, the Dragonfly Biotic Index (DBI) has been developed for prioritising and assessing wetland conditions for conservation purposes (Simaika and Samways, 2009). In South Africa, the South African Scoring System (SASS) was developed by Chutter (1998) and modified by Dickens et al. (2002) as a fast and cost-effective method of assessing wetland health. SASS has become the backbone for the rapid bio-assessment of wetlands in South Africa and has been widely adopted in other Southern African countries such as Zimbabwe, Zambia and Mozambique. Under SASS, macro invertebrate families' scores range from 1 to 15 in increasing order of their sensitivity to water quality changes. The results are then conveyed both as an index score and as an average score per documented taxon value.

Olivier et al. (2008) in their study of the physical and chemical characteristics of thermal springs in the Limpopo province of South Africa, observed that optimal use of a thermal spring was largely dependent upon its physical and chemical characteristics. These characteristics define whether their full economic potential can be realised in a sustainable manner. Olivier et al. (2008) recommended the strict monitoring of concentrations of fluoride and other potentially harmful elements to be mandatory whenever thermal spring water is used for bottling, domestic or full-contact recreational purposes.

Springs can also be seen as environmental islands that enrich the surrounding natural and cultural landscape with distinct qualities. These qualities include the production of waterscapes of religious significance, healing and medicinal properties, provision of unique habitats for endemic species and ecosystems services that support livelihoods of nearby communities (Bascik et al. 2009; Boekstein, 2014; Dixon, 2008). Mariolakos (1998) observed springs to function as landscapes of unique cultural and heritage importance as evidenced by the names given to them and their linkage with local popular traditions and beliefs as far back as Greek mythology. Such traditions have also been sustained in Christianity (Ball, 2004) and some springs have been associated with holy persons or numerous supernatural properties, for example, the St. Vincent Kadlubek spring in south-central Poland (Chełmicki et al. 2011). Bascik et al. (2009) argue that the cultural significance of springs has been the major driving force behind the first attempts to their conservation and protection from over-use or modification. They observed that in the spiritual dogma of clans and societies, some springs were considered to be sacred and untouchable which facilitated their survival undamaged over time.

In Poland, for example, Brocx and Semeniuk (2007) maintain that in some cases springs were acknowledged to be part of natural and cultural landscapes necessitating protection of their aesthetic qualities and as geoheritage sites. Bétard (2016) observed the concepts of geoheritage as being adopted from concepts of the word heritage, which imply something that has been passed on from the past generations, or has been handed down by tradition. Geoheritage conservation, as observed in literature, is an important component of geoconservation which has been driven by the need to conserve geodiversity (Raharimahefa, 2012). Inspired by experiences in biological conservation, Bétard (2016) proposed a new conceptual and methodological framework for the identification of geoconservation priorities by theorising and applying the concept of 'geodiversity hotspot'. The concept would then provide the framework within which geodiversity would be managed and conserved. Drawing parallels with the 'biodiversity hotspot' concept first introduced in 1988 by the British ecologist Norman Myers, geodiversity hotspots are defined as geographic areas that harbour very high levels of geodiversity while being threatened by human activities (Brocx and Semeniuk 2007). Raharimahefa (2012) and Bétard (2016) highlighted the main components of geodiversity to be geoheritage diversity, hydrodiversity (e.g. springs, rivers, lakes), geological diversity (e.g. rocks, fossils, minerals), geomorphodiversity (e.g. landforms and topography), and pedodiversity (e.g. soils and palaeosoils). Examples from north-eastern Brazil's, Araripe basin have shown that there is an observed spatial congruence that often exists between geodiversity hotspots and biodiversity hotspots, in a region where very high levels of geodiversity overlap exceptional concentrations of endemic species and biodiversity (Bétard, 2016).

However, the hotspot approach in the study of geodiversity like springs is shown in literature as having the risk of neglecting some areas such as 'geodiversity coldspots' which may have other types of conservation value (Bascik et al. 2009). Geodiversity coldspots are areas of significantly low concentration of geodiversity, but does not necessarily imply that they become insignificant to the surrounding landscape. A good example would be places of low spring concentration but the few springs having a significant impact on both the cultural and ecological landscape. These observations, therefore, reinforce the need to assess geodiversity not only for itself, but also to support biodiversity research and actions programs.

2.2 Trends in spring studies

The importance of springs as the central focus in the study of hydrology has shifted significantly over the years. Conceptually, Kamp (1995) observed that the origins and nature of springs were the leading questions in the chronological development of hydrogeology as a science. From the seventeenth century until quite lately, springs constituted a high-priority theme in hydrogeology due to their importance as sources of high quality water that was important in the sustenance of human communities and the environment. However, in recent decades, hydrogeology moved its emphasis to studies of groundwater pollution and attention on springs and groundwater flow systems was greatly reduced. For example, in the classic text on hydrology by Meinzer (1942), the chapter on groundwater contained an extensive discussion of springs whereas in the 1970s and 1980s the much-used book by Freeze and Cherry (1979), springs were barely mentioned. More recently, with the increasing emphasis on the larger environmental and ecological pictures, for example, Gibert (1992), springs were receiving multi-disciplinary attention from hydrogeologists, biologists, ecologists, geographers and anthropologists.

Cudennec and Hubert (2008) observed that in the last 50 years, the world of spring studies had changed dramatically with new methods and new research styles having been introduced, as well as new research philosophies that have changed the way spring problems were being considered. The major changes were mainly due to the increased availability of computing power and global-scale remotely sensed datasets. The increased visibility of research results due to the widespread diffusion of web-based publishing, the increased number of avenues for publication and more research groups working on spring hydrology all over the world were some of the developments that facilitated shifts in the study of springs (IAHS, 2012).

Callow and Boggs (2013) argue that the massive growth in the availability of remotely sensed data was likely to continue to considerably change modelling methodologies. This is because remote sensed datasets are remarkably accurate in directly observing the various constituent variables of the water balance like precipitation, evaporation, snow, ice, soil moisture and terrestrial water storage variations. Donnelly et al. (2013) observed that, remote sensing had developed to be a primary source of observations of land surface hydrological fluxes and state variables. This is particularly true in regions where *in situ* networks were scant or non-existent to reconstruct hydrographs in data-poor environments. Schumann et al. (2009) and Donnelly et al. (2013) have noted that the study of surface hydrology including springs using remote

sensing techniques had advanced significantly with the introduction of NASA's Earth Observing System and other research satellite platforms, and with the development of more sophisticated retrieval algorithms.

Elshafei et al. (2015) have noted the study of springs and related waterscapes to be dominated for some time by two main approaches which are namely the social science and natural science approaches. As discussed in Di Baldassarre et al. (2015) the social science method characteristically involve community surveys, followed by statistical analysis to test hypotheses, culminating in a narrative, a depiction of the state of play of springs in a given place. In the social science approach, Brown (2007), states that controls or cause-effect relationships appear implicitly in the narrative if they exist. It was not common to seek general descriptions, or seek ways to extrapolate to other places under this social science discourse. Mapedza et al. (2012), for example, used the social science approach to unravel the linkages between the livelihood strategies of the rural communities and their environmental impact on the spring wetlands of Zambia. The findings were projected through in-depth interviews and questionnaires.

In this context, interesting methods have been developed to combine the strengths of both qualitative and quantitative data with Troy et al. (2015) observing agent-based modelling as progressively being adopted. These models function by prescribing rules on how individuals or institutions (the agents) interact, and therefore allow heterogeneity to be included. Vogel et al. (2015) noted that this method computes interactions at micro level which leads to observed behaviour at higher levels.

According to Di Baldassarre et al. (2015) the natural science method classically involves development of a concept or a hypothesis (e.g. spring water balance), choosing a set of observable variables, followed by building a numerical model, and its forecast tested against data to test the hypothesis. Bryman (1998), posit that the focus is on discovering cause-effect relationships of the whole system and ultimately on achieving a generalisation, including the ability to generalise to other places. Many of the major improvements in hydrology in the past decades have been grounded on the natural scientific method.

Chinnasamy and Prathapar (2016) observed this natural science approach to be dominated by two main methods which are empirical and analytical. Under empirical methods, pump tests and groundwater monitoring, dyes as tracers and isotopes as tracers are the common methods

of studying springs. Under analytical approaches, spring hydrograph separation, kernel functions, incorporating historic data of multiple parameters, mapping of springs, water budget method, conceptual models and mathematical models are the most adopted procedures of studying spring hydrology. Negi (2002) evaluated relationships between rainfall, physiography, lithology, slope and aspect, land-use practices, vegetation, altitude, soil type, and water yield and quality of twelve Himalayan springs using this approach. Chinnasamy and Prathapar (2016) used mathematical models to study springs in Ozarks forests, Missouri, USA and determined that stream water alternates between source and drain from springs.

The analytical and conceptual advances on the biophysical and social aspects of spring hydrology reached a higher level with the big data revolution. Vogel et al. (2015) noted the big data revolution as having expanded our capability to monitor, store, and access large quantities of data (big data) in near-real time, and in archives. This therefore, meant that vast prospects now existed to unravel patterns, trends, and relationships, especially relating to human behaviour and their interfaces with hydrologic processes. The big data revolution has helped in the integration of both social and natural science methods to improve understanding of water systems. Montanari et al. (2013) promoted this integrated approach by arguing that understanding human-water systems and utilising this understanding toward sustainable management of water required a broadening of hydrologic science to embrace the standpoints of both social and natural scientists, with its associated challenges. Further, Elshafei et al. (2015) highlighted that this was also the rationale behind the launch of the field of socio-hydrology and the new global, decadal initiative of the International Association of the Hydrological Sciences, called *Panta Rhei*: change in hydrology and society. Pande and Savenije (2016), for example, presented a socio-hydrological model that could help to better understand the system dynamics of smallholder farmers in India. They did so by coupling the dynamics of the six main assets of a typical smallholder farmer, water availability, capital, livestock, soil fertility, grazing access, and labour. Van Rees and Reed (2014) in their study of spring wetland loss in Hawaii concluded that spring management was determined by the value society attaches to it and this ultimately influenced land use types and changes in the spring biophysical characteristics. This then makes essential to engage local communities in formulating plans for utilisation, conservation and management of springs. Lannas and Turpie (2009) also observed that the spatio-temporal value attached to springs needed to be understood because it determined its use, contribution to people's livelihood portfolios, conservation and

information that is important in steering decisions that can minimise unsustainable use of springs.

2.3 Socio-hydrological approach

This study adopted the socio-hydrological approach in its methodology as promoted for by Di Baldassarre et al. (2015) who advocated for the multi-disciplinary approach in its study. Socio-hydrology adopts both the natural science and humanist research methods in understanding up-and-coming water issues. Vogel et al. (2015) observed the need for a widening of hydrologic science to address the water problems of the emergent anthropocene and for hydrologic science to embrace the perspectives of both social and natural scientists. Sivapalan et al. (2014) maintain that current approaches to studying water sustainability challenges lacked explanatory and predictive power because of the insufficient handling of the two-way dynamic feedbacks between human and water systems. Montanari *et al.* (2013) and Di Baldassarre et al. (2015) made calls for a transformative new hydrological discipline that combined the multiple standpoints needed for confronting water related challenges and also to obtain richer understanding of coupled human-water system dynamics.

Elshafei et al. (2015) defined socio-hydrology as being a discipline aimed at uncovering the dynamic cross-scale relations and feedbacks between the natural and human processes that may give rise to water sustainability challenges. Baker (2015) observed that socio-hydrology aimed at explaining and understanding socio-hydrologic responses in terms of outcomes relevant to human well-being, and discern possible future scenarios of their evolution. It also aims at understanding the meaning and value of water as a culturally, politically, and economically embodied resource necessary for human life. Socio-hydrology explores the co-evolution and self-organisation of people in the landscape with respect to water availability.

In socio-hydrology, it is necessary to study and represent the connection between water and human interventions more deeply. This is because this connection is one of the main drivers of change and is associated with both sustainable water use and sustainable development (a concept embodied in socio-hydrology), (Sivapalan et al. 2012). To achieve this, interdisciplinary collaboration was needed to develop approaches that represented co-evolving systems in water resources modelling meaningfully (IAHS, 2012).

The launch of socio-hydrology as a new science seeking to unravel the link between people and water was highlighted by Postel (2011) to be well placed because it came at a time when

hydrology continued to dwell on the complexities of processes occurring in uninterrupted places or under idealised conditions. These idealised conditions are the exceptions rather than the rule in the real world, and almost all water bodies are affected by people in one way or another. There is therefore, an urgent need for hydrology to adapt and evolve to cope with the evolving scientific and practical challenges in a shifting world (Wagener, 2010). There is also need to prevent and resolve conflicts between humans and water resources, and amongst humans themselves (Koutsoyiannis, 2011). Socio-hydrology addresses these strongly felt needs.

An important part of understanding socio-hydrologic processes is to understand the way in which water is flowing and why this is so. Figure 2.1 shows the multiple forms of connection between a water system and a target study population of people according to Troy et al. (2015).

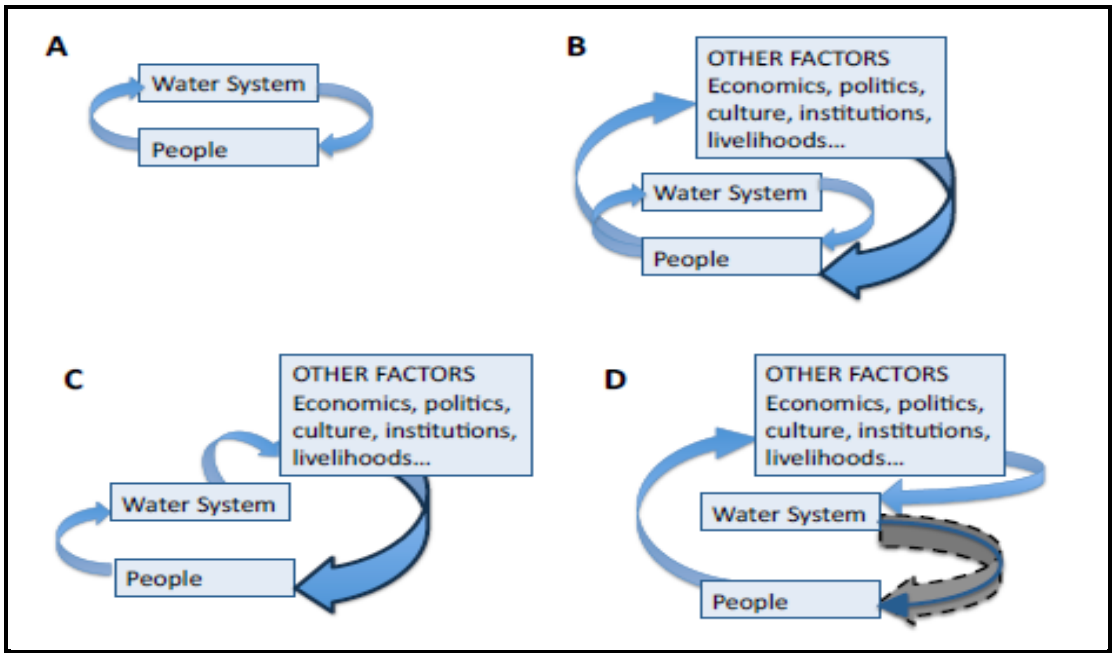


Figure 2.1: Multiple forms of coupling between a water system and people in socio-hydrology

As noted in Figure 2.1, at (a) Troy et al. (2015) observed the water system and the target population to be tightly and directly tied to each other as might arise, for example, subsistence farmers in a water-limited system. At (b), the target population is not only affected by changes in the water system, but also by a host of other issues, meaning that changes to the target population in response to water issues occur slowly. At (c), the effects of water on the target population are indirect and filtered through other institutions, spatial scales and social or environmental systems, meaning that isolating the effects of water from the whole complex

system is difficult, hence a tight connection between water systems and human responses often arises only sporadically. At (d) there is dynamic connectivity often in reaction to a crisis, for critical water scarcity or severe flooding. Socio-hydrology, therefore, treats people as an integral part of the water cycle interacting with the system in multiple ways, including through water consumption for food, energy and drinking water supply, through pollution of freshwater resources, and through policies, markets, and technology (Sivapalan et al. 2012).

Socio-hydrology was postulated by Elshafei et al. (2015) to have four main arms amongst them historical socio-hydrology which can be learnt from reconstructing and studying the past. This includes both the immediate past, and the distant past because water has played a key role in the growth, evolution and eventual collapse of numerous ancient, and contemporary civilisations. The collapse of the Sumerian civilisation was attributed to rising water tables and salinization as a result of extensive irrigation (Ponting, 1991). Interesting patterns of water governance and technologies have also evolved throughout history. For example, Iran saw the development and evolution of 'Qanats', sloping tunnels that tapped into groundwater system without the need for pumping, and have survived the test of time over the millennia.

Comparative socio-hydrology is yet another arm of socio-hydrology which Sivapalan et al. (2012) suggested that instead of attempting to reproduce the response of individual catchments, research should advance comparative hydrology. Comparative hydrology aims to characterise and learn from the similarities and differences between catchments in different places, and interpret these in terms of underlying climate-landscape-human controls. In the context of socio-hydrology, this implies a comparative analysis of human-water interactions across socio-economic gradients, as well as climatic and other gradients, to map any spatial or regional differences back to processes and their temporal dynamics (Peel and Blöschl, 2011).

In process socio-hydrology the interest is to study a small number of human-water systems in more detail, including routine monitoring, to gain more detailed insights into causal relationships. This may involve detailed data collection of the hydrological and sociological processes involved, including real-time learning, to understand human-water system functions in the present to be able to predict possible trajectories in the future (Schaefli et al. 2011).

2.4 Mapping areas of spring occurrence

Groundwater springs are among the most important fresh water resources. They are desired for human and livestock use in many parts of water scarce regions. Corsini et al. (2009) for example, observed that they provided a water back-up system in case of drought and are the main source of water supply during summer in a large number of locations in the Apennines mountains of Italy. This is a place where water supply during summer is limited because the residential population is more than doubled by people staying at their holiday houses and also due to the growing tourism, industry and global climate change. Chinnasamy and Prathapar (2016) observed springs to be the lifeblood of rural communities in the Himalayas region of Nepal because they were in most cases the major, source of agricultural and domestic water.

Increasing demand for fresh water extraction in water stressed regions necessitates the exploration of actual and potential groundwater spring areas. As noted by Zandi et al. (2016), the conservation and management aspects of springs which can be considered to be important in development planning can only be well executed when location and potential areas for spring location can be mapped. Ozdemir (2011) pointed out that groundwater spring potential maps provided useful information to government and local development planners in selecting suitable areas for implementing development schemes for the benefit of local communities. Zandi et al. (2016) have also observed assessment of spring occurrence potential to be a major subject for the authorities responsible for water resource management, regional land-use planning and environmental protection for sustainable development. Potential maps of groundwater springs also reduce the costs of horizontal wells drilling and can allow zoning of areas in which groundwater can be reached with minimal effort, allowing for the identification of new springs that can provide water backup in case of drought (Pourtaghi and Pourghasemi, 2014). The location of groundwater spring potential zones was identified by ICIMOD (2015) as an important tool for performing successful groundwater determination, protection, and management programs.

Taylor et al. (1995), highlighted, Southern African spring waterscapes as being some of the most diverse, both physically and biologically, in the world and possessed multiple values. They noted inventories of spring resources to be required in order to establish baseline data on their area, distribution, seasonality, characteristics and values, before rational management plans can be designed. Information concerning the distribution and status of spring waterscapes

in a country would greatly assist those concerned with wise use of natural resources to reach balanced decisions about their exploitation and conservation.

Examples where mapping of springs resulted in improved management of the resource include; as noted by Chinnasamy and Prathapar (2016), the Sikkim government producing a spring atlas and manuals for the Sikkim part of the Himalayan region. The maps demarcate spring recharge areas and spring shed boundaries to improve landcover/landuse change which might impact on spring flow rates. Mahamuni and Kulkarni, (2012) produced maps of the Himalayan springs and inferred site-specific relationships between springs and recharge areas. The study also indicated the characterisation of the springs while aiding in recharge area protection. They advised consultations with locals during both the dry and monsoon seasons to identify seasonal or perennial springs.

Shahid et al. (2000) posit that the occurrence of groundwater at any place on the earth was not random or accidental but a result of the interaction of the climatic, geological, hydrological, physiographical, and ecological factors. They maintain that the movement of groundwater was controlled by porosity and permeability of the surface and underlying lithology. Ozdemir (2011) also observed the occurrence and movement of groundwater to be determined using a cocktail of factors, such as the topography, lithology, geological structures, fracture density, aperture and connectivity, secondary porosity, and the interrelationships among these factors.

As noted in Ozdemir (2011), some conventional methods have been successfully used for preparing spring potential maps and are mainly based on ground or field surveys. However after the rise of remote sensing and geographic information systems technologies, they have become the standard procedure to map groundwater spring potential zones (Ganapuram et al. 2009). Singh and Prakash (2003) posit the conventional approaches to spring exploration using geological, hydrogeological and geophysical methods to involve high budgets and are uneconomical due to high cost of drilling and time consuming investigation. In addition, these methods of surveys do not always account for the diverse factors that control the occurrence and movement of spring water (Oh et al. 2011). Remote sensing and geographic information systems techniques have become popular due to several advantages of spatial and spectral data, having access to large coverage and inaccessible areas with regular revisit capability and ability to be combined with other spatial analysis statistical methods (Hoffman and Sander, 2007). In addition, when data are limited, Chinnasamy and Prathapar (2016), observed satellite remote sensing techniques to have been used to develop datasets at sub-basin and basin scales.

Meijerink (2000) observed remote sensing techniques to have a high ratio of benefit to cost and availability of data in different wavelength ranges of the electromagnetic spectrum. Through digital image processing of the remotely sensed satellite images, the controlling features of groundwater can be identified accurately. Satellite data provide quick and useful baseline information about the factors controlling the occurrence and movement of groundwater like geology, lithology, geomorphology, soils, land use/cover, drainage patterns and lineaments.

According to Hoffman and Sander (2007), use of the remote sensing techniques has been proven to be very cost-effective in prospecting and preliminary surveys. They maintain that remote sensing cannot and will never replace information gathered from the field surveys. Jha, et al. (2007) concluded that remote sensing becomes a very handy tool in exploring, evaluating, and managing vital groundwater resources which helps minimise the amount of field data collection. However, it is still essential to verify the accuracy of remote sensing data and their interpretation by validation of noted phenomena in the field. Chowdhury et al. (2009) found the combination of remote sensing, geographical information system (GIS), and global positioning system to be efficient techniques for spring water exploration and management.

Corsini et al. (2009) used spatial analysis methods for modelling potential for groundwater springs in northern Italy. The authors identified a statistical relationship between determined springs locations and their effective influencing factors. Their results prove the efficiency of geostatistical methods like the weighting evidences and artificial neural network in predicting the occurrence of groundwater springs. In another study, Ozdemir (2011) identified potential groundwater spring areas using logistic regression in a GIS environment, in the Soltan watershed, Turkey. Seventeen different factors deemed influential to spring occurrences were used in the analysis. Results showed that the accuracy of the created map using area under ROC curve was 82%.

2.5 Spring conservation and management

While spring research, especially on their hydrology, classification, physical and chemical characteristics has recently tended to gain in popularity, the number of publications on strategies for spring conservation and their impact on rural livelihood sustainability remains relatively limited (Chełmicki et al. 2011). This is because hydrologists spearhead most of these works and their focus and approach to springs is mainly informed by the natural science approach (Chinnasamy and Prathapar, 2016) . Literature on spring hydrology mostly covers

karst springs particularly valuable mineral springs. This, as argued by Kresic and Stevanovic (2010), is understandable because they support high discharge flow rates and, as such, the springs were normally used as a source of drinking water as well as for agriculture and power generation. The economic value of springs, translates to only the largest springs being afforded some level of protection by the law. However, large springs are rare features in the landscape of many places of the world, and most are small and inconspicuous, hence liable to degradation (Marambanyika and Beckedahl, 2016) because they are rarely protected yet over utilised.

Bétard (2016) observed in the study of springs, the risk of neglecting some areas of low spring concentration which he termed "hydro-diversity coldspots" in favour of hotspots yet they may have other types of conservation value such as being *Small Natural Features*. Thondhlana et al. (2012) highlighted that in most cases, it was the larger spring waterscapes with a capacity to support diversified functions and services that were of significant value to policy makers. Hence, in most areas of the Global South, they argued that spring wetlands were partly lost because their full value to society was not taken into account in the planning process for both development and conservation. In East Africa, Sakana, et al. (2013) observed spring wetlands to cover an estimated 3–5% of the total land area but were generally small in size, rarely exceeding 20 hectares. They maintain that these springs could support diverse livelihoods of rural communities who could access and use them particularly in the water stressed portions of East Africa. Sakana, et al. (2013) also noted spring water use for crop production to have increased as a direct response to rainfall and food shortages in East Africa. They also posit spring wetland use to have extended to the wetter highland areas that increasingly experienced land shortages and good market opportunities.

Initiatives to conserve and manage springs at a global and regional level are still relatively weak. Von Der Heyden and New (2003) credited this to underrating of functions and services that they delivered and also the subsequent spring waterscapes conditions that presented certain challenges such as being breeding grounds for disease transmitting insects like mosquitos. Spring waterscapes end up being regarded as wastelands not worthy of any management initiatives, hence their rapid rate of degradation. Springs as observed in Kozina (2008) were also not registered on the unique natural feature category of the World Heritage List. The landscapes closest to springs listed among the categories of the World Heritage List were karst and fluvial systems. There are also very few nature reserves or national parks worldwide where springs constitute the main features being protected. Bascik et al. (2009) noted the example of

Northern Florida which is unique for its large number of spectacular karst springs. With approximately 600 springs, it ranks as one of those areas with the utmost concentration of this landscape anywhere in the world. The main focus of conservation of springs to date has been principally the preservation of biota, particularly rare and endangered species (Withers and Horwitz, 1996).

Knüppe (2011) surmised the general failures of current spring water and general groundwater conservation globally, and the hurdles to be overcome as being the fact that the intensive utilisation of spring water assets was of fairly recent origin, dating back to less than half a century in most countries. This situation has led the institutional setting involving utilisation of groundwater resources under most management systems to be greatly disjointed. This institutional disjoint is evidenced by sectoral strategies and planning processes being developed in isolation with collaboration between water managers, scientists, the private sector and the public hardly in effect or were at an early stage in their development. Von Der Heyden and New (2003) argue that surface and groundwater resources were being managed independently and were not combined in an integrated water management approach within the context of the overall hydrological cycle. They maintain that the invisible nature of groundwater makes understanding of the resource features like geological and hydrogeological settings difficult to construct, thus requiring much more sampling which is both pricey and cumbersome.

Brocx and Semeniuk (2007) argued that conservation, should be concerned with more than just protection of biodiversity, but should also embrace the range of natural history features such as purely biological phenomena of scientific and heritage value, such as rare and endangered species, or representative communities. Bétard (2016) argues for the study of features combining biota and geology, geomorphology, pedology and hydrology fundamentally linking biodiversity with geodiversity and purely physical (i.e., non-biological) aspects of scientific and heritage worth, such as unusual or representative springs, rock and landscape formations.

Spring conservation, as noted by Brocx and Semeniuk (2007) is part of geo-conservation which is concerned with the preservation of Earth Science features, such as landforms, natural and artificial exposures of rocks. Globally, it has become important because it has been recognised that Earth features like springs had a story to tell. This is because they were linked to the unending history of human development, providing the resources for development, a sense of place, with cultural, historical, aesthetic and religious values (Chełmicki et al. 2011).

Bascik et al. (2009) observed that several frameworks had been proposed for defining geo-conservation priorities. Amongst several frameworks, for years, geo-conservation had been driven by the need to conserve geodiversity considering the internal or external threats to it, mainly associated with human activities causing damages or irreversible destruction of sites. The main difficulty which arises is in how geo-conservation priorities can be accurately branded at larger scales (e.g., state or regional levels). Encouraged by experiences in biological conservation, a new conceptual and methodological framework for the identification of geo-conservation priorities by theorising and applying the concept of geodiversity hotspots has been suggested. Geo-diversity hotspots can be defined as geographic areas that harbour very high levels of geodiversity while being threatened by human activities (Brocx and Semeniuk, 2007).

As discussed in ICIMOD (2015), when springs are utilised for multiple purposes, precaution should be taken to prevent pollution of water and degradation of the springs. This is because comparing with other sources of water, natural or developed springs are easily polluted by different pollutant agents and are prone to degradation. Marambanyika and Beckedahl (2016) noted effective management and preservation of springs as being important factors in ensuring continual provision of their values and ecosystem services. They also stated the importance of understanding the context in which springs are being conserved at national, regional and individual community level in order to assist in the enhancement of conservation and protection methods.

Throughout the world although there is still limited research on springs and their conservation, there has been a notable rise in the appreciation of the significance of springs. Scarsbrook et al. (2007) highlighted several initiatives that have been implemented to ensure spring protection and sustainable management. Effective management of springs is in principle being achieved by recognising the full range of environmental and societal values linked with spring habitats, understanding threats to the sustainability of these values. Improved appreciation of springs is also being addressed by the framing of strategies that provide a balance between potentially conflicting uses (Sakataka and Namisiko, 2014). Groever et al. (1996) have noted creating a database of springs as an important step towards their effective management. In Germany, the province of Brandenburg has a database containing more than 700 spring sites which was generated after a spring survey. In New Zealand, the Canterbury administrative district database has more than 1 500 springs listed. Conservation processes need a good understanding of the location of springs and their properties. Normally, one of the first steps is

to index information about the location, the natural, scientific, and educational value of each spring of interest, followed by the identification of potential as well as actual threats (Scarsbrook et al. 2007).

According to Bascik et al. (2009), the greatest problem facing spring conservation is possible degradation and contamination of the spring waterscape. Spring cavities are most often damaged when they are built-up or altered for drinking water abstraction. Other frequent reasons for the deterioration of the natural waterscape of springs are: culture-related purposes, agriculture, and road or building construction. Spring contamination is commonly linked to the inappropriate management of the spring catchment, for example, heavy application of chemical fertilizer and use of pit latrines, the littering of the spring and its surroundings. Contamination is also the result of the damage or the alteration of the spring catchment area, as well as extreme interference in the water interactions both near the spring and in its sub-basin (Sakataka and Namisiko, 2014).

As discussed in Chełmicki et al. (2011), the effective protection and management of springs required more than legislation and legal status, the most important factor is education and awareness building within the general public about the objectives of spring management and conservation. Society in general needs to be convinced that natural springs were noteworthy witnesses of water exchange patterns in the ground and within nature as a whole (Scarsbrook et al. 2007). Moreover, people need to understand that springs are good pointers of groundwater quality and quantity. Consequently, the protection and monitoring of springs in their natural form and environment is important not only from a scientific, educational and natural point of view but also of fundamental importance for socio-economic reasons (Barqui and Scarsbrook, 2008).

The conservation of the quality and the quantity of spring water was argued in Poland to be vital in sustaining life supporting services and also economic activity for both current and future generations. This has led to the adoption of the conservationist management approach through the establishment of legal protection status for numerous springs. This was also accompanied by successful educational campaigns by a number of environment protection centres, local authorities, as well as environmental conservation services to build consciousness on the importance of springs as components of natural heritage (Bascik et al. 2009).

In ICIMOD (2015), community management of springs was argued to be a respectable model for managing and conserving rural water supply because of its approval from multiple stakeholders within rural development circles. The idea behind community management of springs is that communities must be intimately involved in the decisions that affect their water supply. Adhikari et al. (2014) highlighted that a well-organised, management structure within communities was essential for this model to succeed and was most often appreciated through the presence of locally elected community water committees. Local water committees preside over local meetings where all decisions dealing with the running of community water are discussed and made.

However, community based management of springs and water points in general have been observed by Harvey (2011) as being not always fruitful in safeguarding the sustainability of water springs. As Harvey (2011) argues, this is because societies were often not suitably prepared for undertaking management activities. Some scholars have argued that the philosophies of community based management, as normally applied in sub-Saharan Africa, needed to be re-evaluated so that institutional support for societies is established and that support to societies needs to be ongoing if the model is to succeed. Whittington et al. (2009) observed consistent monitoring visits by a supervising institution to be an effective way of sustaining communities' readiness to effective spring management. They argue that the visits would provide inspiration, motivation, monitoring and evaluation, participatory planning, capacity-building, specialist technical assistance and financial support when required. Harvey, (2011) observed monitoring and evaluation to be of key importance because any weaknesses in community based management and participation system needs to be recognised and addressed on time.

In Zimbabwe, Kjeldsen et al. (1999) observed that limited information on the spring water resource system and related socio-economic data combined were some of the key barriers to the effective management and conservation of springs. Marambanyika and Beckedahl (2016) argued that the laws were vague when it came to spring protection and that only larger springs were afforded some level of protection. Scarsbrook et al. (2007) posit that conservation and protection of smaller springs largely depended on the motivation of the landowner or the user community.

2.6 Spring management planning

Recognition of springs as part of geo-diversity is an essential step for their management and protection (Brocx and Semeniuk, 2007). This is because groundwater abstraction and consumptive use, as well as land use practices that affect aquifer quality, are key threats to the integrity of spring habitats and services that they support (Sakataka and Namisiko, 2014). However, effective management of springs needs to recognise the full range of environmental and societal values associated with them, understanding threats to the sustainability of these values and formulating strategies that provide a balance between possible conflicting uses (Bascik et al. 2009). As with any management approach, the clear definition of management objectives for springs is a precursor to successful conservation and rehabilitation (Scarsbrook et al. 2007). The following section is a synoptic review of the best practice principles to follow in spring management, emphasising key components that should form the foundation of rigorous spring management and conservation strategies.

2.6.1 Formation of a spring-working group

Springs constitute a unique three-way ecotone assimilating the environmental characteristics and human impacts connected to groundwater, surface water and terrestrial ecosystems. Human society also often directly relies on springs for water supply. To cater for such a diversity of values, services and uses, Brocx and Semeniuk (2007) highlighted that sustainable management tactics required an all-inclusive approach. This can be achieved only through the cooperation of an interdisciplinary group as advocated for under socio-hydrology.

World Water Forum (2015) recognised the involvement of various institutions in promoting sustainable water resources management including women; indigenous peoples, NGOs; local authorities; business and industry and researchers. Each of these groups represented specific types of institutions which were involved in water governance hence clearly bringing out the fact that water resource management was not a responsibility of one individual or institution. For example, Hartnett (2000) noted that the Florida Springs Task Force was formed by 16 scientists, planners and other citizens. These groups have provided detailed advice on spring conservation and have also assisted in the development of a recovery plan for degraded springs. Spring working groups have also been established in Germany in the states of Bavaria and Nordrhine Westphalia, leading to active spring conservation programmes in some districts (Groever et al. 1996).

2.6.2 Spring location

From literature review carried out in this study, very little is known about the distribution, occurrence and density of springs in Zimbabwe. Mapping is an essential element to informed management and conservation of springs (Zandi et al. 2016). Davies and Burgess (2015) posit, in their study on groundwater in Zimbabwe, that a comprehensive database on the location of groundwater points including springs was essential to achieving sustainable investment and development of the resource. Spring census and mapping has been done in many parts of the world using different methods and at different scales. GIS based methods were commonly used to model catchment scale characteristics that could be used to predict the occurrence and state of springs (Gray and Bay, 2016). GIS based methods also had utility in identifying catchment scale characteristics that were important for determining occurrence and health of springs (Ozdemir, 2011).

In their initial effort to produce a countrywide databank of springs, New Zealand, which has turned out to be a global leader in research on the utilisation, conservation and management of springs, mapped over 530 of them in less than two months (Barqui and Scarsbrook, 2008). Spring locations were obtained through polling of management agency staff and the freshwater science community of New Zealand. Spring mapping surveys have also been carried out at a regional level in Germany (Krueger, 1996). In the district of Gueterlosh (220 km^2), a database of 203 springs was compiled in just over a year (Groever et al. 1996); 700 springs were recorded over three years in Brandenburg (29 000 km^2). These surveys show that springs were an important aquatic habitat within the landscape. Interviews with locals and private landowners are essential in locating springs and thus must be tackled at a regional level (Barqui and Scarsbrook, 2008).

2.6.3 Management priorities and direction

Once biotic and abiotic characteristics of springs have been assessed, Scarsbrook et al. (2007) observed that this information could be used to set management priorities and focus. This means that examining the condition and determining whether a spring needed protection or restoration would influence management responses. Priority should be given to protecting unaltered spring environments and to the restoration of springs with a high potential for recovery (Sada et al. 2001). There are many factors that need to be considered in order to establish management priorities and resource agencies must decide which ones are most appropriate for their region and conservation programmes (Sada and Pohlmann, 2006). In the Mojave Desert, for example, springs have been ranked for both relative value and restoration

priority. Key elements of the ranking system for relative value include the presence of rare aquatic species, spring rarity across the landscape, flow permanence, threats from current human activities, land tenure and conflicting uses. Restoration potential is ranked using similar criteria, but also including spring habitat condition and recoverability, reflecting the physical and biological attributes that would need to be restored for a spring to recover (Scarsbrook et al. 2007).

Davis et al. (2017) highlighted environmental education as being important in understanding the ecological importance of springs in the wider community, hence it is a key process underpinning their conservation. Ebner et al. (2016) observed raising awareness on the ecological and intrinsic value of springs as being important in their sustainable management by communities. This could be achieved by researchers promoting their work through the media and non-scientific literature and by advancing the concept of flagship species that live within specific spring environments.

Spatial analyses which combines the mapping of spring locations with the development of scenarios of future water availability is very important in identifying vulnerable systems. This approach to spring management is necessary to ensure that the balance between environmental, economic and social water needs and allocations is accurately assessed (Davis et al. 2017). The legal status of groundwater aquifers can also have an impact on spring health. In many countries, the interactions between surface and groundwater were poorly embedded in law (Narasimhan, 2009). There are also some complications to such legislation, including conflicting water uses and complicated jurisdictional responsibilities, such as, environmental laws and cross-border issues (Deacon et al. 2007). This therefore underscores the need to harmonise environmental and groundwater legislation so that they are aligned.

Davis et al. (2017) observed successful spring management outcomes to depend on recognising the importance of springs as *Small Natural Features* and then designing diverse management approaches. The may include legal protection, innovative restoration programs and using important social, cultural and economic values that encourage spring conservation. Davis et al. (2017) maintain that springs were recurrently exposed to manifold threats which meant that their conservation would depend on a cocktail of management actions that act synergistically to reduce ongoing stressors. Hunter, (2017) observed that, although a diverse set of tools relevant to spring conservation had emerged at different levels, strategic coordination and ecological coherence was still lacking. This then brings about the need for a coherent

foundation for spring conservation to catalyse cross-fertilization amongst the different types of springs and to unify efforts being made.

2.6.4 Spring monitoring for management interventions

Spring monitoring as is the case for any monitoring programme should be designed for specific management objectives and information needs. Monitoring of springs also needs to include defined reporting procedures that can provide information feedback to underpin additional management responses (Barqui and Scarsbrook, 2008). The initial monitoring strategy of how, when and where should set out to describe the spatial and temporal variability in biotic communities and habitats at scales relevant to the management objectives (Brocx and Semeniuk, 2007).

Chełmicki et al. (2011) observed that one of the most frequently asked management questions regarding spring wetlands was 'if they were being degraded or not?' The facts needed to answer this question require an appreciation of the natural variability observed in spring conditions. Results could then recognise whether prevailing environmental factors were outside the natural range, reflecting unacceptable or degraded conditions, or within the natural range of acceptable variation. Because spring habitats can be delicate to a range of human disturbances and may contain rare, locally endemic species, the frequency and harmfulness of sampling methods used in a monitoring programme need to be cautiously considered (Davis et al. 2017).

The environmental context, for example, the hydrogeology and land use of a given spring should also be cautiously considered when formulating management actions to safeguard, enhance or re-establish ecological integrity of springs and its services (Scarsbrook et al. 2007). For example, fencing and exclusion of animals and livestock from springs may have different effects on springs in different regions. In Germany, for example, cattle exclusion was one of the first methods applied during spring restoration programmes, with the result being re-establishment of natural, woodland vegetation around the springs. In contrast, exclusion of livestock reduced plant diversity and the area of free water in springs of Australia, because of increased proliferations of vegetation biomass of the most competitive herbaceous species like phragmites (Davies et al. 2008). An appropriate management regime needs to take into account the natural condition of a spring with respect to inclusion or exclusion of grazing animals, and the constraints imposed by introduced flora and fauna. A grazing and or non-grazing rotation programme may be the solution for the successful management of spring habitats in arid regions (Fatchen, 2000).

Delineation of the spring recharge zone is also desirable in order to protect spring water quality (Barqui and Scarsbrook, 2008). However, this can be difficult to achieve, as it requires a detailed knowledge of the underlying geology and groundwater flows. Identification of the contributing area helps to identify potential sources of groundwater pollution, and to develop best management practices through local land use planning. Areas adjacent to spring sources, or within their recharge basins, have been acquired as part of restoration programmes in Florida (Hartnett, 2000) and Germany (Groever et al. 1996). This gives a much greater level of protection to springs than that provided by localised springhead protection.

As observed by Sada and Pohlmann (2006), where management objectives required the maintenance, or improvement of spring habitats, springs and their related waterscapes should be protected from activities that reduce biological diversity and impact functional changes. Groundwater abstraction close to the spring source and development around the springhead needs to be prudently managed. Diversions, impoundment or other types of habitat alterations, should be circumvented where necessary and there was a need to stop extracting spring water when it is not needed.

Erman (2002) argued that appropriate native riparian vegetation like woodland vegetation or grasses, should be planted or allowed to grow to restore sediment and nutrient runoff filtering and to stabilise springs. Where there was evidence of negative interactions between native and non-native plants and animals, introduced species required controls specific to these species. Generic treatments such as the application of a broad-spectrum herbicides can have deleterious effects on spring biodiversity and ecosystem functioning. Sada et al. (2001) advocated for methods that minimised impacts such as physical removal, targeting only a small percentage of the habitat during a single treatment, or confining natives where they will be protected from treatment effects.

According to Hartnett (2000), educational programmes can help in enlightening communities to understand the relationship between land use and the quality and quantity of spring water. Thus, a well-coordinated education programme, integrating a variety of educational materials like booklets, pamphlets, brochures, seminars or conferences would help to communicate this understanding and facilitate spring protection.

Restoration efforts, as argued by Ball (2004), needed to be directed at springs that have not been highly modified, or that are unique within a given region. In this regard, spring restoration

programmes will be more effective if a regional database of spring habitats is available and from which the selection of appropriate restoration sites and reference or control sites can be made following priority setting exercises (Scarsbrook et al. 2007).

2.7 Spring utilisation, management and rural livelihoods in Zimbabwe and Southern Africa

Literature that directly addresses springs is limited in Zimbabwe. Most literature indirectly addressed springs by studying their resulting waterscapes, hence this section will include literature on both springs and their resulting wetlands. Chirau et al. (2014) posit springs to be important in Zimbabwe from a number of dimensions but the most important being that Zimbabwe is a sub-humid country and relatively water stressed. Springs therefore function as storage for dry season supply of water for communities and the environment. They highlighted spring sites to be generally small in extent, hence greatly vulnerable to degradation. Springs are also extensively distributed in Zimbabwe and if well managed, their prospect for expanded utilisation was big. Matiza (1992) observed Zimbabwe to be generally lacking in fish protein, hence springs could potentially support aquaculture which can potentially increase fish production. Svotwa et al. (2008), highlighted that most parts of Zimbabwe were vulnerable to drought occurrence. Spring waterscapes greatly assist in mitigating this risk and were also an important source of water for wildlife particularly in national parks located in water scarce regions like Mana Pools, Hwange and Gonarezhou.

As stated in Chuma et al. (2012) the potential of springs to contribute to rural livelihood sustainability was closely related to their ability to maintain ecosystem functions which are a consequence of their unique hydrological characteristics. This then underlines the need to strike a balance between conservation and the productive use of springs. Utilisation of springs and related wetlands in Zimbabwe's rural communities comes in the form of direct consumptive and indirect usage. Under direct consumptive use, Matiza (1992) observed springs as providing food security safe nets through provision of water all year that could be utilised to support agricultural activities. As postulated by Svotwa et al. (2008), Zimbabwe has a well-established traditional agricultural practice based on spring waterscapes, which contributes significantly to both inter and intra household food security. Major crops grown on spring waterscapes are vegetables and other horticultural product, maize, livingstone potatoe (*Plectranthus esculentus*,

known locally as *tsenza* which is an edible tuber) and taro (*Colocasia esculenta*, known locally as *madhumbe)*.

As discussed in Marambanyika and Beckedahl (2016), spring water is also utilised for domestic purposes, such as, for cooking, bathing and drinking in addition to other livelihood strategies like watering of livestock. Spring water was also used for religions purposes and healing of numerous ailments, especially hot springs (Tshibalo, 2011). Chirau et al. (2014) highlighted that springs also supported ecosystems that provided important services to rural communities and sustained their livelihoods. These services included provision of reeds for making craft, tourism which brought income to communities, provision of medicinal plants and other fruit plants that could be sold or consumed to help improve family nutrition. Sakana et al. (2013) observed that in areas greatly reliant on natural resources, especially many parts of sub-Saharan Africa, direct use of spring wetlands for cultivation, grazing and aquaculture was widespread. These activities are at the core of livelihood strategies of the predominantly subsistence rural communities in these areas and, as such, were blameable for the degradation of this precious natural resource.

Rebelo et al. (2009) stated the differences in livelihood strategies supported by springs between pastoral and permanently settled communities in the semi-arid region of Southern Africa. They found livestock grazing on spring waterscapes to be of more importance to pastoral communities while the intensive production of cash crops like vegetables dominated the waterscapes of permanently settled communities. They attributed this observed heterogeneity to the multiplicity of biophysical, socio-economic and cultural environments in which the different users operated. Rebelo et al. (2009) also postulated the different spring livelihood strategies to result from the variability in production objectives and resource availability of individual user households in addition to their access to land resources, markets and institutions, even under similar agro-ecological conditions.

In Zimbabwe, research has reviewed that spring waterscape utilisation was highly intensive to semi intensive (Matiza, 1992) in over 90% of the observed cases (Derman et al. 2007). As highlighted in Svotwa et al. (2008), intensive spring waterscape use meant non-stop utilisation of the resource with one crop being grown after the other all year round. Semi intensive use meant using the resource but leaving it uncultivated for a short time, usually for moisture recovery. Since utilisation of springs contributes to rural livelihoods in Zimbabwe in terms of both direct cash income and food security (Rebelo, 2009), it is therefore, improbable that

further development of springs to support rural livelihoods can be stopped when viable substitute livelihood opportunities are lacking.

Marambanyika and Beckedahl, (2016) have observed effective management and conservation of springs as being important factors in ensuring continual provision of their goods and services. They also observed the importance of appreciating the context in which springs were being conserved at national, regional and individual community level. This appreciation would help in formulating effective spring management and protection methods. In the past, there was little pressure to utilise springs and related wetlands in Zimbabwe. This was because of the availability of relatively higher and reliable rainfall that could support dryland farming. It was also due to the fact that rural households had reasonably good support from the government and non-governmental organisations (NGOs) (Bromley et al. 1999).

The populist and socialist government was by then also buttressed by good economic performance which permitted investment in communal agriculture. The situation started to change in the 1990s when new neo-liberal policies resulted in severe economic difficulties and, as noted by Brett (2005), the economy performed poorly and the government became broke and could no longer support poor rural communities to the same extent as in the past. Recurrent droughts and economic decline from the early 1990s to the period after the land reform in the post 2000 era then started to force more rural households to exploit all available natural resources including springs which historically had been used as a response to a crisis, such as, providing assurance against drought (Mbereko et al. 2007). Thus, in many water scarce parts of Zimbabwe springs have become one of the most valued resource supporting rural community livelihood strategies (Bromley et al. 1999). Derman et al. (2007) argued that this upsurge in demand for spring water and related wetlands was one of the root causes of conflicts and contestations by different groups in many water scarce rural communal areas of Zimbabwe. Besides providing an easy fall-back for land-hungry and drought stricken rural households, springs have also become a target for rural land speculators who target and parcel them out in anticipation of future droughts and climatic variability which would make them even more valuable within the rural setting (Sakataka and Namisiko, 2014).

As discussed in Addison and Laakson (2003), agriculture and environmental management can be seen as important economic drivers in Zimbabwe and the government consequently takes a central role in policy invention and governance of those sectors. Although the government tries to align with international norms of policy formulation, elite interests represented by the rich

and policymaking networks influence the process significantly leading to top-down approaches in policy formulation. The top-down approach ignores the importance of local rural communities as active social actors with their own interests in the management of local resources like springs (Derman and Ferguson, 2003). By excluding local communities from decision making or making their input in policy formulation, Mutekwa and Gambiza (2017) observed the government to be depriving itself of diverse viewpoints that may possibly lead to better answers to multidimensional resource management problems.

