

**THE INFLUENCE OF KNOWLEDGE TOWARDS WATER RESOURCE
PROTECTION PRACTICES: A CASE STUDY OF NG'OMBE**

BY

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the award of the degree of Master of Engineering in Project Management

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DECLARATION

I, Iza Chimbo Mukwavi, do hereby declare that this dissertation/thesis represents my own work, and that it has not previously been submitted for a degree, diploma or other qualification at this or any other University. Any published work or material from other work that has been incorporated has been duly referenced and acknowledged.

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CERTIFICATE OF APPROVAL

This dissertation of Iza Chimbo Mukwavi has been approved as partial fulfilment of the Requirements for the degree of Master of Engineering in Project Management by the University of Zambia.

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ABSTRACT

The goal of this study was to establish how knowledge on water resource protection influenced practices involving water resources amongst residents of Ng'ombe living within the Chamba river buffer zone. This was done in order to determine why buffer zone encroachment and degradation appear to be common in Zambia despite the country's laws and policies that have been in existence since 1964. The three key objectives were (1) To establish whether the residents of Ng'ombe were aware of the existing laws and policies on water resource protection in Zambia; (2) To determine what effect knowledge on IWRM principles had on the practices of the Ng'ombe residents within the river buffer zone; and (3) To determine the role the mandated authorities play in sensitizing local communities on water resource protection. The data collection was done using random sampling for the collection of quantitative and qualitative data from 156 households living within the Chamba stream buffer zone in Ng'ombe. The qualitative data was collected from three significant Zambian government organizations that are mandated by law to protect the Zambian water resources using purposive sampling. These were The Water Resource Management Authority (WARMA) The Zambia Environmental Management Agency (ZEMA) and the Lusaka City Council (LCC). It was observed that the majority of the respondents were not aware of the existing laws and policies on water resource protection as only 13% had an idea of the importance of a buffer zone and 11% had an idea on the prescribed minimum distance of 50m for a river buffer zone according to the Zambian law. It was also found that those who had knowledge on water resource protection still practiced negatively impacting activities within the riparian buffer zone. This was mostly related to the legal interactions on matters pertaining to the protection of water resources between the communities and the pertinent authorities being minimal. The results of this study also showed that a variety of other elements, including behavioral modification, the introduction of environmentally friendly alternative livelihoods, and improved educational levels, are crucial for assuring the protection of water resources in communities. In conclusion, the findings demonstrated that knowledge alone was not sufficient in influencing positive practices in water resource protection amongst the residents living within the Chamba buffer zone.

Key words: Knowledge, Practices, Riparian buffer zone, Water resource protection

DEDICATION

This dissertation is dedicated to my husband, children, parents and brothers who gave me unwavering support during the tenure of my studies. I will forever remain grateful.

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ACRONYMS

EE	Environmental Education
IWRM	Integrated Water Resources Management
LCC	Lusaka City Council
LWSC	Lusaka Water Supply and Sanitation Company
MOH	Ministry of Health
SPSS	Statistical Package for Social Sciences
WARMA	Water Resources Management Authority
WRM	Water Resources Management
WRP	Water Resource Protection
WUA	Water User Association
ZEMA	Zambia Environmental Management Agency

CHAPTER 1

INTRODUCTION

1.1 Background

According to Pandey et al. (2022), ecosystems such as riparian buffer zones are one of the most vulnerable ecosystems in the world due to anthropogenic activities that have brought about negative effects. The creation of riparian buffer zones is one of the ways used in water resource protection. Buffer zones are created to act as barriers between human activities and sensitive water resources to curb negative impacts which could be adverse on the resource (Macfarlane & Bredin, 2017).

Some of the key functions of buffer zones include the maintenance of basic aquatic processes, they help reduce impacts from upstream activities and adjoining land uses on water resources and lastly but not the least they provide some ancillary benefits to the society such as economic and social benefits, (Macfarlane & Bredin, 2017) and (Pandey, et al., 2022).

Zhao et al. (2020), cited a number of issues China has with river management, including the conflict of interest brought on by the fragmentation of the management of water resources and water environment, which has resulted in ineffective river management and flawed planning systems. The lack of public awareness for participation in river protection was also listed as one of the problems faced in river management. “The public plays an important role in the management of urban rivers because they are the ultimate consumers, governor and the governed of the urban ecological environment” (Zhao et al., 2020). Additionally, the public if engaged can also make up for the drawbacks of the mandated government institutions and supplement government’s efforts as well.

According to reports, Kenya's two largest industries—agriculture and business—are responsible for over 80 percent of the country's water body contamination and solid waste (plastic) pollution (Ondigo et al., 2018). Deforestation and poor farming methods were also cited as factors contributing to Kenya’s degraded water catchment areas. Policies have been implemented at both the national and regional levels to help guide the

conservation and management of water resources in Kenya (Orema et al., 2019). One such policy is the Water Resource User Association, which manages water at the local level and has reduced illegal water abstraction, catchment encroachments, rehabilitation of catchment areas, and the protection of river banks.

Deforestation to create arable land and to obtain logs for the production of charcoal are the two major anthropogenic activities that have had an impact on Zambia's water resources (Ministry of Energy and Water Development, 2010); (Hamatuli & Muchanga, 2021). Additionally factors such as shortage of state land, proximity to central business district, population explosion, poor planning by the Local Government and ignorance of environmental issue were listed as some factors causing land use change in Zambia (Swali, 2022).

In a bid to have a system that manages water in a sustainable and participatory manner, The Water Resources Management Act no 21 of 2011 (WRM Act) was enacted in 2011. The WRM, Act replaced the Water Act of 1949 in order to improve the pit falls of the previous Act as highlighted in the water policy such as the improved institutional and legal framework for water management (Ministry of Energy and Water Development, 2010). This Act was created in order to manage water in an integrated manner seeing as water resources are a vital part of an economy.

This research will take into consideration the following Zambian regulations prescribed to protect the riparian buffer zones which read as follows “(3). A person shall not, on any area of land within a distance of fifty meters of a bank of any public stream, cultivate or permit the cultivation of any crops, cut any tree, excavate any sand or in any manner conduct any activity likely to loosen the soil or diminish the quantity of water flowing in any part of a public stream” (Water (Protection of Public Stream and Source of Water Supply) Regulations, 2000).

This entails that no activities should be done within 50m of any water resource however, despite the presence of these laws, there are a lot of public streams that have been encroached and are being degraded by communities living within these areas.

The WRM Act has embedded within its laws the Integrated Water Resources Management (IWRM) principles which are based on three concepts namely social equity, economic efficiency and environmental sustainability (IWA, 2021). The IWRM has been defined as “a process which promotes the coordinated development and management of water and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment” (GWP, 2018).

Previous research has shown that enhanced knowledge of IWRM coupled with effective implementation of existing laws and policies improves the attitudes and practices of communities towards water resource protection (Ahmed et al., 2020) (Orema et al., 2019), which is the premise of this research.

1.2 Statement of the problem

It is crucial to manage and protect water resources for both the current and future generations since rivers offer ecological advantages to both the environment and the human population. In Zambia, the current WRM Act of 2011 takes into account the principle of IWRM which involves taking a participatory approach. This entails ensuring that communities also take part in the management and decision making process regarding water resources around them.

Unfortunately, encroachment on many water resources caused by harmful human activity has resulted in severe consequences including pollution and sedimentation, among other negative consequences that have contributed to the degradation of water resources (Chomba & Sichingabula, 2015). This means that livelihoods of communities are affected negatively as water resources have vast uses such as agriculture, domestic and industry (Ministry of Energy and Water Development, 2010).

Even though Zambia has had policies and laws in place since 1964 to prevent encroachment on water resources, many rivers nevertheless appear to have been invaded, including those in townships. One such stream that has been negatively impacted by anthropogenic activities is the Chamba Stream in Lusaka, which has been subject to infrastructure construction and river bank cultivation.

Research has shown that there has been low awareness on water resource protection in Zambia which has led to degradation of Zambia's water resources in many parts of the country (Hamatuli & Muchanga, 2021); (Sikwibele & Chipatu, 2021); (Chisola & Kuraz, 2016). However, the research has not shown what the knowledge gap is with regards to the existing Zambian policies and laws as well as the community's understanding of the concept of the IWRM principles.

This research was created in order to establish whether the prevalence of this vices is as a result of a lack of knowledge on the existing policies and laws as well as the IWRM principles which results in the continued negative practice of communities living within riparian buffer zones. And if so what could be the cause of the knowledge gap or the continued negative practice within the riparian buffer zone. And lastly to recommend solutions on what can be done to curb the encroachment of these zones.

1.3 Research aim

This research aimed to establish how knowledge on water resource protection influenced practices involving water resources amongst residents of Ng'ombe living within the Chamba river buffer zone.

1.4 Specific objectives

1. To establish whether the residents of Ng'ombe are aware of the existing policies and laws on water resource protection in Zambia;
2. To determine what effect knowledge on IWRM principles had on the practices of the Ng'ombe residents within the river buffer zone; and
3. To determine the role the mandated authorities play in sensitizing local communities on water resource protection.

1.5 Research questions

1. How knowledgeable are the residents of Ng'ombe on the existing laws and policies on water resource protection in Zambia?

2. How does knowledge on IWRM principles affect sustainable practices of the residents of Ng'ombe towards water resource protection?

3. How proactive are the existing relevant authorities in the sensitization and disseminating of knowledge to encourage sustainable attitudes and practices towards water resources amongst communities?

1.6 Significance of the study

The Chongwe River and its tributaries are depended upon by a majority of people for agriculture, domestic use, industrial and socio economic purposes. The Chamba stream riparian buffer zone which is the study area, is also part of the Chongwe River catchment area. It is a tributary of the Ngwerere River as shown in Figure 3.1. Unfortunately, due to negative effects attributed to anthropogenic factors, the contribution of the Ngwerere River discharge has been declining by 0.64 percent per decade looking at the period 1970 to 2019 (Tena et al., 2019). This could be that its tributaries are not yielding as much flow into the Ngwerere River.

Because of the importance that this catchment has on the livelihood of the people as well as the sustainability of the environment, it is important to involve all stakeholders including the grassroots by first ensuring that they are well informed on IWRM and existing policies and laws in order to influence their attitudes and practices which will make it easier to enforce the regulations.

In view of the above, this research will add to the existing body of knowledge by assessing the knowledge on water resource protection and the practices of the residents of Ng'ombe living within the Chamba stream buffer zone in order to ascertain their influence on the prevalence of these vices.

1.7 Scope of the study

This research will only focus on the assessment of the knowledge and practices towards water resource protection with reference to the IWRM Principles as well as the existing regulations in Zambia amongst the Ng'ombe residents living within the Chamba stream buffer zone

1.8 Definition of key terms

A **riparian buffer** zone refers to “land that is directly adjacent to water bodies like lakes, reservoirs, rivers, streams and wetlands” (The national Academies press, 2000).

Water resource in this research will refer to any naturally occurring water bodies such as rivers, stream, spring, hot spring, pan, lake, pond, swamp, marsh, watercourse, estuary, aquifer, artesian basin or other body of flowing or standing water (Ministry of Energy and Water Development, 2010).

Water resource protection has been defined as “being fundamentally related to the use, development, conservation, management and control of water resources” (Government of SouthAfrica, 1998a).