The traditional structures characterised by chiefs, headmen and kraal heads only implement programmes on the ground, and were not being fully engaged in policy formulation yet they were the resource users (Derman and Ferguson, 2003). The legislative framework is also not explicit about the role of traditional leadership in the management of resources through sanctions, customary laws and taboo system. Globally it has been proven and accepted that resource management works best when it is driven and supervised by the resource owners and users themselves (Adhikari et al. 2014). A good example from Zimbabwe was observed by Cleaver (1998) who states that critical decisions about the rationing of water from particular sources, for example, springs or dams, were only positively enforced in those communities where the decision is taken at a meeting for the entire community rather than by a management committee alone. Hence, community agreement value-added communal management of resources since it reduced the need for compulsion, monitoring and sanctions. The disregard and collapse of social networks and local institutions that support community based resource management, as highlighted by Adhikari et al. (2014), was a big problem for both the well-being of local communities as well as for protection of natural capital like springs.

Van Koppen et al. (2007) saw the existence of unwritten but effective informal rules and sound conflict resolution mechanisms within rural communities of Africa. They observed that these largely informal rulebooks were not costly to implement but were part of the social fabric and played a key role in determining access to water and its utilisation. Unlike formal legislation, these informal rules were more effective because of their flexibility and had capability to accommodate change. Flexibility of policies is very significant in sub-humid areas where water availability is highly uncertain from year to year and adjustments on utilisation need quickly one. Bromley et al. (1999) and van Koppen et al. (2007) observed that in mature economies, where water sectors were highly formalised, water institutions were able to monitor most water transactions. In resource poor and emerging economies like Zimbabwe, in contrast, the water

sectors are primarily informal, hence, water institutions have inadequate reach, apart from urban pockets. As a result, informal institutions play an important role in spring water resources management and conservation in many rural areas of Zimbabwe.

Derman et al. (2007) posit that before independence in 1980 environmental laws were preoccupied with the hazards of soil erosion, degradation and drying out of springs and related wetlands in Zimbabwe. As such, this prevented a realisation of their full potential through various prohibitive measures on spring utilisation enshrined in the legislature. The legislation and policy were also not backed by solid scientific evidence. Dermana and Hellum (2007) argue that the ban on spring wetland utilisation in general was intended to make it difficult for black Africans to compete with whites in agricultural production. This is because springs on white owned commercial farms could be utilised whereas those on black communal land were prohibited (Chuma et al. 2012). Adams and Hutton (2007) observed the exclusion of local communities from accessing and utilising local and widespread resources such as springs to stem from the now disputed idea of pristine ecosystems that could be well-preserved only if isolated from human presence and use. Research done in the central parts of Zimbabwe has shown that households adjacent to spring wetlands were more food secure as wet conditions enabled the provision of an extensive range of crops and natural products. Springs waterscapes here contribute almost half of the food directly consumed and close to 48% of average annual household total cash income (Bell and Roberts, 1991; Marambanyika and Beckedahl, 2016).

Whitlow (1990) noted that legislative restrictions on spring utilisation had for long retarded the implementation of organisational reforms to support their sustainable use and have contributed to the deterioration of man-land relationships in many communal areas of Zimbabwe. Dube and Chitiga (2011) also saw the legislative restrictions as having made it difficult to plan for spring wetland utilisation and to integrate conservation and development goals at a local level. Further, this tended to push spring utilisation away from the open agenda, hence spring issues were not discussed openly. At Intunjambili in Matopo district of Zimbabwe, Sibanda (2005) observed that agricultural extension staff had not been able to support farmers because of their poor understanding of the regulations. The Environmental Management Act (2002) states that cultivation of wetlands (springs included) without a permit from the minister is not allowed. Extension staff therefore, maintain the perception that it was illegal to cultivate spring wetlands. As a result, spring wetland cultivation has occurred unsupervised or unsupported.

Schuyt and Brander (2004) highlighted that one of the major factors influencing spring wetland degradation was information failure and even where such information was available, it was often for comparatively larger springs and wetlands. They maintain that not much effort has been put in trying to understand the importance of smaller springs probably because they were considered insignificant yet they were extensively used for subsistence agriculture and were important in sustaining rural livelihoods in Zimbabwe. The overall effect of small but numerous springs within a landscape has been seen by Barakat et al. (2018) to have a net beneficial effect on rural livelihoods when compared to the fewer and bigger springs which are mainly inaccessible to the ordinary household. This because they are either protected by conservation agencies or targeted by the elite for exclusive use. This, therefore, brings a need for more case studies of springs communally owned in Zimbabwe, how they are being utilised and their contribution to rural livelihood sustainability.

As noted by Murphree and Cumming (1991) and, Mutekwa and Gambiza, (2017), resource use without resource management is non-sustainable and also any attempt to establish resource management without resource use was likely to flop. This, therefore, means that sustainable management of springs depended on having in place enforceable machineries, in the form of legal frameworks for regulating how the springs are used. Ideally the legal framework should reflect both the physical characteristics of the springs as well as the community in which they are found. Dixon (2008) posit this to imply recognising the fact that springs were used by different actors like women, youth, men, for different uses such as domestic water supply, cultivation and livestock grazing. All these uses have to be reconciled among themselves and also in relation to other ecosystem services that the springs provide. Consequently, as shown in Davis et al. (2017), an effective legal framework governing spring utilisation should echo the fact that springs were nested within a bigger landscape and hydrological system. Different scales of spring utilisation are decipherable, for example, springs are part of local catchments and bigger river basins. In addition springs are also used by diverse actors, for diverse uses such as domestic water, cultivation and grazing. Mapedza et al. (2012) highlighted for the need to recognise within the legal framework that springs were part of a bigger society as they may well be utilised by persons that come from one part of a village, one village, more than one village. Springs are also sources of numerous biological resources and are, therefore important sources of biological diversity that is usually managed under common property resource arrangements. This is because they are used by more than one person and are fragile ecosystems, hence the need for the state to balance individual and public interest in springs.

There is therefore, a need to strike a balance between the utilisation of springs to sustain livelihoods and their conservation in order to sustain provisioning of environmental services that they offer. Van Koppen et al. (2007) suggested that environmentalists concerned with springs could use a method similar to the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE). This is because the difference between spring conservation and wildlife conservation in communal lands of Zimbabwe was not as big as may seem to the casual observer. For example, springs provide a resource to the communal areas used for water supply, cropping and other rural enterprises. The community cannot be persuaded to conserve the springs, either by threats as provided by legislation or pleas for magnanimity. Systems can be formulated that can both safeguard springs and concurrently allow utilisation of their water for the benefit of the community (van Koppen et al. 2007). However, the key to success of such a programme was teaching the society and willing involvement of the user society. The CAMPFIRE approach was likely to be positive with springs because of their perceived productivity in irrigation agriculture (Derman et al. 2007). Adhikari et al. (2014) observed that a well-organised, management structure within communities was vital for this model of resource conservation to be successful and is most often realised through the existence of community water point committees. These committees are in theory a local platform where all decisions dealing with the management of the water are made.

Mapedza et al. (2012) observed that one of the difficulties in dealing with spring and wetland conservation in Zimbabwe was the wide range of types encountered, each with its own mode of formation, hydrology and erosion hazard. Given such diversity, it becomes difficult to prescribe an all-inclusive methodology for spring wetland utilisation and conservation. Customarily, rural communities rely on dryland agriculture as a major economic activity but Sattler (2010) noted that these communities were likely to be incapable of being sustainable without a diversified economic base. As such, development and use of springs and other geo-based resources have been viewed and adopted as essential components in the broadening of the rural economic base (Sakataka and Namisiko, 2014). At the international level, the Commission for Sustainable Development, as stated in Petroman et al. (2010), recognised the utilisation of rural geo-based resources like springs as being a significant development intervention that needed to be encouraged by international organisations and governments.

Given the view by Nkuna et al. (2014) that significant livelihood transformation and sustainability remain a foremost development challenge in Africa, sustainable rural based development approaches anchored on natural resources like springs could contribute to important rural livelihood sustainability. This is because they were socially and economically achievable. Sattler (2010) observed that efforts to conserve and restore rural natural resources have shaped a better environment and created new prospects for sustainable rural livelihoods.

2.8 Access to springs and contestations

According to Dermana and Hellum (2007), in Zimbabwe's rural areas and more broadly in southern and eastern Africa, access to water was an arena of contestation or overlapping and opposing institutions. Access also had an underlying normative framework, which gives limits on what people can do and also sets clear expectations. Marambanyika and Beckedahl (2016) observed factors likely to decrease access to water and increased contests around springs and wetlands in general orbited around the risk of growing water shortage and, therefore, the potential for amplified competition and conflict over its distribution and use. While scarcity will be influenced to some extent by vicissitudes in natural conditions, it is the shifting demographic and economic patterns that were likely to contribute most to future scarcity and conflicts over springs (van Koppen et al. 2007). The contestations will be intensified to a large extent by factors such as lack of public information and education about water issues, lack of adequate consultation with stakeholders before formulating policies, blurred and or inconsistent national development and sectoral policies which have a bearing on water resources development and management. Inadequate financial or human resources with which to adequately develop, maintain, conserve and manage available water resources will also likely exacerbate potential and existing contestations (Matondi, 2001).

Hall et al. (2011) defined exclusion as the methods by which people are prohibited from accessing or benefiting from the utilisation of natural resources such as springs. Exclusion is related to issues of contention, struggle and power relations among actors. Exclusion is also closely connected to proprietorship which signifies the control and maintenance of the contested access to natural resources prized for their contributions to livelihoods. Unequal power relations in communities, therefore, define who utilises springs, paying minimum attention to the water rights over springs in Zimbabwe. Khadka (2009) observed exclusion to

be a complex and multi-faceted process that involved the denial of access to resources (in this case springs), goods, rights and services. Exclusion also involves the incapability to participate in activities obtainable to other stakeholders in the community. It is intimately associated with access, which is all about the means by which people are able to benefit from things and therefore is more similar to a 'bundle of powers' rather than to a 'bundle of rights'. Mutekwa and Gambiza (2017) affirm the concept of access to be focused on issues to do with who gets to enjoy some kind of benefits, in what ways and under which conditions. They maintain that in access to resources, there is a range of powers embodied in and exercised through various instruments, procedures and social relations that affect people's ability to benefit from them.

Mudzengi and Chapungu (2016) observed the nature of power and form of access to resources to change over time because people and institutions were positioned differently in relation to resources at various historical periods and geographical scales. This means that some people have more power in some relationships than in others in the present or at some historical times. Also different political and economic situations can change the conditions of access and may, therefore, alter the specific persons or groups most capable to benefit from a set of resources. The investigation of the matters of access, therefore, necessitates the identification and mapping of the flow of benefits of interest. It also requires understanding the machineries by which different actors involved gain, control and retain the benefit flow and its distribution and an analysis of power relations underlying the machineries of access involved in instances where benefits are derived.

Harvey (2004) referred to 'accumulation by dispossession' where more powerful community members take control of common property (in this case springs), at the expense of other members of that community. Hence, in Zimbabwe, as discussed by Matiza et al. (1992), the benefits of using springs accrued mostly to few powerful members of the community that have access to springs but the burden of degraded springs was shouldered by the poor members of the community. This has been noted to be a source of conflict and contention within communities. The power relations that structure and shape the process of exclusion from springs are found in four intertwined and mutually reinforcing realms that are: regulation, force, markets and legitimation. According to Hall et al. (2011), regulation refers to the rules that determine spring wetland ownership, tolerable land uses, their limits, and circumstances under which the springs and their ecosystem services can be accessed. Force excludes local communities and citizens from accessing springs through numerous forms of sanctions which

involve violence or threats of violence. In Zimbabwe the use of force to exclude citizens from utilising resources is usually done by government officials and members of the state security who are intermittently requested to assist with eviction and management of natural resources. Serious confrontation and violence is not commonly used in enforcing spring exclusion in Zimbabwe, but is observed to be very effective even if it is implied without being directly used. Mutekwa and Gambiza (2017) observed markets to enforce exclusion through pricing or the cost of acquiring permits to access and utilise springs. The value of some key products and ecosystem services provided by springs is very important in understanding exclusion dynamics within an area. They also noted legitimation to be related to the moral basis for justifying exclusion, entrenching regulation, markets and force as tolerable grounds for exclusion. Regulation, legitimation, force and markets constituted the combination of the control elements that were typically deployed by those seeking to exclude and to which the excluded must react to (Hall et al. 2011).

Murphree and Cumming (1991) noted that policy making on land use, environmental issues and the economy in Zimbabwe have historically been disjointed and disjunctive. Ecological issues have often been used to justify short term political and economic commands. Government policy has also mostly overlooked local capacity for resource management and seldom made use of local ecological knowledge which is normally more precise on local circumstances than the information accessible to water and environmental planners. Marambanyika and Beckedahl (2016) have argued that state policies and legislation have made local knowledge redundant. The state's continued appropriation of the communal land resources has fundamentally clipped local institutions' right to legal control and access of local resources like springs. Matose (2011) also highlighted that in Zimbabwe, the colonial and post-colonial resource governance regimes had disempowered, dispossessed, alienated and impoverished local communities.

As noted by Derman and Ferguson, (2003), the Environmental Management Act (2002) makes it illegal to cultivate on springs and wetland systems before getting approval from Environmental Management Agency (EMA). This Act, in a way gives leverage for sustainable utilisation of wetlands by communities (EMA, 2002), but as Mbereko et al. (2007) observed, sustainable utilisation is itself a disputed paradigm. Further, the process of obtaining a written permission for spring utilisation, as prescribed by the law, has been noted by Derman et al. (2007), to be unclear with the communities and their supporting agencies like agricultural

extension officers as well as environmental officers not familiar with the nut and bolts of the process.

Despite such restrictive legislative provisions, spring and wetland degradation continues to take place. This is because there is generally no capacity to enforce these restrictive laws and in the end, whether the utilisation of the springs is sustainable or not is left to the discretion of local community members and traditional systems. Mharapara (1995) observed crop cultivation based on spring water and related wetlands to continue rising owing to a combination of traditional customs that encourage their utilisation, ineffective monitoring and lack of an alternate livelihood base for the local community households. Marambanyika and Beckedahl (2016) assessed wetland utilisation patterns in sub-humid communal areas of Zimbabwe between 1985 and 2013 and the associated benefits to livelihoods of the surrounding communities. They concluded that people's dependence on spring wetlands was high, especially where they had not been degraded, cultivation continued to be a predominant activity and has been growing over the years at the cost of wetland ecosystem integrity and other services. They attributed this increasing wetland cultivation to declining dryland farming produce, market availability for horticultural produce and donor projects.

While Zimbabwe's Environmental Management Act (2002) makes provisions to protect the environment surrounding springs and ecological services that they support, the Water Act (1998) controls access and management of water resources in general without explicitly having a management plan for springs. The aim of Zimbabwe's Water Act (1998) is to increase access to water by all users, while ensuring its productive use. The act created new participatory institutions to improve stakeholder access to water management decision making. These are called catchment and sub-catchment councils which are based in Zimbabwe's seven hydrological zones. In addition, a new parastatal was established called the Zimbabwe National Water Authority (ZINWA) to shift water management costs from central government to the users and to increase the productive use of Zimbabwe's waters. Prior to the Water Act (1998), large-scale commercial farmers controlled Zimbabwe's waters, courtesy of a water rights system called first in time, first in line. This often made it tough for new appropriations to be made to black small-scale farmers who had serious difficulties in finding the means to acquire water rights and to negotiate through the bureaucracy to secure those rights (van Koppen et al. 2007). Under the new Water Act (1998), all water is vested in the President and no person or private institution can claim private ownership of any water.

Derman, et al. (2007) posit that the vesting of water ownership in the President was consistent with Zimbabwe's history as a centralised state though seeming to integrate new international water management principles. The act gives rural communities the right to water for primary use free of charge and defines primary water as water used for domestic human needs, animal life, production of bricks for private use and dip tanks. As stated in Bromley et al. (1999), the right to water for primary use in rural Zimbabwe is recognised by many communities within the broader context as a right to a livelihood. Primary use is, therefore, not limited to drinking and domestic water but is seen as an integrated part of livelihood requirements such as food and housing in the communal areas.

New innovative practices of commercial cropping developing within the common property regimes in the communal lands, such as gardening for consumption and sale, represent a challenge. The challenge is in how catchment councils, when issuing water permits, draw the apportioning line between commercial and primary water uses. These uses render problematic the separation between commercial and primary water. Dermana and Hellum, (2007) noted that communal farmers in most parts of Zimbabwe who take water either for gardens or fields do not expect to pay for it and regard it as common property subject to the local rules of access. When government intervenes, it expects that since the water belongs to the state, it should be compensated for its use, thus creating potential conflict with rural communities.

The right to water for gardening appears to be the subject of increasing contestation than the right to drinking water in many parts of rural Zimbabwe. While the right to drinking water was afforded to everybody notwithstanding village of belonging, kinship and marital status, access to land with available water particularly from springs for gardening is as the main rule allocated to the male head of a household on behalf of the family (van Koppen et al. 2007). This creates conflicts when it comes to single and childless women, widows, divorcees and married women who, due to these formalities, can be perceived as landless. Conflicts merge because women are the primary users of water across the African continent where they fill a complex and leading role in agricultural practices that require access to and management of water resources, such as springs, yet they were often operating on the side-lines of society. However, Matondi (2001), observed that women appear to be acknowledged by most men as owners of the gardens. This strongly suggests that ownership within the family was not attained through rulebooks concerning family representation but by actual use and work on the land. The widespread fencing of vegetable gardens along rivers, springs or wetlands in Zimbabwe

suggested that once land was allocated for gardening, it became family property. Access to both land and water may, thus be limited on the basis of kinship from other potential users (Mharapara, 1995).

The Bonn Conference (2001) highlighted water resources management at local levels to have a pressing need for gender specific tactics. This is because sustainable water management required the incorporation of gender dimensions at all levels and for all water undertakings, from policies to projects. The World Water Council (2000) mentions that, in most cases under-represented users, particularly women who were the main users and managers of water were excluded from key decision-making and planning. It is crucial to note that in some societies men have deep-rooted insecurities about women possessing property, including land and water rights for farming. This marginalisation has, therefore, made water management structures less reactive and less effective to the demands of sustainable water utilisation.

Van Koppen et al. (2007) posit public participation and management approaches for water points to have failed in dealing with the gender issues in access to water, largely because they regarded a society as a group of equal people with a shared vision. In reality, however, communities were made up of persons and groups who command different levels of power, wealth, influence and capacity to express the needs, fears and rights. Therefore, where resources are scarce, as it is the case with spring water in sub-humid areas, there is increased competition for access. With competition, those at the lowermost end of the power spectrum, in most cases the poor and women in particular, will be excluded. In this regard, Van Koppen et al. (2007) argue that applying gender analysis helps to better target resources since water scarceness and its fragility pose diverse challenges for rural men and women. This is due to their dissimilar roles, relations and responsibilities, opportunities and constraints and, uneven access and control of important resources.

Scoones and Cousins, (1994) affirm that the struggle over access and control of spring and related wetlands in Zimbabwe occurred between the state and the local communities as well as within the local communities themselves. Harvey and Pilgrim (2011) highlighted that land (in this context springs), as a resource, was likely to become the focus of increased competition from a diversity of uses. They further maintain that competing uses were likely to become subject to growing controversy in terms of the entitlements made by those encouraging those different uses, and in terms of potentially conflicting national, regional and global interests. Bongale, et al. (2006) highlighted conflicts between different groups within a community

happening when one resource (in this case springs) can support a variety of uses and those with interest in spring utilisation disagree as to which use is the best. Political and economic, cultural and legal struggles, therefore interweave, once local power and less localised power structures interrelate and when political and cultural symbols of power and authority are brought into play concerning resource use.

Peltonen and Sairinen (2010) state that conflicts within communities arose primarily because of contending demands for a limited resource, unbalanced spread of costs and benefits that result from the development and because of environmental effects that arise when the use of land changes. Therefore, land use competition (in this case springs) are the principle according to which a resource is assigned to a specific use rather than any alternate use because it will yield the highest return. Rosch, et al. (2010) maintain that stakeholders using the same resource for different purposes can clash with each other if they target a similar area at the same time. Agricultural land use of springs can compete with recreational land uses because the type of cultivation used on spring wetlands may have a strong impact on the aesthetic value of open spaces for leisure and tourism.

As stated by Dermana and Hellum, (2007), the state's primary objective in centralising control over local resources is to affirm its political power over local interests and not to produce effective resource management regimes. In addition, because of logistical limitations of staff and funding and also because it operates detached from the users of the resource, the state is unable to put effective management institutions in place. The state can also be in conflict with the local community over spring utilisation when they impose their methods of conservation. The blanket ban of spring utilisation at the expense of livelihoods undervalued their impact on rural livelihoods (Dixon and Wood, 2003).

Van der Zaag et al. (2001) posit that, in utilising spring wetlands, local communities will be innovatively dealing with the unpredictability of the rains and with outside institutions, rules, regulations and enforcement officers who 'speak the language of conservation'. They maintain that historically, state actors have used conservation as the main reason for interference to stop spring utilisation with colonial command and control discourse finding fertile ground. A complex set of legal, institutional and technical prescriptions were then formulated endeavouring to harness the conduct of the local communal farmers. For example, research stations were created, where soil erosion was measured and inferred, the Natural Resources Board (NRB) was established and the Natural Resources Act of 1941 enacted; an army of NRB

officers were recruited to enforce the Act, barring spring wetland cultivation and imposing penalties. Therefore, a cocktail of state actors together with new scientific awareness and technologies were unleashed upon the communal areas, provoking what local communities referred to as synchronised sabotage of their livelihoods resulting in conflicts with the state over utilisation of springs. Mutekwa and Gambiza (2017) saw Zimbabwe to be in a period of counter-exclusion and observed that the governance of natural resources ought not to ignore the historical setting where management was dominated by exclusionary approaches. They observed that the 'ghost of history' had a strong effect on current and future resource governance arrangements. They also suggested that restrictive legislation needed to be revised along the model of co-management with local communities.

In South Africa, tension has been noted in some rural communities between traditional water sources and formal water provision. The rural communities, as highlighted by Nkuna et al. (2014), regard springs as a sustainable and reliable means of obtaining water compared to formal water supply sources. However, the challenge is that formal water service providers disregard springs and consider them insufficient for viable water service delivery, hence refuse to support initiatives from communities to harness and utilise these water sources. Bob (2010) also observes that in South Africa, there were contestations between traditional institutions and democratically elected local government structures in the allocation and management of water. This has in some cases resulted in outright conflicts in certain areas, destabilising communities and impending prospects for peace and development.

The WaterAid (2009) saw some of the methods likely to decrease possible and prevailing conflicts around spring utilisation as including improved information, communication and dialogue amongst users with an emphasis on areas of common interest. They highlighted increasing the existing water resources through conservation and recycling processes and generally improved efficiency in spring water utilisation as reducing contestations. The WaterAid (2009) also posit the generation of clear policies and unambiguous legislation on spring water access, allocation and reallocation, based on values of fair access and ensuring improved transparency in decision making with regard to prioritisation of water resources development and apportionment as reducing the potential for conflict.

2.9 Institutional arrangements governing spring utilisation and management in Zimbabwe

2.9.1 Institutions

Institutions impacting on access and utilisation of spring water in Zimbabwe are similar to those that affect access to all the water forms in general. This section will, therefore, review literature on the different institutional arrangements affecting access and utilisation of water in Zimbabwe with a bias towards those that are active on rural spaces. Management of natural resources like springs is not an easy undertaking given the multifaceted physical, biological and socio-economic practices defining their presence and state (Turner et al. 2000). Management must therefore look at the factors that interact at each spring site, if they are to be successfully managed. Literature reveals that effective utilisation and management of spring systems can be attained if the resource users, policymakers and planners comprehend the connection between springs, communities and prevailing human institutions (Dixon et al. 2013). This is because as utilisation of springs and related wetlands was frequently impacted by dynamic institutional arrangements peculiar to each location (Mitsch and Gosselink, 2007). The study of human institutions in spring management is vital in conserving and restoring spring health as suitable procedures can be undertaken to improve and perfect the prevailing institutional arrangements as advocated for by the Ramsar guidelines for wise use of wetlands. Water resources in the seasonally dry and semi-arid environments are observed to be greatly impacted by human activities, hence institutional practices perform an important role in their preservation, supporting community livelihood strategies and providing employment opportunities. M^{C}Cartney et al. (2005) argued institutional conflicts arising from contradictory or dissimilar priorities and purposes as well as institutional laxity to be some of the contributory factors influencing spring degradation and loss. Gumbo (2006) asserts that, institutions provide structures for policy and legislative action. Mazibuko and Pegram (2004) highlighted several instances in South Africa where jurisdictions overlap amongst various institutions in water administration. They stated that in such circumstances respective responsibilities needed to be spelt out in order to circumvent replication and lack of accountability. Collaboration amongst these institutions would be key for effective and well-organised development, management and implementation of water policies, especially where the institutions have mutual, co-dependent or connected responsibilities. Nleya (2005) observed the need for a system of institutional arrangements to be established without compromising any institution's obligation, function and powers. He maintains that government departments in South Africa were constitutionally

directed to work jointly and dodge repetition of responsibilities, yet in practice, boundaries were still drawn amongst departments and at times within departments.

Chuma et al. (2012:40) defined institutions as being "social arrangements that shape and regulate human behaviour, have some degree of permanency and purpose, and transcend individual human lives and intentions". It is through these institutions that procedures governing resource access, utilisation, control and management are shaped (Dixon and Wood, 2007). Institutions, as noted by Meinzen-Dick and Nkonya (2007), are moulded with the institutional environment and institutional arrangements. Institutional arrangements, refer to the structures that humans enact on their dealings with each other while institutional environment refers to rules governing institutions. Spatio-temporal differences have been observed in institutional arrangements (Mharapara et al. 1998) dealing with natural resources management in Zimbabwe. This leads to diverse understandings of institutions by different communities depending on what they wish to attain. The variations in institutional arrangements from one area to another, therefore underscore the significance of spatio-temporal analysis of institutions' roles in spring management (Gumbo, 2006). In Zimbabwe, as argued by Msipa (2009), previous research findings have recognised that for resource management is to be successful, especially water management, research should consider institutional changes that can cope with shifting circumstances.

Nleya (2005) highlighted that the definition of institutions was riddled with risks particularly given the many definitions in the literature. However institutions could best be understood as regulatory structures, legalised practices, set patterns, rules of the game that are designed to standardise human action. These can take the form of numerous practises like customs, laws, rules and policies. In other words, institutions are that *normative factor* that evolves in communities to regulate and standardise persons' conduct.

According to Mogale et al. (2010) during the pre-colonial times, customary institutions in most of Southern Africa were very important in the management and conservation of natural resources in their socio-political and economic interest. Dore (2001) notes that most of these customary institutions were comparatively effective in bringing about sustainable utilisation of natural resources. It is however, imperative at this point to note that customary law from the past viewpoint was not comparatively so much under the influence of present pressures of market forces, population growth and the Global North's powerful information systems and institutions (Kokwe, 1995). The capability of indigenous institutions in natural resources

management was, however, destabilised by intrusion and institutional disturbances instigated by colonial governments. In most African countries, it has been observed that a colonial legacy which was then inherited by post-colonial governments set up resource management structures and institutions which essentially overlooked customary knowledge and common practice (de Prada et al. 2014). However, the customary institutions have remained basically unbroken, though they have been weakened (Dore, 2001; Mogale et al. 2010). The extent of collaboration between government resource management agencies, local societies and customary decision making authorities still differ throughout Southern Africa (Mogale et al. 2010). In some areas like the western parts of Zambia, traditional authorities still return equal, if not more authority to control the turn of events in their areas of influence as the Central Government does (Kokwe, 1995).

The level of achievement of institutions in water resources governance (including spring water) is determined by a cocktail of dynamic factors. Maconachie et al. (2008) observed that the capacity of a particular institution to accomplish its obligation was determined by power relationships, source of the mandate and political correctness or acceptability. An appreciation of the role played by institutions in natural resources management is critical for their maintenance (Marambanyika and Beckedahl, 2016) yet in Zimbabwe little is known about their function and effects on spring management. As noted by Silima (2007) and Mbereko et al. (2007), imposed institutional arrangements in which outside institutions dominate and often disregard the opinions of the local communities have been responsible for natural resource degradation being experienced in several areas of Zimbabwe.

2.9.2 Property Rights

Property rights are also an important institution guiding the access and management of springs in Zimbabwe. Property is defined by Meinzen-Dick and Nkonya (2007) to be an enforceable right of a person or group of people to some usage or benefit from a resource (in this case springs). Property is therefore, a political association amongst people not the resource itself and the right merely stipulates the association amongst users. Derman et al. (2007) note that, property is also a regularly challenged and dynamic institution, continually changing as the relations amongst people change. Since property rights define the relationships amongst individuals in relationship to a specific resource, they also explain the conduct of individuals concerning that resource. Property rights thus, impact on both rules of access and exclusion as well as the rules concerning the usage of that resource.

There are four main property management regimes that reign over the various resources available in Zimbabwe. These, as noted by Matiza (1992), are state property, private property, common property and open access regimes. State property refers to state ownership and control over the usage of a specific resource. The state has the right of excluding persons or groups from the benefit of utilising that resource, for example, national parks, national forests and rivers. The private property regime refers to the right of an individual or corporate body to prevent other individuals or groups from use or benefit of a resource (Mudzengi and Chapungu, 2016).

According to Meinzen-Dick and Nkonya (2007) the common property regime refers to private property for a group and guarantees that each individual member of that group will not be barred from the use or benefits from the resource. The group also has the right to exclude outsiders from the use or benefits of that resource and persons within the group have rights and obligations to protect the resources in question. Both private and common property regimes, as highlighted by Matiza (1992), are individual rights because they give exclusive guarantees to individuals. States, as well as local institutions, can manage common property through administration by local authorities or other established forms of rules and regulations.

Berkes and Farvar (1989) argue that, for a resource to be defined as common property, it must belong to a class of resources for which exclusion is difficult and joint use involves subtractability. Subtractability here refers to the extent to which an individual's use of a particular resource reduces others' use. Thus, the use of a resource by one person decreases the level of the resource obtainable by others. The management of common property resources has for long been inspired by philosophies that favour their privatisation or central administrative control as a means of guaranteeing sustainable utilisation of such resources (Maphosa, 2002). This notion found its most eloquent manifestation in Hardin's (1968) famous phase 'tragedy of the commons'. However, Mudzengi and Chapungu (2016) argued that it was possible to communally use and manage natural resources without necessarily degrading them where indigenous institutions were effective in enforcing exclusivity. The flaw of 'the tragedy of the commons' model is its failure to differentiate between open access and common property regimes, where a well-functioning common property regime (*res communes*) has rights and duties well defined. Meinzen-Dick and Nkonya (2007) highlighted that common property has been and still is subject to particular legal and customary arrangements that specify user groups and exclude non-users. Hardin's model has also been criticised for being Euro-centric and

making far-reaching assumptions that resource users were individualistic and were incapable of uniting towards the greater societal interest. Therefore, it puts more emphasis on competition rather than collaboration and further, in a well-functioning common property regime greed amongst resource users is limited by social norms of the community (Mudzengi and Chapungu, 2016).

The open access property regime, according to Derman and Ferguson (2003), refers to conditions in which there is no property, hence no institutional arrangements to control access and use. Each potential user has complete independence with respect to the utilisation of the resource since no one has legal capability to keep others out. There are no property rights in this regime but merely access. Mudzengi and Chapungu (2016) observed that the invasion of private commercial farms in Zimbabwe in the year 2000 demonstrates that if other citizens refuse to respect the rights of those who own the property and lawful institutions with obligations to enforce exclusion refuse to do so, then, the consequence will be land degradation under the open access regime. The lack of secure tenure for the new settlers exacerbates the situation as individuals are forced to over-exploit resources to maximise short term benefits.

In the Save Catchment as well as Zimbabwe in general, most springs and related wetlands are communally owned and managed. The communal system of resource ownership involves the communities as the '*de facto*' owners of the wetlands on behalf of the '*de jure*' owner who is the state (Marambanyika and Beckedahl, 2016). This exposes springs to multi-institutional management since central government departments, local district authorities, customary authorities, private players, non-governmental organisations (NGOs) and local people contribute to spring and related wetland management. Therefore, there is need to appreciate the influence of cooperation existing amongst the numerous institutions on the physical condition of springs (Chandra, 2011). This is important in light of observations by Russi et al. (2013) that action at all levels by all stakeholders was needed if the prospects and advantages of working with springs were to be effectively realised and the consequences of continuing spring wetland loss appreciated and acted upon.

2.9.3 Legal framework in spring water management

As discussed by Mbereko et al. (2007), in many African countries' use of springs and related wetlands was controlled by more than one piece of legislation administered by different institutions. This sometimes creates misunderstanding on the ground, amongst both spring local actors and natural resource managers. State-defined pieces of legislation known as

statutory law, have tended to override other forms of law regarding how springs must be utilised. However, on the ground, statutory laws are not the only pieces of legislation that direct spring utilisation and management. Springs, as is the case with other common property resources, tend to be administered by more than one legal framework, a phenomenon Meinzen-Dick and Nkonya, (2007) referred to as legal pluralism.

Legal pluralism is defined as the occurrence in a social field of more than one lawful order (Griffiths, 1986). This consequently opposes the idea that law is a single, monolithic and unified set of rules operating from a state hierarchy. Legal pluralism can incorporate numerous arrangements and stages but the most adapted form comprises a twin structure. As highlighted by Chiba (1998), this twin structure is reflected in the legal pluralism literature, as focusing on customary laws, tribal laws, religious laws and social laws working together with state law in a dual structure mostly in non-western countries. Although the terms customary and traditional law are adopted in this study, it can be noted that literature treats them interchangeably with terms like indigenous, informal, and local laws. This research adopted the terms customary and traditional because of their association with historical continuity and they do not suggest rigidity but recognise that management systems are dynamic over space and time.

According to Meinzen-Dick and Nkonya (2007), limited recognition of legal pluralism, referring to the fact that springs are administered by more than one legal framework, is the greatest solitary reason behind the lack of sustainability in the way springs were being utilised and managed. Understanding legal pluralism is, therefore, a significant pre-requisite for appreciating how property rights, which define the way individuals interrelate over a resource with respect to how they gain access to and wield control over the way spring resources are arranged.

As observed by Ferguson and Derman (2004), complications emerge when the state imposes legislation defined without the participation of local community members. In the process it overlooks customary, religious or project laws, which, in many circumstances have been found to be equally, if not more binding than statutory law in resource management. They argue that the usefulness of the legal framework in resource management is to a large extent determined by the extent to which it approximates the anticipations of the local actors, hence underscoring the need to put in place effective institutional arrangements. For springs, for example, the law may operate at local level, i.e. within the spring and its hinterland, within local governmental

structures, within nationally-defined parameters, and taking cognisance of international provisions.

Understanding legal pluralism in spring management and utilisation is a pre-requisite for understanding how property rights are arranged. Property rights explain how people interrelate over the resource with regards to how people gain access to and wield control over the wetland. Property rights must be appreciated as a package of rights that deal with control or decision-making rights, and use rights (Meinzen-Dick et al. 2004). This means that while individual farmers can have control rights over the crops they grow on spring wetlands, they may have only use rights over the land, which may fall under the control of a traditional leader or the central government. Springs are generally indivisible in both physical and social terms and yet substractable in the sense that action of some individuals can have consequences on their services. There is therefore need for appropriate legal frameworks that promote combined action so that, spring users attain mutual good. To this end institutional machineries must be seen to discourage 'free-riders' who want to draw benefits without being accountable for their actions (Marambanyika, 2015).

Matiza, (1992) observed that in legal pluralism, the various forms of laws were not precisely disconnected but somewhat overlap and impact on each other nor are they similarly influential as their effect differs from place to place. Figure 2.2 shows the overlapping forms of law which can be assumed to be like magnetic force fields of variable strength (Meinzen-Dick and Nkonya, 2007). Customary law, for example, may be very robust and state law practically unknown or inappropriate in a remote society with low migration and low penetration of state agencies. In a heterogeneous society with high immigration rates, customary law may be less regarded and much weaker than state law.

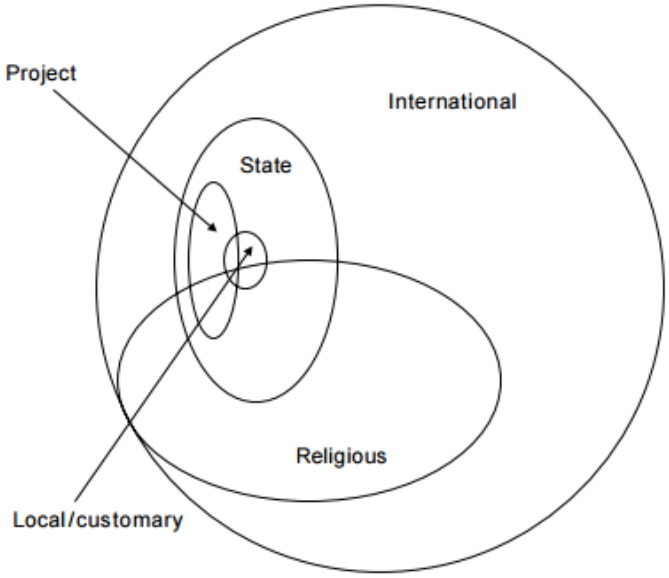


Figure 2.2: Overlapping legal orders involving water
Source: Meinzen-Dick and Nkonya (2007, p.30)

According to Marambanyika and Beckedahl (2016) institutional arrangements are designed to control the usage of resources and management is not limited to the regulation of access to the resources but also encompasses the preservation the state of the resource. This entails the presence of a power structure with capability to enforce the regulations. Hence, despite state regulation, local practices of resource utilisation and regulation entail that there is a procedure of defining a common property regime regarding utilisation of spring resources. This suggests that there exists local appreciation of the significance of springs to the complete production system of the communal areas. Local political processes are intended to maintain those resources as part of the common property regime and thus, guarantee access to only acknowledged group members.

The biggest problem facing communal resource (springs included) management in Zimbabwe, as noted by Matiza (1992), is fundamentally a consequence of the incapacity of the state institutions to replace local level management. This therefore implies that state property cannot be promoted as a viable alternative given the limitations of state management. To argue that state control single-handedly explains the breakdown of local institutions' ability to control local resource use also overlooks the influence of local political, economic processes and responses to integration into the economy. Frenken and Mharapara (2002) have argued that existing institutions were insufficient, weak and not supportive of effective spring management. They therefore, advocated for the need to establish new institutions dealing with spring management. This would involve developing a national management plan for springs

whose objectives may include; the documentation of springs and threats to their existence; development of spring inventories; developing frameworks for spring utilisation; the study of communities and the benefits that they derive from spring utilisation; provision of incentives to local communities in order to promote long term conservation. The strengthening of prevailing institutions; setting up of a training and research institute for springs; setting up of information centres for springs; harmonization of actions to do with springs at inter-ministerial and inter-departmental levels can also be included in the national plan for springs.

Measures of intervention to mitigate the trends in spring degradation are the concern of local, national and global efforts which are manifested in various planning workshops, conferences and treaties respectively. In places where conservation and management of springs seem to conflict with basic needs such as food, the drive must point to the significance of understanding customary institutions to the management of springs and assimilating such institutions into more official management strategies. As observed by Cleaver (1998), in Southern Africa, there has been a noteworthy shift from the centralised state driven natural resource management regimes of the colonial period to devolved and mostly community-based management regimes. Government institutions and other organisations like NGOs were correspondingly restructuring their own functions away from direct participation in management to the direction of supportive, technical and advisory roles. However, experience in the region has shown that local management is not a guarantee for success (Ribot, 2002; Sithole, 2000). It is a multifaceted procedure that requires thoughtful planning and implementation. The change from centralised and state motivated natural resource management is clearly expressed in the theories of collective action and common property resource management where the emphasis is on getting the institutions right. This, however, conveys the *a priori* supposition that institutions are the problem and implicitly rationalises piecemeal institutional engineering (Mandondo, 1998).

2.9.4 Institutional framework and cross sectoral linkages

There is no specific institution in Zimbabwe mandated to solely manage, conserve and conduct research on springs. The spring management process in Zimbabwe is driven by several institutions. As observed by Gumbo (2006), these include local institutions controlled by traditional leaders and wetland committees and external institutions such as local and central government agencies and NGOs. The way in which different institutions participate in water management and springs in particular is influenced by their different institutional obligations

but in most cases priorities are stuck between socio-economic and environmental considerations. Therefore, Moses (2008) and Zsuffa, et al. (2014) argued that wherever a complex circumstance involving different institutions operating at a place arose, an alliance must be made, which necessitates a collaborative approach for effective management of springs and related wetlands.

The new institutional framework for Zimbabwe's water sector as enshrined in the Water Act of 1998 is now dominated by the Zimbabwe National Water Authority, Catchments and sub-Catchment Councils. While these institutions have compelling positions with respect to water resources management and protection in Zimbabwe, there are also other numerous government institutions, parastatal bodies and non-governmental organisations that play an active role in water management in general (Marambanyika and Beckedahl, 2016).

In the past, Zimbabwe's water sector, as highlighted by Gumbo (2006), was controlled by the Department of Water Development, large commercial farmers, urban councils, the Zambezi River Authority and mining companies. Focused on River Boards, entities such as commercial farmers were granted water rights under the Water Act of 1976. This regulatory framework left out most communal areas in terms of involvement in decision making as the District Development Fund (DDF) and Rural District Councils (RDC) made choices for them in as far as where to drill boreholes or exploit groundwater. The DDF as noted in the Zimbabwe Water Policy, (2013) is a centralised institution with its own structures and represented by units at district level was for a lengthy period the main infrastructure provider for rural communities (water included). It was also an important institution under the rural water supply and sanitation programmes. The DDF is not known to involve the local communities in decision making before implementing projects on the ground. This very top-down institution is still operating in many parts of rural Zimbabwe but some of the district level units and equipment have been assimilated into the RDCs.

Rural District Councils were created by Zimbabwean legislation as the equivalent of urban councils and are in charge of all the development occurring in the rural areas. As seen by Gumbo (2006), this institution has a long history of inadequate funds to support its activities, limited human capability, low monetary base, and also liable to making pronouncements on the basis of politics rather than pragmatism. While well placed to include rural communities in decisions to do with the delivery and conservation of resources such as water, it is repeatedly handicapped by the shortage in capital and political interference. In the end the decisions on

water provision are not necessarily grounded on the exact requirements of communities and often NGOs have stepped in to cover the neglected areas (Marambanyika and Beckedahl, 2016). Table 2.1 gives a summary of the institutions and their role in water resources management in Zimbabwe.

Table 2.1: Institutions and their role in water resources management in Zimbabwe

Institution	Role in water sector
Agritex	-Delineates farming plots in and around springs and sometimes assist NGOs in the distribution of farming inputs such as seeds and agro-chemicals for usage on the wetlands. -By apportioning farming plots, it impacts the number of people taking part in wetland cultivation. It also equips wetland users with knowledge on sustainable spring utilisation by promoting adoption of conservation farming techniques.
Zimbabwe National Water Authority (ZINWA)	-Quasi-government agency guiding Catchment Councils and Sub-Catchment Councils. -Plays a strategic role in the management of the water permit system and the operationalisation of water pricing systems, planning, coordination, management of water resources and the delivery of water (Zimbabwe Water Policy, 2013).
District Development Fund	-Provide tillage services to irrigators, services water infrastructure e.g., boreholes and small dams. Plans and constructs small irrigation schemes. -Maintains a small unit for backup borehole drilling, deep well sinking and pump repair and rehabilitation. -Provides technical leadership and know-how to RDCs in planning and supervising rural water supply development (Zimbabwe Water Policy, 2013).
Rural District Councils (RDCs)	-It is the local regulatory authority of rural communities in Zimbabwe. -Accountable for resource management in their spaces of jurisdiction. -Mobilise the local community, farmer selection and irrigation plot allocation in smallholder irrigation development (Marambanyika and Beckedahl 2016).
Environmental Management Agency	-Under the Ministry of Environment, Water and Climate. They control impact assessments for new irrigation schemes and dams, pollution abatement, environmentally healthy catchments. -Involved in regulating wetland utilisation, though not even a single wetland is cultivated with a permit as required by EMA Act (2002) (Subsection 113) and Statutory Instrument (S.I.) 7 of 2007 (Environmental Impact Assessment and Ecosystems Protection) Subsection 20 (1). -They also take part in wetland conservation through education, awareness, monitoring of legal adherence and initiating wetland protection projects (Derman et al. 2007).
Non-Governmental Organisations	-These promote wetland utilisation by facilitating training workshops on crop production in partnership with different government wings such as Agritex, providing material (such as fence) and financial assistance to wetland farmers. Some livelihood activities promoted by NGOs include conservation agriculture (Marambanyika and Beckedahl, 2016).
Traditional Leaders	-They allocate cultivation plots to local residents. They monitor spring abuse by checking local people's compliance to local policies, rules and norms and often punish the culprits. -The value of traditional leaders is attributed to their closeness to the people flagged by kinship ties and shared respect for prevailing social relationships (Matiza, 1992).
Water Committees	-Water committees are elected by water beneficiaries (who are local people) to directly regulate use of the resource. -These determine the number of people accommodated by each wetland by approving new applicants in consultation with traditional leaders and other relevant organisations. -Water committees, with the help of users, protect the wetlands, catch illegal users and report illegal activities to relevant government agencies (Adhikari et al. 2014). -They coordinate wetland management activities and there are spatio-temporal variations in the effect of their performance.

Source: Gumbo (2006:p5)

The battery of institutions presented in Table 2.1 and their various roles do not always complement each other's efforts nor do they synchronise their activities. The principal institution in water resources management, data collection and scientific research, as noted earlier, is the Zimbabwe National Water Authority (ZINWA) as enshrined by the Water Act of (1998). Its policies are shaped by the Department of Water Development in the ministry of Environment, Water and Climate. Other service departments e.g., the Department of Agriculture, Research and Extension Services (AGRITEX) and the Department of Irrigation, under the Ministry of Ministry of Agriculture, Land and Resettlement are professional units providing specialist advice to ZINWA on the demand side of water. These institutions have their own obligations to accomplish and ZINWA can only impact on the manner in which these agencies use water through pricing of the commodity but not necessarily by making calls for conservation (Gumbo, 2006). Only the Environmental Management Agency (EMA) has the legal authority to intervene when over utilisation of water is having a negative impact on the ecological situation prevailing in catchments. To this end, EMA needs to work closely with the Catchment Councils, particularly given that the work of EMA is to a large extent not inhibited by political and administrative boundaries (Mbereko et al. 2007).

Derman et al. (2007) observe that Zimbabwe manages water under seven catchments each under a Catchment Council as enshrined in the Water Act of (1998). This devolved institutional framework for water management, as observed by Mtisi (2011), was drawn from the hypothetical charm of devolution which suggests that a more decentralised framework of management was more exposed and more responsive to local requirements and desires. This decentralisation can therefore be regarded as producing structures of water management that were accountable to local communities and offered an institutional forum for encouraging involvement and representation of diverse water users in decision-making processes. The Catchment Councils are created by representatives of stakeholders existing in the catchment area and account directly to a Catchment Manager under ZINWA. The Catchment Council is expected to make income from the sale of bulk water within its catchment area. Gumbo (2006) argues that the demarcated catchment areas were too large for effective administration, hence the need for sub-catchment councils that are more localised and are lower level management units. Sub-Catchment Councils report to Catchment Councils thus the importance of Catchment Councils and Sub-Catchment Councils to the management of water need not be overstated. According to the Water Act, (1998) Sub-Catchment Councils perform the following functions; formulating strategies for the optimal development and use of the water resources in

their areas, to come up with a detailed inventory of water resources of their catchments, identifying the main water uses within their catchments. They also recommend the sharing of water to various segments of the economy, setting the standards on the maximum acceptable levels of contamination and producing water development proposals in line with the inventory of the resource.

These functions are critical to the success of the management framework of water in Zimbabwe and presume that sub-catchment councillors have a comprehension of matters at hand. However, in reality these are elected people, and as Gumbo (2006) observes, may not be technically competent and may not be able to perform any of the functions stated above and in the end surrogate all the work to ZINWA and the Minister accountable for the Act. In addition, there are some members who come in by virtue of derived power like nominees from rural district councils, ex-officio members e.g., chiefs. These are merely there to protect the positions of their institutions and only come to increase the numbers but do not essentially have to be knowledgeable in the nuts and bolts of water management. In addition Mbereko et al. (2007) observe that, the boundaries of sub-catchment areas and even the main catchments themselves do not always match with district and provincial boundaries. This makes synchronised planning a challenging task, setting the scene for paralyses in making resolutions and squabbling leaving ZINWA to make the main decisions.

Devolution of the water sector in Zimbabwe started way back in 1988 but was then aimed at district administration. With the RDCs in place it was inevitable that services were to be rationalised and provided at RDC level. Government line ministries would now provide services through the RDCs. However, as noted by Derman and Ferguson, (2003) effective devolution has been hindered by the limited income streams at RDC level which has meant that central government has continued to offer vital backing to these entities. The ability to obtain possible revenue has also been compromised by what Gumbo (2006) calls government's equity imperatives which have meant that agencies such as ZINWA are failing to extract the true price of water from the new farmers who occupied the former commercial farms. There has to be acceptance by central government for agencies to charge profitable rates, otherwise there will be devolution deprived of devolution of power.

Mtisi (2011) suggested that in the case of new institutions in the water sector, institutional capacity must be cautiously constructed and specific mandates assigned to the new institutions must be progressively done in order to give them time to develop the required capability to

hold the new responsibilities. He maintains that in Zimbabwe institutional strength can be greatly improved by clearly defining unambiguous responsibilities for the newly formulated institutions (such as ZINWA and its sub-catchment councils), providing training and guidance where necessary. Therefore, even though devolution has its progressive characteristics, there is a risk of the new institutions working outside of prevailing local government and traditional authorities in the management of water.

The participation of more than one institution in the management of each spring waterscape results in either complementary or conflicting roles. Relationships are on occasions less cordial due to inter-agency rivalry, overlapping and contradictory duties (Mbereko et al. 2007). As argued by Gumbo (2006), the main weakness to the existing institutional structure efforts in managing water resources is the absence of coordination and domination of some institutions. NGOs, for example, use their monetary strength to control spring utilisation and management decision making agenda. Absence of a clear institutional framework acts as a hindrance to efficient wetland conservation as institutional responsibilities are not clear. In some cases, institutions like EMA recognise themselves as the lone entity with the mandate of conserving wetlands without recognising efforts of other institutions, a situation which confuses users on whose instruction must be followed. Mbereko et al. (2007) argue that the distant location of institutions such as EMA frequently makes the support that they give to local populations irrelevant as their visits are sporadic. Therefore, there is need to decentralise the operations of key institutions to Ward level in order to intensify their participation in wetland management.

The current institutional arrangement is also impacted by misperception stemming from differences in institutional dimensions. Marambanyika and Beckedahl (2016) observe that different penalties were being charged by EMA, ZRP, RDCs and traditional leaders for similar wetland wrongdoings. Agritex and NGOs are mostly concerned with enhancing agricultural production, hence sometimes fail to caution people engaging in farming practices that contribute to spring degradation. These differences amongst institutions lead spring users to comply with only favourable views i.e., those which permit them to engage in practices such as cultivation which give them direct livelihood benefits irrespective of their impact on spring integrity and functions. This may explain why traditional leaders and water committees are more popular and accepted by local people than EMA which largely prohibit wetland draining for cultivation (Sibanda, 2005).

Some water committees' authoritarian inclinations, whereby they ignore opinions of other wetland users, from time to time lead to conflicts to the detriment of wetland conservation. Sometimes the committees do not value wetland management options made by other users, a condition which breeds resentment and influences subsequent decline of the springs due to mismanagement of the employed agricultural technology (Mbereko et al. 2007). Politicisation of wetland use and management, particularly by councillors is another observed concern as it weakens the efforts of government agencies such as EMA. Access to wetland use is at times done on political grounds and determined by the political connection of individual households, a situation that may lead to the total disregard of the environmental management laws by the users (Derman and Ferguson, 2003).

2.10 Convergences and divergences in literature

Conceptually the study of springs was noted in literature to have changed over time from the purely hydrological approach focusing on their origin and chemical composition that was informed by mainly the natural science approach (Meinzer, 1942; Freeze and Cherry, 1979 and Gibert, 1992; Kamp, 1995). Currently, due to the appreciation of their multiple-functionality, the study of springs was noted in current literature to be dominated by the multi-disciplinary approach, where they are of interest to hydrogeologists, biologists, ecologists, geographers and anthropologists (Cudennec and Hubert 2008; Mapedza et al. 2012; Callow and Boggs, 2013; Elshafei et al. 2015).

Most literature on wetlands and springs in particular, for example, Taylor et al. (1995), Barqui and Scarsbrook (2008), Ozdemir (2011) and Zandi et al. (2016), were noted to agree on the need for inventories on the distribution of springs in order to inform decision making on their balanced and wise use. Most of this literature also agrees that this information was still lacking in both the developed and developing world. It is also notable in literature that most of the larger springs in both the developed and the developing world had been well mapped and were well managed. However, smaller springs that make up the majority of all springs have been widely ignored in inventory exercises. Most of these springs were noted to be too small to be included on the common 1:50 000 maps.

The literature also noted that most of the methods used in inventory studies included field surveys using questionnaires and GIS receivers, using aerial photographs, remote sensing based mapping, GIS techniques and geostatistical methods. The use of geostatistical methods

like the logistic regression methods, bivariate statistical models, hierarchy process, cluster analysis, frequency ratio and certainty factor models were noted to be mainly adopted in determining and predicting areas of potential spring occurrence (Groever et al. 1996; Hoffman and Sander, 2007 and Pourtaghi and Pourghasemi, 2014). Field surveys which were noted to produce the most accurate and detailed inventories, were however, observed to have been used on limited spatial extents because of the high costs associated with the method and also challenges in reaching the most remote and sometimes inaccessible places. Remote sensing and GIS based methods were noted to have the greatest potential for mapping springs and their waterscapes to a reasonable level of accuracy at minimal costs (Groever et al. 1996; Barqui and Scarsbrook, 2008; Ozdemir, 2011 and Pourtaghi and Pourghasemi, 2014).

In terms of their utilisation, most of the literature noted springs to have multiple values, competing uses and contestations in their access, hence the need to balance the needs of all the users (Bell and Roberts, 1991; Marambanyika and Beckedahl, 2016). Springs were noted to be important in agricultural production and ecological health of deep spiritual and aesthetic significance (Derman et al. 2007). In most of the literature springs were noted to be sensitive to pollution and degradation. Because of these many important uses, springs have been noted directly and indirectly in literature to be *Small Natural Features* that have a disproportionate impact on the environment and people's livelihood when compared to their relative sizes (Davis et al. 2017).

Literature from the Global South, for example, Matiza (1992), Svotwa et al. (2008), Rebelo et al. (2009), Knüppe (2011) and Dixon (2013) noted springs to be an important source of livelihoods for most rural communities by supporting food security, nutrition and household income, yet in many of these countries, governments do not openly support their utilisation. There is a notable difference in approach to spring utilisation between researchers from the Global North and those from the Global South. Literature from the Global North, for example, Von Der Heyden and New (2003), Kozina (2008), Bascik et al. (2009), Kresic and Stevanovic (2010) and Bétard (2016) mainly argue for the complete conservation of springs to preserve their important ecological functions. They argue for their protection as important sources of water and as part of geo-diversity and are not seen as being important in the sustenance of rural livelihoods. Those writing from the Global South on the other hand, like Dixon (2008), Van der Zaag et al. (2001) and Meinzen-Dick and Nkonya (2007) argue for their exploitation to support vulnerable rural livelihoods. Springs are also observed to be important sources of water

for communities that are located in mountainous and arid to semi-arid regions of the world (ICIMOD, 2015; Chinnasamy and Prathapar, 2016 and Davis et al. 2017).

Most of the literature also observed challenges in the management of springs to be centred on poor government policies which imposed management methods to local communities without consultations and also due to the erosion of traditional practices that encouraged their conservation. Some literature attributed challenges in spring management to poor community environmental awareness. However, most writers like Derman and Ferguson (2003), Van Koppen et al. (2007) and Mutekwa and Gambiza (2017) seem to recognise the co-management of local resources like springs by locals and government to be the most effective way in conserving them. Some suggested the removal of the restrictive legislation on spring utilisation as being crucial to their conservation because this would recognise both their importance to rural livelihoods and the ecosystems services that they support (Dixon, 2008; Van der Zaag et al. 2001; Dlamini, 2007 and Mabiza, 2013).

2.11 Chapter summary

The chapter gave a detailed review of the literature that was relevant to give the context in which the research problem would be studied. The review was centred on the sub-themes that are important for the understanding of the questions that the research sought to answer. The chapter explored the major debates and conceptual trends in the study of springs. It was noted that the central focus of hydrology had shifted over time with less focus being given to springs than other features of the hydrological cycle. Most research on springs, especially from the Global North, were observed to follow the natural science approach in the study of springs with less efforts being focused on the social dimension of springs. The chapter also advocated for the adoption of the socio-hydrological approach to the study of springs. This approach to the study of springs is argued in literature to be multi-disciplinary, with the adaptation of both the natural science and humanist research methods in understanding emergent water issues. Springs were also observed in literature to have multiple and sometimes conflicting values from one area to another. Springs were observed to support ecosystem services that were key to both environmental and livelihood sustainability. Most literature on spring utilisation seems to concur that effective management can only occur when there is recognition of the complete range of ecological and societal values associated with them, appreciating the threats to the

sustainability of these values and formulating policies that provide a balance between conflicting use patterns. The methodological approaches to the study of springs were also reviewed as well as the issues that influence access and contestations over spring resources. The chapter also went on to review the institutional arrangements in the management and governance of water resources in Zimbabwe with an emphasis towards those involved in the management of springs and related waterscapes. The property rights, legal frameworks and multiple institutional involvement in water resources management were also analysed in this chapter. Most literature seems to agree on the need for institutional reengineering in the arena of water resources management in order to strengthen them and avoid duplicating roles. The major divergences and convergences in literature were also noted in this chapter with most literature from the Global North advocating for spring conservation with minimal use while those in the Global South advocated for the complete transformation of springs to support agricultural based livelihoods at the same time balancing it with the need for environmental protection.

CHAPTER 3 : CONCEPTUAL FRAMEWORK

3.0 Introduction

The chapter examines the conceptual framework that was adopted to inform and guide the study. The chapter introduces and explains the sustainable livelihoods framework, its origins, development and why it was adopted in the study. The weaknesses and strengths of the framework are also discussed as well as how the framework informed the study.

3.1 The sustainable livelihoods approach

One of the major challenges facing Zimbabwe and the rest of Southern Africa is that of precarious rural livelihoods. This challenge needs urgent attention, hence some schools of thought argue that if resource management (water in particular) takes a livelihood-approach some progress towards improving livelihoods can be made (Mabiza, 2013). To unravel deeper understanding of the relationships between spring water utilisation and rural livelihoods, the sustainable livelihoods framework (SLF) was adopted to guide the study. The SLF, as argued by Mazibuko (2013), focuses on people, their livelihoods and how people can mobilise their assets to realise their basic needs of life and lessen poverty. Arthur et al. (2016), highlighted that numerous livelihood studies have adopted and applied the SLF approach giving basis for development studies, thinking, and research. Examples amongst many include; Tabane (2015), adopted the SLF to investigate the role that water plays in securing livelihoods for households in Borakalalo village in Lehurutshe North West Province of South Africa. Mazibuko (2013) explained underdevelopment in South Africa using the SLF as the framework of development thinking. In particular, the study used the settler colonial period to illustrate the importance of structures and processes in the distribution of resources. Mazibuko (2013) further used it in apartheid South Africa to explain exactly how institutions can suppress development instead of promoting it, and therefore, set in the conditions of underdevelopment. Nikolakisa and Grafton (2015) adopted the SLF as a lens to analyse problems linked to tension and conflict in societies brought about by development projects when natural capital is used as the basis for livelihood projects. They used the SLF to examine the allocation of water rights to indigenous groups in remote northern Australia to determine the suitability of this form of natural capital to support sustainable livelihoods. Arthur et al. (2016) used the SLF to explore the nexus between artisanal mining and livelihood sustainability in the Prestea mining region of Ghana.

To analyse the way spring utilisation contributed to sustainable rural livelihoods, it was essential to appreciate the associations amongst variables impacting on the problem (livelihood outcomes) and its drivers (assets). This therefore led to the adoption of the SLF as the focus and lens through which the study conceptualised the research problem as advocated for by the UK (DFID, 1999). The sustainable livelihoods framework (SLF) as written in Massoud et al. (2016), is principally not well-defined as a theory but rather an approach for doing things which does not lay down steps to be followed but instead offers the scope and guidelines which can be employed in a livelihood research project. Mazibuko (2013) also envisaged the SLF not to be a model, but rather as an approach to understanding development problems and to assist in formulating solutions for these challenges. In this research, the SLF was adopted to connect the importance, utilisation and management of springs by rural communities in the Save Catchment and their contribution to rural livelihoods outcomes in the context of inter connected capital domains, vulnerability context and transforming institutions.

3.2 Emergence of the sustainable livelihoods paradigm

The sustainable livelihoods framework came into being as a consequence of debates, consultations and discussions on sustainable livelihoods, poverty reduction, and assets (Arthur et al. 2016). At the global stage, the sustainable livelihoods idea was first put forward by the Brundtland Commission on Environment and Development in 1987. It was then promulgated as a concept by the 1992 United Nations Conference on Environment and Development, which promoted the attainment of sustainable livelihoods as a goal for poverty eradication (WCED, 1987).

The SLF was shown by Krantz, (2001) to be an off shoot from the concept of sustainable livelihoods that has grown and matured through time to be an acceptable way of analysing rural poverty. According to the DFID, (1999) in the 1990s there was an apprehension that poverty, and the practices that led to poverty, must be considered as multi-dimensional, for example, being economical, ecological, cultural, social and political, and also very much context-specific. As highlighted by Scoones (1998), this then led to the advancement of poverty evaluations beyond just its categorisation but towards the examination of the practices that influenced it at numerous levels. Mabiza (2013) observed the SLF to have been quickly accepted as a means of understanding poverty mainly due to the limitations of the monetary

and statistical methods prevailing during the 1970s and 1990s that measured and analysed socio-economic progress in financial terms. Although such econometric methodologies still play a significant role in understanding socio-economic development, it was noted that they failed to address the full essence of livelihoods. This is applicable for rural livelihoods where, institutional factors impacting on access and utilisation of resources remain critical in influencing the quality of livelihoods, hence, such incalculable influences play a significant part in defining the prospects obtainable to households and in turn their productivity. These issues then led to the search for a framework that could transcend the quantifiable analysis of resources but could capture rural livelihoods in their entirety.

Scoones (1998) defined a livelihood as encompassing the abilities, possessions (including both material and social resources) and activities essential for a means of surviving. As argued by Chambers and Conway (1991), a livelihood is sustainable when it can cope with and recuperate from stress and shocks, sustain or improve its capabilities while not undermining the natural resource base. A livelihood, from Massoud et al.'s (2016) point of view, comprises persons, their competences and their means of earning a living, including food, income and assets. Chambers and Conway (1991) argued that, a livelihood was environmentally sustainable if it can preserve or improve the local and global assets on which livelihoods depend and has net positive effects on other livelihoods. They posit that a livelihood is socially sustainable if it can cope with and recuperate from stress and shocks and deliver services for upcoming generations. Nikolakisa and Grafton (2015) observed a sustainable livelihood as one that is resilient and adaptive to shocks, to markets, price risks and capriciousness in landscapes. Kollmair and Gamper (2002) argue livelihoods to be categorised as being sustainable, if they were resilient in the face of outside shocks and strains, if they were free from outside support, if they sustain the long-term production of natural resources and if they did not undermine the livelihood alternatives of other persons or communities. Kollmair and Gamper's (2002) voice on livelihoods was adopted as the researcher's view on livelihoods during the study.

The sustainable livelihoods notion, as noted by Krantz (2001), was first coined by the Brundtland Commission on Environment and Development. The 1992 United Nations Conference on Environment and Development held in Rio de Janeiro expanded this concept, promoting the realisation of sustainable livelihoods as a comprehensive objective for poverty reduction. As observed by Solesbury (2003), so many influences have facilitated the expansion

of the sustainable livelihoods approach (SLA), hence went on to develop a chronology which is shown in table 3.1.

Table 3.1: Sustainable livelihoods chronology

Year	Event
1987	The World Commission on Environment and Development publishes the Brundtland Commission report which coins the term sustainable livelihoods.
1988	The International Institute for Environment and Development publishes papers on The Greening of Aid: Sustainable Livelihoods in Practice (Conroy and Litvinoff, 1998).
1992	UN holds Conference on Environment and Development in Rio. The Institute of Development Studies publishes 'Sustainable Rural Livelihoods: Practical concepts for the 21st century' (Chambers and Conway, 1991).
1993	Oxfam starts to employ the Sustainable Livelihoods approach in formulating general aims, refining project strategies and staff training.
1994	CARE embraces household livelihoods security as a programming basis in its relief and development projects.
1995	UN holds World Summit for Social Development. UNDP adopts Employment and Sustainable Livelihoods as one of five priorities in its overall human development mandate, to serve as both a conceptual and programming framework for poverty reduction.
1998	DFID opens a consultation on sustainable livelihoods and establishes a Rural Livelihoods Advisory Group. It adopts Sustainable Livelihoods as its aim and later publishes contributory papers called Sustainable Rural Livelihoods: What Contribution Can We Make? The FAO/UNDP Informal Working Group on Participatory Approaches and Methods to Support Sustainable Livelihoods and Food Security meets for the first time.
1999	DFID creates the Sustainable Livelihoods Support Office, publishes the first Sustainable Livelihoods Guidance Sheets. Also founds the Sustainable Livelihoods Resource Group of researchers and consultants. FAO organises an Inter-agency Forum on Operationalising Sustainable Livelihoods Approaches, involving DFID, FAO, WFP, UNDP, and IFAD.
2001	DFID commissions research on further development of the SLA framework, practical policy options to support sustainable livelihoods.
2002	World Summit on Sustainable Development (Earth Summit, 2002) held in Johannesburg, South Africa. Called Rio +10.
2012	World Summit on Sustainable Development held in Rio de Jeneiro Called Rio +20.
2017	UNDP publishes a 'Guidance Note' on the application of the sustainable livelihoods framework in development projects.

Source: Solesbury (2003: p. 3-4)

As discussed in Chambers and Conway (1991) the rise of the sustainable livelihoods concept had all the qualities of a classic paradigm shift in the method of approach to rural development and the priorities for policy, practice and research. Ashley and Carney (1999), observed this change as occurring at a period when preceding leading theories and practices mainly those related to integrated rural development were losing their intellectual and political charm. Sustainable livelihoods offered a renewed approach and part of its desirability was the fact that it captured and blended various elements of developing thought and action. Morse et al. (2009) posit the SLA as having theoretical, practical and organisational roots because it conceptually

drew from changing opinions of poverty, recognising the multiplicity of ambitions, took into consideration the significance of assets and societies, the restrictions and prospects provided by institutional structures and processes. In practical terms, the SLA positioned people rather than capitals, amenities or organisations as the focus of concern and action and underscored that development must be participatory and developments must be sustainable. Organisationally the SLF had evolved within research institutes, NGOs and donor agencies and was not limited to one or the other.

Another important component of the SLA, as highlighted by Helmore and Singh (2001), was the appreciation that the roots of community development and economic growth were livelihoods not jobs *per se.* They argue that appreciating the existing livelihood activities, assets, and privileges of a community or individual gives the best guideline as to the ways in which their livelihoods can be made more productive and more sustainable. As discussed in Knutsson (2006), the SLA characteristically reveals the multi-dimensional character of actual life, incorporating environmental, social and economic issues into an all-inclusive framework, which gives a prospect to encourage the cross-sectoral and cross-thematic approach that must be the core of sustainability. The SLA is also directed towards the means by which local societies can pursue basic and ongoing necessities like food and shelter, as well as safety and self-respect through meaningful work, while concurrently determined to reduce ecological degradation, achieve rehabilitation and address fears about social justice (Sears et al. 2016). This can be done through communities concentrating on their assets, strategies, and strengths rather than necessities alone.

3.3 Application of the sustainable livelihoods approach in practice and research

As observed by Morse et al. (2009), application and utilisation of the SLA can be best understood by the speed and profile of organisations that approved and used the sustainable livelihoods concept in their practice. International organisations, such as, the Oxford Committee for Famine Relief (Oxfam), Cooperative for Assistance and Relief Everywhere (CARE), Food and Agriculture Organisation (FAO) and the United Nations Development Programme (UNDP) found it appealing and were quick to embrace it in its different forms in their work. In embracing SLA, Solesbury (2003) observed that these organisations were building on their long established pledge to participatory approaches to development, hence

the SFL idea was in sync with their standing principles and beliefs and also provided them with powerful new analyses and arguments with which to promote them.

For the researchers the sustainable livelihoods concept was seen by Krantz (2001) and Arthur et al. (2016) as providing a rich new approach, hence it swiftly developed into a global focus for both empirical and hypothetical research work since it had the charm of both continuity and change. It was grounded on conventional viewpoints but reconfigured them into a new and attractive paradigm. It was this new intellectual direction in the research community that Official Development Assistance of the Organisation for Economic Co-operation and Development (OECD) recognised and picked it in the 1995–96 period when they were searching for new major research approaches to take on board (Morse et al. 2009).

Before the adoption of the sustainable livelihoods approach, Krantz (2001) noted that the conventional opinion was that, research informed policy and that policy was applied through practice. This linear, one-way connection as depicted in figure 3.1 could be conveyed as Research - Policy – Practice, hence policy was the appropriate target for leading research.

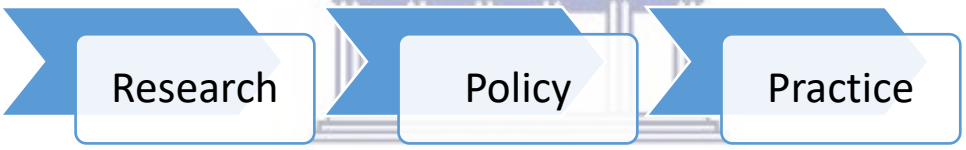


Figure 3.1: The linear relationship of research-policy-practice

The development of the SLA discourse shows a fairly different form of interactions. Research had an effect on practice, as much as it had on policy and the connections are not just one way. Chambers and Conway (1991) remarked that 'livelihoods and sustainable livelihoods, were concepts that had evolved more from open-ended fieldwork than from the closed concerns of surveys and statistics', hence the SLA represents research/policy/practice interaction as shown in figure 3.2 where all three have two-way interactions with each other:

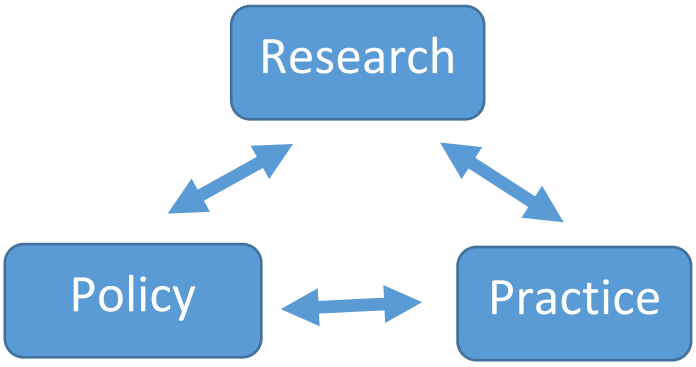


Figure 3.2: Research-policy-practice interface under the SLA

The DFID (1999) observed the SLF to be firmly rooted in multidisciplinary research, which expounds why it has remained usable in numerous geographical areas and sectors, aiding in appreciating and analysing the livelihoods of the poor. The SLF also refines our understanding of livelihoods, in planning new development activities and evaluating the contribution to livelihood sustainability made by operational activities.

3.4 Sustainable livelihoods framework

Based on the sustainable livelihoods approach, Scoones, (1998) noted that the DFID, amongst other organisations developed and promoted a sustainable livelihoods framework (SLF) for organising applied research for development. The framework was chosen and adopted for the study because it provided an analytical framework that encouraged systematic analysis of the underlying processes that linked spring utilisation with rural livelihood strategies and outcomes. The SLF permitted the merging of different approaches to understanding various issues and how these issues shaped the livelihoods of the rural poor as advocated for by (Mazibuko, 2013). The SLF informed the study because it provided a framework under which the interlinked processes that influenced household decision to utilise spring waterscapes to support their livelihoods could be understood. The SLF, therefore, provided the scope through which improved understanding of community livelihoods could be objectively studied in as far as how they influenced the utilisation of springs in the study area. Most importantly, the SLF provided the opportunity for the researcher to actively involve local communities in the research, particularly through interviews, discussions and participatory impact assessments. Figure 3.3 shows the SLF adopted in this study.

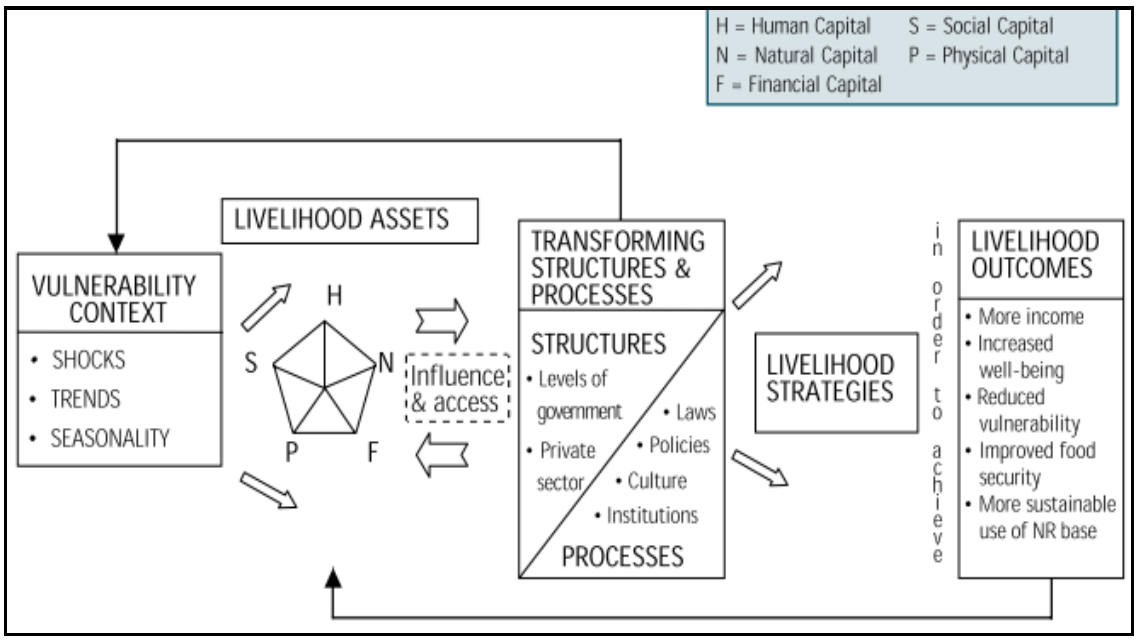


Figure 3.3: The sustainable livelihoods framework

Source: DFID (1999: p.26).

Arthur et al. (2016) observed the SLF as having five main constituents which are; the vulnerability context in terms of stress, shocks and seasonality, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes (Figure 3.3). The arrows in the framework indicate the connections between the different components and show how one component influences another. The components of the SLF were, therefore, adopted in the research to understand the linkages between the manner in which communities were utilising springs to sustain their livelihoods and factors that reduced their access to the springs in the Save Catchment. In its simplest form, the SLF as promulgated by Scoones, (1998) conceptualises a livelihood as being constructed around five major types of interconnected forms of capital/assets obtainable by persons, families or communities. These are graphically represented as a pentagon to emphasise their interconnections and the fact that livelihoods are sustained by an amalgamation of assets of different types and not just from one category (Figure 3.3).

The five interrelated livelihood assets in the pentagon are human capital, social capital, natural capital, financial capital and physical capital. Human capital is characterised by the abilities, skill, quality and amount of knowledge, capability to work and good health that together permit individuals to follow a variety of livelihood strategies and realise their livelihood outcomes. Human capital also includes the labour available within a family that it can mobilise in order

to achieve desired livelihoods as well as the capacity to adapt to changes. Natural capital, refers to both the quantity and quality natural resource stocks, for example, land, water, forests, clean air upon which people depend for their livelihoods. The benefits from this natural capital can be direct or indirect and they are strongly connected with property and user regimes. Mazibuko (2013) notes that rural livelihood strategies are often greatly dependent on the natural resource base like in this case, the springs. Other examples of natural capital include air quality, land and produce, biodiversity, forests, wildlife, water and other aquatic resources.

Financial capital, according to Massoud et al. (2016), refers to the financial resources that individuals use to attain their livelihood outcomes. These are resources in the form of obtainable stocks, access to monetary services, savings and steady inflows of money, for example, livestock and the related flow of income. Financial capital also includes things like credit or debt from both formal and informal organisations including NGOs, remittances, pensions and wages. Physical capital encompasses the basic infrastructure and physical properties that supports livelihoods. Infrastructure also comprises changes made to the physical environment that support people to meet their basic necessities and to be more productive (Sears et al. 2016). Physical capital includes devices, implements and equipment that households require for increasing production in order to earn a living. Good examples include transport systems like roads and vehicles, energy, communication infrastructure, traditional technologies, housing, seed, fertiliser, pesticides, water and sanitation systems.

Social capital is defined as the social resources which people use in quest of their livelihood objectives. These social resources are established through interfaces that increase people's ability to work together, membership of more formalised groups governed by recognised rules and norms, associations of trust that facilitate collaboration, reduce transaction costs and can provide informal safety nets (Mazibuko, 2013). Social capital includes either the poor's connections with more influential individuals (vertical connections) or with individuals similar to themselves (horizontal connections). Social capital largely builds relations of trust, mutuality and exchange that the poor can draw from in times of need and reduces the costs of working efficiently together. Mechanisms for involvement in decision-making processes and collective representation are part of a community's social capital. Social capital has an intrinsic value because respectable social relations are not merely a means, but an end in themselves. Sseguya et al. (2009) added cultural capital to their SLF analysis of farming communities in Uganda after observing that households in their study area had dynamic access to capital. For example,

poorer households tended to have more access to cultural capital and less access to social and economic capital than wealthier households.

In the SLF, as observed by Massoud et al. (2016), the opportunity of following a certain livelihood strategy is affected by a context where susceptibility to shocks, trends and seasonality permits opportunities and also induces restraints on people's choices. Scoones (1998) advanced three broad livelihood strategies in a rural context which are agricultural intensification or extensification, migration and livelihood diversification. Agricultural intensification is a strategy where those enacting the livelihood strategy intensify their production on the existing land base and extensification includes an increase in land under production. Migration includes the individual, household, or collective community moving to new spaces in order to improve their welfare. The third general strategy of diversification is one where a variety of livelihood strategies are selected and combined to enhance livelihoods. The vulnerability context and the livelihood assets are in turn also mediated by transforming structures and processes that influence and govern aspects of access to assets, resources and activities (Scoones, 1998). Mazibuko (2013) observed that from these three aspects of assets, vulnerability context and transforming structures and processes, livelihood strategies are shaped in order to attain diverse livelihood outcomes like income generation, improvement of well-being, accumulation of assets or minimisation of risks and rural transformation.

Arthur et al. (2016) observed that the transforming structures and processes such as culture, laws, and policies in the framework were associated with the vulnerability context which in turn impacts on the livelihood assets available. Livelihood strategies such as gardening, brick moulding are influenced by various transforming structures and processes such as laws, policies, and culture which in turn help to improve or decrease an individual's assets in the community. The institutions, policies, and customs of the transforming structure and processes in the framework either enhance or hinder people's access to an asset or resource such as natural capital (DFID, 1999). The livelihood outcomes in the framework are achieved as a result of livelihood strategies and are linked to livelihood assets to indicate how they improve or increase them (Carney, 1999).

The DFID (1999) argues that, in the SLF assets were both shaped and damaged as an off-shoot of trends, shocks, and seasonality of the vulnerability context. Assets' connections with livelihood strategies demonstrate that persons with access to a variety of assets usually also have a wider array of opportunities and capacity to interchange between various strategies to

safeguard their livelihood base as well as realise positive livelihood outcomes. They argue that the vulnerability context comprises shocks, trends, and seasonality of livelihood strategies which in turn is connected to livelihood assets to illustrate how it impacts on livelihood assets like human capital and natural capital. The vulnerability context in the SLF characterises the external environment in which societies occur. Trends, shocks, and seasonality are the key aspects over which individuals and communities have less or no control over. Scoones (1998) argued that the capability of livelihoods to recuperate from stress and shock was significant to obtain sustainable livelihoods. This brings up the utility of the SFL as the conceptual framework of this research, which focuses on livelihood outcomes, assets owned by people in their pursuit of livelihood strategies such as gardening, tourism and craft making activities, and the vulnerabilities that they are exposed to.

Arthur et al. (2016) observed that the sustainable livelihood framework components, were extremely interweaved and difficult to understand as standalone concepts. For example, abilities can influence access to assets and assets are worthless without capabilities. Expertise, information, decision making capacity, good health, self confidence and self-esteem, are all examples of abilities. When competences are set into practice the outcomes are activities that permit access to assets like springs, food, land, clothing, education, social networks or work. Arthur et al. (2016) maintain that if assets like springs are accessible but the abilities necessary to utilise them are limited, then the assets become worthless, degraded and therefore, do not actually qualify to be considered as assets. Additionally, an appreciation of what an asset or a capability is hinged upon people's insights and experiences. What people view as an asset is heavily dependent on the value system of each community or individual (Chambers and Conway, 1991; Scoones, 1998). Arthur et al. (2016) observe that when capabilities and assets are utilised in the present-day, in ways that ensure future availability, then, sustainable livelihoods are attained. Livelihoods are, therefore, sustainable when there is a preservation of both abilities and resources. They maintain that, sustainability in itself is not only an end but also a means to an end, hence utilising assets and capabilities sparingly produces an environment conducive for future livelihood sustainability.

Carney, (1998) observed that the framework presented means of evaluating how organisations, policies, institutions, cultural norms help construct livelihoods, by defining who gets access to which kind of asset, and deciding on the kind of livelihood strategies that were available and appealing to individuals or societies. The significance of adopting SLF, according to DFID

(1999) was that it encouraged users to make comprehensive and systematic assessments of the elements that influenced poverty, from shocks and negative trends, poorly functioning institutions and policies, or limited assets and to examine the associations amongst them. Krantz, (2001) observed that the SLF does not take a sectoral assessment of poverty, but attempts to merge the influence made by all the sectors to the accrual stocks of assets upon which persons tap to sustain their livelihoods. The goal is to remove the pre-conceived ideas around precisely what people pursue and how they are likely to reach their aims, and to build an accurate and dynamic depiction of how different sets of society function in the context of their environment (DFID, 1999).

3.5 Critiques

In as much as the SLF is comprehensive and makes significant issues difficult to oversee, it has got its own set of weaknesses that the user must take cognisance of. Clark and Carney (2008) argue that if the SLF is used mechanically or uncritically, it may lead to a fundamental weakness of hampering critical enquiry and examination to aspects that are not in the framework. Cahn (2002) argues that the framework over-simplifies complex reality by portraying the connections amongst the different factors and depicting the reality and complexity of a livelihood system in a simple and coherent way. This over-simplification in the end may lead someone to miss the relative significance of some factors and associations among these factors.

Massoud et al. (2016) argued that the SLF was too micro or household based and does not help much in appreciating the connections between local and supra-local institutions or policies and ways to relate this to policy. It has also been criticised for failing to consider the impacts of war, violence and sex relations and giving too much significance to financial and physical assets (Collinson, 2002). The SLF assumes that livelihood matters are politically neutral which in reality contrasts sharply with the essential role that power inequities perform in influencing poverty (Ashley and Carney, 1999) and susceptibility to catastrophes. As observed by Carr (2013), the livelihood approaches that developed in the late 1990s originated from an unspecified and largely uninterrogated, assumption that livelihoods were predominantly about the upkeep and enhancement of the material conditions of life.

As argued by Cahn (2002), the SLF is 'too complicated to be useful', life is complex and any perspective that desires to comprehend something as extensive as how people preserve their livelihoods has to deal with complicated questions. The SLF gives inadequate scope in trying to appreciate people's livelihoods because a good livelihood investigation must primarily understand people's livelihoods before hastening to assist them to develop. This means that the SLF is still valuable in highlighting the conceptual picture on ways livelihoods are shaped but needs to be used critically as a livelihood research instrument.

Krantz (2001) argues that livelihood examination using the SLF frequently ends up doing too little due to its attempts to do too much. Krantz (2001) maintains that it tries to illustrate the vulnerability context and the policies, institutions and processes that shape livelihoods and in the end, it just gives a superficial description of how those aspects have moulded the livelihoods of different people. Van Dillen (2003) makes a sweeping disapproval of the SLF as seeking to capture the huge complexity of development problems at the expense of focus, depth, and analytical clarity. Arce (2003) argues that the SLF tends to give more emphasis on explaining the boxes in the framework diagram at the expense of elucidating the arrows and connections, hence it gives only fuzzy relationships between capitals, resources and social actors. This underlines its common inclination of emphasis on material assets, technical and economic factors, underestimating the significance of institutions. A general, technical and depoliticised portrayal of what people do to earn a living, as in the SLF, is barely a satisfactory foundation for understanding people's limitations and prospects and for analysing how best livelihoods can be sustained (Lautze and Raven-Roberts, 2003).

It has also been argued that the framework is not analytical about contradictory terms such as vulnerability, transformation and sustainability (Arce, 2003). The SLF has the limitation of outlining what assets entail, for example, if political power must be counted as part of the assets (Smith, 2004). Furthermore, as Davies et al. (2008) highlighted that the framework served more the agendas of outside interests, such as, the donor community and not those of the poorest sections of local societies. Scoones (2009) highlighted that his worries with the SLF were due to its incapacity to address macro-scale global processes and their impact on livelihood concerns at the local level. He argues that if livelihood opinions, like from the SLF, fail to contribute to the larger-scale discussions about globalisation, then that space can be occupied by macroeconomic scholars who are particularly under-informed on local level complexities.

The SLF is frequently anticipated to be used to explain livelihoods, but as argued by Krantz (2001), this is both an impractical expectation of any research work and a misinterpretation of the functions of frameworks. No single research study can include everything that is covered by the SLF, and it is not the duty of the framework to set and clarify research questions. A framework only sets out the potential areas that might impact on the theme being investigated (livelihoods) and it offers ways of approaching selected research questions. The research questions must be selected, by the researcher, according to the focus of the study and not through the SLF. The SLF is also not a blueprint on rural livelihood development or poverty alleviation but rather an analytical framework which strives to guide the rationale behind development planning and intervention (Scoones, 1998).

3.6 How the SLF informed the study

An analysis of the impact of spring utilisation on rural livelihoods in the Save Catchment was done by adopting the SLF as the conceptual pivot. The SLF informed the study in several ways. Firstly, the framework advocates for collecting and patching together data from a variety of sources in an integrated, interdisciplinary approach that draws upon both quantitative and qualitative data collection and analysis tools. The study therefore, also adopted the mixed methods approach, as informed by the SLF, in the collection and analysis of data from various sources on the utilisation, conservation and institutional framework guiding spring wetland management on the Save Catchment and their impact on the sustainability of rural livelihoods. Such a consolidated approach to the analysis of livelihoods provided a more detailed and convincing analysis than what any single method could accomplish. Serrat (2017) observed people to respond differently to quantitative and qualitative data, for example, statistics is necessary to convince some audiences, while others are unimpressed by numbers. These relate more to in-depth and contextual information collected using qualitative methods. Triangulation and crosschecks on the results from different methods can increase confidence in the overall study. Use of quantitative and qualitative methods provided a richer base for analysis, where data from each method helped to interpret the other.

In addition to informing the research design, the phases of the SLF guided the organisation of the investigation into sub-themes that guided the collection and examination of information. The framework invoked the researcher to think holistically and dynamically about the study

problem and all possible factors that might have contributed to the understanding of how rural communities of the Save Catchment have constructed their livelihoods around spring utilisation.

The SLF recognises people themselves whether poor or not, as actors with assets and capabilities who act in search of their own livelihood goals, not as passive victims or recipients of government policies and outside aid. This then informed the research to adopt the household as the unit of study in the research. The research sought to understand how the individual households within a community utilised springs to support their livelihood strategies while conserving them for the future, in an environment with diverse institutions and vulnerability context. The SLF helped to determine how individual actions on springs help to understand the overall pattern of spring utilisation and management in the Save Catchment. During literature review and discussion of the results, the SLF provided scope and focus by pointing towards issues that were relevant to the study and needed in-depth analysis. It therefore, made important issues difficult to overlook. The stages and linkages between different components of the SLF provided the research with the discussion points that helped to unravel the meaning of the observed results.

In designing the study, the researcher identified important aspects of people's livelihoods that were not explicitly captured in the SLF but were deemed very significant to explaining household's decisions to utilise springs, other choices they made and consequent livelihood outcomes. The SLF was then adopted to inform the study including the missing but important components. The addition of culture as a standalone asset was done to the pentagon of assets in the SLF that was used in the study because springs in the study area were recognised as part of the cultural landscape and culture played a significant role in their access and management. Culture, which includes things like beliefs, identity, festivals, language, traditions and sacred sites can detect how things have been done in the past, the relationship of certain spring uses or practices to ancestors, or their importance in festivals can influence whether people adopt sustainable ways of utilising them or the extent to which they value them. These cultural assets or factors may not have direct economic value but are centrally important in people's lives, choices and well-being.

Also not implicitly shown in the SLF but considered in the research was the concept of power and power relations. These include intra-household power relationships and women's empowerment and the extent and nature of women's power, as well as if its rise or decline can

have a significant influence on livelihoods supported by springs. The SLF conveys a neutral approach to power issues which contrasts with the central role that power imbalances play in influencing livelihoods and poverty.

The SLF did not clearly guide the researcher into incorporating the significance of historical factors though they could be implied from the shocks, trends and seasonality in the framework. For example, where people have had a history of problems with outside interferences or colonialism, these factors can influence their response to interventions or utilisation of particular resources. The impact of political capital was also considered in the study although it is silent within the SLF. The political capital can include, citizenship, enfranchisement and membership to political parties which can be key in procurement or operationalising rights over other livelihood assets. The above critiques were addressed by including these additional concepts to the SLF whenever they were relevant to the study. Thus, use of the SLF did not have to be limiting but it was simply not adequate on its own for pointing to all possible factors pertinent to the study.

3.7 Chapter summary

The chapter discussed the sustainable livelihoods framework as the conceptual framework on which the research was hinged. The chapter also noted that quite a number of livelihood studies had adopted and applied the SLF approach together with key international organisations such as the DFID, United Nations, CARE and the OECD. The SLF was observed to have risen as a consequence of debates, consultations and discussions on sustainable livelihoods, poverty reduction and assets. These debates then led to a conclusion that poverty and its influencing factors needed to be considered as multi-dimensional and also context-specific. The SLF was observed as having five key components necessary to understand livelihood dynamics which were the vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes.

The chapter also gave a critique of the SLF. This included the fact that, if it is used uncritically, it could lead to the omission of important aspects which are not part of the framework but having significant impact on livelihoods. It was also observed to be too micro-based and having little appreciation of how supra-local factors and policies can impact on local livelihoods. The SLF was also noted to make an assumption that livelihood activities were

politically neutral yet it is observable in reality that power inequalities in communities influence who gains access to assets and livelihood options.

Finally, the chapter highlighted how the SLF was adopted in the study as the conceptual pivot. Firstly, the components of the framework informed the methodology that was used in the study to collect and analyse the data on livelihoods from the study area, hence, the mixed method approach was found to be appropriate. The interconnected categories in the SLF, such as, the vulnerability complex, livelihood assets, transforming structures and livelihood outcomes were also used as sub-themes to guide the collection of relevant literature, presentation, analysis and discussion of results in the research. The SLF was also modified by making additions of missing components that were deemed necessary to understand livelihoods in the study area. Additions included issues to do with power relations in the communities (including gender), historical and cultural factors having an impact on livelihoods.

CHAPTER 4 : STUDY AREA

4.0 Introduction

The chapter gives a detailed orientation of the study area which is the Save Catchment in Zimbabwe. The catchment is situated in south-eastern Zimbabwe. The chapter describes the study areas in terms of its physical and anthropogenic characteristics and it also justifies why it was selected for the study. The details of communities that were selected for in-depth questionnaire surveys are also given in the chapter.

4.1 Study Area

In Zimbabwe, water resources, including both surface and groundwater, are managed by catchments. Each catchment area is under the supervision of a catchment council that comprises the chairpersons and vice-chairpersons of all the sub-catchment councils in a catchment area (Gumbo, 2006). Catchment Councils are statutory bodies that were enacted as fora for all interested stakeholders to consult and jointly manage water resources of a catchment area. Derman et al. (2007) observed the catchment borders to transcend internal political boundaries, such as, provincial and district borders, as they were demarcated using the major river systems, hence operations are not handicapped by political interference. The Save Catchment is one of the seven catchment areas formulated by Zimbabwe's Water Act (1998). The other created catchment areas are Mazowe, Manyame, Runde, Umzingwane, Gwayi and Sanyati catchments. The Save Catchment is located between latitude 18^0S- 21^0S and longitude 30^0E-33^0 E and occupies the South-Eastern parts of Zimbabwe stretching an area of 48 925km^2. Figure 4.1 shows the location of the Save Catchment in Zimbabwe. The Save River and its tributaries form the largest river system inside of Zimbabwe. The river has its source in the high veld of Zimbabwe, flows in a south-easterly direction, enters Mozambique then flows into the Indian Ocean, making it a river of international significance.

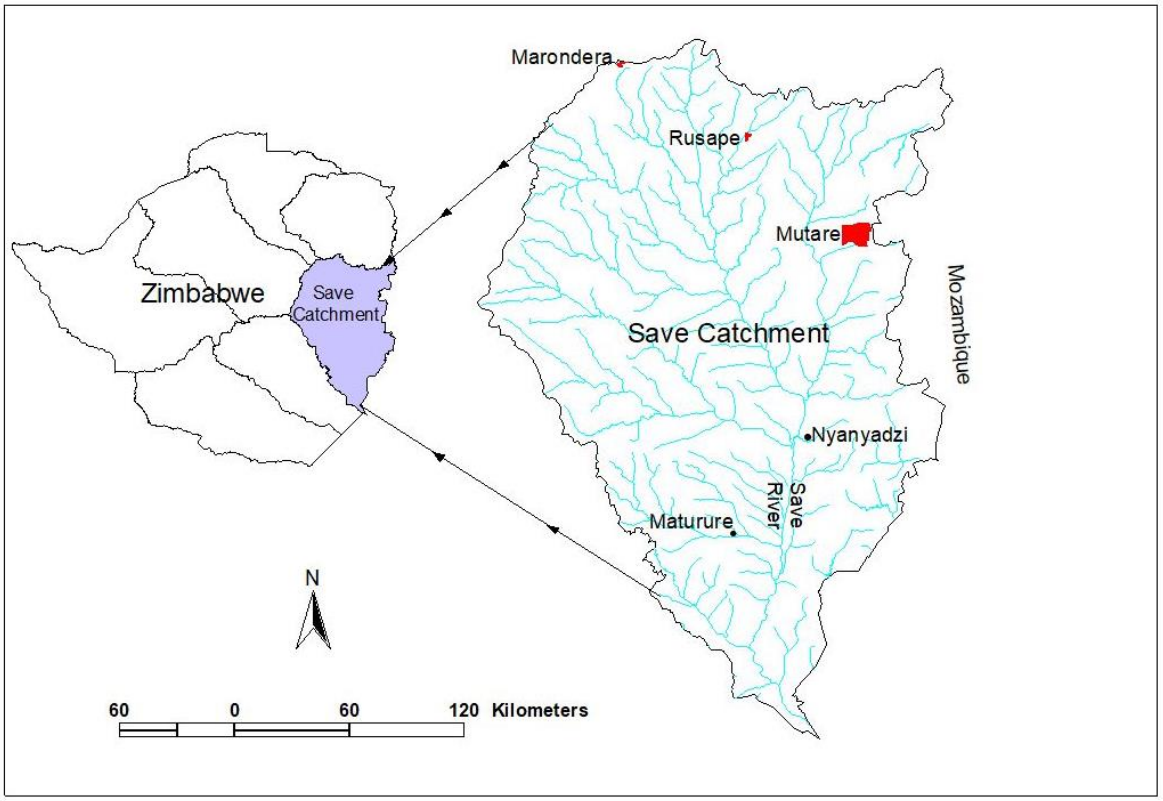


Figure 4.1: Save Catchment

Van der Zaag et al. (2001) argued the Save Catchment to be a physical hydrogeological space in which available water resources are related and in some way interconnected, hence it exists as a tangible entity. They postulate that the declaration and enactment of the new Water Act of 1998 which formed the Save Catchment Council, meant to policy makers and water actors that the Save Catchment now existed institutionally. The catchment exists institutionally because an entity was created with a legal mandate to manage the water resources of the Save Catchment. However, within the Save Catchment, many more realities also occur in the cultural, social, geological, political, geographical and economic spheres and these realities are extremely varied and sometimes fragmented. The Save Catchment area has a wide variety of water uses and users. The catchment area covers potions of the three provinces of Mashonaland East, Manicaland and Masvingo. There are seven sub-catchments that fall under the Save Catchment which are Lower Save, Upper Save, Macheke, Pungwe, Budzi, Devure and Odzi.