Knowledge in this research will refer to the information, understanding and skills that one gains through education or experience (Oxford University Press, 2023). In this case it will refer to the resident’s understanding and awareness of both the IWRM principles and the existing Zambian laws and policies on Water resource protection.

Practices will mean a thing that is done regularly (Oxford University Press, 2023). In this research this will mean both positive and negative water resource related activities that the residents are involved in such as river bank cultivation, brick making, afforestation, construction within the buffer zone area and any other activities undertaken within the stream and its buffer zone.

1.9 Ethical considerations

Ethical clearance was granted by the Social Sciences Research Ethics Committee-IRB reference number HSSREC-2022-April-011 (see Appendix A).

1.10 Layout of dissertation report

This report is presented in the manner highlighted below:

Chapter one: Introduction; Chapter two: Literature review; Chapter three: Methodology; Chapter four: Results; Chapter five: Discussion; Chapter six: Conclusion and recommendations; Literature review; Appendices.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The review of the literature describes the legislative and institutional framework considered in the research. The role of IWRM as well as previous studies that have been conducted on the protection of water resources both globally and in the catchment of the Chongwe River, where the Chamba Stream is located will also be reviewed. The chapter will also highlight additional research on the connections between knowledge and protecting water resources.

2.2 Legal and institutional framework on water resource protection and management in Zambia

Table 2.1 shows the legal framework in water resource protection that were key to this research. Please note that there are other policies and laws in Zambia that look at water resource protection but they one's listed in this section had been considered as the most relevant for this research.

The Zambia Environmental Management Agency (ZEMA) is an agency of the government that coordinates other government agencies and departments that are involved in environment management (see section 9 of the EMA Act, 2011). In addition to this, ZEMA is responsible for development of environmental management strategies that are sustainable as well as providing for public participation in environmental decision making and access to information (Zambia Environmental Management Agency, 2023).

The National Water policy of 1994 was revised in order to incorporate the international standards to water resource management as well as a more holistic and clear approach to the management of water resources (Ministry of Energy and Water Development, 2010). This gave birth to the National Water policy of 2010 whose main outcome was to improve the management of water resources, institutional coordination and defined roles and responsibilities. In addition, the National water policy of 2010 proposed the repealing of

the Water Act of 1949 and replaced it with the current WRM Act of 2011 in order to improve on the limitations of the previous Act.

According to Ministry of Energy and Water Development (2010), some the limitations considered were a threat to the sustainability of the water resources base and its negative impact on the control, quality and availability of water. The Water policy considered the IWRM principles in the development of the WRM Act, 2011. These principles included the following:

1. Principle 1: Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment.
2. Principle 2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
3. Principle 3: Women play a central part in the provision, management and safeguarding of water
4. Principle 4: Water has an economic value in all its competing uses and should be recognized as an economic good

The Water Resources Management Authority (WARMA) is the legislative authority in Zambia that was an output of the National Water Policy of 2010 and is entirely responsible for the management of water resources in Zambia. Some of its functions that relate to water resource protection involve ensuring that as it executes its functions, it is done in a manner that is integrated, collaborative, and participatory and gender sensitive approach. The Authority also takes into consideration elements such as poverty reduction and elimination of water borne diseases such as malaria.

Additionally, the authority is supposed to be proactive in adopting programmes that involve watershed protection, wetlands and infrastructure development. WARMA also has the mandate to advise the minister on relevant policies and work towards mitigation and adaptation activities in light of climate change. The authority is also mandated to penalize offenders who go against the WRM Act, 2011 (see section 172 which shows the general penalties for offences committed).

WARMA is also mandated to recommend to the minister in charge of Environment in order for an area to be declared a water resource protection area (see section 29 of the WRM Act, 2011). Additionally, the Authority also gives water permits for activities that are commercial in nature and may also affect the course, quality and quantity of a water resource (see sections 70 and 71) of the WRM Act, 2011.

The following regulations are used by WARMA in the protection of water resources “A person shall not, on any area of land within a distance of fifty meters of a bank of any public stream, cultivate or permit the cultivation of any crops, cut any tree, excavate any sand or in any manner conduct any activity likely to loosen the soil or diminish the quantity of water flowing in any part of a public stream” (Water (Protection of Public Stream and Source of Water Supply) Regulations, 2000).

The Lusaka City Council (LCC) is part of local government in Zambia. It plays the role of coordinating and implementation of laws in collaboration with relevant authorities at local level. In water resource protection (see section 16(2) on the functions of Local Authority), the council plays a role in conservation and preservation of natural resources; in the control and maintenance of water courses; in the control and prohibition of cultivation and development in places that would affect the public health of a community and it also has the power to demolish structures that are not in accordance to approved building plans or are a danger to the public (National Assembly of Zambia, 2019).

Table 2. 1: Summary of legislative policy and law that guide WRP in Zambia

No.	Act/ Policy	Organisation responsible	Mandate of responsible organization
1	National Water Policy,2010	Ministry of Green Economy and Environment	<ul style="list-style-type: none"> • Promote and coordinate bilateral and multi-lateral cooperation in natural Green Economy and Climate Change in order to promote Zambia's interest and meet international obligations. • Formulation and reviewing of policies and legislation on Green Economy and Climate Change.
2	Water resource management Act No. 21 of 2011	(WARMA)	<ul style="list-style-type: none"> • The Act provides for the management, development, conservation, protection and preservation of the water resource and its ecosystems (Water Resources Management Authority, 2011)
3	Local Government Act, 2019	Local authorities such LCC	<ul style="list-style-type: none"> • Coordinates functions of Acts of Law at local level in collaboration with relevant authorities or arms of government (National Assembly of Zambia, 2019).
4	The Environmental Management Act, 2011	ZEMA	<ul style="list-style-type: none"> • ZEMA is mandated to protect the environment and control pollution in order to provide for the health and welfare of persons, animals, plants and the environment. (Zambia Environmental Management Agency, 2023). • According to section 9 of the EMA Act, 2011, ZEMA is mandated to also coordinate various government institutions such as WARMA that are responsible for the management and protection of respective sectors in the environment.

Source: Author

2.3 The role of IWRM principles in water resource protection

There are many cross cutting issues that may directly or indirectly impact water resource protection globally. Communities that have access to sustainable safe water supplies and sanitation as well as water for productive uses have a greater potential for engaging in

economic activities to reduce poverty and thereby improving their life (Ministry of Energy and Water Development, 2010).

The basis of the IWRM principles is that the many different uses of the finite water resource are inter dependent and thus would need to be managed in a holistic and integrated manner (GWP, 2018).

The National Water Policy of 2010 also recognised the need for a participatory approach in the management of water resources as it considered the views of all relevant stakeholders as valuable in influencing decisions that affect communities in water resource management and development. Additionally this participatory approach promotes ownership amongst the community and would improve water resource protection as in Kenya (Orema, et al., 2019). In Zambia, water resources are managed within catchment boundaries in which a hierarchy of organisations such as a catchment council, sub catchment council and Water User Associations (WUAs) are formed (Water Resources Management Authority, 2011); (Ministry of Energy and Water Development, 2010).

Women for instance could play a major role in water resource protection as they play a critical role in meeting household needs such as acquisition of energy resources and performing home duties which require a water resource (Mago & Gunwall, 2019). Both Hamatuli & Muchanga (2021) and Mago & Gunwall (2019) alluded that a lack of alternative livelihoods such as inadequate energy resources and a lack of access to efficient technologies of energy would force the communities to depend on bio mass energy which in turn affects the river systems through deforestation and land degradation. Therefore it is imperative to involve the women in protecting riparian areas by considering their views in planning and implementing projects as they are the main users of natural resources (Mago & Gunwall, 2019); (The World Bank, 2021). The World Bank, (2021) further reports on how women in certain parts of the world such as Central Asia are left out of meetings where major decisions such as those involving land use, irrigation and water management are discussed. This further causes women to refrain from issues pertaining to water management as they may be unaware of their potential value in that regard.

Water is considered to have economic value in that it can be used in different sectors to derive wealth through for example the agricultural sector (Vallino et al., 2020). Many countries that have water in abundance according to hydrological indicators are said to face difficulties in the utilisation of water in agriculture for instance in a situation referred to as economic water scarcity. This is mainly attributed to a lack of institutional and material means of water management and governance. The National Water Policy of 2010 took this into account as it was proposing the formation of WARMA as the institution mandated to manage water in Zambia. The policy recognised that water having an economic value also comes with a cost of managing it due to the high administrative costs required. WARMA derives its finances for administrative costs mainly from permits for economic purposes (Ministry of Energy and Water Development, 2010).

2.4 Factors influencing water resource degradation in the Chongwe River catchment

Vast research has been done within the Chongwe River catchment in which the study area of this research falls. Much of the research has focused on determining the effects of anthropogenic as well as climate change effects on the river catchment.

One of the main factors lowering the lifespan of dams in the Chongwe river catchment is sedimentation, which is attributed to changes in land use, such as an increase in sedentary agricultural regions and deforestation, which results in more bare ground (Chomba & Sichingabula, 2015).

According to Chisola & Kuraz (2016), an increase in runoff in the Chongwe catchment during the wet season has also been shown to be as a result of reduced infiltration due to increased urbanization in the upper Chongwe catchment. The increase in runoff is mainly due to the discharge of sewer into the Ngwerere River as well as increased storm water flowing into the river. Chisola & Kuraz (2016), further indicated that the major factor influencing the water use conflicts in the catchment were human activities in the upstream parts of the catchment. It was then recommended that it is necessary to sensitize the communities on the importance of water user's association formations as well as the

consideration of a river and catchment restoration programme and encouraging of integrated management of the catchment.

Furthermore, in a research done by Nguvulu et al. (2021), the results showed that within the period of 2006 to 2017, there has been degradation in the water quality of surface water in the catchment. The research showed that agriculture and built up land had the most significant effects on water quality. This degradation in surface water quality had been attributed to factors such as the increase in surfaces that are impervious in the settlement areas; an increase in anthropogenic activities within the catchment; the discharge of sewage that is not treated and the built up land which is spatially distributed in the catchment.

In another research conducted by Tena et al. (2019), it was found that there has been an increase in the demand for water within the Chongwe River catchment and it is projected that it will increase further with the increasing population and socio economic activities which are prevalent in the catchment. Despite the benefits brought about by socio economic developments, the natural environment within the Chongwe river catchment is reported to be negatively affected mainly by these human activities. Research has shown that land use- land cover change has had a terrible impact on the hydrological components such as the stream flow, evapotranspiration and water available for abstraction. The Ngwerere stream on its own was reported to contribute 52.8 percent of the stream flow in the Chongwe River, however, the contribution of the river discharge has been reducing by 0.64 percent per decade looking at the period 1970 to 2019. Activities such as the increase in irrigated arable land is reducing the flows into the Chongwe River, the reduction in rainfall trends as a result of urbanization and deforestation and the decrease in the base flow due to an increase in built up areas which have affected the groundwater discharge.

2.4 Knowledge and practices' influence on Water Resource Protection

Other researchers globally have conducted research that involved the assessment of the knowledge, attitudes and practices of communities living near water bodies in order to ascertain how these factors can influence water resource protection.

Ahmed et al. (2020), conducted a research on the factors influencing people's willingness to participate in sustainable water resource management in Malaysia. People's attitudes, perceptions and behavior were assessed through partial least squares structural equation modelling (PLS-SEM). The researcher acknowledged there were few studies on public participation in water management globally. The research showed a significant indication that the public's perception of and attitude towards water resources as well as drinking water and their perception of water quality influenced the participation of the public in water management platforms. Environmental education can enhance the behavioral intention of the public to willingly participate in water management as well as positively change their attitudes and perceptions about water quality and its management (Sikwibele & Chipatu, 2021). Despite Malaysia having sound policies for water resource management, there seemed to be a challenge when it came to the promotion and enforcement of the policies which were purported to be as a result of low participation of relevant stakeholders as well as inadequate leadership roles from relevant agencies.

Additionally, in a study by Oremo et al. (2019), on the knowledge, attitude, and practices in water resource management among small-holder irrigation farmers in the Tsavo sub catchment, Kenya, the researcher examined the involvement of irrigators in the sub catchment with emphasis on what is known and valued, as well as their practices. The results showed that knowledge, attitude and practice are dependent on culture and impacted by local networks, access to extension, attendance to farmers' education meetings, level of income, access to credit, land tenure and proximity to stream or natural spring.

The research further showed that farmers that had enhanced knowledge of IWRM with better education levels, were more affluent, belonged to a local network, and had access to extension services. Knowledge on water management issues informed attitudes and practices, improved awareness and targeted extension support were necessary in the development and implementation of policy decisions on water resources management. To help curb challenges such as deforestation and poor farming practices, policies had been enacted at both national and regional levels to help guide the conservation and management of water resources in Kenya (Ondigo et al., 2018); (Orema et al., 2019).

These policies included the formation of Water Resource User Association groups to manage water at local level which led to the reduction in illegal abstractions, reduced catchment encroachments and the rehabilitation and protection of catchment areas. The policy of governance at local level was supported by Zhao et al. (2020), who stated that one of the issues with river management was a lack of public knowledge for participation by the public in river protection. Since they are the primary consumers, the governors, and the governed of the urban natural environment, the public is crucial to the management of urban natural water bodies.

Sikwibele & Chipatu (2021), conducted a study with the intention of determining the type of environmental education program, if any, that was being offered in the Chongwe catchment. The study examined the respondents' knowledge of the concepts of environmental degradation and Environmental Education (EE). The results collected showed that most of the respondents who had knowledge on EE were those that had some formal education which was similar to the findings of Orema et al. (2019). In addition, the results also showed that poverty was the leading cause of environmental degradation which is in line with the findings from the National Water Policy hence the realization to manage water in a holistic manner (Ministry of Energy and Water Development, 2010). The researchers showed that EE was mainly offered by agricultural extension officers who mostly taught farmers on mitigation measures against climate change though most of the respondents reported that most of the EE providers lacked seriousness in educating the communities.

Sikwibele & Chipatu (2021), further indicated that river bank farming, deforestation for charcoal manufacturing, and finally a lack of understanding of watershed management were the key factors contributing to catchment degradation. The lack of understanding could be attributed to perhaps a lack of emphasis on knowledge and skills on how to use the environment sustainably despite the subject of environment management being part of the Zambian School Curriculum at different levels (Muchanga & Nakazwe, 2022). A research done by Muchanga & Nakazwe (2022), showed that the Zambian School Curriculum had good knowledge on environment management as well as aspects of human- environment interface for the learner's respective levels from pre primary to

tertiary level of education. However, at Secondary level, Geography was the main subject that looked at the environment extensively and it was an option at that level at that time. It was proposed that perhaps they educators could consider using story telling as a mode of delivery to show how humans affect the environment negatively. The use of both formal and informal learning platforms such as the use of conservation groups and programmes like the Chongololo radio programme could yield more results in educating communities on sustainable environmental use and protection.

Another research was conducted by Hamatuli & Muchanga (2021), in Shibuyunji area where the effects of anthropogenic activities in the buffer zone on Mashili reservoir assessed and potential measures to lessen the effects were identified. The study noted that there was a lack of awareness on environmental protection of buffer zone resulting into the loss of storage capacity for the reservoir thereby reducing its water quality and quantity. Furthermore, the research showed that inadequate environmental and water education among residents and also the lack of alternative livelihoods led to the negative anthropogenic activities within the buffer zone. Other factors that were reported to contribute to the effects of negative anthropogenic activities in the buffer zone of the Mashili reservoir were the lack of legal authority to curb unsustainable land use; the lack of the implementation of provisions of the SI No. 1 of 2000 and the WRM Act and the lack of adequate ecosystem regulation in the Mashili basin. The lack of legal authority's presence in the community was also alluded to by Ahmed et al. (2020).

The majority of the research on the subject region in the Chongwe catchment has been focused on determining how anthropogenic activities have affected the river basin. The sociological factor that has contributed to the dominance of these vices has not received much attention. Little to no knowledge is known on whether these vices have continued over the years because of the lack of knowledge on the laws on water resource protection around the river catchment which could have influenced their practices. It was clear from the past research that harmful human activities are the main cause of the river catchment's degradation. In light of the IWRM Principles and Zambian policies and laws, this research will evaluate the residents of Ng'ombe's knowledge and practices regarding the protection of water resources.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The research design, the study region, the study population, the study sample characteristics, the sampling methodologies, and the data collection and analysis methods that were employed will all be covered in detail in this chapter.

3.2 Research design

This study employed a mixed-methods strategy that combined qualitative and quantitative techniques. The mixed method approach was used in order to triangulate the information that was collected.

3.4 Study population

The study population was determined using Google earth pro as a proxy measure by measuring distances of households within 50m from the Chamba Stream. This proxy method was used because population information of only the households within the buffer zone area was not available at the time of the study. The households within the estimated buffer zone were approximately 233 households from the Google earth imagery of October, 2021. The 233 households made up the study population. The study only considered the households in Ng'ombe that were within 50m from the Chamba stream because the aim of the study was to assess the knowledge and practices of the people that are living within the stream buffer zones contrary to the Water (Protection of Public Stream and Source of Water Supply Regulations of 2000).

3.5 Study sample

The sample size was calculated based on the Slovin formula because little was known about the study population (Glen, 2021).

The researcher used a confidence level of 95% and a marginal error of 0.05. The formula is stated below:

$n = N / (1 + Ne^2)$ Where: n= number of samples; N= total population (233), E= error tolerance (level) (0.05)

The sample size was calculated as:

$$\begin{aligned} n &= 233 / 1 + 233(0.05)^2 \\ &= 233 / 1 + 233(0.0025) \\ &= 233 / 1 + 0.5825 \\ &= 233 / 1.5825 \\ &= \mathbf{147 \text{ households.}} \end{aligned}$$

According to the calculations above, the sample size of 147 was the minimum the researcher could pick from. However, the researcher increased the sample to 156 in order to reduce the marginal error.

3.5 Sampling techniques

Stratified sampling was proposed to be used for this research but the method did not seem feasible during data collection because the activities to stratify were not as many as earlier anticipated. Random sampling was therefore used which gave each household within the buffer zone an equal chance of being selected.

Purposive sampling was used to select the key informant interviews as the research looked at institutions that had been mandated to manage water resources in Zambia. The institutions selected were the WARMA, ZEMA and LCC.

3.3 Study area

The research was carried out on households with activities within 50m of the Chamba Stream buffer zone in Ng'ombe township (please see Appendix B). Ng'ombe Township is a high density community located within Lusaka province, Zambia. The Chamba valley

stream lies within the Chongwe River catchment. The stream is a tributary of the Ngwerere River which in turn is a main tributary of the Chongwe River contributing about 52 percent of water (Tena et al., 2021).

The Chamba Stream sub catchment is approximately 11.54Km in length and has an area of approximately 87.182 Km². The Chamba stream originated at the University of Zambia (UNZA), and it flowed through the neighborhoods of Marshlands, Chudleigh, Chamba Valley, and Ng'ombe in the province of Lusaka. The stream buffer zone in Ng'ombe Township, as depicted in Figure 3.1, was the study area's primary emphasis.

The length of the river within the area of interest is approximately 4Km long according to measurements taken from Google earth pro (start point being - 15° 22' 32.6496", 28° 19' 39.9936" East and end point being - 15° 20' 43.2024", 28° 20' 0.006" East. The Google maps images showed that the study area was characterized mainly by houses constructed within the stream buffer zone as well as river bank cultivation (see map in Appendix B).

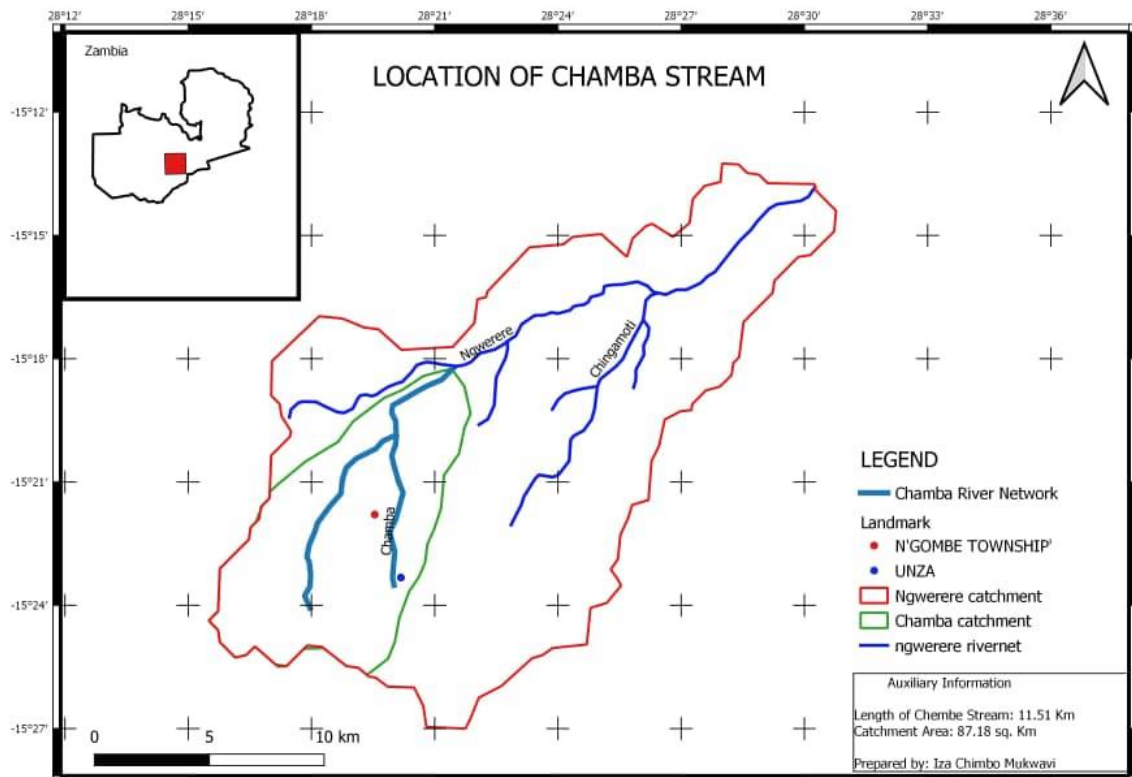


Figure 3. 1: Map of Chamba Stream within the Ngwerere Stream catchment

Source: Author

3.7 Data collection instruments

The 156 respondents who made up the sample population were interviewed using a semi-structured questionnaire (see Appendix E) to gather data for objectives one and two. The questionnaire primarily focused on the demographic and economic information as well as the sample population's knowledge and practices regarding the protection of water resources. Both quantitative and qualitative data were collected using the semi structured questionnaire.