Although there are seven catchments in Zimbabwe through which water resources are managed, the Save Catchment was chosen as the study area because, to a large extent, it characterises most of Zimbabwe's socio-economic and environmental problems. The Save Catchment is typically sub-tropical with one rainy season (November to March) that is often

interrupted by mid-season droughts which impact on crop production, resulting in poor harvests. Mambo and Archer (2007) observed that most of the 48 925km^2 of the Save Catchment constituted, predominantly, of natural agro-ecological zones III, IV and V which are characterised by erratic rainfall and mostly sandy granite derived soils that are mostly of poor quality. However, small portions within the catchment around the Eastern Highlands are classified as being in agro-ecological region 1. According to the Zimbabwe natural agro-ecological zonation, derived by Vincent and Thomas (1960), agro-ecological zone 1 is categorised as the most productive, with uppermost rainfall amounts and deep fertile soils. On the other hand, agro-ecological zone 5 has the lowest agricultural potential, receiving a combination of the least reliable and lowest amounts of rainfall and also containing poor soils. Natural Region 3 specifically receives annual amounts of rainfall between 500 mm and 700 mm and is subject to episodic seasonal droughts, extended mid-season dry spells and unreliable onset of the rainfall season. Agriculturally, it is a semi-intensive farming zone where maize and drought-resistant crops, such as, cotton and sorghum are appropriate and irrigation is necessary for other crop production. Rainfall amounts between 450 mm and 600 mm per annum are received in Natural Region 4, which is mostly suitable for cattle ranching and very uncertain for rain fed farming. Drought tolerant crops, such as, millet and sorghum can still be grown and the region is less endowed with water resources. Similarly, Natural Region V is less endowed with water resources. Rainfall is usually less than 450 mm per annum and generally erratic. The zone is mainly designated as being too dry for successful crop production without irrigation but appropriate for cattle ranching and wildlife.

Close to half of Zimbabwe's 12.5 million people also live in the south-east basin of the country dominated by the Save and Runde catchments (Zimstat, 2013). The future of these people and livelihoods are severely threatened by reduced agricultural performance and land degradation manifesting itself through mainly desertification, soil erosion, and siltation of water resources. As observed by the Institute of Hydrology (1995) and Mambo and Archer (2007), the Save Catchment is one of the most degraded of Zimbabwe's catchments and has been the focus of considerable redevelopment planning efforts. The catchment is also of key national significance to the agricultural development of Zimbabwe, with huge areas of economically significant irrigation schemes in Chisumbanje, the middle Save and Tanganda (Mambo and Archer, 2007). Important small holder irrigation schemes in the catchment include; Devure, Nyanyadzi, Mutema and Mutambara.

The Save Catchment is also predominantly communal covering 40% of the catchment which is made up of mostly subsistence or peasant farmers, although three tenure systems also occur within the catchment. These tenure systems are; resettlement schemes and freeholds for small, medium to large scale commercial farming. The catchment has an estimated population density of 40 to 70 persons per km^2 depending on the specific ward and population growth has been cited as a factor contributing to the deterioration of the environment in the catchment (Zimstat, 2013). Human and animal populations surpass the carrying capacity in many places of the communal areas and environmental degradation is now extensive (Campbell, et al.1989; Stocking, 1996). The upper parts of the catchment are characterised by the extensive occurrence of wetlands which provide an extra potential agricultural production (Mambo and Archer, 2007).

Drought is also a recurrent phenomenon in the catchment, with at least a portion of the catchment experiencing it even during years of good rains. Bolding (1999) highlighted that droughts were now occurring more frequently during the last 20 years in the Save Catchment and expects this trend to continue into the future. Van der Zaag (2001), observed a deteriorating crisis in the Save Catchment of a fast growing population, reduced availability of water and reduced food production. The capacity of food production in the catchment has been pressed to the limit resulting in increased farming of fragile soils, waterscapes and loss of soil quality. The frequent midseason droughts have also heightened the situation, such that even in the years of favourable rainfall, most of the rural households were failing to produce sufficient food. This has resulted in rural communities in the catchment being even keener to enter into a productive engagement with the waterscapes, thus increasing the competition over reliable water sources.

Land degradation in the Save Catchment is widespread and severe, especially in communal areas, which are characterised by devegetated landscapes, poor quality pasture and soil infertility. Stocking (1996) observed that degradation was mostly manifested in the catchment as gullies that have rendered huge expanses of land practically unusable, threatening water supply quantity and quality. Whitlow (1990) observed that soil erosion was prevalent in all of Zimbabwe's agro-ecological zones, but was more evident in zones III, IV and V. The severity of land degradation in the Save Catchment has in the past attracted the attention of more than fifteen organisations, including government departments, local community groups, non-governmental organisations, the private sector and research organisations (IUCN-ROSA,

1996). Attracting this amount of attention from this diversified group of actors implies the seriousness of the problems and the urgency with which land degradation needed to be dealt with. Land degradation within a communal setup is a form of loss that magnifies poverty levels since most household rely on the land for their livelihoods. Notwithstanding their significant achievements in initiating interventions to reduce land degradation, these intervening organisations did not perform to expectation. This was due to poor coordination and piecemeal approaches to the application of interventions which led to unnecessary duplication of effort, disorganisation and competition amongst the actors. The mitigation approaches used by the organisations did not take cognisance of the different land tenure regimes within the catchment, thus impacting on the success of some intervention projects (Institute of Hydrology, 1995). This uncoordinated response to the land degradation problem was observed by Mambo and Archer (2007) to be indicative of a fragile foundation upon which policies and actions for managing natural capital in the catchment were premised. These problems included limited trustworthy evidence indicating the actual and potential land degradation across the catchment, weak institutional frameworks that perpetuate uncoordinated responses to monitoring and impact assessment and an absence of suitable interventions appropriate for the catchment.

Water access in the communal areas of the Save Catchment was observed in literature to be heavily influenced by the socio-economic history of the community with Manzungu (1999) arguing the access and utilisation of water to be a function of previous interventions. Some of these interventions date back to as far as the 1930s, when the colonial authorities forced the establishment of contour ridges in fields of communal lands, the intentional establishment of terraces at some places and the total removal of trees from arable land upon recommendation of the agricultural extension agencies. Past interventions also included the creation of areas for exclusive commercial farming and the subsequent creation of communal lands. In the 1990s, large fenced private game parks were created by merging numerous commercial farms constituting what is now called the Save Valley Conservancy. Here the natural environment is being shaped for exclusive use by tourists, but more recently there has been invasion of these lands by people seeking land. Despite serious legal backup, deployment of several technical and financial resources to monitor and assess management and use of water (including spring water), the resultant state orchestrated resource management regimes have proven to be ineffective in the communal land setup. Bolding (1999), observed that enforcement has proven to be difficult, because the interventions instigated by the state lacked legality and acceptance in the local communities. In reaction, counter discourses were created bringing about the birth

of various informal resource management systems that questioned the legality of the command and control system that was in place leading to further land degradation in the Save Catchment.

4.2 Contrasts in the Save Catchment

Mambo and Archer (2007) observed the Save Catchment in Zimbabwe to be a catchment of severe contrasts in many spheres. The lush and cooler higher parts of the catchment that have a montane ecosystem, and found at altitudes that are more than 2000 metres above sea level are sharply contrasted to the unproductive, water stressed and hotter lower parts of the catchment, with *miombo* woodland ecosystems, found on the Save valley lowveld of less than 500 metres above sea level. Bolding (1999), observed that the high precipitation areas on the windward Eastern Highlands are contrasted to the dry, semi-arid and leeward sections that receive less than 500mm/year of precipitation on average with high inter seasonal fluctuations.

Urban settlements like Mutare, Chipinge Rusape and Chimanimani are set against unspoiled parks which are either state owned, like the Chimanimani and Gonarezhou national parks, or privately owned such as the Save Valley Conservancy and the Malilangwe Trust which are a joint venture between a number of commercial farmers who merged their farms to create a huge animal kingdom. Manzungu (1999) observed the exotic pine and wattle tree plantations in the Chipinge and Chimanimani mountains of the Eastern Highlands to contrast sharply with the extensive sugarcane plantations found in the lowveld around Chipangayi, Chisumbanje and Middle Save, which are grown under irrigation.

The commercial farming areas which are well managed look strikingly much better and have less land degradation when compared to the heavily degraded and mostly overpopulated communal areas. Socio-economically, populations living under the poverty datum line with limited livelihood assets and livelihood options, and little access to basic amenities are contrasted against wealthy commercial farmers with nearly everything in their courtyard. These disparities within the Save Catchment were highlighted by van der Zaag (2001) to co-exist within the same physical space, hence the catchment knits together different water users through the hydrological cycle, making the actors interdependent, with somebody's actions predicating upon another's, sometimes hundreds of kilometres downstream.

4.3 Geology of the Save Catchment

It is a well-established fact that the structure, form and type of areas underlying geology plays the most significant role in the distribution and occurrence of groundwater (Krishnamurthy and Srinivas,1995). Geology controls groundwater accumulation, storage and movement by influencing effective porosity of the underlying rock (Ozdemir, 2011). Figure 4.2 shows the geological map of the Save Catchment extracted from the geological map of Zimbabwe from the Surveyor General's Office (1982). As shown in figure 4.2 the geology of the Save Catchment is dominated by the crystalline basement rocks, which are intrusives of mainly granite of different ages, gneiss, dolerite and gabbro which are largely of secondary permeability. The southern eastern parts of the catchment, however, contain large portions of karoo sediments, alluviums, limestone and shale that are mainly of primary permeability and can support high yielding ground water aquifers.

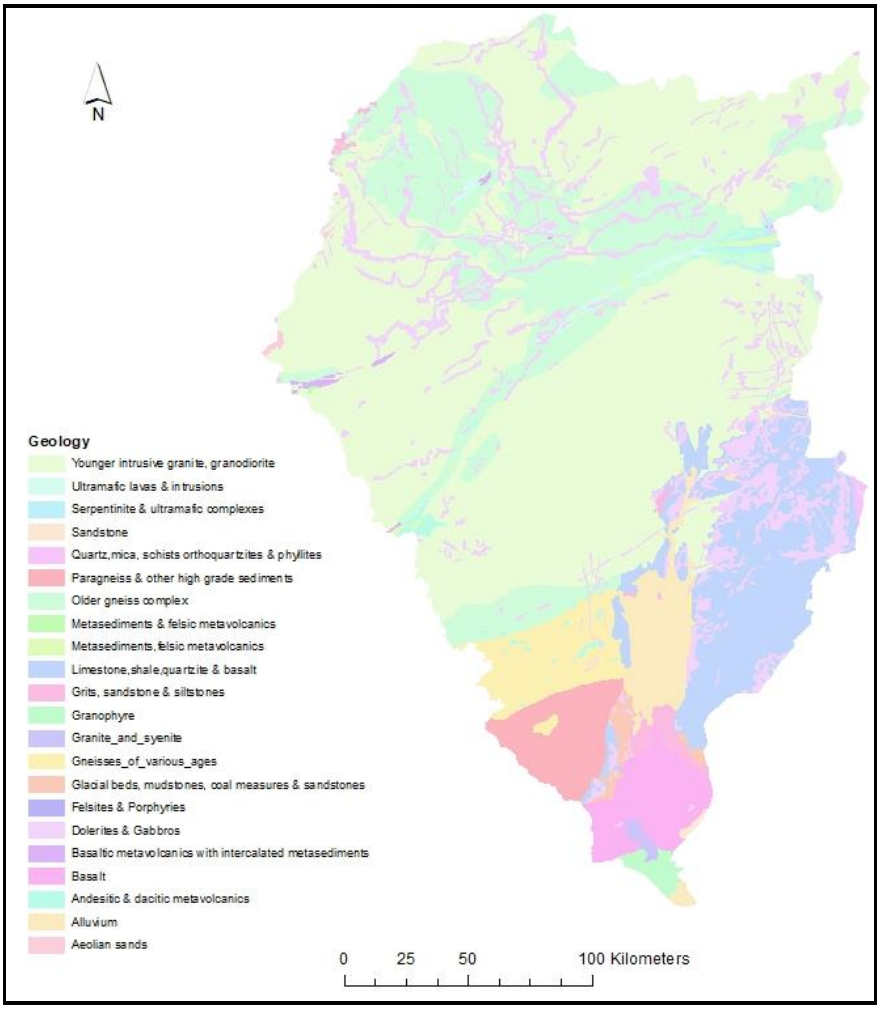


Figure 4.2: Geology of the Save Catchment
Source: Research GIS database data

As shown in figure 4.2, the Precambrian older gneiss formations occupy almost 32 853 km^2 of the total surface area of the catchment, making them the overriding geological attribute of the catchment.

4.4 Groundwater Characteristics

The Institute of Hydrology (1995) estimated the average groundwater recharge in the Save Catchment to characteristically range between 10%-20% of total rainfall received which translates to between 75mm-150mm, of which up to 40mm may contribute to runoff from the catchment. The catchment is mostly of low groundwater yield because it is underlain mostly by granitic rock formations that are generally shallow and of secondary permeability. Aquifers in these formations are found within the weathered regolith and realise limited yields that range between 10 to 50 m^3/day. Groundwater output can be as high as 50 to 100 m^3/day in those limited places with deep weathering. Due to these limited yields, groundwater development in the Save Catchment has mostly been for domestic water supply in both large scale commercial farming areas and communal areas. The rural water supply and sanitation programmes in communal areas of the Save Catchment are mainly based on the development of hand pump boreholes and large diameter wells.

However, the lower Save Valley contains an alluvial plain that is about 20 km wide and 60 km long. This alluvium comprises interbedded silt, clay and sand intercalcated with gravel and scree near the escarpments in the south eastern parts of the catchment. The alluvial plain is of the pliocene age and has a maximum depth of 70m and the Save River runs straight through this alluvial plain as a braided river channel and sand deposits within it are arkosic (rich in feldspar) with a depth of about 15m (Hydraulics Research Station, 1983). Investigations undertaken over the last 50 years have shown the existence of substantial quantities of groundwater within this formation that is observed as one of the biggest aquifers in Zimbabwe. Groundwater yields in this formation are greatly variable but yields greater than 7 000 m^3/day can be obtained. Up to twenty-nine boreholes have been drilled at the Middle Save Irrigation Scheme, fourteen of which are operational and realise yields between 60 to 70 litres/second and have a depth of about 60m. These boreholes have capacity to support irrigation during drought periods (Institute of Hydrology, 1995).

4.5 Vegetation Cover

Mambo and Archer (2007) observed the separation of the natural from the man-made impacts on vegetation to be difficult in the Save Catchment given that vegetation change and soil erosion were part of ecosystem changes particularly in the more resilient savannah ecosystems. In its unmodified form, vegetation of the Save consisted principally of *miombo* woodland on gneiss derived soils. This vegetation community has the deciduous trees *Julbernadia globiflora* and *Brachystegia boehmii* as co-dominants, which constituted about 60 per cent of the catchment area. About 20 per cent of the catchment is also characterised by land which supported, and to a large extent still supports, a *Colophospermum mopane* woodland community. This community is usually confined to drainage lines where there is an accumulation of sodium-rich bases and clays translocated from up-slope soils, hence such areas are prone to erosion. Other climax vegetation communities are also represented within the catchment, but of these remaining groups no single community occupies more than 5 per cent of the total area. These communities are: *Brachystegia glaucescens* community, *Kirkia acuminata* community, *Combretum apiculatum - Acacia nigrescens* community and an evergreen riverine community of varying species composition. Plantations of sugarcane, tea and wood tree species also dominate sections of the catchment particularly in Chimanimani and Chipinge.

4.6 Questionnaire survey sites

Two communities within the Save Catchment were chosen for in-depth studies. These communities were in the Nyanyadzi wards 5, 6 and 8 of Chimanimani District and communities around Maturure wards 13, 15 and 20 in Bikita district. Villages studied include Nyanyadzi, Hotsprings, Maturure, Chikuku and Mupamaonde. Figure 4.3 shows the wards in which questionnaire surveys were administered. The selected study sites are representative of the sub-humid sections of the Save Catchment in terms of climate, land use, livelihoods and population density.

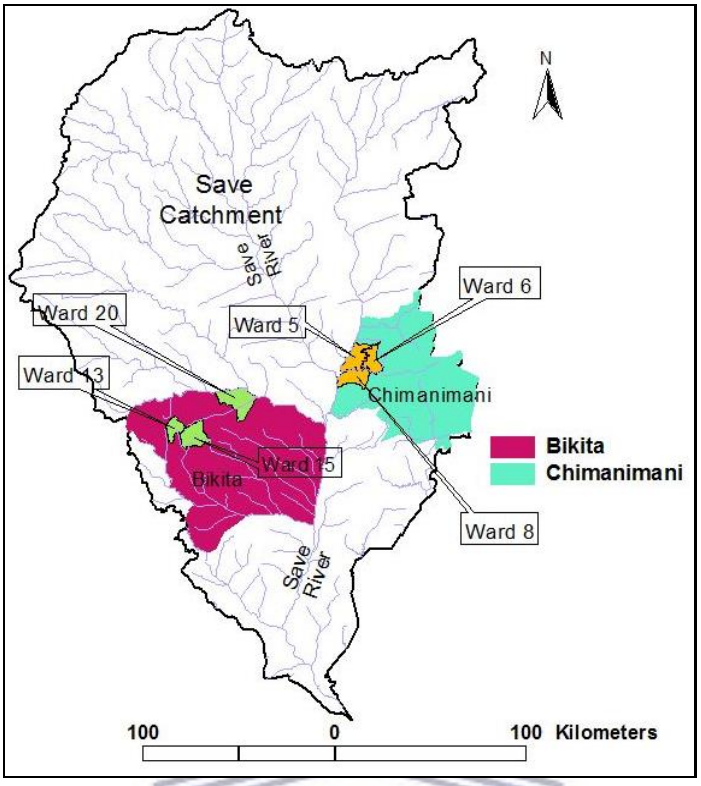


Figure 4.3: Questionnaire survey sites

The study communities are located within the semi-arid parts of the catchment that are predominantly communal where subsistence agriculture is the main source of livelihoods for the rural populates. There are also perennial shortages of surface water in these places, hence springs sometimes become the only source of water for the rural communities. Shocks from droughts and floods are also common in these areas. In Nyanyadzi, some of the springs are hotsprings which are of paramount cultural, mystical and historical significance to the surrounding communities and also attract tourists to the area. In the Maturure community, some springs, like those in ward 15 of the Bikita district, are being harnessed by the local communities and are a source of livelihood for over 42 households. The population of Chimanimani District where the Nyanyadzi community is found is 134 940 of which 48% are male and 52% are female with a rate of natural increase of 2.2%. On the other hand, the population of Bikita District where the Maturure community is found is 162 356 of which 45.5% are male and 54.5% are female with a rate of natural increase of 1.9% (Zimstat, 2013).

The study sites have a mixture of hot and cold springs. The Nyanyadzi area has two hotsprings and the rest were cold springs. Some of the springs in the study area are permanent and produce very high flow rates throughout the year that are capable of supporting diversified functions.

The largest springs in the study area are mainly found in the Maturure and Hotsprings areas. Most of the studied springs however were small, seasonal and vulnerable to degradation if not properly managed with some drying up during drought years and during dry seasons.

4.7 Chapter summary

The chapter gave an in-depth description of the study area which is the Save Catchment found on the south eastern parts of Zimbabwe. It was observed that the Save Catchment, like other catchments in Zimbabwe, was demarcated using the major river system and the boundaries transcended political administrative borders of provinces and districts. The Save Catchment was noted to exist both physically and institutionally. Physically it occurred as a hydrogeological space in which both surface and groundwater resources obtainable were interconnected through the Save River and its network of tributaries. The Save Catchment was chosen as the study area because to a large extent it typified most of Zimbabwe's socio-economic and environmental problems. The catchment was noted to be one of the most degraded of Zimbabwe's catchments and has received a considerable amount of rehabilitation attempts from various organisations. The Save Catchment was observed to be predominantly made up of communal lands that cover up to 40% of the catchment area. The livelihoods of communal areas of the Save Catchment, which are made up of mostly subsistence or peasant farmers were the focus of this study. It was also noted that other land tenure systems like state ownership and freehold tenure also existed in the study area.

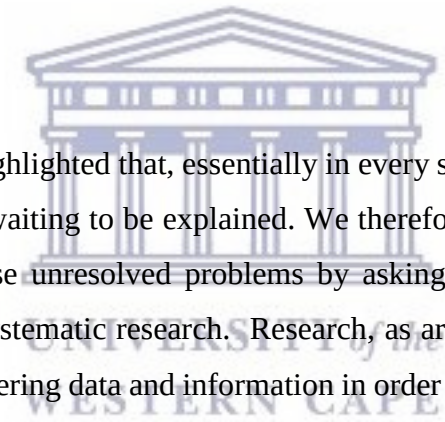
The study area was also observed to be a catchment of contrasts on many fronts, from the precipitation and temperatures received, to the altitude and landuse patterns, poverty levels and water availability. The geology of the Save Catchment was observed to be dominated by the crystalline basement rocks, such as granite of different ages, gneiss, dolerite and gabbro. The Precambrian older gneiss formations were noted to be the overriding hydro-geological characteristic of the catchment. Most of the catchment was also seen to be of poor groundwater potential because of the dominance of the basement rock formations that are generally shallow and of secondary permeability. In its unmodified form, vegetation in the Save Catchment was seen to consist of mostly *miombo* woodland. This vegetation community is composed of the deciduous trees *Julbernadia globiflora* and *Brachystegia boehmii* as co-dominants, which constitute about 60 per cent of the catchment area. Two communities of the Save Catchment were selected for in-depth study. These communities were in the Nyanyadzi wards 5, 6 and 8

of Chimanimani District and communities centred around Maturure wards 13, 15 and 20 in Bikita district. The study communities are located within the semi-arid parts of the catchment that are predominantly communal.

CHAPTER 5 : METHODOLOGY

5.0 Introduction

The purpose of this chapter is to present the overall research design, methodological approaches and specific methods that were employed to achieve the objectives of this investigation. Further, the chapter examines methods that were used in the study during data collection, analysis and presentation. The research adopted the socio-hydrological approach which subscribes to the principles of both the qualitative and quantitative research paradigms. Questionnaire surveys, in-depth interviews and direct observations were used in the study during the data collection process. Both qualitative and quantitative data analysis tools were employed in the research with the results presented in the form of graphs, tables, pictures, maps and written text.



5.1 Research design

Leedy and Ormrod (2010) highlighted that, essentially in every subject area, our knowledge is imperfect and problems are waiting to be explained. We therefore need to address these gaps in our understanding of those unresolved problems by asking relevant questions and then seeking responses through systematic research. Research, as argued by Neuman (2000), is a methodical procedure of gathering data and information in order to increase our understanding of a phenomenon which we are interested in, with the goal of transforming research questions into a testing project.

According to Nemukula (2014), a research design can be defined as the practical way in which an investigation is conducted and it symbolises a methodological endeavour that is adopted to produce evidence in order to answer the research questions. The chosen research methods must be capable of answering the research questions formulated to guide the study. Neuman (2000) observed a research design to be a framework of study that is adopted to guide the gathering and analysis of data. It is a blueprint that is followed in the implementation of a study. A researcher must adopt research approaches that are most appropriate for the investigation at hand and also, the research approaches must be compatible with the research location (Bryman, 2004).

Research methodology is a scheme through which a researcher is able to gather, examine and interpret the collected data in order to accomplish the research goals and objectives. This scheme must also be observed as a framework of procedures that can be used by other researchers doing similar work (Nkatini, 2005). According to Neuman (2000), research methods can be classified into two broad categories which are quantitative and qualitative research methods. Both approaches vary in their orientation and adopt different procedures in gathering relevant data for their purposes, but they can also supplement one another in some instances.

A quantitative approach to research mostly emphasises on data measureable in terms of numbers and events that can be examined statistically. It quantifies the problem by formulating statistical and quantifiable data to generate facts and unravel patterns in the field as well as to generalise the outcomes to a bigger sample population (Bryman, 2004). Quantitative investigators incline more to issues of research design, measurement and sample selection due to their deductive reasoning that gives emphasis on detailed planning prior to data collection and analysis (Neuman, 2000). Quantitative research approaches subscribe to the tenets of positivism which adopts the view that research must embrace technical methods which entail the rigorous examination of numerical data that takes the form of statistical measurements (Atkinson and Hammersley, 1994). In quantitative research soundness is measured by the extent to which the study really measures what it was envisioned to measure and dependability on whether the study can be replicated by other researchers in the same circumstance (Bryman, 2004).

In contrast, a qualitative approach to research is not interested in numerical data that can be used for statistical analysis. Neuman (2000) highlighted that qualitative investigators are more concerned about questions of richness, texture and feeling of raw data because their inductive approach underscores developing insight and generalisation out of the collected data. It subscribes to constructivism associated with the assembly, analysis, interpretation and presentation of narrative data. It is seen to be primarily appropriate for attaining an in-depth understanding of fundamental explanations and motivations in order to provide insights into the background of a given problem (Teddlie and Tashakkori, 2009).

Leedy and Ormrod (2010) observe that qualitative data may be gathered through open-ended questions typically including; views of participants on a certain subject, explanations for observed behaviour and explanations of certain processes, practices or insights with which the

investigator is not acquainted to. A quantitative researcher tends to depend more profoundly on deductive reasoning, starting with certain premises and then drawing logical conclusions from them, whereas qualitative researchers make significant use of inductive reasoning.

The study adopted the socio-hydrological approach in the analysis of the research problem. The socio-hydrological approach, as noted by Vogel et al. (2015), is mainly informed by the mixed methods approach which involves the use of both qualitative and quantitative research techniques. This mixed methods approach was used with a mainly quantitative and supplementary qualitative data collection strategy.

5.2 Methods

5.2.1 Questionnaire survey

The research used the questionnaire survey which involved the use of standardised questionnaires to collect data about individuals and their interests, opinions and actions in a systematic manner. The questionnaire survey method, as observed by Bhattacherjee (2012), can be used for descriptive, exploratory, or explanatory research. The method was chosen because it is best suited for studies that have individual people and households as the unit of analysis. Questionnaire surveys are also an outstanding method for evaluating an extensive variety of unobservable data, such as individual preferences, characters, attitudes, beliefs or factual information. Questionnaire surveys are perfectly appropriate for remotely gathering data about a population that is too big to observe directly. Due to their unobtrusive nature and the flexibility to answer at one's convenience, questionnaire surveys are preferred by some participants. They also allow comparative examination of population subgroups, for example, within group and between group analyses.

Malhotra et al. (2006) noted questionnaire surveys to have some unique shortcomings. They were vulnerable to numerous biases, such as, social desirability bias where participants have a tendency to avoid undesirable opinions or humiliating remarks about themselves, their families, or friends. This produces a predisposition amongst participants to 'spin the truth' in an effort to depict themselves in a socially acceptable fashion which damages the validity of responses gained from questionnaire survey investigation. Recall bias happens when participants may not sufficiently recollect their own motivations or actions or perhaps their

recollection of such occasions may have changed several times over time, hence no longer retrievable. Other biases include, non-response bias and sampling bias.

5.3 Target population

The target population of the research were the rural communities in the Save Catchment. Specifically, the research targeted two places within the Save Catchment for in-depth studies which were; communities around Nyanyadzi in wards 5, 6 and 8 of Chimanimani District and communities centred on Maturure wards 13, 15 and 20 of Bikita district. This target population comprised ordinary rural households centred on the household head but other members of the household utilising springs could make a contribution. Key informants, like community leaders, environmental managers and community based organisations were also the target of in-depth interviews.

5.4 Unit of study

In this research, households were adopted as the primary unit of study. Households that interacted with springs in an endeavour to support their livelihoods were used as the study population to solicit information on utilisation and management of the springs or other relevant questions to answer the research objectives. The overall pattern of spring utilisation and rural livelihoods in the Save Catchment was then made from aggregating the individual household responses.

5.5 Pre fieldwork process

The pre-fieldwork process was performed to deliver information to communities on the purpose of the study. This process is a necessary step to any research practice. This exercise, according to Traynor (2005), provides a firm foundation for a fruitful working relationship between the researcher and the target community. Pre-fieldwork involved introductory and familiarisation meetings with the community leadership of Nyanyadzi and Maturure during which the researcher was introduced to some key stakeholders. The justification of the study, its aim and objectives with specific reference to the expected empirical research procedure in the community, as well as the significance of community involvement therein were also defined to them. This created trust and backing for the household questionnaire survey from

the targeted communities. The traditional leadership also additionally informed the researcher of the cultural norms and values of the community which needed to be rigorously observed too.

5.6 Sampling

Sampling is the statistical procedure of choosing a subgroup of individuals from a population, where the subgroup of individuals is envisioned to produce some information on the population of interest or concern for the reason of making forecasts based on statistical extrapolation (Bless et al. 2006). Two sampling procedures were implemented in the study namely, random sampling and criterion-based purposive sampling. Israel, (2012) observed that researchers rarely surveyed an entire population since the costs become too high and the populations being studied are usually dynamic in the sense that the individuals defining that population can change with time. The three main advantages of sampling were noted as being the reduction in costs, improved speed in data collection, and since the data set is smaller, it becomes easier to ensure homogeneity and to improve the accuracy and quality of the data.

5.6.1 Purposive sampling

Non probability sampling procedures, in particular, purposive and snowball sampling were utilised in different contexts in the selection of the interview participants during the study. Non probability sampling is most appropriate when the researcher pursues data from persons who meet pre-defined criteria (Bryman, 2004) in this case households utilising springs. A strong tradition exists in geography of employing qualitative research methodology (Hay, 2010). Purposeful sampling in qualitative research seeks information-rich participants, for example, those used in the study had in depth knowledge and experiences with spring utilisation and their contribution to rural livelihoods (Anderson et al. 2010). Purposive sampling was more ideal because it permitted the investigator to identify a key group of participants who were deemed most suitable to take part in the research. The nature of the research was also specific to a geographic area and the associated stakeholders within the geographic area. Purposive sampling was also used to select key stakeholders for in-depth interviews.

5.6.2 Snowball sampling

Once key participants and study sites were identified through purposeful sampling, the research then employed snowball sampling methods, where each interviewed participant identified another key respondent appropriate for the research until the list came to a full circle. Heckathorn, (2011) classifies, snowball sampling as the most commonly employed qualitative

research sampling method. He observes it to be a purposeful sampling design because on commencement, it comprises having a few originally contacted participants known as the seeds, who recruit a sequence of possible participants, with connections among a chain of possible participants based on a prevailing social network. Hardon et al. (2004) observe that, preferably, the smaller number of initially contacted participants (the seeds) need to be chosen at random. However, in practice, the original participants often are chosen because they are appropriate to a study and are acquainted to the investigator and they provide the investigator with a good introduction to the next set of potential participants. Snowball sampling was mainly used in the study to recruit participants for the questionnaire survey.

5.7 Sample size determination

Israel (2012) observed the determination of the optimum sample size as the most frequently asked question regarding sampling. He maintains that best sample sizes are determined by reasons such as the aims of the study, total population size, the danger of choosing a bad sample and the acceptable sampling error. Several methods to establishing sample sizes in research have been established and these include; using published tables, adopting a sample size from similar studies and applying statistical formulas to determine a sample size.

Marshall (1996) argues that a suitable sample size in a qualitative research is one that is big enough to permit the investigator to successfully answer the question at hand. Hence, a sample size in a qualitative research can be arrived at subjectively, depending on whether or not the research questions asked at the beginning of the research have been successfully answered and whether the point of data saturation has been achieved. Matshel et al. (2013) highlighted the concept of data saturation as the point of redundancy and to reach the point of redundancy participants are increasingly added into the research to the stage where the data gathered from the participants becomes identical to data that is already collected. At this stage participants will no longer be adding any new information to the research. For this reason, qualitative researchers define this point of redundancy as data saturation. Patton (2002) further argues that there were no strict procedures for determining sample size in qualitative investigations. Sample size depends, to a large extent, on what you want to know, the purpose of the research, what is at stake, what will be beneficial, what will give credibility and the available time and resources.

The research used the point of saturation together with published tables (Table 5.1) to determine the best sample size for the research. The table published by Israel, (2012) provides the sample size that would be necessary for given combinations of precision, confidence levels, and variability. The level of precision which is sometimes called sampling error, is the range in which the true value of the population is estimated to be. This range is often conveyed in percentage points (e.g. ±10 percent), hence if 60% of the surveyed population in the Save Catchment observed a certain trend in spring water quality and a precision level of ±10 is adopted as is the case for this study, then one can be sure that if every household in the area was interviewed, then between 50% and 70% of the participants would have picked that answer. Table 5.1 shows suggested sample sizes for ±3%, ±5%, ±7%, and ±10% precision levels where confidence level is 95% and P=0.5.

Table 5.1: Sample size for different precision levels

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

Source: Israel (2012:p.2).

a = Assumption of normal population is poor and the entire population should be sampled. The confidence level is 95% and P=0.5.

Table 5.1 shows a total of 100 samples to be the point of saturation for surveys with study populations of 20 000 - 100 000 people which is also the population range of the surveyed areas in the study. The sample size of 100 participants was, therefore, adopted for those who took part in the questionnaire survey which was administered to solicit information from the

participants on various aspects of springs. The 100 participants also provided the point of saturation for the responses they produced. The error margin (precision level) of the given responses was 10% and the confidence level was 90% ($p \leq 0.10$).

5.8 Data collection techniques

Data collection techniques permit an investigator to methodically gather data on the subjects of study (people, objects, and phenomena) and about the environment in which they occur (IWSD, 2001). If data are gathered haphazardly, it would be hard to answer our research questions in a decisive way.

5.9 Primary data sources

5.9.1 Questionnaires

Questionnaires are a technique used to gather standardised data from huge numbers of participants with identical information being gathered in a similar manner. Questionnaires are primarily used to gather data in statistical form. The researcher personally administered the questionnaires targeting only the chosen sample of participants in the study area. This made it possible for the researcher to explain and clarify the questions which participants did not clearly understand. The researcher administered questionnaires in the two selected areas (Nyanyadzi and Maturure) from November 2016 - January 2018. The questionnaires were used primarily to solicit for information on how communities utilised and managed their springs to support their livelihoods. The households targeted by the questionnaire survey were those that interacted with springs as a means of earning a livelihood. The advantages associated with utilising questionnaires in the study include the fact that they could be administered to illiterate people and clarifications could easily be made to questions being asked. The results of the questionnaires could also be quickly and easily quantified by either the researcher or through the use of statistical software packages; questionnaires can also be examined scientifically and objectively than other forms of research tools. Once data from questionnaires have been quantified, they can then be used to associate and contrast other research and may be used to determine changes that will have occurred.

The limitations of using questionnaires administered face- to- face, as was done during the study, were that some participants perceived the research to be a vulnerability assessment exercise, hence were expecting to have their names noted down so that they could receive some aid in future. This was however, noticed early during pre-testing of the tool, as such the

investigator had to meticulously present the purpose of the research to the participants till they understood its purpose. Other disadvantages of using questionnaires included; the impracticality of telling how truthful a respondent is being and also impossibility of telling how much thought a respondent has put into their responses. Some of the participants may at times be absentminded or not thinking within the full context of the situation. People may also read differently into each question and, therefore, their replies are based on their own understanding of the question, for example, what can be good for one respondent might be bad for another, therefore, there is a level of subjectivity that is not well acknowledged when one uses questionnaires.

During the study, two sets of questionnaires were utilised, one targeting the rural households and the other targeting the institutions involved in spring water management. The first questionnaire targeting households shown in Appendix A had four sections with the first introducing the research and the research objectives to the participants and soliciting their participation. The second part had questions covering the broad themes of spring utilisation and their contribution to sustainable rural livelihoods. The third section of the household questionnaires had questions on the management of springs and institutional factors in their management. The final section had questions on the demographic profile of the research participants. The second questionnaire, meant for institutions, shown in Appendix B had similar sections with that of households but did not have a section on the demographic profile of the head of household and also indicated the designation of the respondent.

The questionnaires used had a mixture of both structured and semi-structured questions. They were used to gather data from the 100 sampled households and institutions in order to fulfil the research objectives. A structured or closed questionnaire contains a list of questions to which a participant has to reply by selecting the most suitable answer from the choices available (Leedy and Ormrod, 2010). Closed ended questions were used because they restricted participants to select responses only from specific choices which made the data gathered more objective and straightforward to analyse. Closed questions also permitted for the gathering of quantitative data on the influence of springs on household livelihoods and livelihood outcomes.

Some of the closed questions required answers on a Likert scale, where participants are given a range of options, for example, important, very important and not important; agree, strongly agree. The Likert scale is a psychometric scale where participants do not select between ‘yes’ or ‘no’ but there will be precise choices centred on the extent to which they agree or disagree

with a certain question in the questionnaire. It can contain a sequence of questions and requests the level to which a participant agrees or disagrees with it. The Likert scale is one of the most widely adopted question forms in questionnaire surveys and is important in gauging a respondent's judgement or attitude towards the research theme.

Some semi-structured or open ended questions were also used in the questionnaire because they were found to be flexible and permitted new but related questions to be brought up during the interview. This flexibility, offered the participants the chance to share their experiences on the relationships between spring utilisation and rural community livelihoods without limiting them. Bhattacherjee, (2012) observes that this semi-structured questionnaire technique was formulated for gathering everyday knowledge and it assumes that participants have in-depth knowledge about the subject of study. Using a closed interview structure gives little chance for participants to express their own unguided thoughts. In the study and during data collection, most interviews took the form of a discussion with one or more household members, with the questionnaire giving the wide-ranging questions that were explored. Members of one household may carry out different livelihood activities (Scoones, 1998). For this reason, the flexibility to embrace the views of as many members of a household as feasible, ensured that different livelihood activities that utilise springs, which may be done by different members in a household, were captured. The flexibility of allowing all members of a household to participate in answering the questions also helped in achieving gender balance of the participants as most of the livelihood activities utilising springs were gender specific, hence the need for balanced views from different genders. Open-ended questions were, however, more challenging to extract quantifiable data from when compared to closed questions during data analysis. Open ended questions required the researcher to first thematise and then code the answers. Coding identifies a number of categories in which people have responded and makes the data compatible with statistical analysis tools.

5.9.2 In-depth interviews

In order to get more information about the study area and the research problem, in-depth interviews and discussions with key informants were held. Valuable information regarding the utilisation and management of different springs and how they contribute to sustainable rural livelihoods in the study area were obtained. In-depth interviews are a qualitative data collection instrument, which gives a chance to capture rich, descriptive information about persons' behaviour, opinions, approaches and insights and unpacking complex practises (Bryman,

2004). According to Bhattacherjee (2012), in-depth interviews are suitable if one needs to gain an insight into personal assessments of particular material or want to investigate new and innovative issues in-depth.

They are often used to give context to other data such as results, offering a more comprehensive picture of what is occurring and the reasons for the occurrence. Heckathorn (2011) observes the principal benefit of in-depth interviews as being that they give much more comprehensive information than what is obtainable through alternative data assembly tools, like questionnaires. In-depth interviews also might offer a more comfortable atmosphere in which to gather data and individuals may feel at ease having a conversation with the researcher about their research as compared to completing a questionnaire. Body language during in-depth interviews is also important in adding a higher level of understanding to the responses. In-depth interviews are also conducted using an interview guide which facilitates the flushing out of the participant's opinions through open ended questioning.

As Boyce and Neale (2006) highlight, in-depth interviews can assist in providing a history of performance and shifts that have occurred over time when conducted with somebody who has been resident in the local community for a long time. They can also bring out group versus individual occurrences by deliberating matters that may be difficult to rise in a group scenario. In-depth interviews can also unravel divergent practices and outlier attitudes when compared to focus group discussions that frequently do not permit one to appreciate experiences that may change from one individual to another. In-depth interviews are also acknowledged to offer a quick penetration into societal norms by providing a rapid impression about a society, its desires and concerns. Bhattacherjee (2012) also observes that during in-depth interviews, it is a much easier task to talk to an individual and retain their attention than addressing a gathering of persons and it is also much easier to avoid scheduling difficulties with only one person. In-depth interviews are more suitable to use when compared to focus group discussions if the targeted participants may probably not get included or will not be comfortable to discuss openly in a group environment. They are also best suited when there is a need to differentiate personal as opposed to group sentiments about issues and are often the best means of engaging illiterate or a low-literacy populace.

In-depth interviews are however vulnerable to bias as answers given by members of the participant community or programme beneficiaries might be biased owing to their stake in the programme on top of other motives. They can also be time-intensive due to the period it takes

to have the interviews done, record them and examine the results. The outcomes from in-depth interviews are also not generalizable to the entire population because small samples are selected; not every member has an equal chance of being selected and random sampling procedures are rarely adopted (Matshel et al. 2013).

Key participants were identified and interviewed in the study. The participants were grouped separately in terms of the different roles they play in the utilisation, management and conservation of springs in the Save Catchment. The in-depth interview participants were grouped as local traditional leaders; local water committees' representatives; government conservation agencies like EMA, Forestry Commission and ZINWA; Local Government officials, Hotspring Resort workers, Ward Environmental Monitors, Local Scientists and other Community Based Organisations operating in the study area. These participants were chosen because they are part of institutions that directly or indirectly influence the access, utilisation and management of springs in the study area.

The in-depth interviews were conducted using an interview guide that contained guideline questions. The interview guide used in the study is shown in Appendix C. The guide had three main sections with the first section dealing with the introduction of the researcher and research objectives to the interview participant and soliciting for their consent to take part in the study. The second section, as shown on Appendix C, dealt with questions addressing the broad theme of spring utilisation and rural livelihoods of study communities. The final section of the interview guide explored the management and conservation of spring wetlands. Although pre-determined guideline questions were prepared, the researcher also had the flexibility to ask an assortment of follow up questions based on the replies given by participants, and for this reason, a voice recorder was used to capture the conversation. In addition, written notes were taken mainly to capture any accompanying body language and non-verbal gestures that occurred throughout the interview period.

All interviews were then completely transcribed by the researcher in order to facilitate the preliminary data analysis. The transcription procedure allowed for fine grain listening and examination of the interview content. Direct transcription of interviews without verbally recording them would have probably left out some non-verbal sounds, such as, laughing and tone of voice, all of which can meaningfully contribute towards data analysis.

5.9.3 Observation

Observation is a technique of data collection that allows researchers to examine social actors in their normal setting and is a suitable technique for studying behaviour. Kawulich, (2005) notes observational research to be a type of correlational or non-experimental study in which an investigator observes ongoing behaviour and permits the investigator to produce data of appropriate complexity and richness from the research subjects and the environment. There are diverse observational research forms, each of which has both strengths and weaknesses. These forms are classified by the degree to which the investigator interferes with or controls the environment. It is typically divided into naturalistic or non-participant observation and participant observation. In naturalistic observation, there is no form of intrusion from the investigator. It includes just studying actions and phenomena that transpire naturally in natural settings, as opposed to the artificial environment of a controlled laboratory scenario. Notably, in naturalistic observation, there is no effort to influence factors. However, naturalistic observation is limited by its inability to unravel the actual reasons behind observed actions and incidences.

Participant observation as noted by DeWalt and DeWalt (2002) is the process permitting researchers to study about the behaviour of the phenomena of interest in their natural situation through observing and getting involved in those activities. Schensul et al. (1999) defined participant observation as 'the process of learning through exposure to or involvement in the day to day or routine activities of participants in the research setting'.

Observation methods are useful to researchers in many ways including giving researchers ways of checking for non-verbal manifestation of moods, determining who interrelates with whom, understanding how research subjects communicate with one another, and checking for exactly the amount of time being spent on numerous activities (Schmuck, 1997). Participant observation also enables researchers to observe actions that participants might be incapable or reluctant to share during discussion owing to their sensitivity and also to observe circumstances participants will have described during interviews, thus making them conscious of misrepresentations or impreciseness in narratives made by participants (Marshall and Rossman, 1995). DeMunck and Sobo (1998) note participant observation as enabling unique access to the 'backstage culture' of research participants and also enabling prospects for observing or participating in unprepared occasions. DeWalt and DeWalt (2002) add that it increases the quality of data gathering, analysis and enables the formulation of novel research

questions or hypotheses in qualitative studies. The research observations may capture phenomena that consistently escapes the awareness of the participants and adopting a variety of techniques and familiarity with specific contexts exposes the researchers to discovery and induction rather than guessing what the context is like.

Several researchers, including DeWalt and DeWalt (2002) and Kawulich (2005) have noted several limitations associated with using observations as a tool for data collection. They note that male and female investigators have access to different information because they are afforded access to different kinds of people, locations and bodies of knowledge. Participant observation is done by a subjective human being who functions as the tool for data collection, thus the investigator needs to appreciate the manner in which their gender, culture, class, and theoretical approach might impact on observation, examination and interpretation of gathered data. In almost all cases of participant observation, researchers need to acknowledge the Hawthorne Effect created by researchers when conducting observation. This, as observed by Kawulich (2015), is the modification of behaviour by research participants, due to their mindfulness of being observed which may provide wrong information to the investigator.

The empirical observation method was used mainly to check how the communities were utilising springs and state of the springs in the Save Catchment with several visits being paid to the study area and field observations being made. Observations were also made during preliminary visits to the study sites to familiarise with the different springs in the study areas. Observations were also conducted during questionnaire distribution and completion. Observations included types of springs, utilisation patterns, management practices, crops being produced at different garden sites, types of food being consumed at different households and waste food visible. Where permissions were granted, photographs were taken as part of the observation technique, as a way of supporting the research findings.

5.10 Secondary data sources

According to Robinson (2002) one of the most commonly used methods of gathering data is using and examining available information. Its main benefit is that it is cheap, because the information is already there and permits analysis of changes over time (time series analysis). Using the information already available also offers important cross validation of some of the collected data, either supporting or contradicting them (Nayaran, 1996). The limitations are that some of these data sources are not always easy to access because of ethical matters to do

with the right to privacy, some of the information may have gaps, may be inaccurate or inadequate and there are ethical complications to do with researching using personal data without consent from affected parties.

In the study, secondary data collection entailed the systematic review of contemporary scholarly and policy literature that focus on spring waterscapes, spring based rural livelihoods and their sustainability. This was done in order to provide the conceptual framework and scholarly background to the investigation and to equip the researcher with the knowledge and systematic understanding of the connections between spring utilisation, rural livelihood sustainability, influencing institutions and the response mechanisms amongst these factors. Secondary data in the form of the Environmental Management Agency natural resource inventory was used to locate wetlands classified as springs that were available in the study area as a starting point to search for other springs. Secondary data were also used to make an analysis of Zimbabwe's institutional factors in spring water management and in the discussion of the results that were obtained.

5.11 Data analysis and presentation

Data analysis is a procedure for scrutinising, summarising and modelling collected data with the aim of displaying, patterns, valuable information, reaching conclusions and supporting decision making in order to recognise the implications of the gathered data (Bless et al. 2006). Data analysis was done in three stages during the study. These were preliminary data analysis, data capture and the actual analysis. For in-depth interviews, preliminary data analysis began during the data collection process. This approach permitted the researcher to redefine interview questions for future interviews according to the dominant subjects that became clearer during the process of data collection. The formally and informally collected interview data was then transcribed. Data was then checked for accuracy and possible inaccuracies. If errors were noted, the participants were contacted and requested to explain or re-emphasise certain points.

Fine grain analysis then followed the completion and cleaning of the collected interview data. This was performed by making multiple readings and evaluative note-taking of what was said and what was not said. Grouping data into several broad themes and examination of divergences and convergences within and between interviews then followed. The themes were itemised and content analysis was used to extract meaning from the transcriptions. In-depth examination of finer themes which may have been previously unnoticed was then performed.

Finally, a written narrative of the results was done. In presenting results of in-depth interviews, care was taken not to attempt to quantify the information, but to use qualitative descriptors. Providing direct speech marks from participants in the report added credibility to the information being presented. Care was also taken not to identify the respondent or present quotes that could be easily tracked back to a person because confidentiality was a requirement.

Questionnaire data was first pre-processed before it was subjected to analysis. . This essentially involved the inspection and correction of errors from responses given during the questionnaire survey to guarantee data accuracy and dependability. The process continued with coding of all variables considered for the study. This involved assigning numeric and alphanumeric codes to all the variables under study. Data coding was, therefore, an analytical procedure in which data, in both quantitative form, such as questionnaires results or qualitative, such as interview transcripts, was categorised to facilitate numerical analysis. Coding entails the transformation of research data to be compatible with computer statistical software. The classification of data was an important step in the preparation of data for computer processing with statistical software. According to Matshel et al. (2013), questionnaire data can be pre-coded by assigning codes to expected answers on a designed questionnaire, it can be field-coded by assigning codes as soon as data is available, usually during fieldwork, post-coded by coding of open questions on completed questionnaires or office-coded which is done after fieldwork. In the research the questionnaires used were post-coded after carefully examining the answers given by the participants.