Qualitative data was obtained using key informant interview guides shown in appendix E to get information from the WARMA, ZEMA and the LCC because of their mandates to protect the environment. Officials from each of the three institutions was were interviewed. The officials interviewed were recommended by the institutions. The qualitative data was obtained to answer objective three, however, information from the household questionnaires was also used to supplement the qualitative data obtained.

3.8 Data analysis

The researcher used Statistical Package for Social Sciences (SPSS) as well as Microsoft Excel to analyse the quantitative data. The qualitative data was analysed using Microsoft excel.

Objective one was analyzed using descriptive analysis to determine how knowledgeable the sample population was on existing Zambian laws and policies. The mode was determined to show the highest result. Tables and graphs were generated to show the results.

Objective two was analyzed using descriptive analysis. This was done using contingency tables which showed different relationships between variables. The analysis was done in SPSS.

Objective three was analyzed using both thematic and descriptive analysis. The data collected was put into themes and then graphs were used to show the results. Excel was used to tabulate the themes and create graphs to present the results.

CHAPTER 4

RESULTS

4.1 Introduction

The outcomes of data collection and data analysis are presented in the following section. To provide the reader a quick overview of the sample population, the first section will present the demographics of the sample that was interviewed. The analysis of data based on the three objectives and their associated research questions will come after the demographics.

4.2 Demographics

The social and economic characteristics of the sample population surveyed in Ng'ombe, Lusaka, are displayed in Table 4.1 and Appendix C.

Table 4. 1: Social and economic demographic information of the sample size

Variable	Percent (%)
Sex of respondent	
Male	35.3
Female	64.7
Age of respondent	
18- 23 years	22.4
24-29 years	19.9
30- 35 years	14.1
36- 41 years	11.5
42- 47 years	11.5
48-53 years	4.5
Above 54 years	16
Level of education	
Tertiary	5.8
Secondary school	51.9
Primary school	37.8
Never been to school	4.5
Source of livelihood	
Formal	15.4
Informal	56.4
None	28.2
n= 156	

Source: Author

Table 4.1 shows the key demographic data from 156 respondents that were interviewed using semi structured questionnaires. Among the 156 individuals interviewed, 65 percent of the participants were women and 35 percent were men. Most of the participants, as seen in Table 4.1, were between the ages of 18 and 29. The majority of the people shown in Table 4.1 claimed to have completed primary school (37.8 percent) and secondary education (51.9 percent). Informally employed respondents made up 56.4 percent of the sample, while formally employed respondents made up 15.4 percent and unemployed respondents made up 28.2 percent (see Appendix C).

4.3 Presentation of key results

The results in this section will be presented by objective.

4.3. The awareness of the residents of Ng’ombe on the existing laws and policies on water resource protection in Zambia.

Table 4.2 shows that 74 percent of the respondents had indicated that they had heard of a river buffer zone as opposed to 26 percent who had reported that they had not.

Table 4. 2: Responses to whether respondents had heard of a river buffer zone

Heard of the term River buffer zone	
Response	Percent (%)
Yes	74
No	26
Total	100

Source: Author

Figure 4.1 further shows that of the 156 sample population interviewed, 13 percent had good knowledge on the importance of river buffer zone protection, while 87 percent of the sample had sparse knowledge on its importance to buffer zone protection.

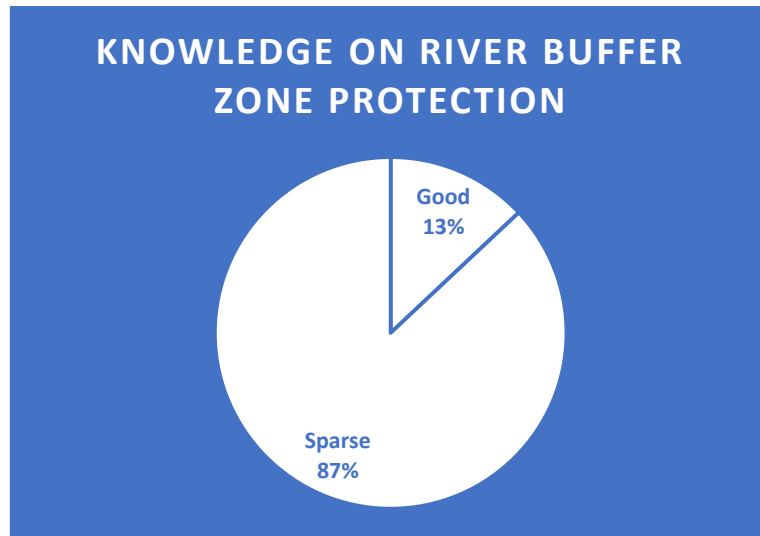


Figure 4. 1: Percentage distribution of the respondents who understood the importance of a river buffer zone in water resource protection

Source: Author

Table 4.3 shows that 60 percent of the 115 respondents that said they had heard of a river buffer zone reported that it was important because it helps prevent houses from collapsing due to the stream overflowing into people’s houses thereby weakening the house structure. Only 4.3 percent, 1.7 percent and 6.1 percent of the 115 respondents respectively gave reasons that related to the protection of the environment which was to prevent the eroding of the river bed, to avoid household waste from polluting the stream and to allow water in the stream to flow undisturbed respectively.

Table 4. 3: Responses to why a river buffer zone is important

Why do you think a river buffer zone is important			
No.	Response	Count	%
1	To allow for space to build bridges	1	0.9
2	To avoid waterborne diseases	4	3.5
3	To avoid household waste from polluting the stream	2	1.7
4	To allow water to flow freely	7	6.1
5	Not sure why it is important	12	10.4
6	To leave space for people to pass	4	3.5
7	To avoid people drowning in the stream	16	13.6
8	To prevent the eroding of the river bed	5	4.3
9	To avoid the collapse of houses due to floods	69	60.0
n=115			

Source: Author

The results showed that 97 percent of the respondents indicated that they knew what the legal minimum distance for a river buffer zone in Zambia was as depicted in Table 4.4.

Table 4. 4: Percentage distribution of respondents who indicated that they knew the prescribed buffer zone distance

By Zambian law, do you know the distance from either side of a river that is required to be left undisturbed?		
Response	Count	Percent (%)
Yes	97	62
No	59	38
Total	156	100

Source: Author

Additionally, Figure 4.2 shows the responses of those who said they knew what the legal minimum distance was. The results show that 42 percent said it should be less than 50

meters, 11 percent said it should be 50 meters, and 10 percent said it should be more than 50 meters.

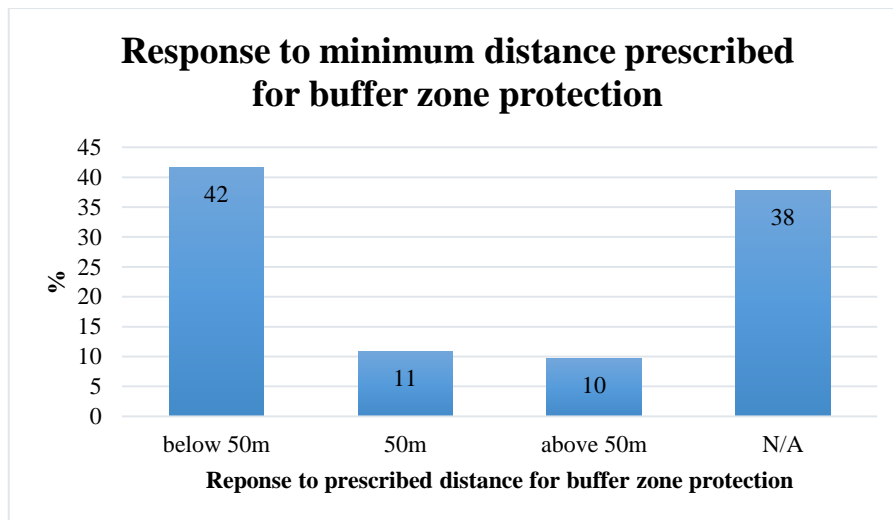


Figure 4. 2: Percentage distribution of responses to what the respondents thought the prescribed minimum distance for a buffer zone was

Source: Author

Table 4.5 compares the level of education of the respondents with the responses given on what they thought the prescribed distance for a buffer zone is according to Zambian law. The results showed that of the 17 respondents who had indicated that the prescribed distance is 50m, 70.6 percent had attained a secondary level of education, and 11.8 percent tertiary level of education, 11.8 percent primary level of education and 5.9 percent had never been to school. Of the 65 who had indicated that the prescribed distance is below 50m, the majority which was 50.8 percent had attained a secondary level of education. For the respondents who had indicated that the prescribed distance is above 50m, the majority being 66.7 percent of the 59 had attained a secondary level of education.

Table 4. 5: Cross tabulation of the highest level of education attained against the response of the prescribed distance

		Highest level of education				Total
		Tertiary education	Secondary level	primary level	Never been to school	
What is the prescribed distance of a riparian buffer zone by Zambian law	Below 50m	3.10%	50.80%	41.50%	4.60%	
	50m	11.80%	70.60%	11.80%	5.90%	
	Above 50m	0.00%	66.70%	33.30%	0.00%	
	N/A	8.50%	44.10%	42.40%	5.10%	
	Total	5.80%	51.90%	37.80%	4.50%	100.00%

Source: Author

Figure 4.3 shows that most of the respondents (69.2 percent) did not have knowledge on WRM shared with them. 30.8 percent indicated that they had knowledge on WRM shared with them.

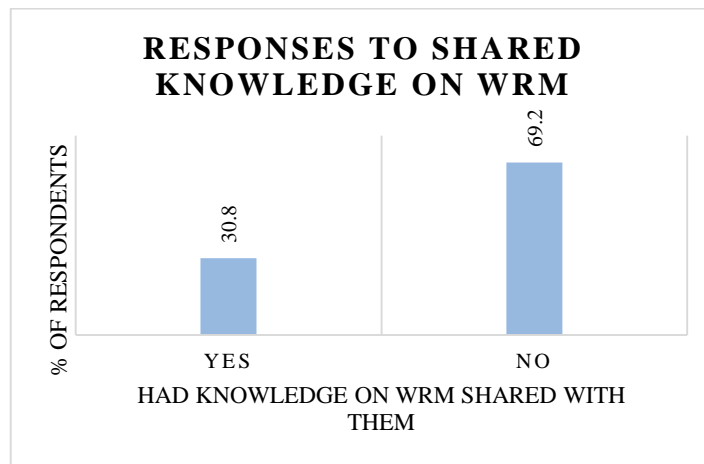


Figure 4. 3: Respondents who had knowledge on WRM shared with them

Source: Author

4.3.2 The effect of knowledge on IWRM principles on the practices of the Ng’ombe residents within the river buffer zone

4.3.2.1 Principle 1: Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment.

Table 4.6 below shows which activities in this research were considered non- impacting and those that were considered negatively impacting to the river buffer zone. Based on Appendix C, the researcher found that 39.1 percent of the respondents interviewed were the landlords of the households they lived in and 60.9 percent were renting households they lived in. Therefore, for the purpose of this research, ‘None’ will refer to households that have a house within the river buffer zone but do not do any other activity within the buffer zone. It is assumed that since the majority of the respondents are renting, they may not be considered as having had built within the river buffer zone. For the purpose of this research, only the items listed under negatively impacting will be considered as bad practices.

Table 4. 6: Impact of activities on the river buffer zone

No.	Activity	Impact
1	None	Non- impacting
2	River bank cultivation	Negatively impacting
3	Brick making	Negatively impacting
4	Water used for irrigation	Non- impacting
5	Washing in the stream	Negatively impacting
6	Fish ponds	Negatively impacting

Source: Author

Table 4.7 shows that 48 percent of the respondents indicated that water in natural water bodies like rivers can deplete if not properly managed while 52 percent reported that it was an infinite resource. The 52 percent gave the following reasons as to why they believed that water resources like the Chamba Stream could not deplete: streams are created by God; the source being the UNZA Goma lakes does not deplete; its replenished

by the rains; it's been in existence for years thus they have never seen it dry and because of the continuous flow of water from people's homes and sewer into the stream.

However, despite the 48 percent acknowledging that water in natural water bodies is a finite resource, 18 percent of the respondents were still practicing activities that would negatively impact the stream. Of the 52 percent that indicated that water from natural water bodies was an infinite resource, 11 percent were practicing negatively impacting activities. The ratio of the respondents (18 percent/48 percent) that had knowledge on IWRM principle 1 but still practiced negatively impacting activities to those (11 percent/52 percent) that did not have the knowledge and practiced negatively impacting activities was 2 to 1. The calculations are shown below:

$$(18 \text{ percent}/48 \text{ percent}): (11 \text{ percent}/52 \text{ percent})$$

$$=0.4: 0.2$$

$$=2:1$$

Table 4. 7: Cross tabulation showing the responses to whether respondents considered water from natural water bodies as finite resources against the practices

		What type of activities are done within the river buffer zone other than infrastructure development						Total (%)
		None	River bank cultivation	Brick making	Water used for irrigation	Washing in the stream	Fish ponds	
Do you consider water from natural bodies like rivers as a resource that can be depleted?	Yes (%)	31	10	0	0	7	1	48
	No (%)	40	7	1	1	3	0	52
	Total (%)	71	17	1	1	10	1	100

Source: Author

4.3.2.2 Principle 2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Table 4.8 shows that the majority of respondents (61 percent) thought there was no participatory approach in managing the Chamba Stream. 44 percent of the respondents who were the majority indicated that they thought the management of the stream should be done by the community because they are the ones close to the stream. 13 percent of the respondents thought the management should be done by all stakeholders while 16 percent indicated that it should be done by the government and the community and 15 percent that it should be done by the government only. The results showed that the majority of the respondents were aware that the community needed to take part in management of the stream and 13 percent said it should be managed by all stakeholders. The respondents did not seem to have an understanding of what a participatory approach was in managing water resources.

Table 4. 8: Cross tabulation showing who they respondents thought should manage water against whether there is a participatory approach in managing the steam

Is there a participatory approach in managing the stream		Who do you think should manage water?								Total (%)
		GOVT	The community	water users	all of the above	People who leave near the stream	GOVT and community	GOVT and water users	GOVT and NGOs	
	Yes (%)	0	5	0	0	0	0	0	0	5
	No (%)	15	39	8	13	1	16	2	1	95
	Total (%)	15	44	8	13	1	16	2	1	100

Source: Author

* GOVT means the Zambian government

4.3.2.3 Principle 3: Women play a central part in the provision, management and safeguarding of water

Table 4.9 shows that the majority (94.9 percent) of the respondents indicated that they thought women could play an important role in managing water resources in Zambia while

5.1 percent indicated that they did not think women could play a role in managing water. Of the respondents that indicated that they thought women could play a role, only 13.5 percent indicated that they actually played a role and 81.4 percent indicated that women did not play a role in the community.

Table 4. 9: Cross tabulation showing the response to Do women play a role in managing water resources * Do you think women can play an important role in managing water resources in Zambia

		Do you think women can play a role in managing water resources in Zambia		
		Yes	No	Total
Do women play a role in managing water resources?	Yes (%)	13.5	0	13.5
	No (%)	81.4	5.1	86.5
	Total (%)	94.9	5.1	100

Source: Author

4.3.2.4 Principle 4: Water has an economic value in all its competing uses and should be recognized as an economic good

Table 4.10 shows that 79 percent of the respondents agreed that they could pay for water in the streams in order to ensure it is managed well while 21 percent said they would not pay for it. Using the water in the stream at the time of the research was free to the public to use at no cost. Mainly because the stream is in a deteriorated state and most of the respondents indicated that it was too dirty to be used.

It's important for water to be managed as an economic good so that they community can realize its importance in uplifting their livelihood (Vallino, et al., 2020). If this is considered as such, the community would ensure its protection so as to safe guard their livelihood. WARMA could consider working with the community to restore the catchment through some community units that are already present.

Unfortunately, the researcher could not ascertain the relationship between IWRM principle 4 and the practice at the time because there was no practice or requirement of paying for water in the stream at the time.

Table 4. 10: Percentage distribution of response to whether the respondents thought water should be paid for in order to manage it better

Do you think water from natural resources should be paid for in order to help manage it properly		
Response	Count	Percent
Yes	124	79
No	32	21
Total	156	100

Source: Author

4.3.3 The role the mandated authorities play in sensitizing local communities on water resource protection.

The researcher had separate key informant interviews with officials from the WARMA, LCC and ZEMA.

In contrast to the LCC, ZEMA and WARMA were not extremely active in the research area. However, according to both WARMA and ZEMA, the main activities that had been carried out in the areas with riparian bodies in order to safeguard them included penalizing offenders, raising awareness among the public via radio, and conducting compliance checks to ensure that the legislation is adhered to (see Figure 4.4). ZEMA also indicated that they integrated their laws into the Zambian School Curriculum and engage relevant authorities before decisions are made on projects that require either Environmental Impact Assessments (EIAs) or Environmental Project Briefs (EPB).

Additionally, a Memorandum of Understanding (MOU) had been established between WARMA and LCC in order to ensure that communities are deterred from building within the river buffer zones.

All in all, the institutions indicated that there was very little coordination amongst the authorities as shown in Figure 6 where it was stated as one major challenge.

Furthermore, the LCC reported that their organization provided garbage collection services to the communities at a monthly fee of 75 ZMW per household to deter them

from disposing garbage into the stream. This was affirmed by the respondents who indicated that people who were seen throwing garbage in the stream were reported to the police and fined. However, despite this effort by the council, people still threw garbage into the stream during the night when they could not be seen easily.

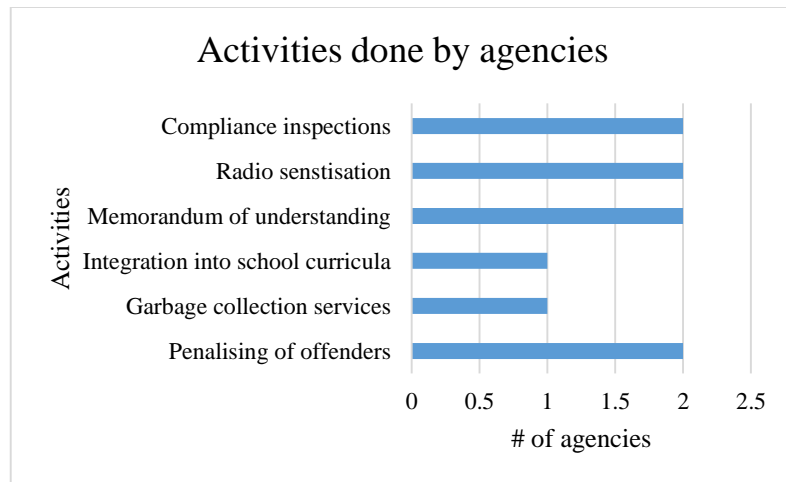


Figure 4. 4: Activities reportedly done by the agencies responsible for water resource management

Source: Author

Despite the reported efforts made by the authorities questioned, they acknowledged that they face a variety of difficulties, as shown in Figure 4.5. According to all three authorities, ineffective enforcement, poor coordination between the various parties, and political involvement were the main obstacles to ensuring the protection of water resources in communities. Inadequate sensitization caused by a lack of radio frequency in some cases was also reported as a constraint.

The quotes below show some of the responses from the representatives from the three organisations on the major constraints they face in protection of riparian buffer zones.

“Traditional leadership influence is the major player of informal set ups.”

“Plot allocation is done in areas designated for other purposes.”

“Approval should be decentralized because the authorities in charge of approving matters are not on the ground to see what is happening”

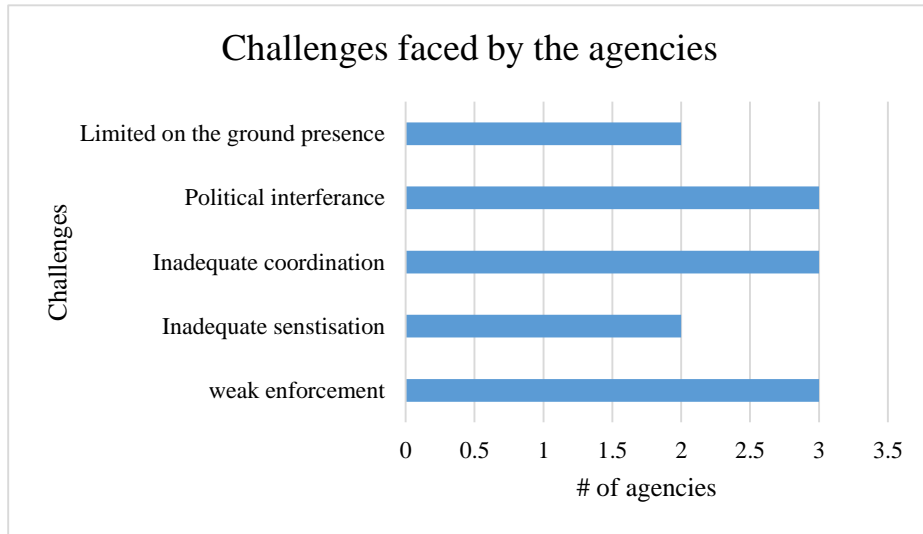


Figure 4. 5: Challenges reportedly faced by the responsible agencies in charge of water resource management

Source: Author

Table 4.11 shows that 55 percent of the respondents indicated that they knew who was responsible for the management of water resources in Zambia.

Table 4. 11: Percentage distribution showing responses to who is responsible for WRM in Zambia

Do you know who is responsible for ensuring the management of water resources in Zambia		
Response	Count	Percent
Yes	86	55
No	70	45
Total	156	100

Source: Author

Figure 4.6 indicates that the majority of the respondents who indicated that they knew who was responsible for WRM reported that it was the LCC followed by the Lusaka Water Supply and Sanitation Company (LWSC) shown in Figure 4.7.