This was followed by data entry and display into the software package SPSS version 20.0 that was used for data analysis. Data entry consisted of entering the responses of each respondent into the spreadsheet according to each variable. After entry, the data were subjected to the data view spreadsheet display in SPSS in order to check for errors and the accuracy of the data entry procedure. This process enabled instant checking of errors and omissions thus ensuring data of the best quality. Although this was a very slow and meticulous process considering the number of participants and variables, the entire exercise laid a solid foundation for analytical processing of data, both qualitatively and quantitatively.

In SPSS, the collected data were analysed quantitatively using descriptive statistics. Descriptive statistics provided a concise summary of data which was done both numerically and graphically. The frequency count was the most employed method of descriptive analysis in the study. It involved the enumeration of how often a certain measurement or answer to a

specific question occurs within all the responses given. Frequency distribution in the study were calculated in percentages (relative frequencies). This made it easier to compare groups than when only absolute numbers are given and also percentages standardise the data. The results were presented in the form of tables, graphs (figures), pictures (plates) and in the form of texts. Figure 5.1 shows the methodological flow that was used in the research.

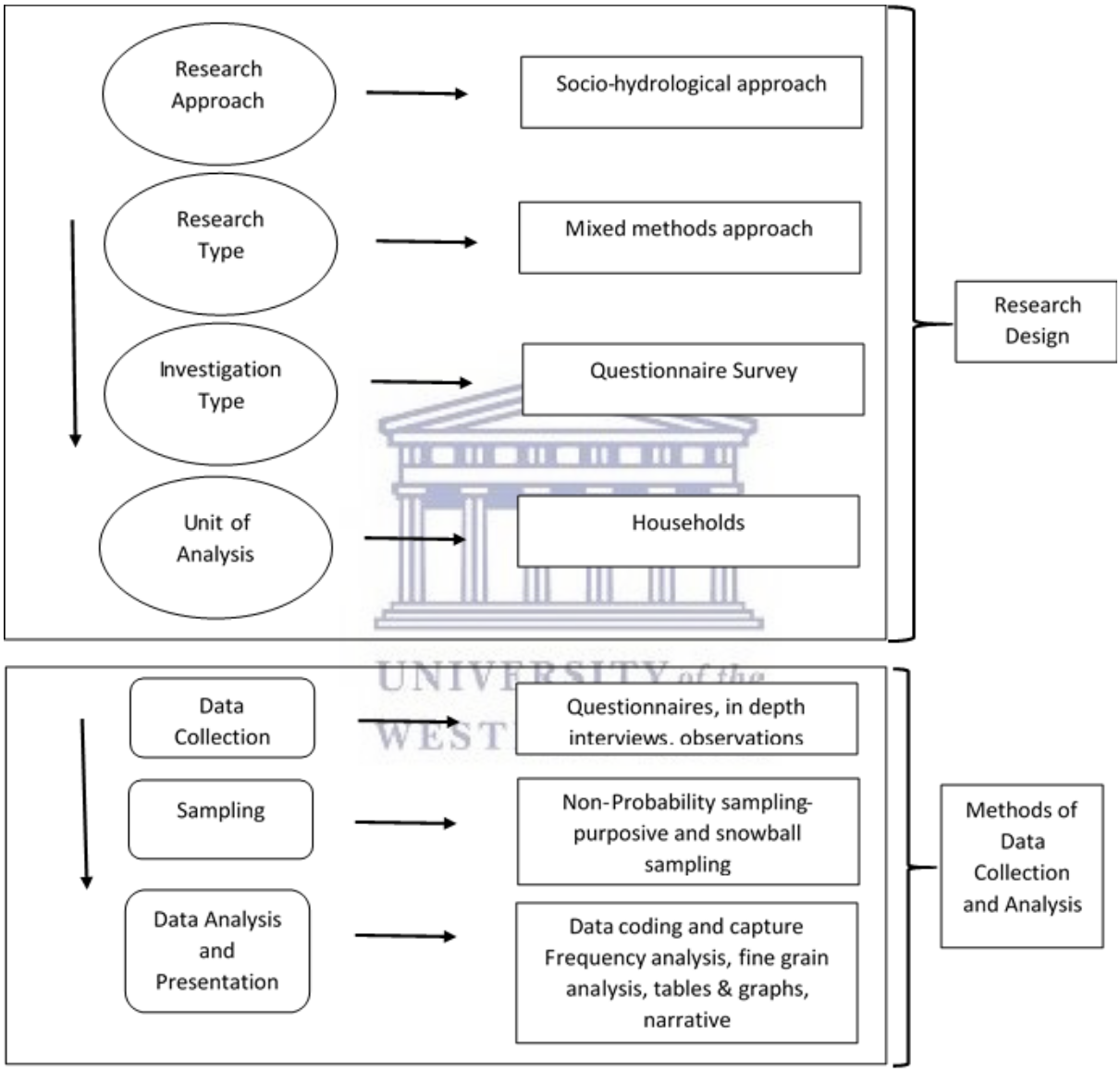


Figure 5.1: Methodological flow used in the research

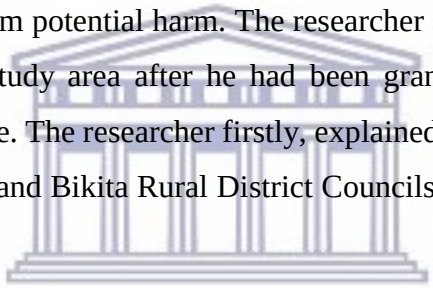
5.12 Data protection

Protection of the gathered data (both primary and secondary) was of high priority to the research. To safeguard the collected secondary data, it was stored in external hard drives,

protected with passwords and in cabins that only the researcher had access to. The completed questionnaires were administered, coded and analysed personally by the researcher to avert data leakage and also stored in locked cabinets. To protect the participants and the information they provided, there was pseudonymisation and anonymisation of their responses during data collection and analysis. The researcher, therefore, collected, analysed and reported the data without compromising the identities of participants.

5.13 Ethical considerations of the study

Ethical matters in research are concerned mostly with balancing the right of the people to privacy, safety, confidentiality and security from deceit with the search of scientific endeavour (Polit and Hungler, 1998). Considering that the study required personal narratives during interviews with participants from Nyanyadzi hotsprings and Maturure springs, certain ethical considerations were taken into account before commencing data collection to guarantee that participants were protected from potential harm. The researcher sought permission to conduct the research in the selected study area after he had been granted ethical clearance by the University of the Western Cape. The researcher firstly, explained the contents and intention of the study to the Chimanimani and Bikita Rural District Councils who are the local authorities in the main study sites.



The researcher also sought clearance from the Environmental Management Agency to use their data in the study. The researcher made sure that likely participants were also fully informed of what the research was all about, its desired outcomes and what it required of them before their input was solicited. Participants were given an information letter and a consent form which they signed after reading its contents. The informed consent form guaranteed participants that their participation in the research was voluntary with no form of compulsion and that participants reserved the right to pull out of the research at any stage and for any motive whatsoever.

The right to confidentiality was observed through protecting the identity of participants in the research. Schmuck, (1997) notes confidentiality to be an active endeavour to eliminate from the research records any components that may indicate the participant's identity. Issues of confidentiality and anonymity were observed in the research to give participants the confidence to deliver research data honestly without fear. The gathered data was reported without any alterations as a true reflection of the findings.

5.14 Major constraints in data collection

The major and perhaps the most persistent limitation during the study was the time constraints on the part of the participants. Obtaining commitment from all targeted participants was not always possible because of other obligations and at times non-availability on their part. Additionally, the in-depth interviews done in the research were of fine scale and, therefore required only a certain group of people with the relevant information. If this group of participants were not available, then this affected the study.

There was also a volatile political climate in parts of the study area which was created by two parliamentary by-elections held in Chimanimani West and Bikita West constituencies on the 25th of November 2016 and on the 21st of January 2017 respectively. These by-elections coincided with the research fieldwork in these areas, hence some people, especially those perceived to be part of the opposition became reluctant to respond to the questionnaires despite the fact that they were informed that they could respond anonymously and that the researcher would not keep a record of names or identification. In some cases, there were some raw feelings and conceptions that the participants had not yet dealt with at the time of the questionnaire interviews. They alleged that some political party officials were using all means necessary to win the elections including moving from door to door threatening and intimidating villagers saying they would beat up everyone if they lose. However, the volatile situation also worked in the favour of the research in some cases as most people became readily available at their homes due to fear of uncertainty associated with elections in Zimbabwe.

Other participants wrongly perceived the research to be a government household vulnerability assessment or an evaluation tool, hence would overstretch the truth to make sure that they would not miss out on potential aid. There were also other participants who could not be interviewed face-to-face because they continuously indicated that they were too busy with other business. For them, questionnaire completion took a long time and the researcher had to visit them several times, often without getting fruitful results. It was also frustrating that there were those who ended up not completing their questionnaires all together.

Another constraint was the lack of knowledge of relevant issues among the selected participants. Only nine government and civic officials were able to answer the questions set for them. At times, participants who attempted to respond to the questionnaires left out questions they either did not feel comfortable to answer or were not knowledgeable about. At some spring

water use sites, users were suspicious and did not feel free to participate in the research. Although the purpose of the research was explained to them in depth, they still remained reluctant to respond to the questionnaires. Despite these shortcomings, the researcher was still able to collect sufficient and reliable data that formed the basis of this study.

The internal institutional bureaucracies and red tape also delayed certain in-depth interviews and questionnaire completion because permission had to be granted from top management who sometimes wanted input into the type of questions asked and also required access to both pre and published data. This resulted in some degree of censorship of the data. At times during the interview, participants would ask for the voice recorder to be switched off particularly when it came to questions which they felt were contentious. This then required the researcher to take manual notes of the issues that were being raised, a scenario that led to some data being lost despite the participants' desire to have certain activities exposed. At times participants felt uncomfortable when written notes were being taken and preferred them to be taken when the interview was completed and did not wish to be associated with any whistleblowing.

5.15 Chapter summary

Research is a methodical process of gathering, examining and interpreting of data to produce new knowledge in order to answer predetermined research questions or to resolve a problem. Research methodology is the approach used by a researcher to systematically solve the research problem. It may be understood as a science of studying how research is scientifically performed (Leedy and Ormrod, 2010). In this chapter, the methods employed by the researcher in studying the research problem along with the rationality behind them were examined and limitations encountered in the data collection process were also noted. The research adopted the socio-hydrological approach which uses a mixture of both the quantitative and the qualitative research methods. The household was used as the unit of data collection and analysis. Non probability sampling techniques, in particular, purposive and snowball sampling were utilised on different occasions during the study in the selection of the interview participants. Purposive sampling was used to select the participants of in-depth interviews while snowball sampling was used in recruiting the subjects for the questionnaire survey. Both qualitative and quantitative methods of data analysis were used to analyse the data from questionnaires and in-depth interviews, with some responses being coded and entered into a statistical package for statistical analysis while some were thematised and analysed using qualitative methods of data

analysis. The results were then presented in the form of tables, graphs, maps, pictures and written narratives. The collected information was protected either through the use of passwords or locked in cabinets that had restricted access. To protect the participant's right to confidentiality and the information that they shared, there was pseudonymisation and anonymisation of their responses at all stages of the research process. The main challenge the researcher faced was in obtaining commitment from targeted participants who were not always available due to other commitments. Fieldwork was also difficult because of a volatile political climate in parts of the study area that had parliamentary by-elections. Another significant constraint was limited information on relevant issues among the selected participants.

CHAPTER 6 : UTILISATION OF SPRING WATERSCAPES AND RURAL LIVELIHOODS ON THE SAVE CATCHMENT

6.0 Introduction

The chapter presents the results of the first specific objective of the study, which was to determine how springs were being utilised and how they have contributed to rural livelihood sustainability on the Save Catchment. The chapter gives a detailed description and analysis of the livelihood strategies and other uses to which springs were being put in the study area. It also examines the factors that influence household access and exclusion from springs. The chapter ends by making an analysis of the extent to which the study communities have constructed their livelihoods around the utilisation of springs. The demographic characteristics of the main participants during the questionnaire survey were also presented and an analysis on how it impacted on spring utilisation was done.

6.1 Demographic profile of the participants

The demographic profile essentially shows the characteristics of the population that took part in the study. Although all member of the household were free to contribute during the questionnaire survey, it is only the demographic profile of the household head that was presented. It was essential to analyse characteristics of the population taking part in the research because these can be important confounding variables or background variables that influence how people utilise springs and livelihood outcomes that they can obtain from them. The demographic characteristic also forms part of the human and social capital in the sustainable livelihoods framework which is important in influencing livelihood strategies followed by households to achieve sustainable livelihoods. Figure 6.1 shows the gender of the leading participants in both Nyanyadzi and Maturure. Since the household was the unit of study, and everyone within the household who was present when the questionnaire survey took place could make a contribution, the demographic profile presented in the study is for the leading respondent who was not necessarily the household head. In Nyanyadzi 62% compared to 32% in Maturure of the leading participants were males, which illustrates a gender gap in favour of males in Nyanyadzi. In Maturure, the sex of the participants is skewed towards the female users (68%) when compared to Nyanyadzi (38%).

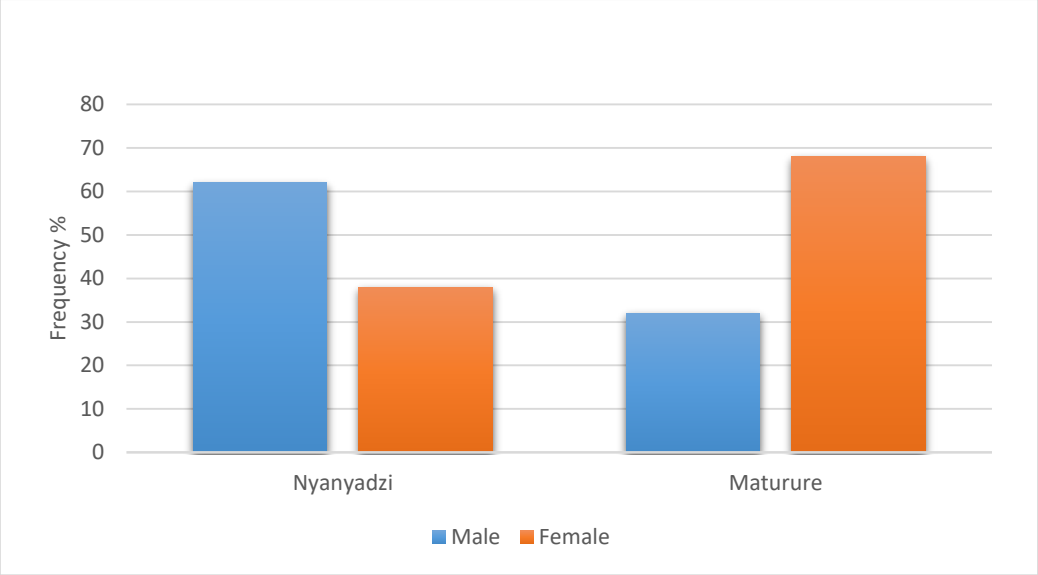


Figure 6.1: Sex of the participants (n=100)

Sex has a strong bearing on the level of knowledge of the participants since most roles in the catchment, which is a patriarchal society, are defined by sex. In the case of water, which is the main subject of study, traditional culture prescribes most duties of water management to women. In the study area woman interact with water more in their socially prescribed duties of cooking, washing, watering the gardens and collection of water for household use, hence they needed to be well presented amongst the participants.

Figure 6.2 shows the age distribution of the participants. The 31-40 year age group was the most dominant in spring utilisation in Nyanyadzi with frequencies of 48% and 32% in Maturure then followed by the 41-60 year age group. Also of note, was the fact that 20% of the participants in Maturure over the age of 60 years still utilised springs for their livelihoods, compared with about 2% the same age group in Nyanyadzi. The youngest age group of 18-30 years had the least interaction with springs in their livelihoods, with a 14% frequency in Nyanyadzi and 15% in Maturure. The results, therefore imply that spring waterscape utilisation was dominated by the economically active age groups and the youth. Most of the work at spring waterscapes, such as, gardening and brick kilning were observed to be mainly manual, especially given the fact that it was done at a micro-scale, hence were dominated by the relatively energetic age groups. The low representation of the elderly was mainly due to their ill health and old age, with observations made during interviews showing that they were the most vulnerable and poverty stricken.

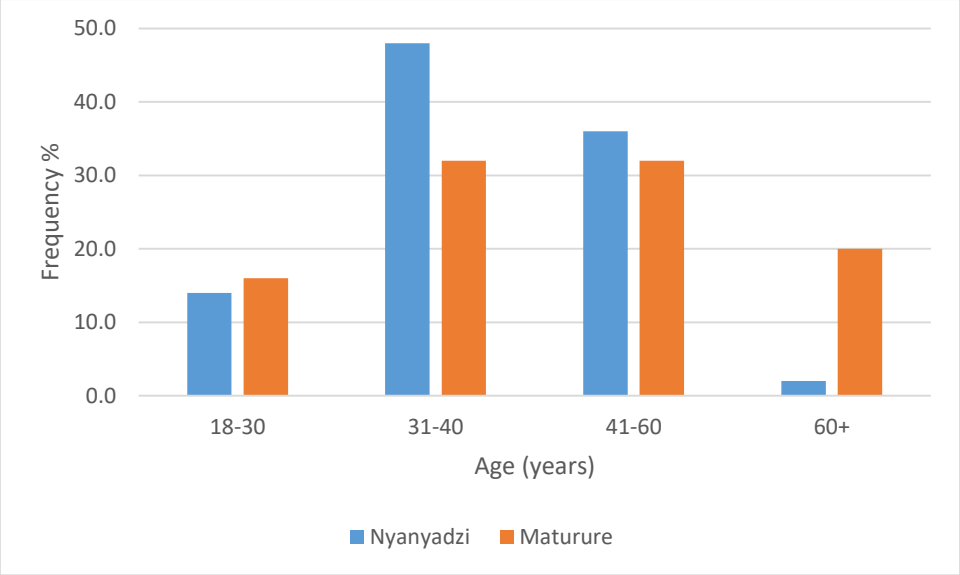


Figure 6.2: Age of the participants (n=100)

Figure 6.3 shows the marital status of the participants who took part in the study. The majority of the participants, who utilised springs for their livelihoods, were married with frequencies of 80% in Maturure and 68% in Nyanyadzi. Widows had frequencies of 14% in Maturure and 12% in Nyanyadzi. Spring users who were single were more dominant in Nyanyadzi 18% compared to 4% in Maturure. It can therefore, be concluded that spring utilisation is a livelihood activity that involved more married people with wives dominating in Maturure and husbands being more dominant in Nyanyadzi.

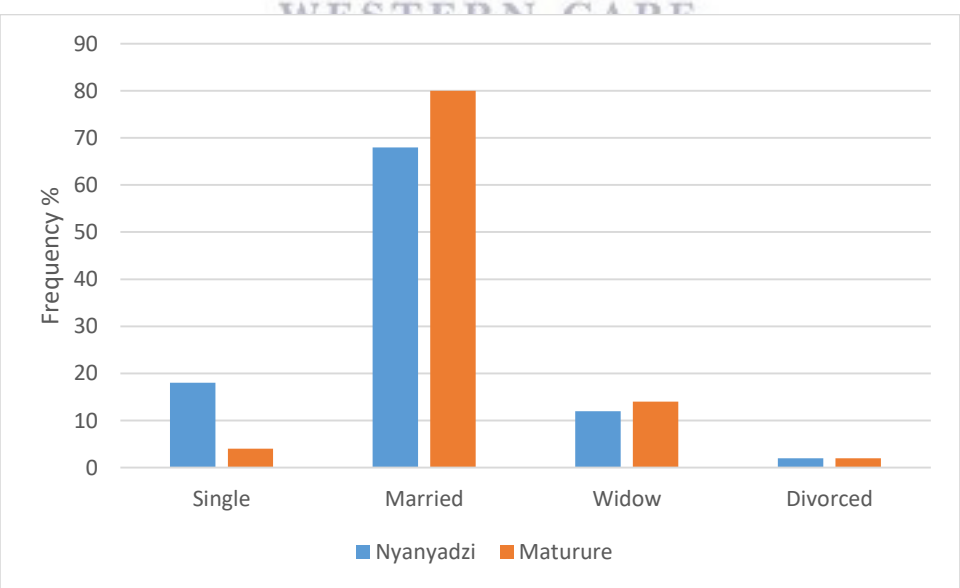


Figure 6.3: Marital status of the participants (n=100)

The majority of the participants in Nyanyadzi (70%) and Maturure (60%) had secondary education, followed by primary education (Nyanyadzi (18%) and Maturure (28%)) as shown in Figure 6.4. Those with tertiary education were 12% for Nyanyadzi and 10% in Maturure, with those that had no formal education being less than 4% in both places. The majority of those with no formal education were in the 60+ age group and were born before Zimbabwe's independence in 1980. Those with no formal education were observed to be dominated by women who alleged that during those times, families prioritised sending boys to school because of limited funds and the bottleneck system in education during those colonial years.

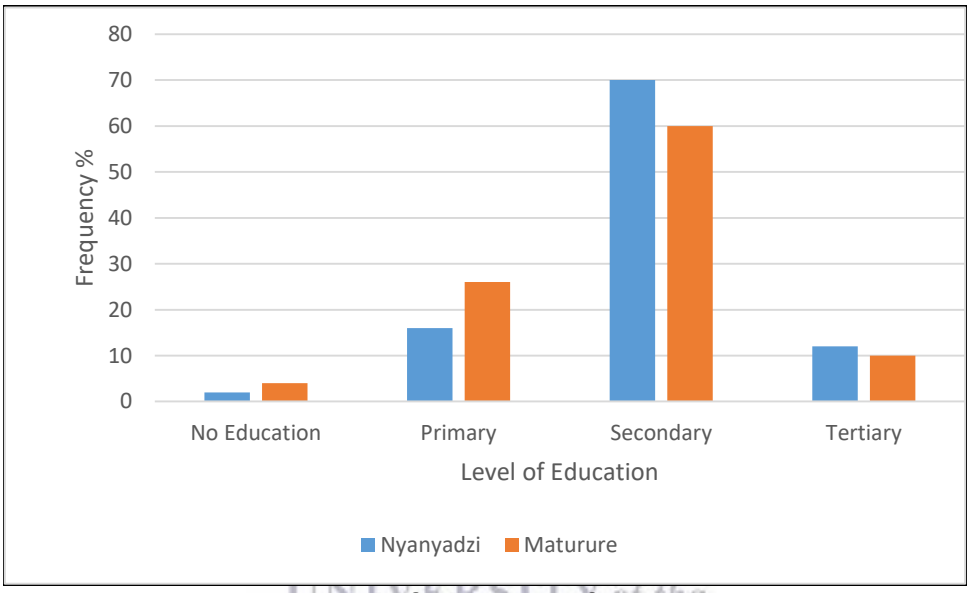


Figure 6.4: Level of education of the participants (n=100)

6.2 Utilisation of springs

The results show the multi-dimensional utilisation of springs on the Save Catchment. Springs were noted to have meaning in the livelihoods of rural communities of the Save Catchment by providing supporting, provisioning, regulating and cultural services. Figure 6.5 shows the livelihood strategies and services that the surveyed Maturure and Nyanyadzi communities of the Save Catchment derive from springs. At both places, agricultural food production was observed to be the most dominant practice supported by springs with 100% of the participants in Nyanyadzi and 90% in Maturure acknowledging it. The participants observed an over-reliance on springs to support agricultural food production mainly through food gardens which they argued to be an important component in household nutrition and food security. This is unlike in the past, as observed by some key informants, when household food production was

done in the fields under dryland agriculture with garden food being done mostly seasonally. Participants also observed the diversity of crops being grown on spring waterscapes to have increased over the past 10 years. They observed that in the past it was just traditional vegetables (*chomolia*, pumpkin leaves and cow pea leaves) and brown rice, now other crops including carrots, peas, cabbages, butternuts, spinach and butter beans were being grown. Some households were noted to be taking crop production as a business and obtaining income that was being used to buy mealie meal, other food items, basic goods (such as, cooking oil, clothes, electricity) and to pay school fees and health expenses. Key informants also observed the increased demand for spring water utilisation to be a result of high unemployment levels, limited opportunities outside agriculture compounded by recurrent droughts. These factors then force households to use springs because they provided insurance against possible droughts and also as a source of alternative employment that could provide for some of the household requirements like food and money.

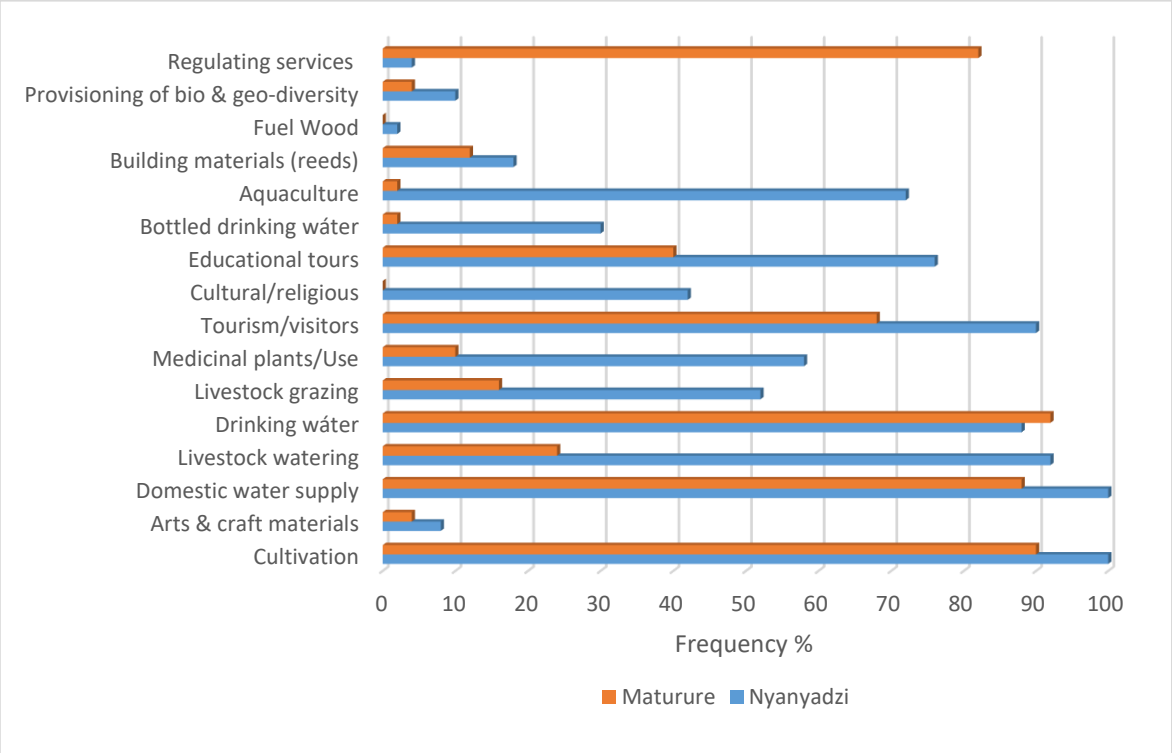


Figure 6.5: Livelihood activities and services provided by springs in Nyanyadzi and Maturure

(n=100)

Plate 6.1 shows one of the consolidated community gardens in Maturure that was being supported by spring water.

Plate 6.1: Consolidated community garden in Maturure

Springs, as noted in Figure 6.5, were also an important source of domestic water supply for both Nyanyadzi and Maturure communities with response frequencies of 100% and 88% respectively. Domestic water supply here includes; water for drinking, cooking, bathing and sanitation. This makes springs extremely important in supporting the livelihoods of the two communities, especially their role in improving household health. Plate 6.2 shows the methods of water collection for domestic purposes used in Maturure, Nyanyadzi and Rupise. The Maturure spring (a) is not protected and is vulnerable to pollution whereas the Nyanyadzi spring (b) which is a hotspring that produces lukewarm water, was protected and has its core fenced and piped. Both springs provide water for domestic use. At (c) and (d) is water being collected at the Rupise hotspring in Chipinge. Here people come from villages as far as Rimbe (30km) and Mwachete (5km) to bath, collect water for drinking and for other domestic and productive purposes such as construction. Of importance here, is the fact that almost an average of 50-60 people come and do their laundry and camp at the spring site for the whole day because most will have travelled from far off, hence bring laundry for the whole week or even month which takes more time to clean. The interviewed users viewed the hotspring as the only available source of good quality water that best suits some of their livelihoods. They observed that most of the alternative water sources, like boreholes and wells in the area, produce water that has high mineral content that makes it hard and also sometimes dry up or lack maintenance hence dysfunctional. They argued hard water to be a nuisance because it tastes bad, consumes more soap during bathing and laundry and also damages their clothes faster when compared to water from the hotspring. There are also no limits set to the amount of water one can fetch from

the spring. This is in recognition of the fact that some of the spring users travel long distances to access the spring water. However, those who bring very huge (drums with a capacity over 200 litres) or numerous (over 5) containers, have to give other users a chance and cannot fill all their containers at once.

(a) **(b)**

(c) **(d)**

Plate 6.2: Water collection for domestic purposes at (a) Maturure, (b) Nyanyadzi, (c) and (d) Rupise

Nyanyadzi shows high rates of spring water utilisation by livestock for both watering and grazing with frequency rates of 92% and 52% respectively, as compared to Maturure which has livestock watering and grazing frequency rates of 24% and 15% respectively. The participants noted livestock to be a very important component of their economy through provision of draught power, milk, transport and food. This, therefore, meant that by supporting livestock production, springs were providing an important support system to their livelihoods. Plate 6.3 shows some cattle grazing close to the spring core at one of Nyanyadzi's hotsprings.

Plate 6.3: Cattle grazing at one of the spring cores in Nyanyadzi

Commercial ventures, like attracting tourists, were also an important function supported by springs in both communities as noted by 90% of the participants in Nyanyadzi and 68% in Maturure. In Nyanyadzi participants observed more tourists to visit the hotsprings compared to other cold and variable springs in the area. Plate 6.4a shows some of the accommodation chalets at the main hotspring site in Nyanyadzi. The hotspring resort also provides conference facilities, spa treatment, swimming facilities and recreational fishing on a small dam fed by water from the hotspring. However, not all springs in the study area can be protected and used commercially even though they may be desirable as shown in Plates 6.4b and 6.4c at Rupise hotsprings. The springs are regarded by the locals as being sacred and the oracles do not tolerate any modification of the site to support tourism that excludes the local households from accessing the spring. Most residents interviewed at the spring site confirmed this by saying:

Mbuya vepano vanodziisa mvuva yechitubu havadi zvechirungu, vose vakamboda kuvaka pano vakakonewa

This translates to 'the spirits of the spring responsible for warming the water do not want to see western forms of development on the site and those who have tried to build close to the spring have failed'. Participants of in-depth interviews highlighted that each time there was an attempt to construct buildings with brick walls, at certain heights, the walls would mysteriously collapse and eventually one of the construction workers would mysteriously die. This explains all the abandoned structures and swimming pools at the site.

Plate 6.4a: Some accommodation chalets at the main hotspring site in Nyanyadzi

Plate 6.4b: Abandoned attempt to build a hotel at Rupise hotspring

Plate 6.4c: Disused swimming pools at Rupise hotsprings

In Nyanyadzi, 76% of the participants and 40% in Maturure saw educational and research tours as important services provided by springs. The participants noted visits from local and international schools, colleges and researchers who come to learn more on how communities were deriving livelihoods from springs and the hydrology of the springs. They observed that the number of visitors coming solely to study and learn about springs and how they related to the environment and communities to be on a steady increase over the past 10 years. Participants also observed that it was mainly the bigger and more popular springs that were attracting all the attention from learners. Bottling of water for commercial purposes was also noted to be a practice by 30% of the participants from Nyanyadzi and 2% from Maturure. The bottling was being done by the locals and sold to mainly tourists who visit the area and very limited amounts were marketed out of the locality. Aquaculture, mostly fish farming was noted by 72% of the participants in Nyanyadzi and a mere 2% in Maturure to be a service supported by spring water. This was observed to be a relatively new practice to which those who have access to springs and other reliable sources of water were getting outside assistance to venture into.

Springs were observed by 18% of the participants from Nyanyadzi and 12% from Maturure to be an important source of building materials. These materials included; thatching grass for roofing houses, reeds for making crafts, brick moulding and kilning and poles for building houses. In Maturure, 82% of the participants, as compared to only 4% in Nyanyadzi, recognised the role of springs as regulating the environment from micro-climatic stabilisation to stream flow and supporting biodiversity. A notable 10% of the participants from Nyanyadzi and 4% from Maturure observe springs to be part of unique geo-diversity that was important to conserve and also as supporting unique biological diversity like rare tree species, bee hives, fruit trees, wild animals and medicinal plants. Plate 6.5 shows a bee hive on one of the springs in Maturure being used in the production of honey which the households can sell and obtain extra income.

Plate 6.5: Bee hive on one of the springs in Maturure

Important to note is that 42% of the participants in Nyanyadzi viewed springs to be of cultural significance (non-consumptive utilisation) as compared to none in Maturure. Participants from Nyanyadzi believed some of the springs, especially those close to mountains and hotsprings, to be of mystical significance with some being seen as sacred and were used for cultural events like rainmaking ceremonies. Beer brewing was also cited during in-depth interviews to be a common cultural practice that used spring water. Beer brewing was mainly reported to be the cultural role of women, especially those above 50 years. Beer brewing was also noted as an important traditional practice that the communities considered as being important during festivities and traditional gatherings that were both traditional and social. During such festivities beer was given to those taking part, free of charge, but sometimes beer brewing was said to be done as an income generating activity and sold to supplement household income. Here, the frequency of beer brewing was determined by the need to have income to meet family needs, such as, food, soap and school fees.

Plate 6.6 shows the outlet of the main hotspring in Nyanyadzi. Many tourists came and threw coins into the spring source after making a wish in the belief that the practice will bring good luck. An in-depth discussion with some of the visitors showed that most of them were not visiting the spring for the first time and some confirmed that all the wishes that they made in previous visits had come true. Some participants noted people coming to the hotspring site to bath and cleanse themselves from bad luck during specific public holidays, such as, New Year's Day. On a visit to the hotspring in Nyanyadzi on New Year's Day, one of the interviewed visitors who had travelled all the way from Harare said:

Isu hatiendi kwanaProphet Magaya naMakandiwa kunobviswa munyama asi tinouya pano gore negore kuzobviswa munyama nemvura iyoyi.

This translates to ‘we do not visit popular prophets like Magaya and Makandiwa to be cleansed of bad luck, but we visit this hotspring which has cleansing qualities’. Observations on the site also noted people from different religions from Christianity such as Catholic sisters and African spirit mediums visiting the hotspring for prayers and cleansing ceremonies.

In Nyanyadzi, which has hotsprings, 58% of the participants viewed springs as having medicinal properties which were being exploited by the community and its visitors. The spring water was observed by participants to cure skin diseases, stomach problems, arthritis and all sorts of pain in the legs, a practice known locally as *kupara makumbo*. Some participants noted some springs to support plant species that were of medicinal value and were being exploited by local communities.

Plate 6.6: Outlet of the main hot spring in Nyanyadzi with coins thrown inside

Some 8% of the participants from Nyanyadzi and 4% from Maturure observed springs to provide materials that they used to make art and crafts that they would eventually use to decorate their homes and sometimes sell to tourists. These materials included items like baskets, pottery and mats. The collection of fuel wood, though not very popular at the two places, was noted by 2% of the participants from Nyanyadzi to be occurring on or near springs. All of the services supported by springs (except for regulating services), as observed in Figure

6.5 were found to be more pronounced in Nyanyadzi which is more semi-arid when compared to Maturure, meaning that springs are more important as a resource that is widely exploited to support livelihood strategies and options in Nyanyadzi when compared to Maturure.

6.3 Access and exclusion from springs

Figure 6.6 shows how the use and access to springs was controlled and managed in Nyanyadzi and Maturure areas of the Save Catchment. About 44% and 46% of the participants from Nyanyadzi and Maturure respectively saw access to and utilisation of springs as being mainly controlled by the enforcement of standing rules and regulations. These included; both formal and informal policies, rules, by-laws, legislation and property management regimes. Through enforcement, the responsible institutions control access issues.. In Nyanyadzi some springs, like the main hotspring, have been commercialised and access is granted only after payment to the resort company, as noted by 22 % of the participants. However, these participants also observed that only tourists had to pay a fee of one United States dollar (USD 1) to gain access and locals still gained entry free of charge. At Nyanyadzi, 26% of the participants and 28% from Maturure noted that authorisation had to be given before one is entitled to use springs in the area. Authorisation took the form of allocation of the spring to a family, permission to cultivate or derive other forms of services from the spring.

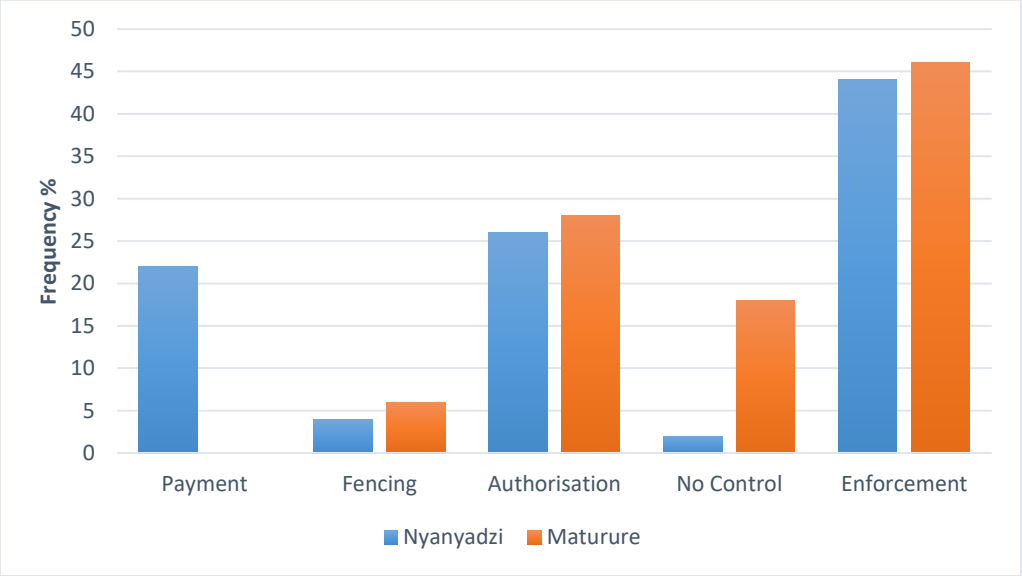


Figure 6.6: How use and access to springs is controlled (n=100)

Less than 10% of the participants noted fencing as a method used in both areas to control and restrict access to springs. However, in some areas participants saw fencing to be undesirable

and, in some cases, prohibited as they felt it could anger the resident 'mermaids' and lead to the drying up of the springs. Plate 6.7 shows the fencing restricting and controlling access to (a) main hotspring (b) second hotspring in Nyanyadzi. More springs in Maturure (18%) compared to 2% in Nyanyadzi have no form of control to access and utilisation meaning anyone can have access at any time and do what they wish on these springs (Plate 6.7c).

(a) **(b)**

(c)

Plate 6.7: Fences controlling access to (a) main hotspring, (b) second hotspring in Nyanyadzi and (c) uncontrolled and unprotected Rupise spring

Figure 6.7 shows the temporal restrictions to access and utilisation of springs in Nyanyadzi and Maturure. Most of the springs in Maturure (68%) had no form of restriction on the time or season in which they can be utilised whereas in Nyanyadzi 36% of the participants had a similar

perception. In Nyanyadzi, almost 34% as compared to 4% of the participants in Maturure noted springs in the area as having daily restrictions, in most cases springs could only be accessed during the day and were forbidden at night. There were also some seasonal restrictions in both areas with Nyanyadzi (30%) having more seasonal restrictions than Maturure (18%). Seasonal restrictions take different forms and vary from season to season, for example, during years of drought water from springs could be rationed and people could be discouraged from using springs during the rainfall season to allow them to recharge.

Weekly restrictions, as noted in Figure 6.7, were only practiced and observed by 10% of the participants from Maturure. Under these weekly restrictions, watering the gardens, for example, in Maturure ward 15, could only be done during specific days of the week which were on Mondays, Wednesdays and Fridays and prohibited during other days. However, at all the sites, it was observed that most of these restrictions did not apply when it came to water for domestic and primary use. Even though there were no restrictions on water quantities to be drawn from springs for domestic uses, recurrent visits to the springs sites with big containers or pulling carts was forbidden in most areas and only authorised by village heads in situations of large gatherings, such as, weddings and funerals.

Also noted was the fact that in some cases there were no direct restrictions to utilisation and access but some of the springs are very sacred to the extent that the community of users end up limiting their use only to specific times of the day. As highlighted during in-depth interviews, at Rupise spring, for example, those that try to use the spring at night, would mysteriously start hearing drum beats that may 'hypnotise' them, drive them into a 'trance' then start seeing an old lady or a snake, which in many cases ends in their death. If one tries to use the spring before sunrise, early in the morning, they may see white clothes hung around the spring and risk being taken by mermaids. Such myths and stories have naturally restricted the users to come and utilise the spring water only after sunrise around 09:00 am – 5:00 pm, just before it gets dark although nobody specifically monitors these times.

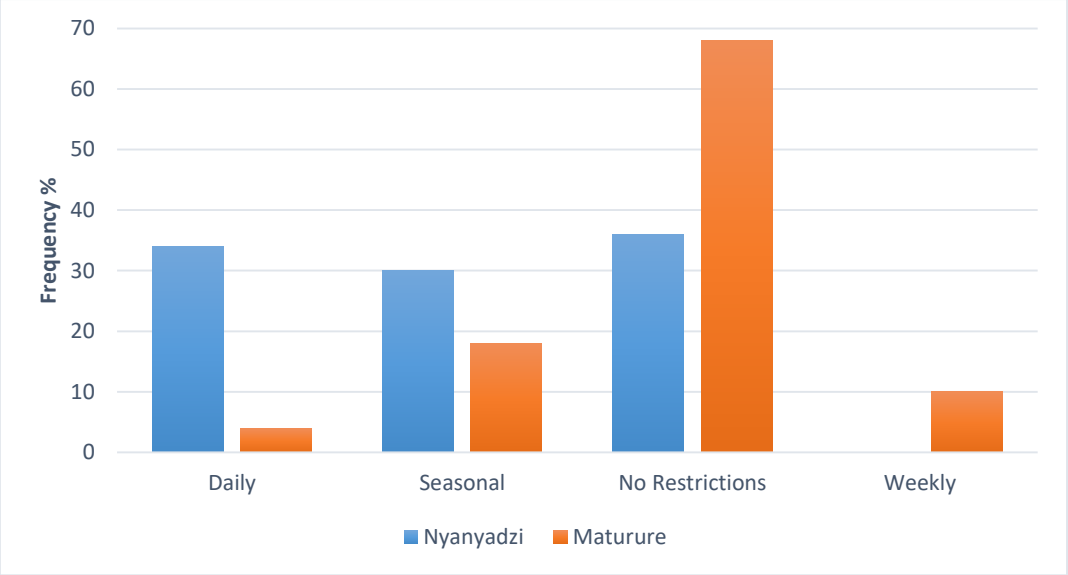


Figure 6.7: Temporal restrictions to access and utilisation of springs (n=100)

In addition, to the temporal restrictions, at most springs in the study area, in-depth interview participants also noted that collection of the water could not be done in any container; people were prohibited, in most cases, to fetch water using metal containers which would have been used on fire before. This has a double effect of ensuring that the water is not contaminated with soot and also reduces the quantities that can be extracted.

6.4 Importance of springs to rural livelihoods

As observed in Figure 6.8, springs play an important socio-economic role in the rural areas of the Save Catchment with those in Nyanyadzi (68%) and Maturure (14%) viewing springs as being important in sustaining their livelihood base. On the other hand, 86% of the participants in Maturure as compared to 30% in Nyanyadzi viewed springs as being extremely crucial in supporting their way of life and would find it difficult to sustain a living without the functions and services that they provide. Participants observed springs to offer an opportunity for households to diversify and make their livelihoods more sustainable and resilient to both internal and external shocks, such as, droughts, food shortages and food price increases.

However, close to 2% of the participants viewed springs as being insignificant in supporting their livelihoods. This group of households was mostly made up of those who could not have access to spring sites due to the fact that they were not locally available, were not original residences of the area and also because the springs had been degraded beyond use. The majority of the 2% who did not see springs as making meaningful contributions to their livelihoods were

generally of low social standing, poor and food insecure. Most of these relied on deep wells as a source of water or had to walk very long distances to the nearest borehole. Their livelihoods were mainly centred on dryland agriculture which they noted to be unreliable, on begging, doing piece jobs on neighbouring plots and also surviving on remittances.

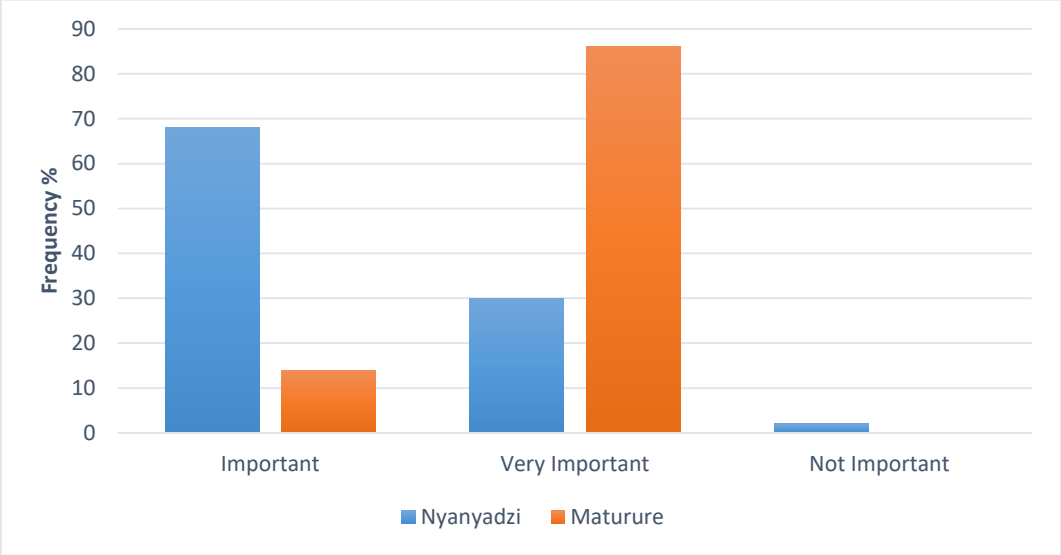


Figure 6.8: Importance of springs to livelihoods of study communities (n=100)

As shown in Figure 6.9, a combined use of springs for both commercial and subsistence purposes was practiced in Maturure for sustaining rural livelihoods with a frequency of 70% and 36% for Nyanyadzi. Under commercial and subsistence use, a household obtains spring services for mostly family consumption and then sells or exchanges the surplus to obtain money or other goods or services they require. In some cases, the diversity of the crops being grown on spring waterscapes has increased and households were venturing into crops that they did not have capacity or need to grow in the past. For example, in Maturure, some crops like peas were being grown using spring water solely for the markets. The use of springs for only subsistence purposes was also noted with 30% of the participants in Maturure and 60% in Nyanyadzi using spring services solely for household consumption. Only in Nyanyadzi were some springs used solely for commercial purposes with a 4% frequency.

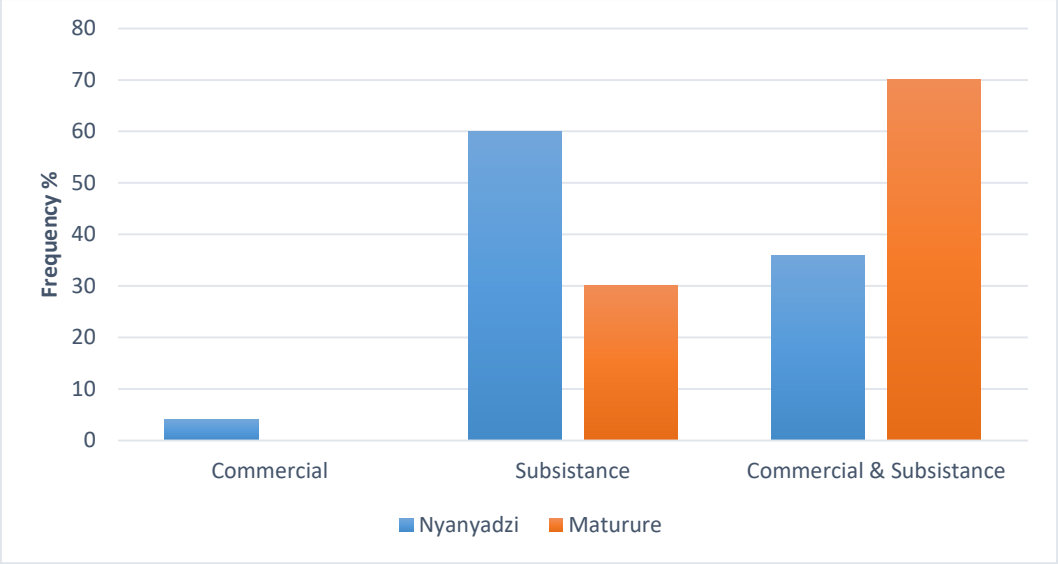


Figure 6.9: Form of spring utilisation in Nyanyadzi and Maturure (n=100)

Figure 6.10 shows the places where produce from both Maturure and Nyanyadzi springs were sold for those who produced extra to sell. In Nyanyadzi, most of the produce were being sold locally (10%) and to tourists and passers-by (6%). In Maturure, most of the produce were sold at commodity markets (22%) followed by neighbouring villages (16%) and locally (12%). The participants from Maturure, therefore, had access to commodity markets for spring output that were bigger and more diversified when compared to those from Nyanyadzi, making them more resilient to shocks and sustainable.