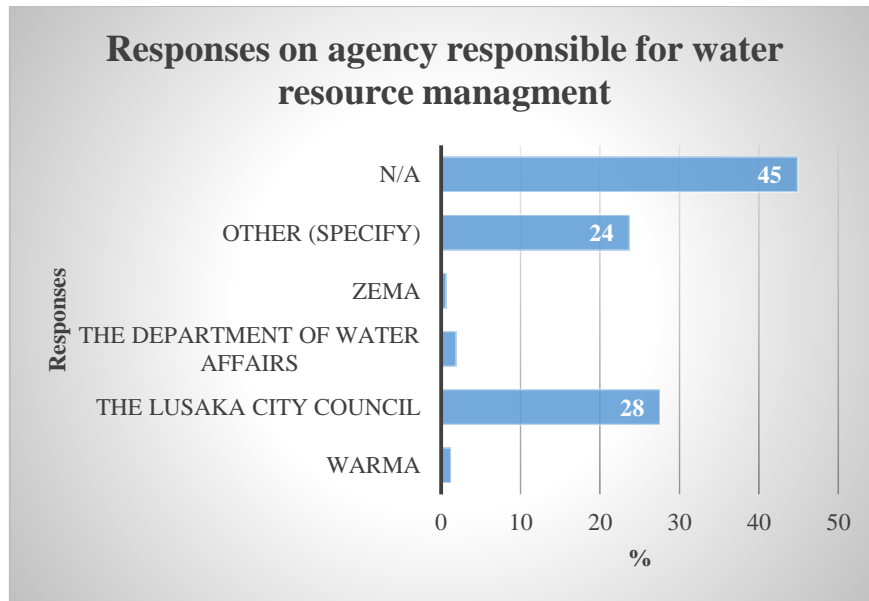


Figure 4. 6: Graphical presentation of responses to agency responsible for WRM in Zambia

Source: Author

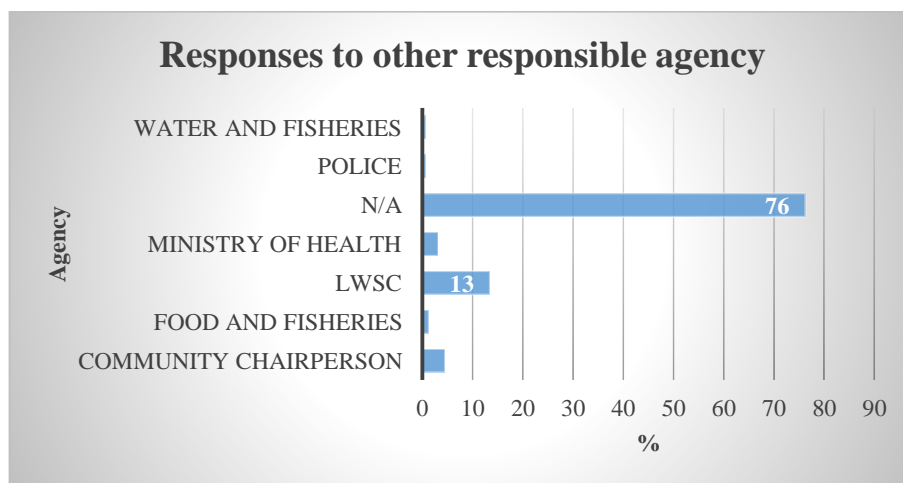


Figure 4. 7: Response to other specify of responsible agency in WRM in Zambia

Source: Author

CHAPTER 5

DISCUSSION

5.1 Introduction

This section will interpret and discuss the results presented in chapter 4 of this dissertation report. The results will be compared with literature that was reviewed in chapter 2. The discussion will be done in sub sections by objective.

5.2 The awareness of the residents of Ng'ombe on the existing policies and laws on water resource protection in Zambia

This research indicated that the majority of the respondents who were residents of Ng'ombe were not aware of the existing policies and laws on water resource protection as very few of them had an idea of the importance of a buffer zone and on the prescribed minimum distance of 50m for a river buffer zone according to the Zambian law.

Some of the respondents who reported that the prescribed minimum distance of a river should be 50m, based their response by comparing it to that of the distance prescribed as a buffer during road and railway lines construction while others gave a good guess.

The knowledge on the prescribed distance was compared to the level of education attained by the respondents in order to ascertain whether it would have an influence on the knowledge levels of the respondents. The results revealed that the majority of the respondents who knew the prescribed distance of 50m had attained secondary level of education. However, some of the respondents who knew the prescribed distance of 50m indicated that they had never been to school yet they were able to give a correct answer. Similarly, most of the respondents who did not know the prescribed distance of 50m had also attained a secondary level of education. Furthermore, some of the respondents who knew about the prescribed distance of 50m indicated that they were educated on water resource protection through television, the Ministry of Health (MOH), The LWSC, CARE International and the Ng'ombe Development community project.

The results show that there are low awareness levels on water resource protection, as the majority of the respondents indicated that they had not had anyone share with them any knowledge on the topic.

This was in line with findings from the research done by Hamatuli and Muchanga (2021) whose study showed that there was a lack of awareness on environmental protection of buffer zones which resulted into the degradation of the water quality and quantity of water resources in Zambia. Most of the respondents who indicated that they knew the importance of a river buffer zone reported that it was necessary in order to prevent their houses from flooding and collapsing, very few of the respondents gave examples that directly related to water resource protection.

Most of the research done in the Chongwe River catchment had shown that the leading cause of degradation of the catchment had been as a result of anthropogenic activities (Chisola & Kuraz, 2016); (Nguvulu et al., (2021). Researchers such as Hamatuli and Muchanga (2021) and Chisola and Kuraz (2016) had attributed the prevalence in the vice to the lack of environmental management awareness of the communities. A study by Ahmed et al. (2020) showed that EE can enhance the behavioral intention of the public to willingly participate in water management as well as positively change their attitudes and perceptions about water quality and its management.

This research suggests that there is need for deliberate efforts to ensure that the public is sensitised on water resource protection through various media. Sikwibele & Chipatu (2021), showed that an increase in the level of education would influence the level of EE, this was also alluded to by Orema et al. (2019). Muchanga & Nakazwe (2022) showed that the Zambian School Curriculum had good knowledge on environment management as well as aspects of human- environment interface for the learner's respective levels from pre primary to tertiary level of education. However, the limitation could be that they could be a lack of understanding by the learners which could be attributed to a lack of emphasis on knowledge and skills by the EE on how to use the environment sustainably. In addition, environmental education was not compulsory for secondary and tertiary level of education in Zambia which could have also contributed to the results appearing as they do. This research showed that the level of education alone could not guarantee that the public

would have knowledge on water resource protection. Informal ways of education such as sensitisation by the relevant authorities partnering with environmental conservation associations like the Chongololo club could help increase the knowledge levels even for people who may not have a chance to go to school. If the low awareness levels on water resource protection go unaddressed, it could lead to more degradation to the water resources Zambia owns and thereby reduce the resource base which will affect the livelihood of many adversely.

5.3 The effect of knowledge on IWRM principles on the practices of the Ng'ombe residents within the river buffer zone

The discussion will be based on if the respondents had knowledge on the IWRM principles and if they practiced the knowledge, if any.

5.3.1 Principle 1: Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment

The results showed that the majority of the respondents indicated that water resources like rivers were infinite resources whether managed or not. Some of the responses that were given indicated that there was little knowledge and understanding on water resource protection with regards to IWRM principle 1 which would definitely affect the practices of the community towards natural water sources.

Additionally, the research showed that some of the respondents who had knowledge on IWRM principle one, were still practicing negatively impacting activities within the buffer zone. The ratio showed that the practice of negatively impacting activities by the knowledgeable respondents to those who were not so knowledgeable on the principle was 2:1. This basically shows that irrespective of the knowledge on IWRM principle one, respondents would still practice negatively impacting activities. This could be as a result of lack of an alternative source of income. The research by Sikwibele & Chipatu (2021), attributed poverty as the leading cause of environmental degradation while Hamatuli & Muchanga (2021), found that the lack of alternative livelihoods was reported to cause the degradation of buffer zones. The results affirm the findings of Sikwibele & Chipatu (2021) and Hamatuli & Muchanga (2021) in that some of the negative activities reported were

river bank cultivation, brick making and fish ponds which provided a livelihood for some of the respondents which were negative impacting to the buffer zone. Most of the respondents indicated that they were in informal employment thus may have depended on making a living from the activities indicated. Others used the stream for washing because they had no money to pay for the alternative source of water provided by the LWSC which was at a cost. The understanding of principle 1 is important because of the different uses of water by different sectors which if not used well would affect the social- economic aspect and environmental aspect of a community (GWP, 2018). In addition, water moves within a catchment so if untreated sewer continues to be deposited into the stream as it was mentioned by some respondents, it will most definitely affect the quality of the water in that catchment.

5.3.2 Principle 2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

The research showed that the majority of respondents were aware that they are supposed to manage the stream since it is in their community but they did not indicate that a participatory approach should be employed. The major responses indicated that there was no participatory approach that was being undertaken in the community towards the protection of the Chamba Stream. Given that most respondents did not know which organization was in charge of protecting water resources, as shown by the results in Figures 4.5 and 4.6, it is possible that the relevant authorities are not doing as much to inform the community about water resource protection. Those that knew which organization was responsible indicated that it was the LCC seconded by the LWSC. Most pointed out that they did not know where to go to report matters on water resources.

“The public plays an important role in the management of urban rivers because they are the ultimate consumers, governor and the governed of the urban ecological environment” (Zhao et al., 2020). Therefore, it is important to engage the grassroots for effective management. WARMA has a provision to create WUAs in its current Act of parliament. However, these have mostly been created in farming blocks or where agriculture is done. It would be imperative to create these associations in communities living along township

streams and rivers like Chamba Stream also even if the livelihood is not predominately agriculture because they are tributaries to major rivers that if not taken care of can affect the quantity and quality of water in the major rivers. This is an approach that has been employed in Kenya which has resulted in the reduction of the degradation to river catchments and increased their protection as well as the rehabilitation of the buffer zones (Oremo et al., 2019). WARMA was created to incorporate the principle of participatory approach to water resource management because as it was realised that the views of all relevant stakeholders are valuable in influencing decisions that affect communities in water resource management and development (Ministry of Energy and Water Development, 2010).

This research suggests that the lack of both knowledge on principle two and the proactivity by the relevant authorities responsible for water resource protection in working with the community could have led to the lack of a participatory approach in the protection of the Chamba Stream.

5.3.3 Principle 3: Women play a central part in the provision, management and safeguarding of water

The research showed that the majority of the respondents thought that women could play a role in managing water resources because they were the ones that used water the most to do house chores and were the ones mostly home when men go out for work. Others said that women were also responsible for instilling morals in children so that they take care of their environment.

However, despite this knowledge, the research showed that the leading polluters of the Chamba Stream were purported to be the women. This was because they washed in the streams and threw garbage in the streams from their households. Most women interviewed indicated that they did not have enough money to pay for water provided by the LWSC and perhaps also for garbage collection provided by the LCC though this was not mentioned.