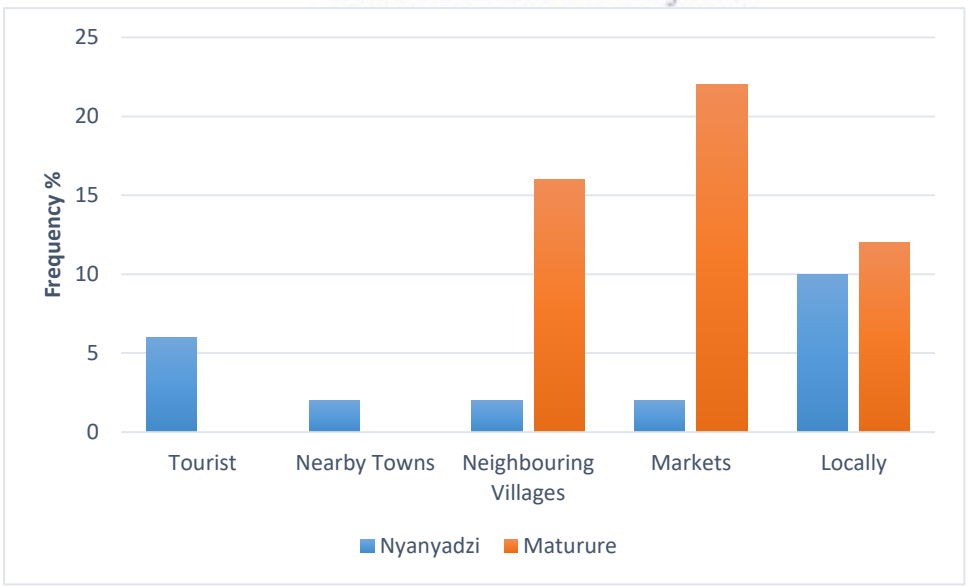


Figure 6.10: Places where produce from springs is sold

The numbers in figure 6.11 show that relatively few (at most 22%) of the households produced excess produce for selling, especially in Nyanyadzi, the rest observed themselves to be struggling to produce sufficient food for family consumption. Figure 6.11 shows the average monthly income derived from spring output for the households that managed to sell products derived from springs. Most of the income from selling spring products was derived from springs in the Maturure area with 2 % of the participants earning an average of up to USD $80 per month, 8% earning up to USD $60 per month and up to 10% of the participants earning up to USD $50 a month. In Nyanyadzi, generally the income from springs is low when compared to Maturure with an average of 8% of the participants earning an average income ranging from USD $20-$30 per month.

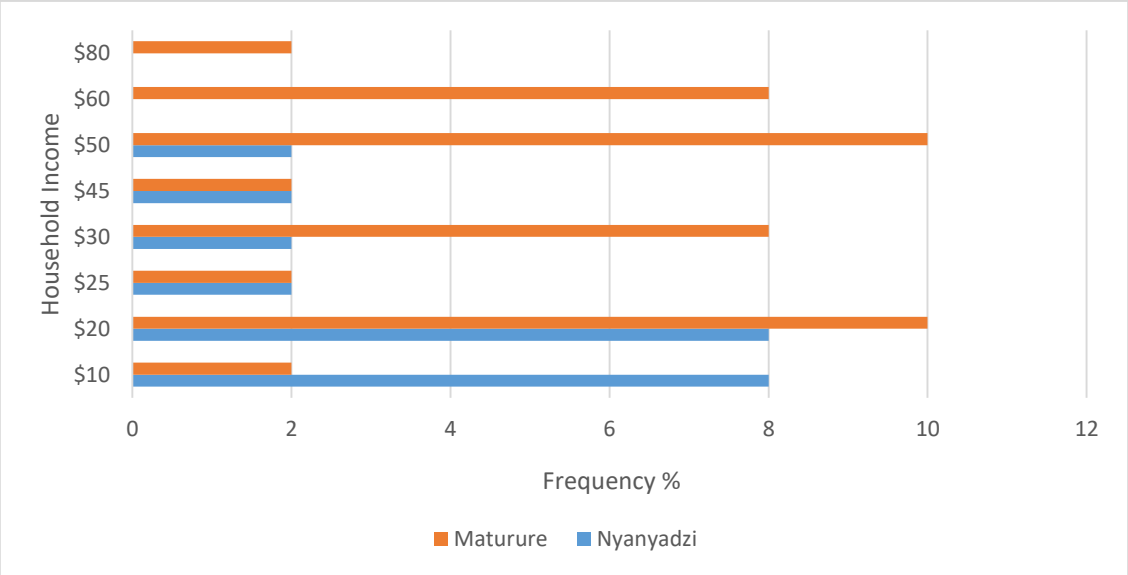


Figure 6.11: Average monthly income derived from spring output (n=100)

Figure 6.12 shows the contribution of springs to total household income. In both Nyanyadzi and Maturure, households earned between 5%-65% of their income from springs, depending on the place and time of the year. This meant that their contribution ranged from minor to significant depending on the household. However, the Maturure communities derived more income from spring utilisation when compared to those from Nyanyadzi.

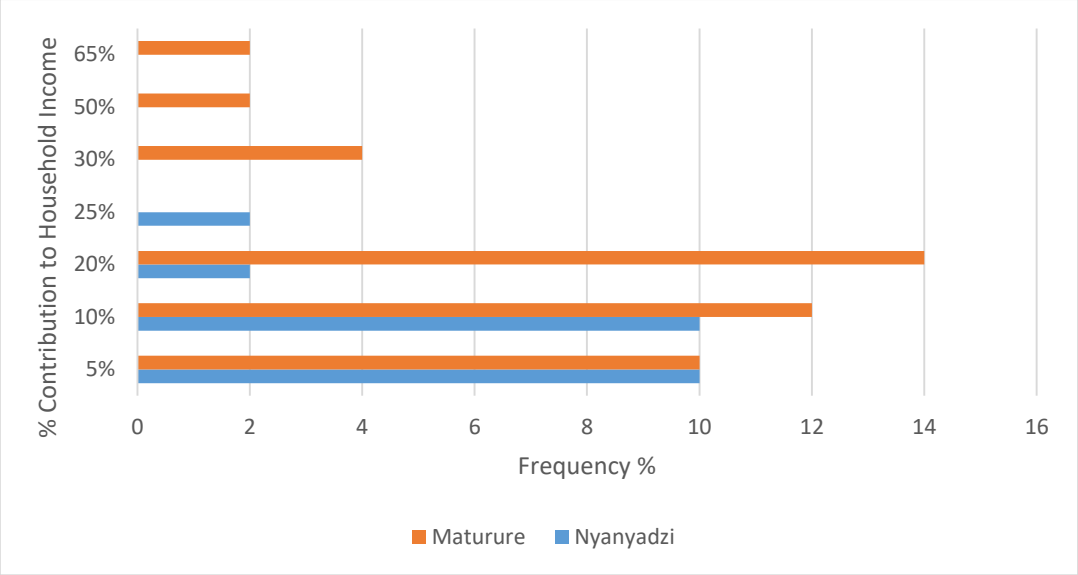


Figure 6.12: Contribution of springs to total household income (n=100)

Figure 6.13 shows the contribution of springs to the sustainability of rural livelihoods in both Maturure and Nyanyadzi. A total of 32% of the participants in Nyanyadzi and 24% in Maturure noted the total contribution of springs to their household livelihoods to have declined as compared to the past 10 years. On the other hand, 14% of the participants from Nyanyadzi realised an improved contribution of springs to their livelihoods and so did another 4% from Maturure. Further, 24% of the participants from Maturure and 8% from Nyanyadzi viewed the contribution of springs to their livelihoods as fluctuating from season to season depending mainly on the climatic and economic conditions experienced. Less than 5% of the participants at both places viewed the contribution of springs to their livelihoods as unchanged. Given that for springs to comfortably contribute to sustainable rural livelihoods, their contributions to livelihood enhancement must have either improved or at least, be stable and also continued to deliver the required levels of functions and services over time. It can, therefore, be argued that the contribution of springs to rural livelihoods has been declining in both areas of the Save Catchment although there are other areas where their contribution has improved over the past 5 years. This however does not imply that the importance of springs to rural livelihoods is diminishing but means that too much pressure is being put on them to support the agro-based livelihoods in the area. This sustained pressure on springs combined with erratic rainfall that must recharge the springs has resulted in the reduction of the ecosystem services that they provide.

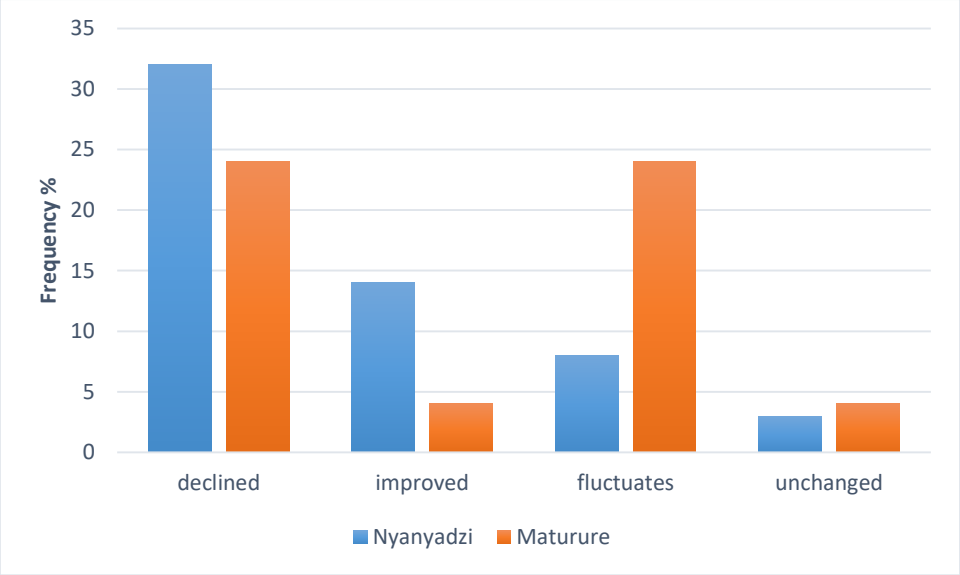


Figure 6.13: Contribution of springs to sustainability of livelihoods (n=100)

6.5 Discussion

The population which took part in the research represents the human capital in the SLF. The abilities and structure of the population to a large extent determines the livelihood strategies followed by household. As shown in Figure 6.1 the majority of households utilising springs in Nyanyadzi had males leading the households whereas in most of the Maturure households, females took a heavy responsibility of leading the households and pursuing livelihood activities. As observed from the participants, both Maturure and Nyanyadzi were patriarchal societies and gender roles put women in direct contact with springs most of the times. Most of the spring uses noted in both areas like cultivation, watering of the gardens, fetching water for drinking and other domestic purposes, making of crafts and collection of firewood were largely female tasks while males were often engaged in non-spring livelihood activities, such as jobs in the formal and informal sectors. This was also reflected, to a large extent, in the level of depth of the responses that were being given during both the questionnaire survey and in-depth interviews. The women seemed to be well versed with the nuts and bolts of the utilisation, management, challenges and institutions in spring water management more than their male counterparts. This was also confirmed by Sattler (2010) who observed that females utilised and conserved springs and other natural resources to provide basic needs for their households, hence management of these resources in rural areas could not be done efficiently without the participation and education of females.

In depth interviews with key participants reviewed that in some areas of the Save Catchment, females could not freely attend community meetings and trainings in conservation being facilitated by outsiders due to cultural normative practices. This creates problems in the management of water resources especially given that women culturally interact with water more than males. Information disseminated from such trainings and gatherings of mainly males is often not correctly transferred to their female companions who are often the most involved in spring utilisation practices. Makonese (2008) observed that women can meaningfully contribute towards sustainable natural resources utilisation if they were empowered, hence, women's poor representation shows the need to target more women in natural resources management education.

In the study area, just like most of Zimbabwe, land for gardening is only parcelled out to male members of the family. This means that any woman whether married, single or widowed cannot be directly allocated land for gardening under the traditional model of land distribution. Despite this fact, most of the observed gardens in the study areas were known to belong to the female member of the family who worked on it. At almost, all the gardens observed, where the researcher asked for the owner, he would hear names like '*igadheni raMai Tapiwa, raMai Chido, raMaiPeter* e.t.c. This shows that while women do not own the land, they were acknowledged as the owners and managers of the gardens. Dermana and Hellum, (2007) maintain that, one of the greatest factors working against women in Zimbabwe is land tenure systems because in most cultures land is passed on to man and not women.

The majority of spring users in both Nyanyadzi and Maturure were in the 31-40 and 41-60 year age groups. Combined with the fact that married people constituted the dominant majority of spring users in both areas, these age groups were the most economically active and also displayed the highest concern for family responsibility and for which provision of household livelihoods is mostly a priority. Studies by the Tegemeo Institute (2006) showed agriculture to be a key source of employment for those in the economically active age group, hence, the propensity of the age bracket 34-50 years dominated the age distribution in wetlands. This suggests that spring utilisation was closely tied to the pursuit of employment as much as it is to livelihoods. This finding was confirmed by King et al. (2005) who observed in South Africa that conservation had numerous impacts and implications, in specific communities that were tied to the livelihood and governance structures and younger people were less likely to take

part in resource management and conservation programmes but rather display more interest in employment generating activities on the wetlands.

In both Nyanyadzi and Maturure, 96% of spring users had formal education with secondary education being the most dominant, therefore, the level of education did not seem to play any significant role in the choice and use of spring resources by the people who utilised them. Hulme and Murphree (2001) also observed that the greatest leading influence on spring wetland utilisation by communities was related to the prevailing livelihood and governance systems, hence, livelihood requirements had preference over knowledge and education about the ecological impacts of wetland utilisation. Marambanyika (2015) also observed that formal education did not translate to improvement of individual's knowledge on wetland conservation since wetland studies were not a specific component of the school curricula. In the study, lack of community awareness of sustainable spring utilisation was also observed to threaten effective spring management.

The utilisations of springs at Maturure and Nyanyadzi fall under livelihood strategies in the sustainable livelihood framework. Livelihood strategies show how livelihood assets are being mobilised to achieve the desired livelihood outcomes. The spring utilisation question in both Maturure and Nyanyadzi, as observed by key informants, is dominated by two extreme views, one seeking their complete preservation as a fragile but important resource and the other encouraging their utilisation transformation to support agriculture production and improved livelihoods. This has also been observed in other parts of Africa with Dixon et al. (2013) noting that these approaches to springs utilisation lack thoughtfulness as there are also other important livelihoods and ecosystem functions that springs provide to households.

The research observed a cocktail of services provided by springs with cultivation, provision of domestic and drinking water being the main uses in the study area. Most of the observed uses utilised spring water throughout the year. In most places of Maturure and Nyanyadzi there were intensive uses of spring water for agriculture, especially in the cultivation of gardens. Intensive use means that there is irrigation of one crop followed by another all year round without periods where springs are left to recharge. This is unlike in the past, where the participants confirmed that they only utilised springs during years of drought or during the dry seasons of the year. Research done in many parts of Zimbabwe also reveals that use of springs and related wetlands is now increasingly becoming more intensive to semi intensive (Matiza, 1992) in over 90% of

the observed cases (Derman, et al. 2007). There is, therefore, over use and over reliance on spring water by households in order for them to achieve food security.

As observed by Robinson et al. (2004) in rural Zimbabwe, like many other rural areas in the Global South, households require water for their domestic needs as well as for small-scale livelihood activities, such as, backyard gardening, livestock watering and beer brewing. However, the delivery of rural water facilities in Zimbabwe by both the government and international agencies has conventionally concentrated only on the health benefits of water supply, and has not been tailor-made for local community manifold water needs. A good example is the Integrated Rural Water Supply and Sanitation Programme which primarily concentrated on provision of hygienic water for domestic use from communal boreholes and deep wells (Makoni et al. 2004). It can therefore, be argued that since the provision of water for livelihoods was absent in these water supply programmes, springs developed to be one of the most significant sources of water that provide for the communities' multi-dimensional water requirements.

Participants also observed, that as population pressure increased and climate variability caused frequent droughts, the communities were exploiting more and more of springs because they guarantee yields even during years of drought. Matiza, (1992) also observed springs as providing a food security safety net through provision of water all year that could be utilised to support food production. Svotwa et al. (2008), also noted Zimbabwe to have a well-established traditional agricultural practice based on spring waterscapes that have a very significant input for household food security. As noted by key informants in the study, the area under cultivation supported by springs has been on the increase when compared to the past ten years. Matiza, (1992) also observed an increase in spring waterscape farming in Zimbabwe's communal areas even though the practice was unlawful and offenders were deprived of access to extension services and financial aid. Vitoria et al. (2012) attributed this increase in spring utilisation to the fundamental role agriculture plays in rural livelihoods of semi-arid areas of Zimbabwe.

Over-reliance on natural resources like springs, as argued by Sakataka and Namisiko (2014) was a sign of high levels of poverty in communities. They observed that, on average, the non-poor households cultivated smaller plots of land near springs than the poor do, and a good number in both groups do not cultivate at all. Thus, this suggests that the cultivation on springs does not inevitably increase the odds of avoiding poverty but, those sections of communities

whose livelihoods are supported by the land are more prone to poverty than those groups who have diversified sources of income. This, therefore, means that mitigating the impact of spring degradation due to intensive cultivation must include finding alternative livelihood sources amongst the priority action measures. This was also confirmed in the research with participants observing that provision of livelihood diversity or alternative livelihoods from agriculture would reduce the pressure on springs. Rebelo et al. (2009) observed that since utilisation of springs contributes significantly to rural livelihoods in Zimbabwe in terms of both direct cash income and food security, it was improbable that additional development of springs for agriculture could be prevented when viable alternative livelihood opportunities were unavailable. Research done by Bell and Roberts (1991) then Marambanyika and Beckedahl (2016) amongst others has shown that households utilising springs for gardening were more food secure as availability of water permitted the cultivation of a wider variety of crops and other natural products that contributed to nearly half of the food that they directly consumed and close to 48% of average annual household total cash income.

Springs were observed to be a major source of domestic water in both Maturure and Nyanyadzi. The communities relied mostly on spring water for bathing, cooking, laundry and general sanitation. Springs were also an important and sometimes the only source of drinking water for the Nyanyadzi and Maturure communities. Drinking and domestic water constitute primary water use in Zimbabwe's Water Act (1998) which is a basic right for all Zimbabweans. Key informants observed that the government's failure to provide formal water supply, like boreholes to communities in rural areas of the Save Catchment, has led to communities depending on natural sources like springs as a source of primary water where they are present. At some fenced springs in Maturure, only water for drinking and domestic purposes could be directly obtained from springs and had no form of restriction, other uses obtain water from either weir dams or collector wells constructed downstream of the springs to avoid contamination and degradation.

The utilisation of springs in both Nyanyadzi and Maturure areas of the Save Catchment also had a scientific and educational dimension. Participants observed that students and researchers at all levels from primary, secondary schools and the universities visit springs in their areas to study and understand their hydrology and to learn how society is interacting with them. Springs noted to be mostly studied in the study area included the Nyanyadzi and Rupise hotsprings and Maturure springs which support nutritional gardens with 42 beneficiary households.

Utilisation of springs as research sites constitutes non-consumptive use and the interests from researchers as noted by the participants were important because they helped to understand the scientific-educational meaning of springs to communities as an incentive for their wise use. Participants also observed the education of communities on wise use of springs through wetland day workshops and awareness campaigns to improve community conservation of springs. This is also congruent with Ball (2004) who observed the educational role of springs to be essential because of the extensive limited appreciation of the impact of their utilisation on groundwater quality, quantity and implications for human life. Sada et al. (2001) observed the education of the public about the importance of springs to be one of the greatest spring resource management goals. Bascik et al. (2009) noted research on springs to be increasing in popularity but still having a lot to go in terms of refining our understanding of their systems, particularly in the approaches to spring conservation where they noted the number of publications to be still relatively small.

Tshibalo (2011) advocated for some springs in South Africa to be used specifically as spring research and education centres to increase community understanding of springs. Day and Malan (2010) also observed the educational value of springs, as researchers and students from numerous institutions of learning visit them for academic excursions. In terms of the hotsprings, some countries like New Zealand and Germany, have introduced geothermal science education near hotspring resources (Arslan and Huber, 2010). These centres introduce geothermal education at diverse stages and with diverse emphases and training coming in the form of workshops, short courses, and graduate studies. Some centres solely disseminate geothermal knowledge and information to high school students and the general public.

Springs also have a very important traditional and cultural dimension in both Nyanyadzi and Maturure. This is particularly so for some springs e.g. some of the hot and cold springs in the Nyanyadzi area. These springs were noted by participants to have healing (*kupara makumbo*) and mystical properties (such as cleansing of evil spirits, healing of various diseases and bringing luck), they are also used during rain making ceremonies and for hosting traditional beer ceremonies. Tshibalo (2011) and Boekstein (2014) have also noted springs to be used for religions purposes and healing of several illnesses, particularly hotsprings. Mariolakos (1998) observed springs' cultural value as being shown by the names given to them and their relationship to local widespread traditions and beliefs as far back as Greek mythology. To give an example, some springs have been associated with holy people and several miraculous

properties e.g. the St. Vincent Kadlubek spring in Poland. Springs in the Save Catchment can, therefore, be argued to be part of cultural property.

Provision of water and supporting livestock grazing pastures was also observed to be an important function of springs in both Nyanyadzi and Maturure. By sustaining livestock which are an important source of draught power, transport, food and as a form of affluence, springs, therefore, become very important to the economies of the study areas. Marambanyika (2015) also observed livestock as a source of rural communities' wealth and farmers sell them to buy food during drought periods.

Tourism based on spring sites in both Maturure and Nyanyadzi offered a chance for the communities to diversify their economies to improve their income and livelihoods (Figure 6.1). This also constitutes a non-consumptive use of springs and diversification to the economies of Maturure and Nyanyadzi from agriculture. As observed in the SLF, diversification reduces community vulnerability to external shocks and trends noted under the vulnerability context. However, despite its potential, tourism facilities in the study area were either dilapidated or non-existent at many spring sites. Tshibalo, (2011) and Boekstein (2014), amongst others, have also observed springs to have tourism potential in South Africa but continued to be seriously underdeveloped, for example, in the rural areas of the Limpopo Province, there were 23 thermal known springs, but only 10 had been developed to hotspring resorts.

In Nyanyadzi, some communities near the hotsprings, have, with the help of NGOs harnessed the water flowing from springs into ponds that they use for fish farming or aqua-culture. Participants have noted this to help them diversify their sources of income and household nutrition with most households observing a particular shortage in fish protein in the area. However, they noted very limited institutional support in terms of education and extension services, hence some of the initiated aquaculture projects have since stopped operating. Other livelihood materials such as firewood, building materials, medicinal plants and crafts were also observed to be sourced from springs and the wetlands that they support. Depending on the area, these materials were noted to be crucial to the survival of the communities who use them. Chirau et al. (2014) observed that springs also support ecosystems that provide services to rural communities and sustain their livelihoods. These services include; provision of reeds for making craft, tourism which brings income to communities, provision of medicinal plants and other fruit plants that can be sold or help improve family nutrition. Dixon and Wood (2003) observed that where craft industries were developed, they could upsurge the pressure on springs

if the spring products deliver raw materials but also noted that this may also lead to the appreciation and valuing of springs and preservation in their natural state.

Participants also observed springs to have important ecological functions such as regulation of stream flow and provisioning of geo and ecological-diversity. Participants viewed these functions as being important natural livelihood assets for their wellbeing. However, their role in supporting their livelihoods was not highly valued. Frenken and Mharapara (2002) also observed that such a viewpoint was influenced by community wellbeing, hence, the poor constantly prioritise material satisfaction before they turn to environmental protection concerns.

The access and utilisation of some springs in Nyanyadzi and Maturure did not have any form of restriction. Most participants observed no institution imposing any control on how households utilised springs and perceived ownership of the springs to be in the hands of the community. This implies that the application of both state and traditional law on spring access and utilisation was not present at these spring sites. On observation, most springs where there were no restrictions to access were, generally small, in a state of degradation and participants acknowledged the need for some restrictions to be imposed. Maclean et al. (2009) also observed the communal tenure system governing ownership and use of wetlands as discouraging the spirit of environmental stewardship and increasing competition for use rather than conservation. Fleischman et al. (2014) also observed that communal natural resources were abused because their usage as common property made surveillance and exclusion difficult.

Where restrictions were imposed, they took daily, weekly and seasonal dimensions. Daily restrictions applied mostly in the Nyanyadzi area. Here springs were used mainly during the day and at night traditional laws prohibited their use for cultural reasons. These cultural practices also helped to conserve springs as all activities could be monitored during the day. Weekly restrictions of springs were only implemented in the Maturure area. These were mainly formulated by the water committees and supported by the traditional leaders. Weekly restrictions took different forms from place to place, for example, at some places, families were allocated only three days a week, where they were allowed to water their gardens. However, the cultural norms in the study area did not allow restrictions to water for domestic use which could be incepted for use at any time of the day. Seasonal restrictions were applicable in both Nyanyadzi and Maturure and also varied from place to place. In some cases, the use of springs

was not allowed during certain months of the year to allow for their recharge, especially during the rainfall season or when other sources of water were available. At some places, springs were noted to be seasonal, hence could be exploited for their services during specific times of the year to conserve them. In other cases, use of water was rationed especially during drought years and also restrictions in the sizes of land that can be put under irrigation from spring water.

All these restrictions were meant to have productive use of water in a manner that also conserved the springs from degradation. Participants highlighted that it was the responsibility of mainly local institutions like traditional leaders and water committees to impose these restrictions on use. Dermana and Hellum (2007) also observed local institutions to be the best in imposing effective management regimes on springs because the central government agencies had logistical limitations of staff and funding and also functioned detached from the users of the resource. Some participants saw that the imposition of some of these restrictions as a basis for contestations and disharmony within societies, particularly when water committees or outsiders do not consult before imposing them. Zimbabwe's rural areas and, more broadly, in Southern and Eastern Africa, access to water has been noted to be an arena of contestation, overlapping and contending institutions. Marambanyika and Beckedahl (2016) observed that issues that limited access to springs also amplified competition and conflict over their distribution and use.

Most participants and key informants highlighted springs to be very important, especially to their livelihoods because they supported services that were very crucial for their survival as observed earlier in the study. The participants in most instances observed the right to access springs as being the same as the right to a livelihood, hence they continued using them for their survival even if the law gives restrictions to their access and their utilisation. They observed that denying them access to springs was the same as saying that they should not eat, send their children to school or even to survive. As noted by the participants, important livelihood outcomes from springs included reduced vulnerability to droughts, increased household income, improved food security, improved nutrition, better spring water management practices, improved social relations and improved wellbeing.

Most of the participants used springs for both commercial and subsistence purposes. This meant that they grew crops on their gardens for family consumption with the intention of also selling the surplus to the markets to earn some income. Dixon and Wood (2003) observed springs to be increasingly offering the prospect for additional income generation through the

cultivation of locally sought-after crops, such as vegetables. However, those who used springs exclusively for commercial ventures were found in Nyanyadzi. In Zimbabwe only water for primary use in rural areas is free, other forms of water use can only be done after obtaining an abstraction permit from ZINWA and paying for its use. Dermana and Hellum, (2007) also noted that new innovative forms of commercial cropping such as gardening for consumption and sale, represented a challenge to how authorities can draw a dividing line between commercial and primary water uses hence the need to pay for access.

The place where products from springs are being sold is an important indicator of the level of connectivity of the places' economy with other distant places. This also determines how vulnerable a place is to external shocks as highlighted in the SLF. The local markets for products from springs were important in both Nyanyadzi and Maturure, however, it was noted in many instances to be very small to sustain the continued production of produce and sometimes it was over-supplied. The availability of external markets, therefore, determined the sustainability of the producing communities. In Maturure, commodity markets in nearby places and neighbouring villages represented its major external markets whereas in Nyanyadzi, tourists and nearby towns represented the major markets for their produce from springs. The two places were, therefore well connected to the outside world in addition to the local demand for products from springs. However, it was noted that the volume of trade is sometimes affected by seasonality which falls under the vulnerability contexts in the SLF with some participants observing tourist arrivals to increase only during major holidays and low demand for vegetables when boarding schools are closed. In some places like Maturure some participants resorted to reducing production on spring based gardens when the markets will be too suppressed to absorb their excess produce. In South Africa, Turpie (2010) also observed external factors such as market dynamics to have an influence on the demand for wetland resources.

The income from selling spring based products in both Nyanyadzi and Maturure ranged from 5% - 65% of the total household income depending on the place. It must be stressed that most of the figures on income from springs were likely to be conservative approximations because it is difficult to calculate with precision the household income resulting from crop sales. This is due to the understandable reluctance to disclose such information, the difficulty of remembering and sometimes households may not always account for the small sums of cash they acquire from informal local exchanges, particularly if they usually sell their produce in bulk. Participants may feel it not worth reporting the sale of a few carrots or tomatoes to

neighbours. Similar studies by Marambanyika and Beckedahl (2016) revealed that up to 61.9% of total household income can accrue from wetlands utilisation in the Midlands province of Zimbabwe. Thondhlana et al. (2012) observed that about 20% of household income comes from the utilisation of natural resources, including springs in Zimbabwe, under semi-arid conditions. Springs, therefore, formed an important source of income to households that could be used to obtain other things like paying medical bills, buying books for school children and sourcing other household goods depending on the realised income.

Most of the households in both Nyanyadzi and Maturure highlighted the contribution of springs to the sustainability of their livelihoods to be declining over the years for various reasons depending on the place. Some attributed the decline to increased population pressure, others to climatic variability, degradation of springs and economic downturn amongst many factors. Similar results were also observed by Zinhiva et al. (2014) in their study of the Mutubuki spring in the Gutu district of Zimbabwe, they highlighted that, following the marked decline in the flow rate of the spring, the services derived from the spring ecosystem had subsequently and significantly dwindled. They also observed the fact that as the flow rate of the spring declined, so too did their socio-economic wellbeing and environmental integrity. Whitlow (1990), also confirms a close association between the economic wellbeing and nutritional status of families and access to wetland gardens in a studies done in Kwekwe located in the Midlands Province of Zimbabwe. He posits that households with gardens were nutritionally better off than those without gardens, and moves against wetland cultivation were strongly resented by communal farmers because of their positive contribution to the nutritional needs of their households. In Kenya, Sakataka and Namisiko (2014) saw the yields of main crops grown using spring water to be displaying a decreasing trend in productivity, implying a mounting risk of serious poverty in these areas. In Zimbabwe, Gumbo (2006) observed that water demand in many rural areas surpassed or was threatening to outstrip sustainable levels of supply with the condition likely to be accentuated under climate change. This, therefore, means that conventional approaches to promote increased water supply could no longer meet mounting future needs and were incapable of coping with the uncertainty rising from increased climate variability and climate change. Thus, for the Save Catchment, there was need to channel efforts towards reducing water demand and to mobilise non-conventional water sources like springs through appropriate policies, laws, enticements and technical measures.

Some participants in both areas, but especially in Nyanyadzi, noted the ecosystem services supported by springs to have improved. They attributed this to improved management and conservation of springs, hence they were now deriving more benefits from their utilisation compared to the past years. The benefits as shown earlier included improved food security and nutrition and also income from using springs. The participants also noted that as the springs improved in health so too did the security of their livelihoods.

The significant contribution of springs to livelihood sustainability was also observed by some participants to be unstable and fluctuating from year to year depending on climatic conditions and availability of inputs. Most, however, noted that despite fluctuations in spring contribution to livelihoods and due to limited alternatives, springs still offered the best guarantee to secured livelihoods in the area. Fewer than 5% of the participants observed springs to have been stable in supporting their livelihoods. This implies that very few springs were being managed in such a way that they have either maintained or improved their support to the livelihoods of households in both Maturure and Nyanyadzi.

6.6 Chapter summary

The chapter investigated the manner in which springs were being utilised within the study areas, the factors that influenced access to spring waterscapes and the extent to which springs were important in supporting the livelihood of the rural communities of the Save Catchment. The utilisation of springs on the catchment was observed to be multi-dimensional, from supporting livelihood activities, to non-consumptive functions like environmental regulation and cultural purposes. The value of springs was also observed to vary from place to place but in almost all communities, most of the springs were shown to support agricultural food production and provision of water for primary use and for livestock grazing and watering. Other important uses included provision of water for aquaculture, provision of building material, medicinal plants. Non consumptive uses highlighted included regulation of streamflow, cultural and sentimental value, provision of bio and geo-diversity, as well as use as educational centres and tourism. Most of the uses under which springs were subjected to could be seen as competing, hence high likelihood of conflict over access if the users disagree on the best use or fail to accommodate one another. It was also observed that agricultural use of springs had intensified over the past 10 years and the crops grown were increasingly diversified. Some of the livelihoods constructed around spring waterscapes included; gardening (new crop varieties

planted), tourism, livestock production, art and craft making and brick kilning. The access and utilisation of springs was mainly shown to be controlled by enforcement of local traditional rules and norms, policies, rules, by-laws and laws on land tenure regimes. Restrictions to spring water access and utilisation were observed to be daily, weekly, and seasonal with the time restriction depending on the location of the spring, but at most springs, there seemed to the no form of restriction.

It was also noted in the study area that springs were very important in the sustainability of rural livelihoods of the Save Catchment and in most cases very important for household food security, nutrition and income. The study noted that most of the households utilised springs for both commercial and subsistence use with surplus produce being sold locally, to markets, neighbouring villages and sometimes to tourists making it a diversified market for produce from springs. The income from springs also varied from less significant to significant depending on the place but ranged from $10-$80 per month and constituted between 5%-65% of the total income of households. However, most springs in the study area were observed to be on the decline in both water quality and quantity with few cases of noted improvements. This was noted to be a threat to sustainability of rural livelihood in the study area considering that the communities had limited livelihood options from agriculture. There was, therefore, a need for urgent management interventions to try and reduce the noted decline in spring water quantity and quality.

The chapter also gave the demographic characteristics of those who participated in the questionnaire survey. This was important because demographic characteristics can be important confounding variables that influence how people get access to and utilise springs as well as the livelihood outcomes that they can obtain from them. It was also observed that gender had a strong bearing on the level of knowledge that the participants had in terms of spring waterscapes due to the patriarchal nature of the studied communities where interaction with water based livelihood activities is mostly a feminine role. Generally, there was a balance in gender in terms of the participants but Maturure had more female participants when compared to Nyanyadzi. The 31-40 year age group was the most dominant in spring utilisation in the study and an overwhelming majority of the participants who utilised springs for their livelihoods were married. The majority of the participants in the study had acquired secondary education.

CHAPTER 7 : MANAGEMENT AND THREATS TO SPRING WATERSCAPES

7.0 Introduction

The chapter mainly gives the results for the second objective of the study that specifically investigated the management and key threats to springs on the Save Catchment. In particular, the chapter explores the state of spring waterscapes and the challenges which the communities are facing in the management of springs. The chapter then examines ways in which the user communities can best manage their spring resources.

7.1 State of spring waterscapes

As shown in Figure 7.1, 74% of the participants from Nyanyadzi and 60% from Maturure perceived the quality of spring water in their areas to be declining over the past 10 years. In Nyanyadzi, 10% of the participants and 16% from Maturure saw the spring water quality to be improving as compared to the past 10 years. Participants based their perceived improvements in spring water quality to improved clarity and portability of the water which occurred after protection and rehabilitation of the springs. In most cases participants posit that before rehabilitation efforts, the water was very turbid, had a dark colour and was not suitable for human consumption through drinking or bathing. A further 16% and 18% of the participants from Nyanyadzi and Maturure respectively perceived the quality of spring water to be unchanged and 6% from Maturure noted the quality to be fluctuating from time to time depending on usage. This, therefore, implies that generally most of the participants perceived the quality of spring water to be on the decline in many parts of the study area which may threaten the sustainability of the livelihoods, functions and services that they provide to communities.

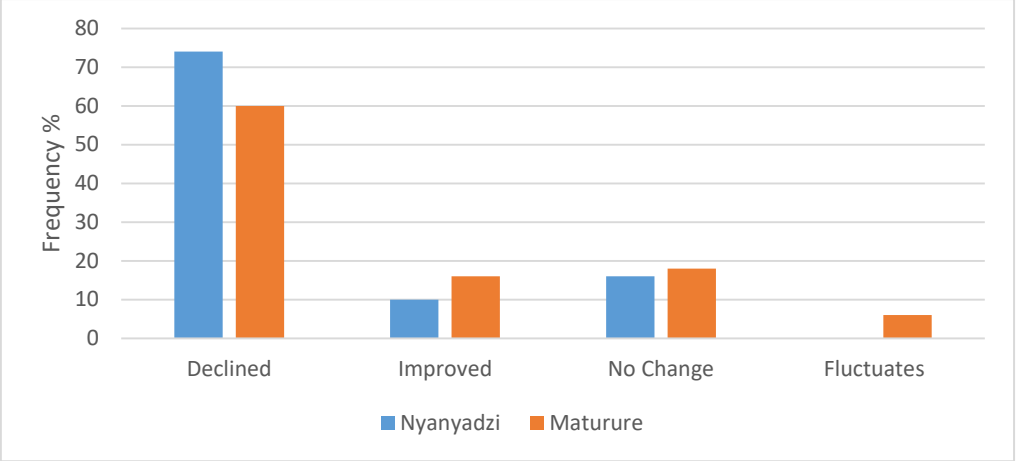


Figure 7.1: Perceptions on quality of spring water over the past 10 years (n=100)

The quantity of spring water was perceived by 90% of the participants from Nyanyadzi and 70% from Maturure to be declining over the past 10 years as shown in Figure 7.2. In Maturure, 12% of the participants compared to 4% from Nyanyadzi viewed spring water quantity as improving over the past 10 years. The perceived improvements in spring water quantity by the participants occurred after conscious efforts had been made to manage the springs thorough enhancing groundwater recharge, protection of the spring core amongst other interventions. In both communities, 6% of the participants did not notice any changes to spring water quantity. In Maturure 12% of the participants perceived the water quantity to fluctuate from season to season compared to 2% in Nyanyadzi. It was highlighted that, where the quantity of spring water was limited and there were effective local institutions, water utilisation practices such as brick making and gardening were prohibited and water was strictly meant for domestic purposes only, hence preserving its quantity.

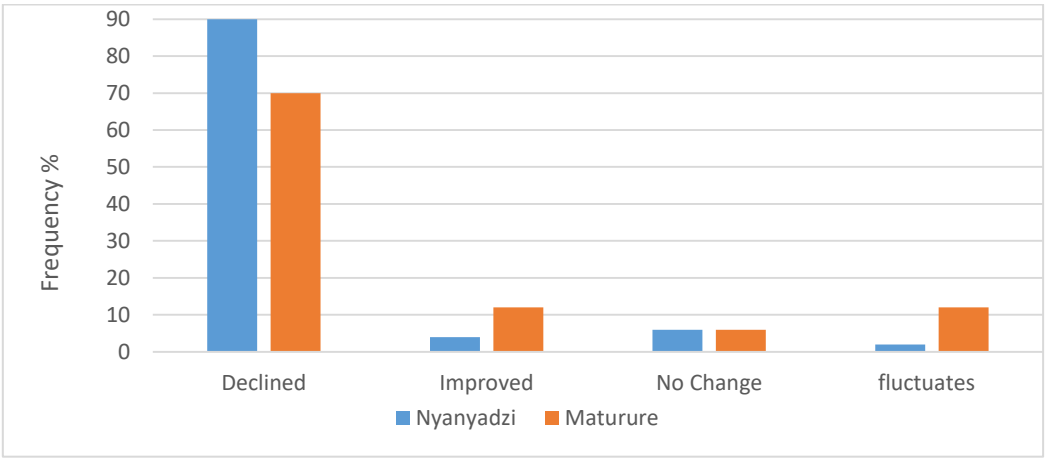


Figure 7.2: Perceptions on quantity of spring water over the past 10 years (n=100)

Plate 7.1 shows the state of some of the springs at (a) Maturure, (b) Nyanyadzi and, (c) Rupise

(a) **(b)**

(c)

Plate 7.1: State of some of the springs at (a) Maturure, (b) Nyanyadzi and (c) Rupise

As shown in Figure 7.3, 86% of the participants in Nyanyadzi and 78% in Maturure observed that natural environmental changes like increases in temperatures, decline in rainfall quantities and sometimes seasonal shifts, had led to the decline in both spring water quality and quantity. Some participants noted that where there were trees, some of their leaves fell into the springs and degraded its quality when they decompose. In Nyanyadzi 62% of the participants and 82% in Maturure perceived the expansion of settlements as being responsible the degradation of springs within the Save Catchment. A further 20% of the participants in Nyanyadzi and 46% in Maturure perceived population pressure to have a major impact on spring degradation. Participants maintain that as populations of both people and livestock increased, so too did the

need for building new homesteads resulting in the encroachment of settlements into the periphery of springs, leading to their eventual decline. Land degradation processes like soil erosion were also acknowledged by 50% and 66% of the participants in Nyanyadzi and Maturure respectively, as factors contributing to the degradation of springs as this leads to the silting and blocking of the spring cavities.

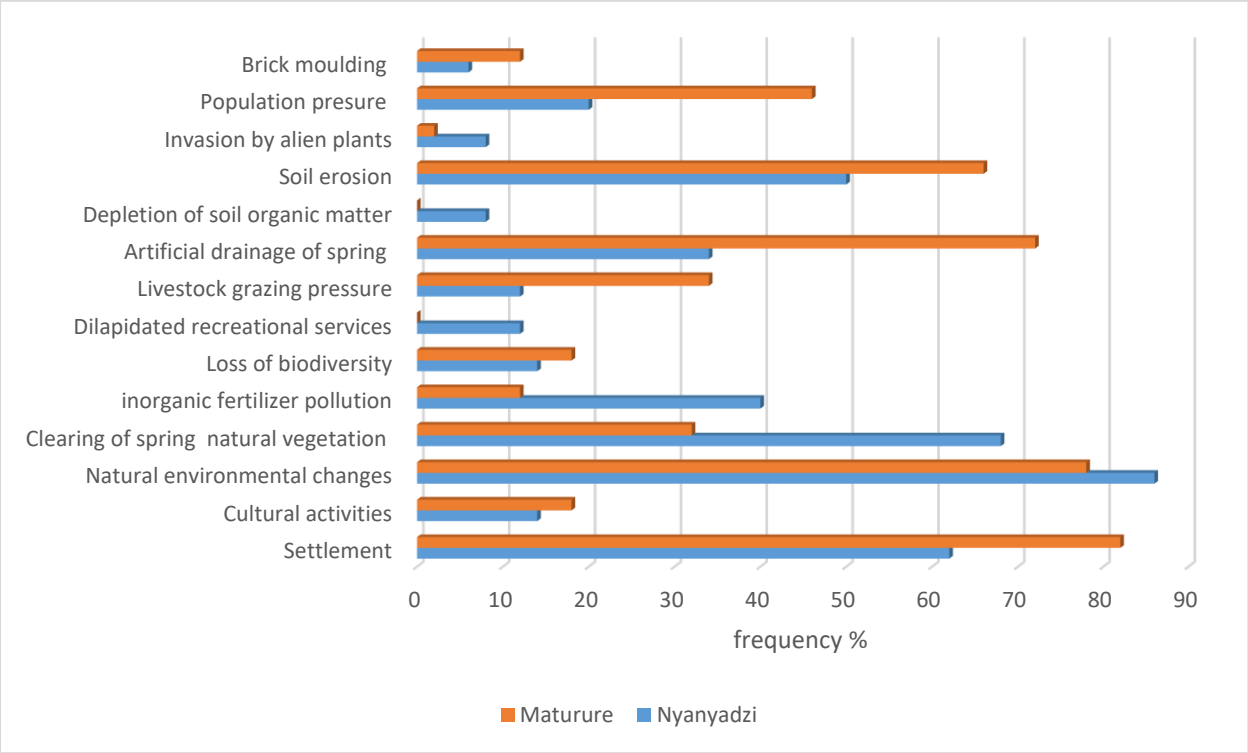


Figure 7.3: Practices degrading springs in Nyanyadzi and Maturure (n-100)

In Maturure artificial drainage of springs through motorised pumps, canals, pipes and sinking of boreholes was noted by 72% of the participants as a major factor contributing to decline in water quantity as compared to 34% in Nyanyadzi. This implies that entrepreneurship through the utilisation of spring water was more pronounced in Maturure when compared to Nyanyadzi. This could also be evidenced by the fact that there were more organised community gardens in Maturure when compared to Nyanyadzi. In Nyanyadzi, 68% of the participants compared to 32% in Maturure viewed the clearing of vegetation around springs and their recharge zones as a factor contributing to their degradation. Pollution of spring water, through the use of inorganic fertilizer when cultivating around the springs, was shown to be higher in Nyanyadzi, as acknowledged by 40% of the participants when compared to 12% in Maturure. Spring degradation, as shown in Figure 7.3, could also be attributed to livestock grazing pressure due to overstocking. This was particularly higher in Maturure where 34% of the participants, when

compared to 12% in Nyanyadzi, acknowledged this fact. Other livelihood activities, like brick moulding and kilning, were acknowledged by 6% of the participants in Nyanyadzi and 12% in Maturure, as also contributing to the degradation of springs.

7.2 Challenges in spring management

The frequent occurrence of droughts as shown in Figure 7.4, was acknowledged to be a major challenge to spring management in both Maturure (88%) and Nyanyadzi (46%). The participants observed that, as droughts increased in frequency and magnitude, more households were increasing their exploitation of spring water to have security in food production through irrigation of their crops. This further led to unsustainable levels of spring utilisation that eventually culminated into their degradation. Limited environmental education and awareness were also observed to be a major handicap to spring management with 38% of the participants in Maturure and 22% in Nyanyadzi acknowledging this fact.

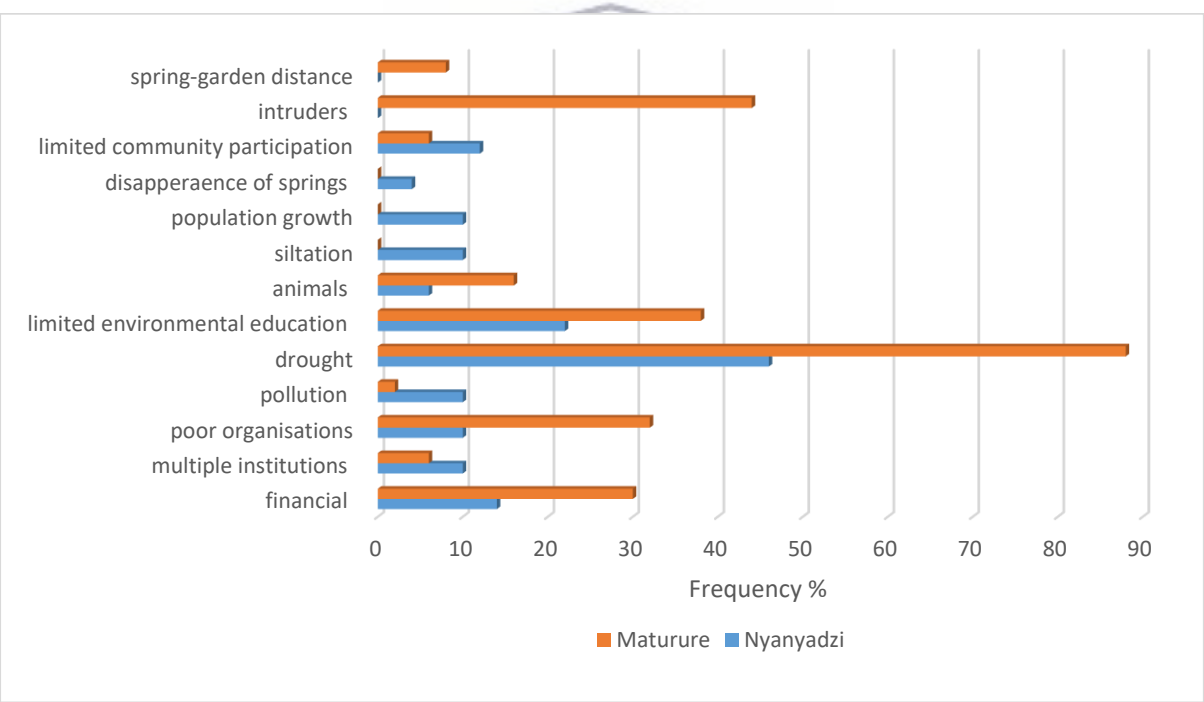


Figure 7.4: Challenges in spring management (n=100)

In Maturure, 32% of the participants noted poor community organisation as a challenge to sustainable spring management as compared to 10% in Nyanyadzi. Poor organisation which included disharmony in the community, lack of leadership, partisan politics and reduced social cohesion were also fuelled by multiple institutions with different mandates giving different instructions on how to manage springs. This was highlighted by 10 % of the participants in

Nyanyadzi and 7% in Maturure. For example, Agritex comes to peg gardens for community members close to springs, a scenario opposed to EMA who prohibit any agricultural activity close to the springs in the name of conservation. Traditional leaders might regard certain springs as sacred and do not allow them to be fenced or piped but other institutions like EMA and Agritex may want to fence and pipe the springs to protect them from degradation. Close to 14% of the participants from Nyanyadzi and 30% from Maturure viewed the lack of financial capital to be a major handicap in spring management. They noted that the core of springs needed to be fenced off in order to protect them from animals and human interference, but due to limited availability of financial capital, most springs were not protected. Participants highlighted that funds were required to build structures like ponds, weir dams and storage tanks to harvest water from springs, thus preventing users from directly accessing the spring core to collect water and degrade the spring in the process.