Another reason could be the attitude and lack of knowledge of these vices and their effects on the environment as well as their health. Ahmed et al. (2020), further indicated that the participation of the public in water management platforms depended on the public's perception and attitude towards water resources protection. This implies that it is necessary to look at the behavioral change of a community in addition to providing EE. Some of the female respondents indicated that they used the water to clean their homes and also for cooking despite the water not being potable. This also points to the lack of alternative solutions and perhaps poverty as attributed by Hamatuli & Muchanga (2021).

It could also be that some issues like water resource protection may be considered as a man's issue and women may not be part of making decisions in such matters (The World Bank, 2021). Some of the respondents that thought women could not play a role in water resource protection actually mentioned that it is the Government and a man's job to do so. However, this opinion was not a minority which is a good indicator that people are well informed on the role of women in the protection of water resources. Therefore it is imperative to involve the women in protecting riparian areas by considering their views in planning and implementing projects as they are the main users of natural resources (Mago & Gunwall, 2019); (The World Bank, 2021).

This research suggests that despite the majority of the respondents having knowledge on principle three of the IWRM, most of the women were not actually involved in the management of water resources in the community and were the ones reported to be contributing the most to the poor quality of the water in the stream.

5.3.4 Principle 4: Water has an economic value in all its competing uses and should be recognized as an economic good

Most of the respondents indicated that if they had to pay for the water in the stream to be clean, they would do that because it is within their community and it is imperative that it is clean so that it can provide water for those that are unable to pay for water provided by the LWSC; to prevent water borne diseases and to help those who depend on it for irrigation of cash crops. However, this principle could not be analyzed against any practice

because the water in the stream was a public good that could be consumed for free and did not seem potable for human consumption.

5.3.5 Conclusion on The effect of knowledge on IWRM principles on the practices of the Ng'ombe residents within the river buffer zone

This research suggests that that irrespective of knowledge or lack of knowledge on the IWRM principles one and three, communities would still involve themselves in practices that were against the principles by undertaking activities that would negatively affect the river buffer zone. IWRM principle two showed that the relevant mandated authorities are necessary to ensure that communities are aware of their existence and their mandates so that they can work with communities who are on the ground. Principle 4 could not be analysed against any practice because the stream was a public good that did not require anyone to pay for it to in order to use the water in it.

The research suggests that knowledge alone on water resource protection did not have much of an effect on the practices of the respondents as most of them despite having the knowledge still practiced activities that were detrimental to the buffer area and stream. This suggests that increasing actions for protecting water resources involves more than just raising community awareness through EE. Aspects of behavioral change, provision of environmentally sustainable alternative livelihoods, and enforcement by the appropriate authorities are imperative in water resource protection in communities.

5.4 The role the mandated authorities play in sensitizing local communities on water resource protection.

The research showed that the authorities interviewed were working towards being proactive in their mandates to engage the communities living in river buffer zones but perhaps their efforts have not been sufficient. This research suggests that they need to coordinate more with other relevant stakeholders who have similar mandates and engage the communities more so that the communities are able to understand their mandates and role to ensure an IWRM approach is achieved. The relevant authorities did not seem to coordinate much on issues to do with water resource protection.

In addition, there would be need to increase the enforcement of the laws that surround water resource protection in the communities because as the results have shown, despite having knowledge, the respondents still engaged in negative practices. Hamatuli & Muchanga (2021) and (Ahmed et al., 2020) support the results suggested by indicating that the lack of law enforcement may also contribute to the continued degradation of water resources.

This research has shown that majority of the respondents did not know WARMA and ZEMA as institutions responsible for water resource protection. Most of the respondents indicated that the LCC was responsible for water resource protection as most of them mentioned that the LCC provides garbage collection services and prohibited people from throwing garbage into the stream who also fine culprits who are seen throwing in garbage in the stream. It is hoped that since a MOU was signed between WARMA and LCC, more engagement will be done with the communities to ensure that enforcement is improved.

ZEMA had indicated that they had incorporated the aspect of environmental management into the Zambian School Curriculum which was affirmed by Muchanga & Nakazwe (2022), however despite most of the respondents having attained a secondary and primary school level of education, they had very little knowledge on the topic of water resource protection. The EE may consider changing the mode of delivery to perhaps storytelling and incorporation of field visits so that learners may have better understanding on the importance of protecting the environment. Incorporating the informal education through conservation clubs to educate communities as earlier mentioned may also help increase the awareness levels.

Some recommendations that were made by the representatives of the authorities interviewed in order to improve the enforcement of the relevant authorities are that the approval of activities should be decentralized so that decisions are made at a local level as opposed to from the headquarters who are not on the ground.

It was suggested that the traditional leadership's influence on informal set ups should be controlled as they tend to allocate areas of land in places designated for other uses and there is usually no proper plan in place.

Lastly, the allocation of plots in protected areas should be curtailed so as to curb the degradation of river buffer zones.

5.5 Limitations of the study

The research faced the following limitations during the undertaking of the research which may I have affected the research to some degree:

5.5.1 More female than male participation

During the time the research was undertaken most of the men were either working or too busy to have a moment to be interviewed or had gone out for work. The women were the ones mostly at home, often times doing house chores.

5.5.2 Lack of will to participate in research by some members of the community

Because of the sensitive nature of the research, other members of the community would decline to take part in the research. The subject was sensitive in that at the time, the Government through the LCC were breaking down homes that were built in areas that were designated for other purposes like the railway line buffer area.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The overall aim of this research was to establish how knowledge on water resource protection influenced practices involving water resources amongst residents of Ng'ombe living within the Chamba river buffer zone. This was done in order to establish why riparian buffer zone encroachment and degradation seem to be prevalent in spite of existing laws and policies in Zambia.

This research found that, there was sparse knowledge on the existing Zambian policies and laws amongst the Ng'ombe residents living within the river buffer zone of the Chamba Stream. Most respondents did not know what a river buffer zone was and for those that did, most were of the view that the prescribed distance was below 50m. The low level of knowledge in water resource protection was mainly attributed to the low interaction between the community and the relevant authorities responsible for water resource protection in Zambia.

This research also suggested that knowledge alone may not be sufficient to improve water resource protection in order to protect riparian buffer zones. This is because in some instances, despite some respondents having knowledge on the IWRM principles, the practice of the residents was negative. Therefore, in most instances knowledge did not influence a positive practice amongst most of the participants with knowledge on water resource protection.

Furthermore, the mandated authorities have not been proactive in involving the communities in playing a part in water resource protection as most indicated they did not know about them and their mandates. The levels of enforcement were also low which may be the reason why the stream has continued to be degraded with time. Additionally, despite the institutional and legislative frameworks providing a platform for coordination, there was very little coordination amongst the relevant authorities as well.

This research was able to add to the existing literature by giving the social view on how the communities perceive water resource protection in order to help the relevant

authorities and other scholars provide a framework that will ensure an effective IWRM approach.

6.2 Recommendations

6.2.1 Include households that are not within the buffer zone of the Chamba Stream

For further research, one may consider including even the households that were not within the river buffer zone to determine if they had built away from the buffer zone due to knowledge on water resource protection or it was due to coincidence. Other factors such as level of education; livelihoods and attitudes can be included in the research to determine which major factor affects the degradation of buffer zones the most.

6.2.2 Determine the effectiveness of the aspect of environmental management in the Zambian curriculum

Future researchers may consider determining the effectiveness of the aspect of environmental management in the Zambian curriculum particularly the water resource aspect. The researcher may consider checking the level of understanding of both the teachers and the pupils on the topic.

6.2.3 Determine the efficiency of the current Water User Associations (WUAs)

Future researchers may consider conducting a study to determine the effectiveness of the current water user association in improving water resource protection in Zambia. This can be done by comparing how the compliance levels regarding the WRM Act of 2011 have improved after its implementation as well as if the degradation to the buffer zone has also improved.

6.2.4 Airing of animated cartoons on media like ZNBC

The authorities may consider airing programmes with animated cartoons to appeal the young ones so as to inculcate in them at an early stage the importance of protecting our water resources.

6.2.5 Conservation groups to work with authorities in sensitising communities

Conservation groups like the Chongololo club and the university clubs can work with the authorities in finding interactive and exciting ways of engaging the different communities on water resource protection.

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Appendix A: Ethics clearance approval letter



**THE UNIVERSITY OF ZAMBIA
DIRECTORATE OF RESEARCH AND GRADUATE STUDIES**

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777 Fax: (+260)-211-290 258/253 952 | E-mail: director.drugs@unza.zm | Website: www.unza.zm

APPROVAL OF STUDY

***IORG No. 0005376
HSSREC IRB No. 00006464***

26th May, 2022

REF NO. HSSREC-2022-APRIL-011

Ms Iza Chimbo Mukwavi
The University of Zambia
Department of Civil and Environmental Engineering
P.O. Box 32379

LUSAKA

Dear Ms. Mukwavi

**RE: “AN ASSESSMENT OF THE KNOWLEDGE AND PRACTICES TOWARDS
WATER RESOURCE PROTECTION: A CASE STUDY OF NGOMBE RESIDENTS”**

Reference is made to your submission of the protocol captioned above.

The HSSREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are

REVIEW TYPE	ORDINARY REVIEW	APPROVAL NO. HSSREC-2022- APRIL-011
Approval and Expiry Date	Approval Date: 26 th May, 2022	Expiry Date: 25 rd May, 2023
Protocol Version and Date	Version - Nil.	26 th May, 2022
Information Sheet, Consent Forms and Dates	<input type="checkbox"/> English.	To be provided
Consent form ID and Date	Version - Nil	To be provided
Recruitment Materials	Nil	Nil
Other Study Documents	- Questionnaire - Interview Guide	
Number of Participants Approved for Study		

not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to HSSREC within 5 days.
- All protocol modifications must be approved by HSSREC prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.
- All protocol deviations must be reported to HSSREC within 5 working days.
- All recruitment materials must be approved by HSSREC prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. HSSREC will only approve a study for a period of 12 months.
- It is the responsibility of the PI to renew his/her ethics approval through a renewal application to HSSREC.
- Where the PI desires to extend the study after expiry of the study period, documents for study extension must be received by HSSREC at least 30 days before the expiry date. This is for the purpose of facilitating the

review process. Documents received within 30 days after expiry will be labelled “late submissions” and will incur a penalty fee of K500.00. No study shall be renewed whose documents are submitted for renewal 30 days after expiry of the certificate.

- Every 6 (six) months a progress report form supplied by The University of Zambia Humanities and Social Sciences Research Ethics Committee as an IRB must be filled in and submitted to us. There is a penalty of K500.00 for failure to submit the report.
- When closing a project, the PI is responsible for notifying, in writing or using the Research Ethics and Management Online (REMO), both HSSREC and the National Health Research Authority (NHRA) when ethics certification is no longer required for a project.
- In order to close an approved study, a Closing Report must be submitted in writing or through the REMO system. A Closing Report should be filed when data collection has ended and the study team will no longer be using human participants or animals or secondary data or have any direct or indirect contact with the research participants or animals for the study.
- Filing a closing report (rather than just letting your approval lapse) is important as it assists HSSREC in efficiently tracking and reporting on projects. Note that some funding agencies and sponsors require a notice of closure from the IRB which had approved the study and can only be generated after the Closing Report has been filed.
- A reprint of this letter shall be done at a fee.
- All protocol modifications must be approved by HSSREC by way of an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by HSSREC before they can be implemented.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of HSSREC, we would like to wish you all the success as you carry out your study.