At both sites, wild and domestic animals were also highlighted by 16% of the participants in Maturure and 6% in Nyanyadzi, as compromising effective management of springs. These animals continuously trample on the spring cores and wetlands, in the process loosening the soil, making it vulnerable to erosion and pollution. In Nyanyadzi, 12% of the participants and 6% from Maturure observed the lack of participation by local communities in formulating by-laws, polices and rules on spring protection, as being a major challenge to their effective management as locals tend to resist the imposition of new sets of laws from outsiders who come as agents of the government, RDCs or agricultural extension officers.

In Maturure, it was uniquely that 44% of the participants saw the intrusion of springs by undesirable elements, thieves and free riders to be a challenge to their management. Also 8% of the Maturure participants viewed the distances that they have to walk from a designated spring water collection point to their gardens to be very long (almost over 300m in some cases). The long distance then ends up forcing some of the spring users to collect water directly from the core of springs, which leads to their degradation. Participants observed the distance to the spring sites as having a huge impact on their ability to engage in diversified livelihood activities that are important for their households using spring water. The siltation of springs (10%) after rainfall episodes, continued increases in population (10%), pollution of the springs (10%) and complete disappearance of some springs (4%) that used to be perennial were also highlighted as challenges to spring management by participants from Nyanyadzi.

7.3 Managing the challenges

To minimise the observed challenges as shown in Figure 7.5, 42% of the participants in Nyanyadzi and 24% in Maturure suggested the fencing of the springs to restrict access to their core. Participants from Maturure (38%) and 8% from Nyanyadzi suggested imposing deterrent penalties to those who bridge the rules of spring management or some form of punitive measures. In Nyanyadzi, 32% of the participants, as compared to 26% from Maturure, suggested having regular educational workshops where communities will taught about wise use of springs and best practice methods in their protection. They highlighted that it was through education that communities can improve their environmental consciousness and learn to utilise springs in a manner that does not degrade them. At least 12% of the participants from Nyanyadzi and 34% from Maturure highlighted that an improved water management regime was potentially a good solution in minimising the challenges to spring water management, especially on the supply side. Suggested measures included the sinking of and maintenance of available boreholes to provide alternative water sources, construction of spring water collector wells and weir dams and the adoption of water saving irrigation techniques. Most participants saw some of these interventions as being too expensive for the local communities to implement independently but suggested the possibility of external funding from NGOs in partnership with the local government.

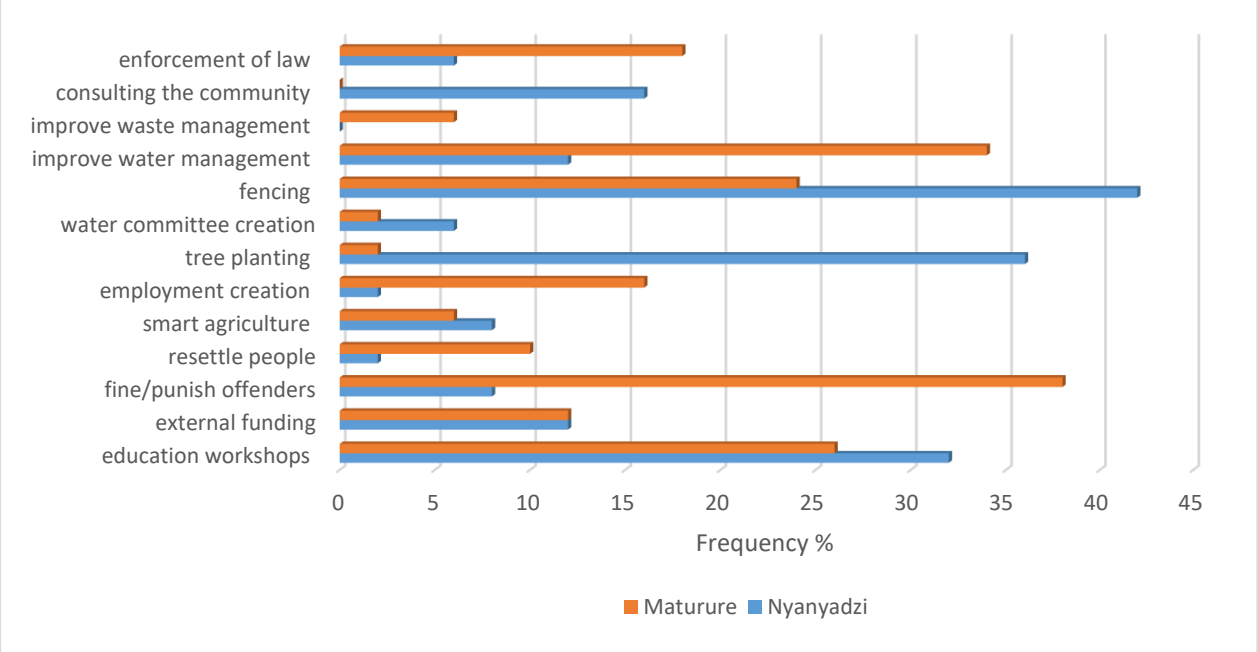


Figure 7.5: Minimising challenges to spring management (n=100)

In Maturure, 18% of the participants and 6% from Nyanyadzi advocated for the strict enforcement of laws, by-laws and policies to save springs from degradation. Participants argued that the laws that can protect springs were there but were just not being implemented or were being selectively enforced. In both Maturure and Nyanyadzi 10% of the participants (Figure 7.5) noted the sourcing of external funds as being the most effective way of minimising the challenges to spring management. The external funds would be used to acquire the necessary spring water management technology, fences to protect springs, hybrid seeds and in educating the community on the importance of springs in the ecosystem. These funds could be sourced by the local authorities, NGOs and Government on behalf of the local communities.

At least 8% of the participants in Nyanyadzi and 6% in Maturure saw the need to practice smart agriculture which utilises organic fertilizer and conserve water as a way of solving the problems of spring water pollution and over utilisation. In Nyanyadzi 36% of the participants, as compared to 2% in Maturure, suggested the planting of trees on bare areas and spring recharge zones to minimise the problems of silting of springs and also maximising their recharge. In Nyanyadzi, 16% of the participants suggested the consultation of communities before implementing policies and laws on spring management and observed co-management of the springs with the local communities to be the best solution for effective minimisation of challenges in spring management rather than the prevailing top-down approach.

A total of 16% of the participants in Maturure and 2% in Nyanyadzi suggested the diversification of the local economies which will then create more employment opportunities outside agriculture as a way of minimising the current over reliance on springs in supporting livelihoods. Also 10% of the participants in Maturure and 2% in Nyanyadzi viewed the decongestion of both human and animal populations as being the best solution to the conservation of springs and the services that they support. This could be done by resettling them to other less populated areas. A total 6% of the participants in Nyanyadzi and 2% from Maturure suggested the creation of elected local water committees as a solution to ameliorate spring decline and improve their management. These water committees would perform the day to day management and coordination of spring utilisation and conservation. This would also include liaison with any external organisation wishing to make interventions in the areas of utilisation and management of spring water resources.

Figure 7.6 shows suggestions from the participants on ensuring sustainability to services provided by springs. In Nyanyadzi 48% of the participants and 42% in Maturure observed

restricting access to springs to a few households as being the best move to improve their management and ultimately leading to the sustainability of the services that they provide. The participants noted that most springs could be accessed by anyone, hence there was an urgent need to impose some form of restrictions including daily, seasonal as well as on people who can utilise them and how they could utilise them. Strict monitoring of all activities occurring at springs was also recommended by 22% of the participants in Nyanyadzi and 46% in Maturure.

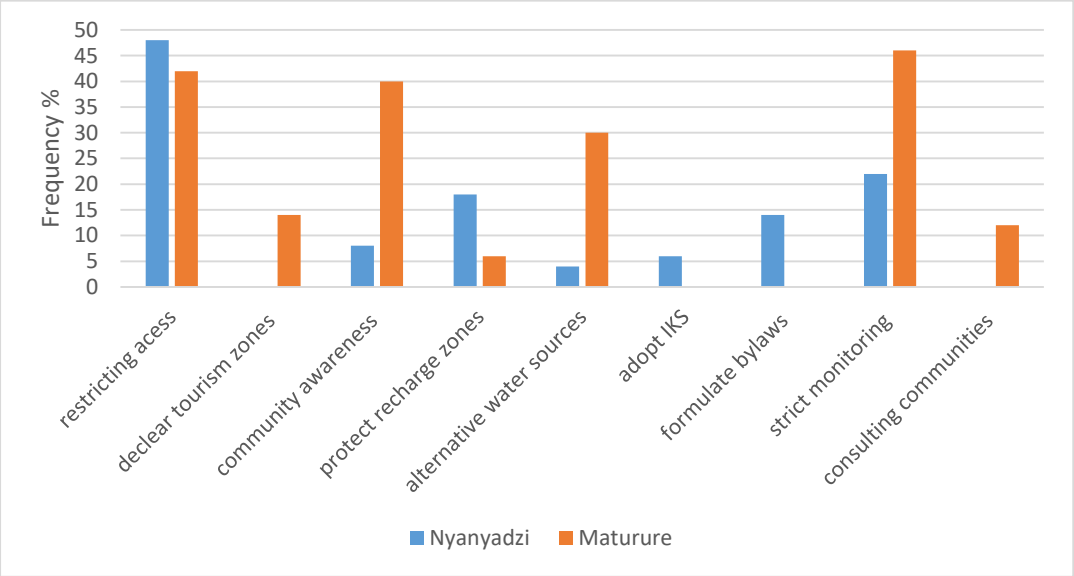


Figure 7.6: Ensuring sustainability to services provided by springs (n=100)

Participants observed that when tight monitoring is done, especially through strong local institutions like traditional leadership, few individuals will indulge in activities destructive to springs. On observation, most of the springs that were important culturally and were protected mainly using local traditional customs, were noted to be in a much better state than those that were readily available for the local communities to exploit. In Maturure, 14% of the participants viewed giving springs more legal protection by declaring them green tourism zones or nature parks as the way to go in ensuring sustainability in their use. By declaring springs tourism zones, the participants were advocating for the non-consumptive use of springs. This was however observed to be practical only for those springs that were large enough to support diversified services. Another 12% of the participants in Maturure viewed consulting and involving the community in the formulation of management strategies as a very important way of ensuring sustainability in the management of springs. In Nyanyadzi, 14% of the participants saw formulation of spring specific by-laws by the local authority as the best way of ensuring

sustainability in the use and services provided by springs. A further 6% viewed the adoption of indigenous knowledge systems (IKS) as a way of ensuring that springs continue providing the services they were providing. Participants argued that indigenous knowledge systems and customs were more effective in the management of local resources if given a chance. Eighteen percent of the participants in Nyanyadzi and 6% in Maturure view the identification and protection of spring recharge zones as an effective way of ensuring sustainability in services that they provided to the community.

Figure 7.7 shows the factors viewed as obstacles to effective spring management in Nyanyadzi and Maturure. Close to 80% of the participants in Maturure and 4% in Nyanyadzi viewed poverty and climatic variability as major obstacles to effective spring management. They noted with concern that during years of low rainfall there will be over-utilisation and degradation of springs because they provided a safety net from the negative effects of the drought. Due to poverty, participants observed that communities failed to protect springs through, for example, fencing and also made it difficult to obtain alternative livelihoods or sources of water, hence turning to springs which were easy to exploit but were easily polluted and degraded. Participants also observed that it was difficult culturally to prohibit the poor people from utilising springs if they were the only source of their livelihood.

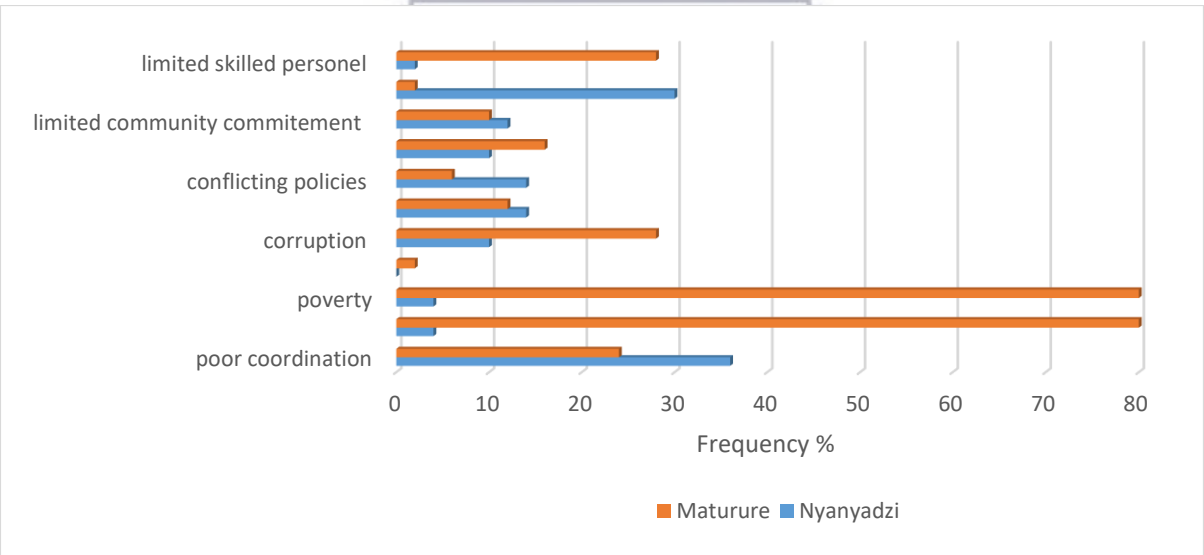


Figure 7.7: Obstacles to effective spring management in Nyanyadzi and Maturure (n=100)

Poor coordination within communities and amongst institutions which interact with springs was noted by 36% of the participants in Nyanyadzi and 24% in Maturure as being an obstacle to effective spring management. The participants noted conflicts at local level especially those

pitting the traditional leaders against the elected leaders, like councillors. Participants highlighted that where these two arms of leadership were not working in harmony, local community coordination and involvement in planning and management of local resources was seriously hindered. Corruption and bribery of politicians, traditional leaders, water committees and other government officials allocating land to people on protected springs or turning a blind eye to illegal use of springs, was noted by 10% pf the participants in Nyanyadzi and 20% in Maturure to be an a serious obstacle to spring management. Twelve percent of the participants in Nyanyadzi and 10% in Maturure saw the lack of commitment by communities to protect springs as one major obstacle to their effective management. They also noted that, lack of awareness and ignorance on the importance of springs (10% in Nyanyadzi and 16% Maturure) was a major handicap to their effective management.

In Nyanyadzi, 30% of the participants compared to 2% in Maturure noted poor enforcement of policies and laws that protect springs as hindrance to their effective management. They saw poor enforcement to be a result of overwhelmed government agencies, corruption and institutional fatigue. Inadequate institutional support to communities was also identified by 14% of the participants in Nyanyadzi and 12% in Maturure as a factor limiting effective management of springs. In Nyanyadzi, 14% of the participants compared to 6% in Maturure observed conflicting policies as an obstacle to effective spring management with different institutions taking different approaches to suit their mandates in the management of springs. Limited skilled personnel to teach communities on wise use of springs and rehabilitation of degraded ones was cited by 20% of the participants in Maturure and 2% in Nyanyadzi as a factor limiting effective management. A small portion of the participants in Maturure (2%) view limited alternative livelihood options to those supported by springs as an obstacle to effective spring management. Culturally most of the rural households in the Save Catchment see themselves as farmers and as such, when the rains fail, they look to the springs to provide them with a guaranteed source of sustaining their livelihoods.

7.4 Discussion

Most participants observed the quality of spring water to be declining in both Nyanyadzi and Maturure. The declining water quality was attributed mainly to the heavy application of inorganic fertilizers in places close to the springs and also poor sanitation as population

pressure increases. At certain spring sites in Maturure, participants observed leaves from vegetation growth around the springs to be falling into the water and reducing its quality. In some cases, wild animals, like wild pigs and baboons, disturb and pollute the water quality when they have access to spring core. Bascik et al. (2009) also noted in Poland that one of the greatest problems facing spring conservation is pollution of the spring and its water. They observed spring water pollution to be mostly linked to the improper management of the spring's surrounding environment, for example, application of chemical fertilizers. Sakataka and Namisiko (2014) also noted that, spring water pollution was mostly linked to the improper management of its surroundings (for example, pit latrines), as well as extreme interference in the water interactions, both near the spring and in its sub-basin. Marambanyika, (2015) noted organic certification as having potential of improving the sustainability of wetland farming due to a number of social, economic and environmental prospects that it presents. He observed measures like the banning of chemical fertilizers, insecticides and herbicides in favour of local inputs from plants and animals, composting and green manure as having positive implications on the ecological condition of the springs.

Some participants in both study areas also noted that the spring water quality had either not changed or has improved. They noted that improvement in spring water quality was linked to improved management of springs and their catchment. Only in Maturure did participants observe the spring water quality to change from time to time depending on use and the natural environmental conditions.

Most participants in both Maturure and Nyanyadzi observed the water quantity to be declining (Figure 7.2). They attributed changes of water quantities to the damage of spring cavities most often impaired when they were modified for drinking water extraction, over use, natural climatic variations and settlement expansion. In some cases, participants observed spring water quality to be declining and the quantity to be improving, meaning that the spring management will be well executed but poor farming methods and management of the spring catchments will occurring. There were also fewer springs that had their water quantity improved after previously having declined. This implies that spring rehabilitation was a very complicated process that had limited success. Participants in some places of the catchment observed that education of communities on the importance of springs and best practices on wise use of springs had led to an improvement in their flow rate.

Factors influencing the decline of springs in the study areas were noted to be interlinked and cyclic in nature. In the study area, some participants attributed the decline in both water quantity and quality mostly to natural environmental changes that were being experienced in many parts of the Save Catchment. In particular, they observed climatic variability to be increasing the magnitude and frequency of droughts within the study area. Key informants also highlighted that years of below average rainfall were on the increase and water shortages were now occurring annually in some parts of the Save Catchment even in years of good rains. The main signature marks for the noted natural environmental changes, as observed by the participants, were raising temperatures and declining precipitation amounts. These then set in motion a negative snowball effect of other impacts that led to spring decline. Reduction in precipitation amounts led to the reduction of spring recharge which ultimately led to reduced flow rates. Reduction in precipitation also led to spring decline because most households would start exploiting them as a major support to agricultural production leading to over use and pollution from fertilizers due to the desire to maximise yields. Owen et al. (1995) also observed that due to prolonged periods of lower than average rainfall, many springs in Zimbabwe appeared to be dying out. Mazvimavi (2010) also observed the problem of climatic variability resulting in irregular precipitation in Zimbabwe. Climatic variability is, therefore, observed in the study area to be the main trigger of a battery of other negative impacts on springs. The broader picture on the impact of drought on springs in Zimbabwe therefore shows a snowballing effect.

Expansion of settlements due to population pressure also led to the degradation of springs. As populations in the study areas increase, the demand for land to build houses and for agriculture expansion also increases. As prime land diminishes, participants observed more people to be increasingly settling and cultivating on marginal land and sensitive ecosystem areas like springs. Construction of homesteads near spring sites was observed by participants in the study sites to impact on their state and health and as one moves closer to homesteads, the probability of finding springs in a healthy state significantly diminishes. Construction degrades springs because it compacts the land, encourages draining of wetlands which ends up destroying the spring cavities. Population pressure also led to the clearing of vegetation for agricultural land, fuel wood and building materials. In the process the spring recharge areas get degraded leading to further reduction in recharge of springs and their flow rate. Svotwa et al. (2008) also observed that, as the population increases, more pressure will be applied on wetland resources because the need for productive land also increases as people struggle to improve livelihood

opportunities under semi-arid conditions. Mbereko (2008) also argued that population growth resulted in agriculture expansion on spring wetlands which reduces their ecology, resulting in direct or indirect loss of ecological services. Dixon and Wood (2003) noted that as population pressure increases, the need for agricultural land and spring cultivation also intensified in Ethiopia. At the same time commercialisation and communication networks have spread, increasing the market demand for food and other products produced using spring water. Sakana et al. (2013) also viewed fast population growth to trigger land hunger, which in turn motivates livelihood search into fragile ecosystems like springs. Meanwhile, Marambanyika and Beckedahl (2016) observed that stopping of cultivation supported by springs to be challenging to implement because livelihood opportunities were limited and households primarily earned a living from agricultural production. Rebelo et al. (2009) also observed limited livelihood opportunities for spring users as a significant factor sustaining continuation and expansion of cultivation on springs.

Participants also observed that population pressure and settlement expansion led to the occupation of land previously reserved for livestock grazing in the study areas. In the end livestock were being left to graze in marginal areas like spring peripheries. The situation was further compounded by high levels of overstocking, as noted by some key stakeholders, to be leading to excessive levels of erosion that are triggering the siltation and sedimentation of springs when heavy rains pelt the trembled and loosened soils. Musamba et al. (2011), in their study of Uganda, observed spring supported wetlands to provide suitable pasture for livestock grazing as well as a perennial source for livestock watering. They maintain that such a situation had potential for spring degradation as they noted that a marginal increase in livestock numbers had a negative impact on wetlands. Scarsbrook et al. (2007) observed fencing and exclusion of animals and livestock from springs to have different impacts on springs in different regions. In Germany, cattle exclusion was one of the first measures implemented during spring restoration programmes, with the desired outcome being re-establishment of natural, woodland vegetation around the springs. In contrast, exclusion of livestock reduced plant diversity and the area of free water in springs of Australia, because of large increases in vegetation biomass of the most competitive herbaceous species. Considering the omnipresent importance of livestock to the sustenance of rural socio-economic activities in both Maturure and Nyanyadzi, use of springs and resultant wetlands for grazing was likely to persist. On the other hand, Scoones and Cousins (1994) observed that despite the assumed contribution of overgrazing and livestock overstocking to degradation, studies in the communal lands of Zimbabwe have indicated that

the erosion patterns at that time were not concentrated in key grazing areas and degraded areas did not have an effect on livestock production.

Erosion of the soil was also accelerated by the cutting down of trees to clear agricultural land and provision of building materials in the study area. Sometimes gullies were observed by participants to have developed very close to spring sites, leading to an acceleration of the rate at which water flows from springs and their eventual degradation. Whitlow (1990) also observed erosion to be a major problem affecting wetlands put under intensive utilisation in Zimbabwe. Dixon and Wood (2003) observed springs to support fragile and transient ecosystems that were easily prone to erosion and degradation through natural processes and anthropogenic exploitative interventions. The Institute of Hydrology (1995) observed the main factors responsible for erosion in the Save Catchment to be both physical and human, noting in particular the sandy soils derived from granites that were found on the greater part of the catchment to be easily eroded, population pressure and poor land management.

In some instances, springs were completely drained and degraded by efforts to harvest more water from them through artificial pumping or draining the water. This was observed to disturb the natural rate at which springs release water to the environment, thereby degrading them. Sada and Pohlmann (2006) observed that groundwater abstraction close to the springs and development around the springhead needed to be carefully controlled because they caused functional changes to the springs. They also noted the need for diversions, artificial drainage and impoundment to be avoided.

Livelihood strategies such as brick moulding were also noted to be disturbing the natural functioning of springs. These activities were normally done close to spring sites and their related wetlands because they have favourable soil types and are close to water supplies. Participants highlighted the excavation of soils close to springs and cutting down of trees to kiln the bricks as triggering soil erosion, which in the end created gullies at spring sites. This was observed to be a common environmental problem in both Nyanyadzi and Maturure. Chuma et al. (2012) saw the need for management interventions which balanced ecosystem functions and human needs to be important in the management of springs, hence the need to avoid livelihood activities like brick kilning close to spring sites because of their potential negative impacts on their integrity.

Some participants noted invasion by alien species close to springs and their recharge zones to be responsible for the drying up of some springs. Specifically, they observed the eucalyptus species normally used to revegetate previously deforested areas to be responsible for draining of springs in areas where they have been planted. Erman (2002) observed that suitable native riparian flora needed to be planted or allowed to grow to protect spring recharge zones and where there was evidence of negative interactions between native and non-native species, they recommended the introduced species to require controls specific to those species.

Poor environmental awareness was noted in Nyanyadzi and Maturure to be a handicap to sustainable management of springs. Participants observed that some of the spring degrading activities such as inorganic fertilizer pollution, overuse and cutting down of trees occurred because the communities were ignorant of the importance of springs in the ecosystem and linkages between spring health and sustainable livelihoods. Participants recommended that community environmental education could be enhanced if there were drives towards educating communities through participatory workshops on the value of springs and their wise use. Dixon and Wood (2003) observed the widespread misconception that wetlands were wastelands that could be converted to other uses such as agriculture, industrial development or residential. According to Hartnett (2000) educational programmes can assist in improving community understanding of the relationship between land use and the quality and quantity of spring water. They then advocated for coordinated education programmes, incorporating a range of educational materials from brochures, pamphlets, booklets to conferences in order to help communicate this understanding and facilitate spring protection. In Zimbabwe, Matiza (1992) observed that the limited awareness on springs and their functions led to poor public and national insights on springs. This perception is illustrated by the absence of a specific national policy on spring utilisation and management except for the wider framework on all wetlands provided in the Water Act (1998). Related to awareness, Dixon and Wood (2003) also observed the need for spring wetlands to be recognised as a critical element of the long-term livelihood and natural resource management strategy rather than a resource to be utilised as a quick fix answer to address food shortages.

The situation is however, unlikely to improve soon as observed by key informants who noted responsible institutions to be seriously under-funded and under-staffed with most of them having officers only at district level or higher. This was contrary to the expectations of the

communities who prefer regular extension visits from institutions responsible for spring management. They prefer the supporting institutions to be available at least at ward level.

Inadequate institutional support and presence of multiple institutions were also notable challenges to spring water management in the study area as noted earlier. The major problem comes from the fact that activities by responsible institutions were not always synchronised, institutions involved had different mandates and often contradicted each other. Communities in the study areas, therefore advocated for institutional re-engineering in to improve the way in which the institutions delivered their services to the communities. The participants also argued that communities lacked skilled individuals in spring management, wise use and rehabilitation to enhance livelihoods, hence they needed supporting institutions to be closer to them. In particular communities saw the need for practicing smart agriculture as a remedy for reducing pollution of spring water but they lacked the technical know-how to implement it. Sithole (2000) noted that, experiences from the Southern African region have shown that institutions were not always the problem and getting the institutions right did not give assurance for success in the management of springs. Gumbo (2006) observed multiple uses, for example, agriculture, ecotourism and the environment whose management requirements may be in conflict to be a major challenge to effective spring management.

Participants also observed that the local communities were not being consulted in the process of formulating management plans for springs in their locality. They argued that outsiders were coming to impose on them ways to conserve springs in a typically top-down approach that sometimes led them to act in ways that defeated spring conservation goals. Participants advocated for a participatory approach in the formulation of policies and co-management of springs, a condition which they say instils a sense of ownership of the resource. Murphree and Cumming, (1991) observed policy making on land use and environmental issues in Zimbabwe to have mostly ignored local capacity for resource management and seldom made use of local environmental knowledge. Marambanyika and Beckedahl, (2016) have noted that the state's policies and legislation had made local knowledge redundant and had fundamentally limited local institutions' right to legal control and access to local resources like springs. Van Koppen et al. (2007) suggested spring conservation and management to take an approach similar to the CAMPFIRE where systems can be devised which can both protect springs and concurrently allow utilisation of their water for the benefit of the local community. However, the key to success of such a programme is education and willing participation by the user community,

with Scarsbrook et al. (2007) arguing that protection of springs largely rested on the motivation of the landowner or the user community.

At some springs, poor community organisation was noted to be a challenge to spring management. In the SLF, this was recognised as social capital which Scoones (1998) sees as an asset upon which people drew in search of their livelihood objectives through relations that increased people's capacity to work together, affiliation to more formal groups governed by established norms and rules. At some springs in both Nyanyadzi and Maturure, there were no structures that guided the way people utilised springs and there were no fora for users to discuss water related issues. This lack of organisation has led to individualistic ways of spring management responsible for the noted 'tragedy of the commons' where there is competition for use of springs leading to their degradation. In comparison, springs in areas where there was solid community organisation creating structures like water committees and clubs responsible for spring management, springs were much healthier and supported more services than those that were free for all. Marambanyika (2015) observed deviant behaviour demonstrated by some members of rural communities to be blameable for gross violation of wetland laws. He noted that stubbornness and disobedience led some community members to deliberately embark on prohibited activities that degraded wetlands.

Poor community organisation was also blamed by some participants on sour community relations, lack of social cohesion which they observed to be mainly planted by interferences from political and rural elites who capture any aid meant for the community for their personal benefit. Other examples of poor community relations included; vandalism of fences meant to protect springs from animals and thieves who steal produce from household gardens. Hall et al. (2011) observed exclusion to be a source of poor community organisation and conflict. They interrelated it with the control and maintenance of the disputed access to natural resources valued for their contributions to livelihoods. Exclusion is connected with issues of contention, conflict, and power relations among actors and is closely linked to uneven power relations in communities that control who gets to benefit from utilising natural resources. Harvey (2004) referred to 'accumulation by dispossession' where more influential society members take charge and control of common property (springs), at the expense of poor members leading to bitterness in the community. Marambanyika (2015) observed that violations of spring conservation laws were caused by local people excluded from their use. Since these people will

be deprived of spring water benefits, they see no value in safeguarding the resource, hence they intentionally disrupt effective management initiatives.

Lack of financial capital was also observed as a challenge to the management of springs. Access to financial capital is a key asset in the SLF which greatly influences the capacity of households obtain sustainable livelihoods. Most springs in both Nyanyadzi and Maturure were not protected from intruders or wild and domestic animals. Most participants viewed fencing as an effective method of protecting spring cores from degradation but due to lack of funds, most were open to access by anyone who so wished. On the few larger springs that have been fenced through funds from donors or government, beneficiaries still found it difficult to maintain it. Participants advocated for the local government to source external funds from NGOs or any other philanthropic organisations to fund some of their projects that protected springs like fencing, borehole drilling and motorised pumps. Most suggestions put forward by the participants to try and minimise spring degradation, such as restricting access, fencing and education workshops involved initial financial injection for them to take off, hence it was a factor which influenced the success of spring conservation. Similarly, Matondi (2001) observed insufficient financial or human resources with which to effectively develop, sustain, protect and manage existing water resources to be factors that imposed challenges on spring water management and contestations in their access. Some key informants were however critical of external intervention in community livelihood development. They suggested that external funding was not sustainable as initiated projects mostly collapsed once external funds were exhausted or stopped. Key informants also suggested that there was a high risk of the community developing a 'donor syndrome' which reduced their capacity to work towards achieving community development.

However, fencing and protecting springs was found not to be always socially acceptable as a method of managing springs and improvement of their services. In some places of the study area, it was regarded as a taboo to fence off or harness water from spring through the use of pipes for fear that this could lead to drying up of springs. The most striking example is that of the Rupise hotsprings, which participants observed to have dried up after being fenced but started flowing again after the appeasement of the local spirits and the removal of the fence. In a research done by Mazvimavi and Zanamwe (2000) on evaluating the Chimanimani water supply and sanitation programme initiated by Christian Care, they observed that in some wards, traditional leaders refused to allow the protection and piping of spring water out of fear that

any disturbance to these springs will anger the local spirits which would cause them to dry up. They further recommend the use of persuasive methods in those cases where local beliefs are against utilisation of an important resource that is in abundance in an area. They maintain that those implementing projects that locals feel were not traditionally acceptable, should, during initial stages, select sites where success is certain to avoid initial failure that would confirm the beliefs of the local people, making further use of the resource unacceptable.

Poverty was noted by participants to be a challenge in the management of springs in both Nyanyadzi and Maturure. Coupled with lack of alternative livelihoods outside agriculture and increases in drought frequency, the poor had no choice but to expand their utilisation of springs to secure a sustainable livelihood which may end up leading to over-utilisation, a factor related to degradation. Participants observed employment creation outside agriculture to be an important factor that would reduce pressure on springs as household livelihoods would have been diversified. Due to poverty, community leaders ended up giving very lenient sentences to those who broke the law on natural resource protection which in the end would not be deterrent to potential offenders. Chuma et al. (2012) observed that due to limited resources rural communities were often unable to invest in sustainable management of natural resources unless they had an incentive to do so. The poor, therefore, tended to have short term perspectives and valued more immediate needs. Dermana and Hellum (2007) also noted that engaging rural societies in long-term change processes, mostly when it needs substantial investment and when the payoffs were not initially noticeable to be a major challenge. Chuma et al. (2012) noted another challenge as being that of ensuring that short term incentives did not create community donor dependency. As noted earlier in the study, some participants cited lack of donor support as a factor in the decline of produce from springs.

Participants observed the need for the formulation of effective community based by-laws that gave springs legal protection as a means of protecting them from further degradation and also ensuring that local indigenous institutions and other knowledgeable groups were engaged. Participants also saw the need for laws that seriously punished offenders as a deterrent to would be offenders. However, Bascik et al. (2009) are of the opinion that effective protection of springs required more than provision of legal protection. Society needed to be swayed on the importance of spring protection as components of natural heritage and their multiple benefits through awareness campaigns and development of educational materials by institutions, such as, local authorities, NGOs and government environmental agencies. Chuma et al. (2012)

observed negotiated local rules and by-laws which discouraged unsustainable use of springs as one of the key cornerstones for sustainable wetlands management.

Participants also noted partial and selective enforcement of laws governing protection of springs to be a challenge in their management. They observed effective enforcement as being hampered by the lack of resources for strict monitoring, political interference, corrupt enforcement agents and limited community will to assist in the protection and management of springs. Maconachie et al. (2008) observed the ability of a given institution to achieve its mandate as depending on power relations, source of mandate and political correctness or acceptability. Rebelo et al. (2009) observed that given the measures already in in force to protect springs and other wetlands, their sustained and extensive infringement in Tanzania could be attributed to a combination of both the weakness in enforcement and the inappropriateness of the measures.

Improvement of water management techniques, such as proper harvesting and storage of spring water, improved organisation and efficiency in water use through adoption technologies like drip irrigation and abstracting water, only when needed, were noted to help reduce unsustainable levels of water extraction from springs, in the process conserving them. Also alternative sources of water to supply irrigating plots and gardens were observed by the participants to reduce pressure on springs. The alternatives suggested included boreholes and small earth dams. Dixon and Wood (2007), in their study of springs in Ethiopia, also observed the need to develop viable spring use technologies that balanced the needs of communities for water and the hydrological system.

It can be noted that in both Nyanyadzi and Maturure, there were low standards of spring conservation and the reasons have been given to be interconnected with the occurrence of one negative factor triggering a host of other factors. As such management efforts to reverse these negative impacts must also take into consideration the linkage in these factors in order to be effective. Chuma et al. (2012) advocated for the development of solutions to spring degradation using the learning wheel methodology which generates experience-based conceptual frameworks from practice, building on the lessons and success factors of practical examples in an analytical and appreciative manner. Springs in the Maturure and Nyanyadzi areas of the Save Catchment can, therefore, be best described as ‘silent springs’ because, despite their importance in the support of rural livelihoods, they continued to be seriously exposed to degradation and pollution which threatens the services they provide.

7.5 Chapter summary

The chapter examined the state of springs in the study area in terms of water quality and quantity, looked at the threats that springs faced in the study area as well as the methods that could be used to minimise these threats. In terms of the state of springs, it was observed that the quality of spring water in most parts of the study area was on the decline over the past 10 years, at the same time there was also an observed reduction in spring water quantity over the same period. This therefore, implies that in the long-term, sustainability of livelihood strategies supported by springs could be threatened by this declining trend. The main factors and practices observed to be threatening the health of springs were; the encroachment of settlements close to spring sites, natural environmental changes, clearing of vegetation, soil erosion, population pressure, use of inorganic fertilizer and artificial drainage of springs, with the importance of each factor varying from spring to spring. Only natural environmental changes constituted external shocks beyond human control with the rest of the factors being anthropogenic and associated with poor natural resources management, hence the need for effective and all-inclusive spring management plans for the Save Catchment. Limited environmental awareness, poor implementation and enforcement of spring protection laws and policies sometimes resulted in adoption of practices that degraded them. A mixture of socio-economic and institutional challenges explained the current low environmental awareness and level of implementation of the prevailing policies. There was an observed need for mobilising funds and resources to empower and capacitate regulatory institutions to effectively educate and supervise communities' adherence to relevant policies.

CHAPTER 8 : INSTITUTIONAL FRAMEWORK IN SPRING WATERSCAPE LIVELIHOOD DEVELOPMENT

8.0 Introduction

The chapter examines the institutional framework through which processes governing spring water access, utilisation, control and management are shaped in the Save Catchment of Zimbabwe. Institutions impacting on access and utilisation of spring water in the catchment are similar to those that affect access to water in general. An analysis of the different institutions and how they impact on access, the main activities done by the institution and the frequency with which they engage with the local communities is done in the chapter.

8.1 Institutional factors in the access and management of springs

Figure 8.1 shows actors that grant the right to access springs in order to exploit ecosystem services that they provide. Since springs are part of water resources and natural resources in general, the same institutions also play different roles in the management of water resources in the Save Catchment. In both Nyanyadzi and Maturure communities, traditional leadership including Chiefs, Headmen, Elders and Spirit Mediums played an important role in granting access to springs which are part of common property. Traditional leadership was, however, very dominant in Nyanyadzi (64%) as compared to Maturure (36%), a point confirmed by the previously noted fact that Nyanyadzi springs had more cultural significance as compared to those in Maturure. Taboos and customs were enforced by this institution as exclusion mechanisms to access specific springs. For example, in Bikita, close to Chibvumani monument there is a perennial spring known as *dzivarembwa* (pool of dogs) that can only be accessed by old women who have reached menopause; the water is then used mainly for brewing beer which will be used during rain making ceremonies. This therefore, directly limits competition for the use of the water and saves the spring from over-exploitation. Traditional institutions also influenced utilisation and access by allocating land close to or on springs that could be utilised as food gardens. They were also noted to enforce traditional customs and norms that conserve springs and punish the offenders. Since traditional institutions were noted to play a very important role in the access and exclusion to springs sites, their power and influence becomes very important in the sustainability and utilisation of springs in the study area. Where the traditional institutions have more power and influences, like in the Nyanyadzi area, the springs

in that area were generally well managed and in a better state when compared to those in Maturure where the power and influence of traditional institutions was not very wide spread.

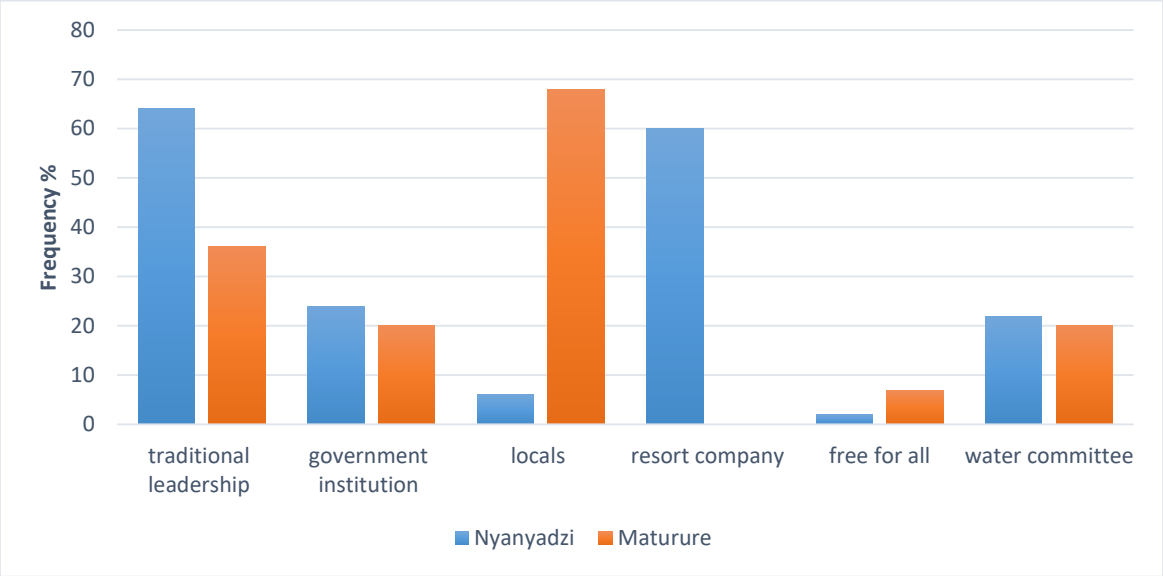


Figure 8.1: Institutions that grant access to springs in Nyanyadzi and Maturure (n=100)

Government institutions like the RDCs, EMA, AGRITEX and Forestry Commission were observed to have more penetration (influence) and dominance in Nyanyadzi (24%), as compared to Maturure (20%), in controlling access to springs. These institutions were observed to restrict access to springs by enforcing legal instruments that limit what people can do on or near springs. Some of these institutions also promote spring utilisation by allocating them to specific user groups for utilisation. Locally elected spring water committees also had influence in granting access to springs and spring water in Maturure, with 20% of the participants viewing them as being important in granting access as compared to 23% in Nyanyadzi. In Nyanyadzi, an important source of permission to access springs as perceived by 60% of the participants, was the Hotspring Resort Company which runs a resort on one of the springs which is a hotspring. Some of the springs, as noted in Figure 8.1 were managed by locals as common property with no individual or institution having overriding control over others. This was noted by at least 68% of the participants from Maturure and 6% of the participants from Nyanyadzi. In all cases the participants mentioned that every local person must be responsible, have self-control, utilise the springs wisely and guard them against free riders. Free riders are individuals who want to maximise their benefits from spring utilisation without putting efforts towards their conservation. Free riders in most cases lead to the degradation and under-provision of ecosystem services that spring provide.

Less than 10% of the participants at both places observed no one to have the legal right to exclude anyone from getting access to springs as they noted them to be free for all resources which anyone from anywhere can have unrestricted access. These springs were normally found in areas that were disputed when it comes to local traditional leadership, or where traditional leaderships were weak or on buffer zones that border communal and large scale commercial farming areas. For example, the Rupise hotsprings are in a poor state because they are found on the buffer zone of communal lands and large scale commercial farming areas as well as on an area where three Village Heads are claiming to be in charge of. As a result, anyone wishing to make developments on the site will not know who exactly to approach, in terms of traditional leadership. The local authority in the area, the Chipinge Rural District Council, seems to support Village Head Mutema as the recognised local traditional leader but other Headmen strongly oppose that position. Strong traditional leadership was, therefore, observed to have a strong bearing on the level of conservation of the spring resources found in the area of study.

Figures 8.2a and 8.2b show the institutions that were observed to have an involvement in the management of springs in Nyanyadzi and Maturure communities. The figures show that 10 institutions were actively involved in the management of springs and these were the Traditional leaders, the Rural District Councils (RDCs), Wetland committees, the Environmental Management Agency (EMA), Agricultural Technical and Extension Services Department (Agritex), Research institutions, NGOs, Forestry Commission, Heritage Management (Museums and Monuments of Zimbabwe) and the Zimbabwe National Water Authority (ZINWA).

Figure 8.2a shows that the traditional institutions were the most active and visible in Nyanyadzi with a combined annual, monthly and weekly frequency of 90% which was the highest for all institutions. Close to 80% of the participants from Nyanyadzi observed that traditional institutions played a role in the management of springs on a weekly basis. Weekly interventions in the management of springs, as used in the research, include involvement or engagement of traditional institutions from daily to at least once a week depending on the need for different places in Nyanyadzi and Maturure. In Maturure, as noted in Figure 8.2b, traditional institutions had a combined frequency of 76% and a weekly frequency of 72% which was also the highest for all the institutions from the area. This means that traditional institutions have more influence on spring water management in Nyanyadzi as compared to Maturure but have the most penetration or widest reach in both communities compared to other institutions.

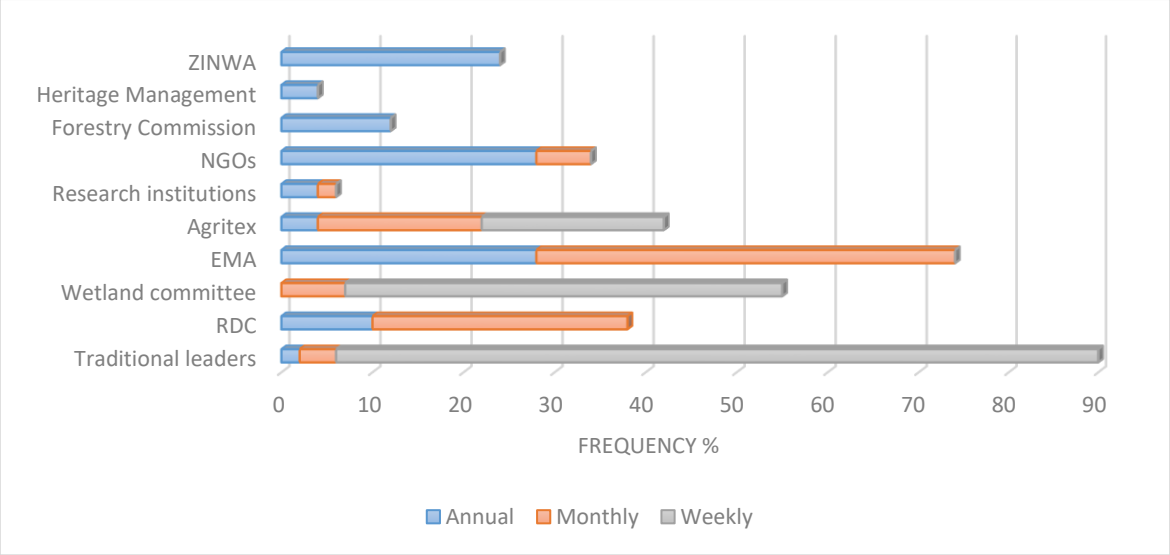


Figure 8.2a: Institutions in the management of springs in Nyanyadzi (n=100)

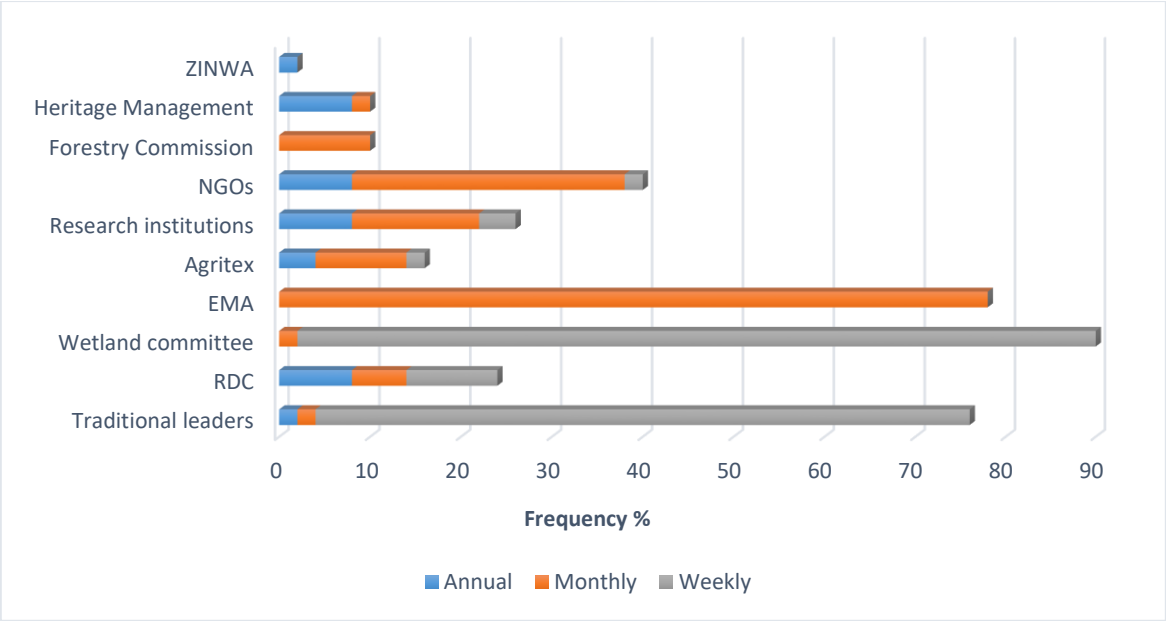


Figure 8.2b: Institutions in the management of springs in Maturure (n=100)

In Nyanyadzi, EMA was the second most influential institution in the management of springs with participants giving it a 28% annual frequency and 46% monthly frequency. Annual frequency implies that the organisation visits and inspects the springs at least once a year and monthly implies at least one visit per month. This therefore, means that depending on the place, EMA mostly makes efforts towards the management of springs in Nyanyadzi at least once a month. In Maturure, EMA was the third most influential organisation in the management of

springs with 78% of the participants noting them to have monthly visits, as noted in Figure 8.2b.