Yours faithfully,



Dr. J.I. Ziwa

DR. J. I. Ziwa

ACTING CHAIRPERSON

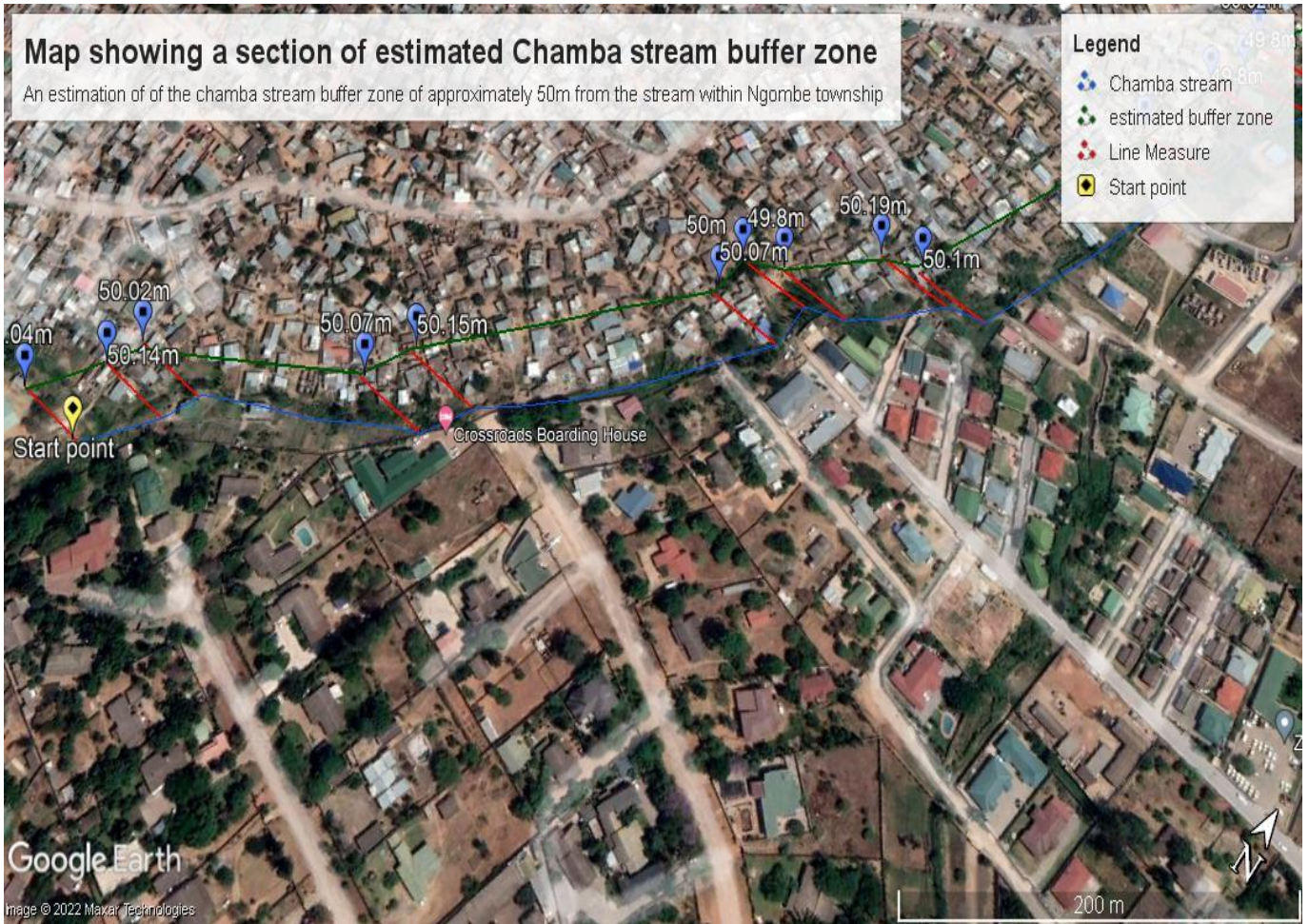
**THE UNIVERSITY OF ZAMBIA HUMANITIES AND
SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE - IRB**

cc: Director, Directorate of Research and Graduate Studies

Assistant Director (Research), Directorate of Research and Graduate Studies

Assistant Registrar (Research), Directorate of Research and Graduate Studies

Appendix B: Image showing a section of estimated Chamba Stream buffer zone within Ng’ombe Township



Source: Google earth pro image, October 2021

Appendix C: Additional demographic information for households interviewed

Variable	Count	Percent (%)
Head of house		
Yes	56	35.9
No	100	64.1
Marital Status		
Single	47	30.1
Married	94	60.3
Separated	2	1.3
Divorced	2	1.3
Widowed	11	7.1
Source of livelihood		
Formal	24	15.4
Informal	88	56.4
None	44	28.2
Land lord of the house		
Yes	61	39.1
No	95	60.9
# of years lived in Ng'ombe		
Less than a year	9	5.8
1 to 5 years	36	23.1
6 to 10 years	24	15.4
above 10 years	87	55.8
n= 156		

Source: Author

Appendix D: Key informant interview schedules



**THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING**

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Key informant interview schedule for WARMA official

Position of WARMA employee:

Date of interview:

1. How does WARMA determine a buffer zone for a stream or river?
2. Does WARMA engage the communities that live within river buffer zones within the city to reduce the degradation and encroachment of these zones?
3. If so, how is the engagement done for both the literate and illiterate in the communities?
4. Which communities with rivers / streams running through them has WARMA engaged? Like Ng'ombe Township?
5. Does WARMA face any challenges in managing the water resources within these communities?
6. If so, how are these challenges managed?
7. What would you attribute the prevalent cases of buffer zone encroachment to in the country despite existing laws and policies since 1964?
8. Are there any plans the institution has to curb this vice?
9. Does WARMA work with any partners to help with this vice?
10. If so which partners?
11. How does WARMA coordinate with ZEMA and the Lusaka city Council who have similar mandates?



THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Key informant interview schedule for ZEMA official

Position of ZEMA employee:

Date of interview:

1. Does ZEMA engage the communities that live within river buffer zones within the city to reduce the degradation and encroachment of these zones? (the literate and illiterate)
2. If so, how is the engagement done?
3. Which communities with rivers / streams running through them has ZEMA engaged? i.e Ng'ombe?
4. Does ZEMA face any challenges in managing the water resources within these communities?
5. If so, how are these challenges managed?
6. What would you attribute the prevalent cases of buffer zone encroachment to in the country despite existing laws and policies since 1964?
7. Are there any plans the institution has to curb this vice?
8. Does ZEMA work with any partners to help with this vice?
9. If so which partners?
10. How does ZEMA coordinate with WARMA and the Lusaka city Council who have similar mandates?



THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Key informant interview schedule for Lusaka City Council Official

Position of employee:

Date of interview:

1. Does the council engage the communities that live within river buffer zones within the city to reduce the degradation and encroachment of these zones? (the literate and illiterate)
2. If so, how is the engagement done?
3. Which communities with rivers / streams running through them has the council engaged?
4. Does the council face any challenges in managing the water resources within these communities?
5. If so, how are these challenges managed?
6. What would you attribute the prevalent cases of buffer zone encroachment to in the country despite existing laws and policies since 1964?

7. Are there any plans the institution has to curb this vice`?
8. Does the council work with any partners to help with this vice?
9. If so which partners?
10. How does the council coordinate with WARMA and the Lusaka city Council who have similar mandates?
11. Does the council allocate plots in areas that are within river buffer zones?
12. If so, does the council have plans on how to ensure that the occupants of this land sustainably manage the buffer areas to reduce environmental degradation?

Appendix E: Household questionnaire



THE UNIVERSITY OF ZAMBIA

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HOUSEHOLD 'S QUESTIONNAIRE

Questionnaire Identification number:

A. Demographic information

1. Are you the head of house? If not, skip to 1b

- a. Yes
- b. No
- c. N/A

1b. If no to 1 (a) above, kindly indicate your relationship to the HH?

- a. Spouse
- b. Sibling
- c. Cousin
- d. Friend

- e. Child (above 18 years old)
2. What is your marital status?
 - a. Single
 - b. Married
 - c. Separated
 - d. Divorced
 - e. Other

 3. What is the age of the respondent?
 - a. 18 to 23 years
 - b. 24 to 29 years
 - c. 30 to 35 years
 - d. 36 to 41 years
 - e. 42 to 47 years
 - f. 48 to 53 years
 - g. Above 54 years

 4. What is the highest level of education attained?
 - a. Tertiary education
 - b. Secondary level
 - c. Primary level
 - d. Never been to school

 5. What is your source of livelihood?
 - a. Formal
 - b. Informal

 6. Are you the land lord of the house you live in?
 - a. Yes
 - b. No

7. What land tenure is your land registered under?
 - a. State
 - b. Customary
 - c. I do not know?
 - d. Other (Specify)

8. How long have you lived in Ng'ombe township?
 - a. Less than 1 year
 - b. 1 to 5 years
 - c. 5 to 10 years
 - d. Above 10 years

9. What type of activities do you do that are within 50m of the Chamba stream?
 - a. River bank cultivation
 - b. Infrastructure development
 - c. Brick making
 - d. Other (specify)

B. Knowledge on existing Zambian laws and policies in water resource management

10. Do you know about any Zambian laws on water resource management and protection?
 - a. Yes
 - b. No

11. If so which ones do you know of?
 - a. Water resources Management Act no 21 of 2011
 - b. The water policy
 - c. Water Act of 1964

- d. Environmental Management Act no. 21 of 2011
- e. Other (specify)

12. Do you know who is responsible for ensuring the management of water resources in Zambia?

- a. Yes
- b. No

13. If yes, to the question above, please state who?

- a. WARMA
- b. The Lusaka city council
- c. Department of Water Affairs
- d. ZEMA
- e. Other (specify)

14 (a) Have you heard of a river buffer zone?

- a. Yes
- b. No

14 (b) If yes, explain you know its

importance?.....
.....
.....

14 (c) By Zambian law, do you know the distance from either side of a river is required to be left undisturbed ?

- a. Yes
- b. No

14 (d) if yes, what is the distance?

.....

Part C: Knowledge of Integrated water resource management principles

15 (a) Have you had any one or organization share knowledge on Water resource management?

- a. Yes
- b. No

15 (b) if yes, who?

16 (a) Do you consider water from natural bodies like rivers as a resource that can deplete?

- a. Yes
- b. No

16 (b) Kindly give a reason for your answer in 16 (a)

.....
.....
.....
.....

17 (a). Do you think water from natural resources should be protected and managed?

- a. Yes
- b. No

17 (b) Kindly give a reason for your

answer?.....
.....
.....
.....

18. Who do you think should manage water?

- a. The government
- b. The community

- c. Water users
- d. NGOs
- e. All of the above
- f. It should not be managed
- g. Other (specify)

19 (a). Do you think women can play an important role in managing water resources in Zambia?

- a. Yes
- b. No

19 (b). Kindly give a reason for your answer in 19 (a)

.....
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20. Do you think water from natural resources should be paid for in order to help manage it properly?


- a. Yes
- b. No

21. Kindly give a reason for your

answer.....
.....
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.....

End of interview, thank you for your time

Appendix F: Author certificate of publication



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