Local elected water committees were the most visible institution in the management of springs in Maturure with a combined monthly and weekly frequency of 90%. However, 88% of the participants observed the wetland committees to have a weekly presence (Figure 8.2b). In Nyanyadzi wetland committees were the third most influential institution in the management of springs with a combined monthly and weekly frequency of 62% (Figure 8.2a). Close to 14% of the participants observed the committees to be active monthly and 48% noted them to be active on a weekly basis in the management of springs. Wetland committees were, therefore, more active on a weekly basis in both places but were more visible in Maturure than in Nyanyadzi. Locally elected committees however have limitations in that they do not have the powers to enforce their rules and to punish offenders. Also not all spring waterscapes have such structures in place.

The RDCs which are the local authority and mandated to conserve natural resources in their areas of jurisdiction were noted by a combined 38% of the participants to be active in the management of springs in Nyanyadzi. Ten percent of the participants observed it to have monthly activities whereas 28% to have only annual activities. The participants noted that the RDCs were involved directly or through ward councillors, its environmental committees, ward environmental monitors, through provision of funds and indirectly by engaging NGOs to assist communities with spring management activities in their areas of jurisdiction. In Maturure, the RDC had a combined frequency of 24% being active on weekly, monthly and annual timescale in the management of springs. About 8% of the participants viewed them as being active annually, 6% noted them to be active monthly and 10% saw them to be actively involved on a weekly basis. It was therefore, noted that the RDCs were more active in Nyanyadzi than they were in Maturure in the management of springs.

The Agritex was noted by a combined 42% of the participants to be taking part in the management of springs in Nyanyadzi. A mire 4% of the participants interacted with them on an annual basis, 10% on a monthly basis and 20% on a weekly basis. The participants noted that Agritex pegged gardens for them near springs, teaches them on conservation agriculture and the best crops to grow. In Maturure on the other hand, Agritex had a combined frequency of 16% with 4% interacting with them on an annual basis, 10% monthly and 2% weekly. It is

in Nyanyadzi, however, that Agritex was more actively involved in the management of springs compared to Maturure.

NGOs were also having an impact in the management of springs in both Maturure and Nyanyadzi. In Maturure, as noted in Figure 8.2b, NGOs had a combined penetration of 40% in the management of springs. Close to 8% of the Maturure participants viewed NGOs as taking an active role annually in the management of springs, 30% viewed them as taking part in the management of springs monthly and 2% viewed them as taking part in spring management weekly. It can, therefore, be noted that NGOs were involved in the management of springs mainly on a monthly basis in Maturure. In Nyanyadzi on the other hand, a combined 34 % of the participants viewed NGOs as taking part in the management of springs with 28% of those noting that they were active annually and 6% noting them to be active monthly (Figure 8.2a). This therefore, meant that in Nyanyadzi, NGOs are more active annually as compared to monthly in Nyanyadzi.

Research institutions, for example, universities, colleges and schools were also playing an important role in the management of springs in both Nyanyadzi and Maturure. In Maturure, they had a combined frequency of 26% with 8% of the participants saying that they interacted with them annually, 14% interacted with them monthly and 4% weekly. In Nyanyadzi on the other hand, research institutions had a combined frequency of 8% with 4% of the participants interacting with them annually and 2% monthly. Research institutions, therefore, had more visibility and penetration in Maturure when compared to Nyanyadzi.

ZINWA, which is an organisation mandated to manage all of Zimbabwe's water resources only had an annual visibility in both study areas. In Nyanyadzi, 24% of the participants and 2% in Maturure observed ZINWA to take part in the management of springs annually. Gauging from the frequency with which they interact with spring wetland users, it can be noted that ZINWA does not seem to value them as important sources of water as they do with dams and rivers. The Forestry Commission was also observed by 12% of the participants from Nyanyadzi to have annual activities in the management of springs. In Maturure, the Forestry Commission was noted by 10% of the participants to have monthly activities in the management of springs. In Maturure, Heritage management institutions were recognised by a combined 10% of the participants to be involved in the management of springs, with 8% noting their annual activities and 2% noting their monthly involvement. In Nyanyadzi on the other hand, only 4% of the

participants observed the Heritage management institutions as taking part in the management of springs on an annual basis.

8.2 Discussion

The research observed eleven institutions to be involved in the management of groundwater springs in the Nyanyadzi and Maturure communities of the Save Catchment. These institutions were the Traditional leaders, RDCs, Water committee, EMA, Agritex, Research institutions, NGOs, Forestry Commission, Heritage Management, and ZINWA. These institutions are noted in the SLF by Scoones (1998) as transforming structures and processes that govern both access and mobilisation of livelihood assets, in this case, springs. These institutions also influence livelihood strategies that communities adopt to achieve livelihood outcomes and are in turn also influenced by the livelihood assets, with some institutions, like water committee and ZINWA, created specifically to manage water resources which constitute natural assets. There were notable spatial and temporal variations in the presence of these institutions and their effectiveness in the management of springs within the Save Catchment. The involvement of so many institutions in spring management in the study area is supported in Agenda 21 of the Rio Summit (1992) which clearly argued that effective resource management was not a responsibility of one individual or institution. It then encouraged the involvement of various institutions in promoting sustainable resource management including; women, youth, local peoples, NGOs, local authorities, scientists and researchers.

Traditional leaders were the most visible institution in controlling spring utilisation and management as they worked with local people more than EMA, RDCs and NGOs (Figure 8.2a and 8.2b). The power of traditional leaders is institutionally derived from the Traditional Leaders Act (1998) which empowers them to manage local natural resources in their areas of influence. Traditional leaders, together with water committees, had the highest frequency of participation in the monitoring and management of springs in both Maturure and Nyanyadzi, with their activities taking place almost on a daily basis. The high frequency and visibility of traditional leaders in the management of springs was influenced by the fact that they stay within the user community, they were closer to the people and the springs, hence they could do daily monitoring of spring water utilisation and punish the offenders. Specifically, in both Nyanyadzi and Maturure, traditional leaders also granted people access to springs by allocating land to families and communities that contained springs. After allocation of land the traditional leaders still retain authority to enforce local traditional customs and by-laws in the management of

springs. Most of the participants and key informants observed the traditional leaders to be the most efficient institution in enforcing environmental laws and credited this efficiency to their familiarity with the people cemented by kinship ties and common respect for prevailing social relations.

However, changes in the socio-political and environmental spheres in various instances, as observed by key informants, were making management of resources, like springs using traditional or local knowledge, less effective as they used to be in the past. Some significant changes were happening faster than the rate at which traditional approaches to conservation can cope with making them redundant in some instances. This explains why at certain places (although small potions) within both Maturure and Nyanyadzi, traditional leadership involvement in the management of springs was non-existent. Some key informants also observed the disrespect of local traditional authority by the local communities as the main handicap in the management of springs. They attributed this disrespect to the legal pluralism environment that is prevalent in the Save Catchment, where state law and traditional or customary law operate together and some citizen opt to be ruled under the state law. State law has been argued to be weak, less responsive and less effective when dealing with localised problems. Degradation of springs and related waterscapes has continued to occur with minimal deterrence regardless of all the pieces of legislation put in place to stop this practice. Households have continued to utilise spring waterscapes illegally without repercussions due to the weaknesses in these legislation and the fact that the state agencies like EMA are incapacitated to monitor utilisation at the lowest level of the community. The state actors also operated too far from the people as they operated at district level, making it very difficult to visit all the communities regularly to fulfil their mandate. Derman and Ferguson (2003) have observed that in Zimbabwe, government policy had generally overlooked local capacity for environmental management and hardly made use of local ecological know-how that has been noted to be, in most cases, more accurate on local environments than the data accessible to water and environmental planners in government institutions. They noted that traditional structures only directly implement programmes on the ground but were never entirely involved in policy design yet they were the resource users.

Murphree and Cumming (1991), then Mudzengi and Chapungu (2016) observed serious resource degradation in Zimbabwean communal lands to be influenced by the disempowering and subordination of tradition institutions to the central government even in dealing with very

localised problems, hence their role environmental protection including springs was greatly reduced. Historically, during colonial times, traditional leadership was reduced to that of implementation of centrally designed environmental laws as they lost their power to Native Commissioners established by colonial administrators. Traditional leaders, therefore, became progressively associated with the colonial government and became alienated from their people, further worsening resource degradation. Maphosa (2002) observed that the circumstances of traditional leaders were further worsened by determination of the immediate post-independence government to decrease their powers for having cooperated with the colonial governments. Village Development Committees (VIDCO) and Ward Development Committees (WADCOs) introduced were, thus perceived to have been fashioned to replace traditional authority, resulting in conflicts and competition for allegiance between these institutions. Contestations regarding land distribution and water resources became endemic, leading to the collapse of accountable institutions, thus further increasing the pace of water resource decline. With the reluctance of the state to give up *de jure* ownership of communal lands, coupled with its incapacity to efficiently manage resource use at local levels, Mudzengi and Chapungu (2016) argued that the role of traditional institutions in resource management was significantly reduced, producing circumstances akin to those of the open access property management regime that led to serious resource degradation.

Of these eleven institutions playing a role in the management of springs in the Nyanyadzi and Maturure areas, only the locally constituted and voluntary spring water committees had the management of springs as their sole mandate. These spring water committees were made up of locals who came together and elected amongst themselves members who would take an active role in the management of springs in their area, which they deemed to be important in supporting their livelihoods. These committees also created significant links between the community and the outside world that may have a bearing or interest on how they managed their springs. This included important linkages with the local authority, RDC, EMA and NGOs who had activities in their area. The water committees also reported those members of the community practicing activities likely to degrade springs to the local traditional leadership or to relevant organisations, such as EMA.

The spring water committees in the study areas also controlled access to springs by way of authorising activities that could be done on springs, coming up with management plans for springs and formulation of a code of conduct for the authorised users. They also determine the

number of people accommodated at each spring by approving new applicants in consultation with traditional leaders and other interested government agencies, like Agritex. Maconachie et al. (2008) observed the role of water committees in coordinating wetland management activities and the spatio-temporal differences in the consequence of their success in Ethiopia, just like in the Save Catchment, where their effect varied from community to community. Water committees however, have inadequate powers to enforce local by-laws and agreed standards, hence the need to work together with the local RDC and traditional leadership. Water committees represent local management of local resources, though a forum in which people freely discuss issues to do with water and important decisions such as rationing water use, are made at such fora as a consensus reached by the resource users. This reduces conflict amongst the water users and enhances social cohesion. This was also noted by the ICIMOD (2015) which sees community management of springs as a dependable model for managing and conserving rural water supply because of its effectiveness and also acceptance from multiple stakeholders within rural development circles. Adhikari et al. (2014) observed that a well-organised management structure within communities was important for water committees to succeed.

Water committees in both Nyanyadzi and Maturure worked towards the management of springs almost on a day to day basis and were especially more active in Maturure when compared to Nyanyadzi. Daily access gives them a compelling position in the management and conservation of springs compared to other institution who were involved on monthly and sometimes annual timescales. This was also observed by Mwakubo and Obare (2009) who noted the number of visits by institutions to be a significant determinant of the willingness of local people to participate in spring management and conservation. Water committees however have very limited powers to implement their plans, have no legal backing and can easily the challenged by offending individuals.

However, not all springs within the Nyanyadzi and Maturure communities had these water committees in place, as observed by the 20%-22% frequency of their active participation in granting access to springs. Only the larger and productive springs that could support more services and functions had such committees in place. Some springs were either allocated to families or private companies or were too small to support significant livelihoods for many households, making water committees non-admissible. Marambanyika and Beckedahl (2016) also observed that some water committees had oppressive inclinations and ignored important

concerns and opinions of other wetland users, occasionally leading to contention which comes at the expense of effective management of wetlands. This normally occurs when the committee has been captured by local elites who then protect their interests by imposing their views on other spring users. Despite these weaknesses, Dixon (2008) maintained water committees to be necessary in safeguarding the viability of community water systems due to their indigenous structure that was entrenched in the social capital of the society and had credibility within the local communities.

EMA was the most visible government institution involved in spring management in Maturure and Nyanyadzi. As noted in the results, they took part in spring management mainly through the enforcement of environmental laws and statutory instruments that protect springs from utilisation. EMA mainly took part in the management of springs through monthly activities and annual activities depending on the area, but were skewed towards monthly interventions. EMA was noted by key informants to be more active in the management of larger and more popular spring sites as compared to the smaller ones. In both Maturure and Nyanyadzi, EMA was also noted as being more reactive in its management of springs resulting in its low frequency of visits. They occasionally responded to spring degradation threats such as over-utilisation, fire and erosion instead of unchanging management of the resource, a situation which they attributed to underfunding of the institution. EMA also infrequently participated in spring maintenance through environmental education, awareness campaigns, monitoring of legal adherence, initiating wetland protection projects and monitoring illegal extension of gardens. Most of the participants admitted that the institution was more known to local communities because of its punitive measures on spring degrading activities.

The Environmental Management Act of (2002) and its statutory instruments prohibit cultivation on springs and their resultant wetlands except with a permit from EMA but despite these provisions, cultivation on spring wetlands without permits was noted by key participants to have expanded in most parts of Nyanyadzi and Maturure over the past 10 years. Legislative restriction on wetland utilisation were observed by Whitlow (1990) to have delayed, for a long time, the implementation of institutional transformations required in order to support their sustainable utilisation, a situation which has led to their further degradation. Dube and Chitiga (2011) have also noted that these legislative restrictions have made it challenging to plan for spring wetland utilisation as part of the development plans for rural areas. The situation has also further pushed spring utilisation away from the open access agenda with some agricultural

extension workers having a perception that it is illegal to cultivate spring wetlands, therefore, they do not provide extension services. As a result, wetland cultivation occurs in many cases unsupervised or unsupported (Sibanda, 2005). This scenario has also been noted by Dixon (2003) who observed that most developing countries did not openly support wetland utilisation and development despite their important contribution to the sustainability of rural livelihoods. On the other hand, Clare and Creed (2014) have observed in Canada that the use of springs without government permits resulted in serious degradation of the resource, hence they concluded that the continued use of wetlands without clear environmental management plans was a threat to wise use of the resource.

Agritex was also one of the government wings that took part in spring management in both Maturure and Nyanyadzi communities of the Save Catchment. They took part in the management at different time scales from weekly to monthly and even annually depending on availability of funds, the place and need for extension services. Participants observed Agritex to take part in spring management by encouraging their utilisation to enhance agricultural production. It demarcates gardening plots in and around springs and wetlands and sometimes assisted NGOs and other intervention organisation in the allocation of farming inputs such as seeds and agrochemicals for utilisation on the wetlands. By allocating gardening plots, Agritex, therefore influences directly the number of users accommodated on spring cultivation. Agritex also equipped wetland users with knowledge on sustainable spring utilisation by promoting adoption of conservation farming techniques.

Both the Chimanimani and Bikita RDCs, where Nyanyadzi and Maturure are located have departments responsible for environmental conservation and their participation in spring management did not spread to all places under their jurisdiction, but had visibility covering all time scales from weekly, monthly and annually. As the prime protectors of resources in their areas of jurisdiction, the RDCs enact by-laws that safeguard the environment and outlaw actions that damage springs. Key informants noted that RDCs were well positioned to make noteworthy inputs in the management of springs and delivery of alternate water sources for rural communities but they had remained largely inactive in many places of Nyanyadzi and Maturure and had low participation level where they are visible. The same situation was also observed in Ethiopia by Dixon et al. (2013) who identified limited involvement of local governments as a common problem in spring management. RDCs have also been observed by Gumbo,(2006) to be crippled by politics which makes it difficult for them to evict illegal spring

users whose basic livelihoods depend on them. Harvey, (2004) noted that in many cases, councillors break wetland laws by authorising encroachment of gardens into spring cores in violation of both wetland law and expectations of local tradition and custom in order to promote livelihood benefits and gaining political mileage in the process. Gumbo (2006) observed the RDCs in Zimbabwe to be institutions with a long history of inadequate financial support, limited capability, vulnerable to capture by politicians and elites and liable to making resolutions on the basis of politics rather than pragmatism which decreases their efficiency in resource management.

NGOs with their capital strength, influenced the management of springs by encouraging their utilisation to support rural livelihoods in both Maturure and Nyanyadzi. Their activities also varied in time but were mainly visible on an annual and monthly basis depending on the place. They encourage wetland utilisation by facilitating training workshops on smart crop production in partnership with the RDCs and sometimes Agritex; they provide material, such as fencing, to protect the springs and offer financial assistance to spring users. Some livelihood activities promoted by NGOs in Nyanyadzi and Maturure included organic farming, fish farming/aquaculture and bee keeping. Generally, NGOs participated at the initial stages of project development and implementation and taught the local people best practices when donor funding is still available. Their interventions were observed by participants to be unmaintainable as they donate materials like seeds and tools to communities then leave them on their own without further support which leads to the crumbling of initiated projects as soon as they pull out. Some participants who have noted a decline in output from spring based activities, directly attributed this decline to NGOs withdrawing their support for crucial inputs. As noted by key informants, the key challenge with NGO interventions in spring management was not empowering the communities or not dealing with the community donor syndrome to make sure that projects continue supporting community livelihoods after the NGOs withdraw their support.

ZINWA had the least frequency compared to all government institutions involved in spring water management in the study areas yet it is the sole governmental body that is empowered by Zimbabwe's Water Act (1998) to manage all of the country's water resources for its development. In both Nyanyadzi and Maturure, ZINWA took part in spring management on an annual basis and is virtually unknown in many other places. Key informants observed that ZINWA had no eloquent action plans or specific policy when it came to the management of

springs yet at some places abstractions from these resources were significant. Key informants highlighted that ZINWA seemed to concentrate on other water resources and not giving enough attention to the management of springs yet significant abstractions of water were being done from these resources and were making important contributions in supporting livelihoods of rural populates.

Private players were also playing an important role in the utilisation, protection and management of springs. In Nyanyadzi, the Hotsprings Resort Company (partly owned by the Chimanimani RDC) was active on a daily basis in the management of the hotspring in the area. They have protected the spring from natural elements like erosion and siltation. They have also controlled access through pavement and fencing of the area. The hotspring is now a source of income for the owners through tourism and also supports the livelihoods of at least fifteen employees. The facilities at the hotsprings resort were, however, in a state of decline due to both the general economic meltdown that has beset Zimbabwe for the past 10-15 years and also poor management. The downward trends in tourism based on springs have also been documented in South Africa which has some 87 documented thermal springs (Tshibalo et al, 2010), although only about one-third of these have been developed into resorts of numerous sizes and the rest were underdeveloped (Boekstein and Spencer, 2013). Examples from other countries have shown that hotsprings have enormous potential to inspire rural transformation and local economic growth, especially in spring health (balneotherapy, recovery and rehabilitation) and Spa tourism (Boekstein, 2014).

The Forestry Commission infrequently but noticeably played an important role in the management of springs and their activities were confined to annual and monthly timescales but were not visible in some areas. In Maturure and Nyanyadzi, their activities are mainly confined to monitoring of forest cover in the recharge zones of springs and punishing those who cut down trees. Deforestation of forests for wood, building materials and other craft products was noted to significantly modify the state of springs in the study area, thus enhanced protection of catchment vegetation was key in ensuring increased productivity from springs. Also in the study it was observed that land cover under forests increased the probability of groundwater spring occurrence, hence forest protection also improves the productivity of springs in the study area. In Maturure, for example, some participants observed protection of forests as one of the reasons behind enhancements in flow rates from springs in the area. Mharapara (1995) also observed that the protection of catchment forests was critical in minimising wetland loss.

The study also observed research institutions to be playing an important role in the management of springs in Maturure and Nyanyadzi. These constituted individual researchers and research institutions, like universities, that carried out projects in the study areas at infrequent time intervals. There is, however, no institution in Zimbabwe that coordinates, sets agendas and priorities for research programmes on springs. This means that there is no specialised repository or institution that acts as a bank for information and knowledge on springs in Zimbabwe. Research on springs has been noted, at other places of the study areas, to improve understanding and management of springs, helped maximise ecological and societal value of springs and provided regular baseline monitoring needs to be conducted. Adverse effects on springs could also be detected through research and allow informed remedial action to be taken. Chuma et al. (2012) argued for technical management interventions to balance ecosystem functioning and human needs to be a key cornerstone in the sustainable management of springs in which research institutions are key actors. They observed that research institutions had significant roles of leading research to assess and further improve interventions, invent and test suitable interventions, develop training material for users, researchers, policy makers, and ecological managers and training to produce spring wetland scholars and environmental managers.

The discussed battery of institutions and their numerous roles are not necessarily complimentary nor are their mandates synchronised. Marambanyika and Beckedahl (2016) highlighted that, the manner in which institutions connected with each other in wetland management was important. They argued that a harmonious approach was more beneficial to conservation efforts because it would eliminate existing or potential conflicts especially given the fact that the involvement of more than one institution at each wetland resulted in either complementary or opposing roles. Participants observed in the research that the presence of many institutions with different approaches to the management of springs created confusion in the communities as to whose directive to follow. Chuma et al. (2012) observed agreed-upon and efficient institutional arrangements which enabled and controlled sustainable wetland utilisation and conservation to be one of the key cornerstones for sustainable wetland utilisation.

The institutions involved in spring water management in Maturure and Nyanyadzi had different obligations and inspirations in policy development, hence different approaches to spring management. For example, EMA's focus is on environmental management and conservation,

and RDCs' are wedged between environmental conservation and improving rural livelihoods. Key informants observed that sometimes these institutions had combined meetings, workshops and campaigns. Institutions that sometimes collaborated in both Nyanyadzi and Maturure were the traditional leaders, RDCs and EMA. These organisations also sometimes operated through the same ward environmental monitors in some places to coordinate their activities. There was also a noteworthy association between RDCs who sanction and direct NGOs to specific areas they have to work in order to improve livelihoods. Whenever these institutions worked together in the management of the environment (including springs), it was observed that the state of the environment would be good. This complementarity between different actors in the management of springs is a major departure from what was happening during the 1980s and 1990s when different organisations working within the catchment did so individually. This resulted in the duplication of efforts, unnecessary wastage of resources eventual failure in developing sustainable management of natural resources.

IUCN-ROSA (1996), highlighted that the severity of land degradation in the Save Catchment at one time in the past managed to attract the concern of more than fifteen organisations, including government departments, local community groups, NGOs. Mambo and Archer (2007) observed that the organisations did not achieve the best possible results in rehabilitation efforts compared to the resources invested due to poor synchronisation and piecemeal approaches to implementation. This led to detrimental duplication of efforts, inefficiency and competition amongst the intervening organisations. This uncoordinated response to the degradation problem was indicative of a fragile foundation upon which strategies and actions for managing natural resources in the catchment were premised and also a poor institutional set up that perpetuated uncoordinated responses for monitoring and impact evaluation.

Inter-agency rivalries and jealousies were also highlighted by some key informants in the management of springs in both study areas. They noted that some institutions went to the extent of declaring themselves the only effective organisation in the management of natural resources undermining the efforts from other organisations.

8.3 Chapter summary

Ten institutions were observed to influence the management of springs and these were the Traditional leaders, the Rural District Councils (RDCs), Wetland committees, the Environmental Management Agency (EMA), Agricultural Technical and Extension Services Department (Agritex), Research institutions, NGOs, Forestry Commission, Heritage Management (Museums and Monuments of Zimbabwe) and the Zimbabwe National Water Authority (ZINWA). The chapter showed that in the common property regime, the local traditional leaders were the most important institution that granted the right to access and utilise springs. Traditional institutions influenced utilisation and access by allocating land close to or on springs that could be utilised as food gardens. They were also noted to enforce traditional customs and norms that conserve springs and punishes offenders. Government institutions like the RDCs, EMA and the Forestry Commission were observed to impact on spring utilisation by restricting access and by enforcing legal instruments that limit what people can do on or near springs. Some of these institutions like AGRITEX also promoted spring utilisation by allocating them to specific user groups for utilisation, hence some of the roles of the institutions were contradictory.

CHAPTER 9 : SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

9.0 Introduction

This chapter provides an overview of the research and summary of the findings of this study. The chapter also highlights the impact of the research to the study area, contribution of the study to knowledge, conclusions that can be drawn and recommendations that can be made, as a result of the work done during this research.

9.1 Overview of the study

The study investigated access, utilisation and conservation of springs, and their impacts on rural livelihoods on the Save Catchment of Zimbabwe. In order to achieve this aim, three specific objectives were developed. These were; to determine the utilisation of springs and how they have contributed to rural livelihoods on the Save Catchment; to investigate the management and key threats to springs on the Save Catchment and; to examine the institutions influencing access to and utilisation of springs on the Save Catchment. In order to achieve the above objectives, data were collected both in the field and available secondary data. The research was conceptualised using the sustainable livelihoods framework and adopted the socio-hydrological approach which is informed by both the quantitative and qualitative methods of data collection and analysis. One hundred questionnaires were administered to the chosen participants in the two areas (Nyanyadzi and Maturure) that where selected for in-depth studies. In-depth interviews with key informants were also done together with observation of the state of springs and their utilisation patterns within the study area. Non-probability sampling, specifically purposive and snowball sampling techniques were utilised in the selection of study sites and participants of the questionnaire survey. Throughout the study, research ethics principles using the University of the Western Cape guidelines were strictly observed.

9.2 Major findings of the study

The uses of springs in the study area were observed to vary from place to place but in almost all the communities, most of the springs were observed to support mainly agricultural food

production and provision of water for primary use which included domestic and drinking water. Other notable uses included provision of water for livestock and aquaculture as well as provision of building materials and medicinal plants. Non-consumptive uses of springs were also noted in the study including regulation of streamflow, cultural and mystical value, provision of bio and geo-diversity, use as educational centres and tourism. However, these non-consumptive functions were not highly regarded by participant households as being key to their livelihoods. The measured utilisation of spring waterscapes was seen in the study as making the intensification of agricultural production conceivable. It was also shown as enabling the extension of crop growing periods as well as the diversification of the grown plants. This reduced the risks of agricultural loss due to drought at the same time improving household financial position, nutrition and food security. None of the major uses of springs and their waterscapes were found to be complementary, rather most of the uses could be seen to be competing with each other, a situation that leads to contestations over which use must take priority. The biggest contestation observed was between conservation of springs for environmental use and their transformation and utilisation to enhance agricultural production. Also observed was the intensification of agricultural production around springs with most being used all year around with one crop being grown after another and also an increase in the diversity of crops being planted.

It was also noted that springs were very important in the sustainability of rural livelihoods of the Save Catchment and in most cases very important for household food security, nutrition and income. The study noted that most households utilised springs for both commercial and subsistence purposes. Surplus produce was sold locally, to markets, neighbouring villages and sometimes to tourists, thus making it a diversified market for produce from springs. The income from springs also varied from less significant to significant depending on the place. It was shown to range from $10-$80 dollars per month and constituted between 5%-65% of the total income of households. However, participants perceived most springs in the study area to be on the decline in both water quality and quantity with few cases of perceived improvements. Participants perceived this decline in springs to be a threat to the sustainability of their livelihoods considering that they had limited livelihood options from agriculture. There was, therefore a need for urgent management interventions to try and reduce the noted decline in spring water quantity and quality.

Natural environmental changes such as climatic variability were shown to be impacting on spring heath and also imposing complex livelihood conundrums to the agro-based livelihoods dominant in the study area. Other practices observed to be threatening the sustainability of springs were expansion of settlements, clearing of vegetation, soil erosion and population pressure. The prominence of each noted factor was observed as varying from one spring site to another. Only natural environmental changes constituted external shocks beyond human control with the rest of the factors being anthropogenic and were associated with poor natural resources management. This therefore underscores the need for effective and all-inclusive spring management plans for the Save Catchment. Considering the observed importance of springs to the livelihoods of communities in the Save Catchment, it was most likely that the trend in these degrading practices would continue unless serious interventions were made.

Limited environmental awareness, poor implementation and enforcement of spring protection laws and policies sometimes resulted in adoption of practices that degraded them. A cocktail of socio-economic and institutional challenges explained the current low environmental awareness and level of implementation of the current policies. Springs were observed to be used and conserved through local practices, which varied from spring to spring and had different levels of success. However, in Zimbabwe, there is no specific national policy that guides spring governance. This situation undermines the review of spring protection strategies and intensifies confusion in spring management at every level. A national groundwater spring policy developed through a participatory process is recommended. This would assist in promoting the adoption of appropriate local rules, norms, and regulations. It would also encourage their sharing and possibly adaptation in different local contexts. The formulated national policy should also encourage monitoring and documentation of local rules and regulations and ensure continuous compliance to all local policies regarding sustainable spring utilisation.

There was a noted need for mobilising revenue and resources to empower and capacitate regulatory institutions to effectively educate and supervise communities' adherence to relevant policies. However, given the prevailing serious economic decline in Zimbabwe which restricts the disbursement of sufficient resources for environmental management, it is recommended that there be recruitment of voluntary spring monitors at village level. These can be occasionally paid through part of the income that is generated from fining spring users engaging in activities undermining sustainable and wise use of springs. The study noted that

most households using springs generally had more sustainable livelihoods including food security and had developed effective strategies to manage and conserve springs. Hence, the sustainability of spring based livelihood programmes relied more on effective participation and co-management of local communities and the adoption of local environmentally friendly technologies and approaches.

In the study area, ten institutions were noted to be influencing utilisation and management of springs in the surveyed communities. These institutions were traditional leaders, RDCs, water committees, EMA, Agritex, Research institutions, NGOs, Forestry Commission, Heritage Management, and ZINWA. The level of participation of different institutions in spring management varied from place to place and from time to time. However, traditional leaders and local water committees were observed to have deeper community penetration and were the most involved in the entire spring management process in most areas. It was noted that the level of success in spring management and conservation mainly depended on the level of participation of these two community based institutions. It was also observed that springs in places where traditional leadership was strong were wisely utilised and were in heathier state when compared to those places where it was weak or non-existent. The level of participation by other institutions varied over time and space, with institutions responsible for promoting spring conservation being less visible than those promoting utilisation. Complementarity of local, Governmental and Non-Governmental organisations in the management of springs was shown to be very key to the successful implementation of initiatives. It was shown that each time different actors worked or complemented each other, there was successful implementation of spring protection activities. This is unlike in the 1980s and 1990s were different organisations worked in the Save Catchment in isolation, unnecessarily repeating efforts and wasting resources. For successful combined efforts, it was observed that the roles and mandates of different institutions in relation to spring management needed to be clearly defined. This would minimise confusion and conflicts between institutions which sometimes resulted in ineffective monitoring and degradation of the springs.

It was also observed that there was no public institution solely mandated to manage springs within the Save Catchment and activities of institutions operating were in most cases not synchronised. There was therefore a need for institutional re-engineering in the management of springs within the Save Catchment. A sound and functional institutional structure involving local people and interested institutions needs to be created. In the proposed institutional structure,

roles and synergies between different institutions should be clearly defined if sustainable spring utilisation is to be achieved. Local institutions led by traditional leaders and water committees should be placed at the core of the proposed new institutional framework given their proximity to users and the resource. The incorporation of local institutions at the core of spring governance system may provide a low cost model for spring waterscape management in resource constrained countries like Zimbabwe. This is due to their nearness to both springs and spring users and the fact that the performance of government institutions was currently weakened by limited financial and human resources. However, RDCs and other government agencies should play advisory, technical and supervisory roles to guarantee that the principles of sustainable resource management are followed.

The results of the thesis showed the importance of adopting the socio-hydrological approach as propounded by Montanari et al. (2013) and Di Baldassarre et al. (2015) in trying to get an in-depth appreciation of how communities interact with springs to support their livelihoods and how external shocks and institutions mould this interaction. The conservation and management of springs for the sustainability of rural livelihoods needs a holistic and community centred approach to spring management that balances the need for utilisation and environmental integrity.

The study has shown that households in the Save Catchment have constructed their agro-based livelihoods around the utilisation of springs. Access to and utilisation of spring waterscapes in the Save Catchment has led to an improved food security and income to some rural households. However, climatic variability, legal restrictions, poor institutional support and over-utilisation has reduced the capacity for springs to support sustainable livelihoods in the Save Catchment.

Conclusively, the research managed to show that water resources specifically springs play a major role in the livelihoods of rural communities in the Save Catchment. The study has also shown that institutional arrangements are key to the sustainable development of communities living around springs. Complementarity between intervening institutions was also key to the successful management of spring waterscapes. The study also introduces the need for multi-disciplinarity understanding community livelihoods and water resources.

9.3 Impact of the results on the study area

The study adopted the socio-hydrological approach in its methodology. The results imply that future studies on the Save Catchment need to adopt a similar multi-methodological approach in the study of springs and other resources in order to obtain a balanced view of issues at hand. The results observed that there was no central place that provided basic information and knowledge on springs in the Save Catchment. To improve on their management, there was a need to create a centre or institution to coordinate and provide a repository of information to do with activities being done on springs, methods being used to exploit them and research being done and what still needed to be done. This will provide information to different stakeholders interested in spring water management and also avoid duplication of efforts by researchers and institutions interested in interventions.

The results also observed disconnections between macro level rural development planning and local realities in terms of productive use of water. An important feature of springs noted in the study area was their relatively wide distribution which made them physically accessible to a high proportion of the rural population in places where they were found. This implies that spring cultivation is more accessible to households in the communal areas of the Save Catchment than irrigation done through government sponsored smallholder schemes in the catchment. These include the Save, Nyanyadzi, Mutema and Mutambara irrigation schemes which were created in many cases without community involvement, hence belonged to the government, not the farmers and irrigators had no responsibility towards them but were just users. To combat the twin evils of poverty and food insecurity which are being worsened by declining investments in important rural infrastructure, such as irrigation equipment as well as other socio-economic services, there is need for the government to recognise spring wetlands as having potential to increase micro-scale irrigation. This is against the background of irrigation development having been given priority since independence. It is therefore, important that micro-scale irrigation be recognised by authorities in the Save Catchment and is given due weight in rural development plans.

Within the challenges and environmental limits outlined in this research, there still exists the possibility for increasing spring water utilisation, particularly for garden cultivation in the study area. To facilitate such an imperative extension, there is a need to seriously spell out national policy, especially concerning obstructive legislation and support to communities with the

provision of agricultural guidance and credit. The probability of success for gardening as a model of rural development and sustaining rural livelihoods is high. This is so bearing in mind that past successes in spring cultivation were attained devoid of outside intervention and the fact that this is already a significant and integral part of traditional Zimbabwean agriculture that cannot be ignored in rural development planning. Furthermore, in terms of reducing food insecurity, food production controlled by households through the utilisation of spring water, as in the case of the study area, is more dependable and sustainable than nutrition interventions that rely on government aid and financial support. Community gardening through the use of spring water can, therefore be a sustainable approach for improving livelihoods, food security and incomes when the gardens are well adapted to local agronomic and resource conditions, cultural traditions and preferences.

9.4 Recommendations

- The over-reliance of the rural communities of the Save Catchment on natural resources and agriculture is inevitable given the levels of poverty in the area. The local authorities or government need to set aside funds for micro environmental protection projects such as consolidated community gardens as a strategy for the prevention of spring degradation. The projects will not only secure additional income and food for the community but will reduce spring cultivation activities. It is easier to support and monitor people working as groups than individuals at numerous springs.
- The local authorities should also consider funding for the construction of alternative sources of water such as boreholes, collector wells and small earth dams in the Save Catchment as a strategy for coping with the recurrent droughts and also to ease the demand for direct use of spring water.
- There is need for the local authorities and noted key institutions, particularly EMA, to increase environmental education awareness campaigns for the communal population emphasising the need to balance utilisation and protection of springs from degradation.
- The rural communities of the Save Catchment should be advised against the introduction of exotic plants on spring ecosystems and they should be removed from springs and replaced with indigenous trees that can thrive on spring ecosystems without disturbing them.

- Women are the main users of springs in the patriarchal Save Catchment, hence interventions targeting wise use of springs must be targeted towards the empowerment of women in order to be successful.
- There is need to capacitate and empower local institutions, especially traditional leaders to instil and enforce cultural values which are key to the protection of springs. Local institutions also need to be empowered through education to control and manage spring utilisation. Enforcement of cultural values for the protection of springs also needs to be backed by legislation given the non-existence of local institutions at some places of the study area.
- The Water Act of 1998 provides sufficient basis for a water policy framework, but there is a need to go a step further and formulate through an all-inclusive consultation process, specific policies on springs and relevant management plans. Policies with clear spring utilisation guidelines should be developed for the benefit of user communities and protection agencies.

9.5 Concluding remarks

It is recommended that the researcher revisits the studied communities to report back on the findings of the study that they took part in. The feedback would be aimed at giving them a deeper insight into the nature of interaction between them and their springs and with the hope that this can help them improve ways that they manage their spring resources. The noted key institutions also need to be engaged with the outcome of the research with the hope that they will support the fact that institutional recalibration is key to the success of conservation and sustainable utilisation of springs in the Save Catchment.

9.6 Chapter summary

The chapter gave an overview of the study which was aimed at investigating the access, utilisation and conservation of springs and their impact on rural livelihoods on the Save Catchment of Zimbabwe. The major findings of the research were then synthesised highlighting the key outcomes. The implications of the results on the study area were then given as well as the recommendations of the research in light of the outcomes.

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CHAPTER 10 : APPENDICES

APPENDIX A-ASPRING UTILISATION AND RURAL LIVELIHOODS HOUSEHOLD QUESTIONNAIRE

UNIVERSITY OF THE WESTERN CAPE

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL STUDIES & TOURISM

STUDY SITE: [ ]

Household ID……

GPS Location	
Y (S)	
X (E)	

Introduction and consent

READ OUT ALOUD

My name is David Chikodzi, I am a researcher from the University of the Western Cape. I am conducting an academic research on utilisation and management of springs by rural communities in the Save Catchment of Zimbabwe. I will be talking to communities on how utilisation of springs has contributed to sustainability of rural livelihoods and the methods they use to manage them. Your household has been randomly selected and I would like to discuss these issues with you, or any adult member of your household.

Your opinion is valuable to me as it will help me to get a better understanding on community utilisation of springs. There are no right or wrong answers. The interview will take approximately 20 minutes. The answers you give will be treated with confidentiality. It will not be easy also to identify your answers from the many other people I will interview, and moreover, I will not record your name, address or any information that may make it easy to pick you out from what you say. Feel free to tell us what you think.

Are you willing to participate? (TICK THE ANSWER GIVEN)

Yes [ ] No [ ]

IF NO: READ OUT: 'Thank you for your time. Goodbye.'

IF YES: IF WILLING TO PARTICIPATE, READ OUT THE FOLLOWING:

Thank you for agreeing to participate in this study. Just to emphasize, any answers you provide will be kept confidentially, and there is no way anyone will be able to identify you by what you have said in this interview. We are not recording either your address or your name, so you will remain anonymous. The data we collect from these interviews will always be kept in a secure location. You have the right to terminate this interview at any time, and you have the right to refuse to answer any questions you might not want to respond to.

Are there any questions you wish to ask before we begin?

Specify:

……

……

……

SPRING UTILISATION AND RURAL LIVELIHOODS HOUSEHOLD QUESTIONNAIRE

SECTION A: SPRING UTILISATION AND RURAL LIVELIHOODS

1. What are the services your household derives from spring utilisation?

1	Cultivation	
2	Arts and craft materials	
3	Domestic water supply	
4	Livestock watering	
5	Drinking wáter	
6	Livestock grazing	
7	Medicinal plants/Use	
8	Tourism/visitors	
9	Cultural/religious	
10	Educational tours	
11	Bottled drinking wáter	
12	Aquaculture	
13	Building materials (reeds)	
14	Fuel Wood	
15	Provisioning of bio and geo-diversity	
16	Regulating services such as water recharge and discharge	

2. How is acesss to the spring managed and who controls the accesss?

……
……
……
……
……
……

3. Are there any seasonal and / daily time restrictions in the utilisation of the spring services, if so why?

……
……
……
……
……

4. How important are springs to the livelihoods of your household?

……
……
……
……
……..

5. Do you use the spring for commercial or subsistence purposes or both?

1. Commercial ☐ 2. Subsistence ☐ 3.Both commercial & subsistence ☐

6. Where do you sell the products/ services derived from spring?

1. Tourists ☐ 2.Nearby towns ☐ 3. Neighbouring villages ☐

4. Markets ☐

7. If commercial, how much money do you get per month? (approximately)

$.....

8. What percentage does the income obtained from the spring contribute to average monthly household income?

…….%

9. Compared to five years ago, has the contribution of springs to the total household income changed? If yes, please explain.

……
……
……

SECTION B: MANAGEMENT OF SPRINGS

10. In your opinion, what has been the overall change in the state of the spring in terms of water quality and quantity?

……
……
……
……
……
……

11. In your opinion what are the practices that contribute to spring degradation?

1	Settlement	
2	Cultural activities	
3	Natural environmental changes	
5	Clearing of spring wetland natural vegetation for vegetable gardens	
6	inorganic fertilizer pollution	
7	Loss of biodiversity of terrestrial and aquatic life	
8	Dilapidated recreational services	
9	Livestock grazing pressure	
10	Artificial drainage of spring and wetland water	
11	Depletion of soil organic matter	
12	Soil erosion	
12	Invasion by alien plants	

12. What challenges is the community facing in managing the springs and related wetlands? (list them)
    ……
    ……
    ……
    ……
    ……..
13. What can be done to minimize the these challenges.
    ……
    ……
    ……
14. What can be done to ensure sustainable use of springs? (list)
    ……
    ……
    ……
15. Which institutions have influenced/ supported community spring management and conservation decisions?

		Frequency of participation		
		Annual	Monthly	Weekly
Traditional leaders				
Councillor				
RDC				
Wetland committee				
EMA				
Agritex				
Research institutions				
NGOs				
Forestry Commission				
Heritage Management				

SECTION D: DEMOGRAPHIC DATA

16. a) Relation to head of house……..

b) Sex Male ☐ Female ☐

c) Age 18-30 ☐ 31-40 ☐ 41-60 ☐ 60+ ☐

d) Marital status Single ☐ Married ☐ Widow ☐

Divorced ☐

e) Highest level of education

No Education ☐ Primary ☐ Secondary ☐ Tertiary ☐

Thank You

APPENDIX B: Questionnaire for Institutions

UNIVERSITY OF THE WESTERN CAPE

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL STUDIES & TOURISM

DISTRICT:……..INSTITUTION……

Dear Participant

My name is David Chikodzi, I am a researcher from the University of the Western Cape. I am conducting an academic research on utilization of springs by rural communities in the Save Catchment of Zimbabwe. The general purpose of this questionnaire is to collect information on how utilization of springs has contributed to sustainability of rural livelihoods and the management and conservation methods used by communities in the Save Catchment. My intention is to use this information for my doctoral thesis. I also intend to publish all or part of my findings from this study, which may include information that you would have kindly provided. Your District has been selected because it is located within the Save Catchment. The interview will take approximately 30 minutes. The answers you give will be treated with confidentiality. It will not be easy also to identify your answers from the many other people I will interview, and moreover, I will not record your name, address or any information that may make it easy to pick you out from what you say.

Are you willing to participate?

Yes	1
No	2

If No, thank you for your time. Goodbye.

Do you understand that you have the right to stop this interview any time you want and you can choose not to answer some or all the questions on particular issues that you may not wish to discuss?

Yes	1
No	2

At this time, do you wish to ask me anything, or are there issues that you need to be clarified about the survey before we proceed?

Yes	1
No	2

If yes; Question/clarification. ----------

May I begin the interview now?

Yes	1
No	2

1. I fully understand the purpose of the research.
2. I am participating in this research on my own free volition without force or coercion.
3. I am aware that I have the right to terminate this interview whenever I may feel so without any prejudice on my part.

Participant signature……Date…….

SECTION A: SPRING UTILISATION AND RURAL LIVELIHOODS

1. What services do the communities in your area derive from springs?
   .....
   .....
   .....
   .....
   .....

2. How has the utilization of springs by rural communities in your district contributed to rural development and improved livelihoods?
   ……
   ……
   ……
   ……

3. Which spring-based rural livelihood strategies are most sustainable in your district?
   ……
   ……
   ……

SECTION B: MANAGEMENT OF SPRINGS

4. In your opinion, what has been the overall change in the state of springs within your district?

   ……
   ……
   ……
   ……

5. Which practices are having negative effects on spring water quality and quantity?

   ……
   ……
   ……

6. What activities have been undertaken or are being implemented by your organisation in the management of springs?
   ……
   ……..

7. What challenges do you face as an organisation in assisting communities to manage their springs?
   ……
   ……
   ……

Thank You

APPENDIX C: Interview Schedule for key stakeholders

UNIVERSITY OF THE WESTERN CAPE

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL STUDIES & TOURISM

Dear Participant

My name is David Chikodzi, I am a researcher from the University of the Western Cape. I am conducting an academic research on utilization of springs by rural communities in the Save Catchment of Zimbabwe. The general purpose of this interview is to collect information on how utilization of springs has contributed to sustainability of rural livelihoods and the management and conservation methods used by communities in the Save Catchment. My intention is to use this information for my doctoral thesis. I also intend to publish all or part of my findings from this study, which may include information that you would have kindly provided.

Are you willing to participate?

Yes	1
No	2

If No, thank you for your time. Goodbye.

If Yes, do you want me to tape record the interview or write notes as we progress?

Use Tape Recorder	1
Write Notes	2

Do you understand that you have the right to stop this interview any time you want and you can choose not to answer some or all the questions on particular issues that you may not wish to discuss?

Yes	1
No	2

At this time, do you wish to ask me anything, or are there issues that you need to be clarified about the survey before we proceed?

Yes	1
No	2

If yes; Question/clarification. ----------

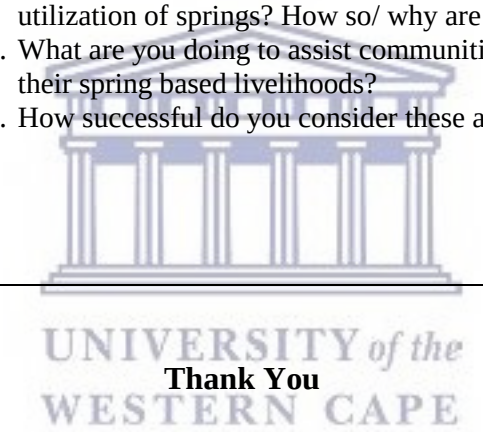
May I begin the interview now?

Yes	1
No	2

1. I fully understand the purpose of the research.
2. I am participating in this research on my own free volition without force or coercion.
3. I am aware that I have the right to terminate this interview whenever I may feel so without any prejudice on my part.

Participant signature……Date…….

THEME	GUIDING INTERVIEW QUESTIONS
Section A: **Spring utilisation and rural livelihoods**	1. Do springs have any benefits to rural communities in your area? 2. If yes, what benefit does the community derive from springs? 3. How has the utilization of springs changed over time in the Save Catchment? 4. Is there any relationship between settlement patterns and location of springs in the Save Catchment? 5. Do rural communities experience any problems related to the existence springs in this area? 6. Which spring-based enterprises are profitable in this area? 7. What have you done to encourage these enterprises? 8. Who has access and who controls the utilization of springs that are in your area of jurisdiction? 9. Has the utilization of springs by rural communities in the Save Catchment contributed to sustainability of rural livelihoods?
Section B: **Management of springs**	10. In your opinion, has there been any changes in the state of the springs in the last 20 years? 11. If any what have been the major drivers of this change? 12. Do you think rural communities are optimally benefiting from the utilization of springs? How so/ why are they not? 13. What are you doing to assist communities to conserve springs or improve their spring based livelihoods? 14. How successful do you consider these activities and why?



Thank You