

# An Assessment of the Knowledge and Practices Towards Water Resource Protection: A Case Study of Ng'ombe Residents

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**Abstract:-** The goal of this study was to determine whether there was a relationship between knowledge and practices regarding the protection of water resources among Ng'ombe residents who lived within the buffer zone around the Chamba stream. 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 the relationship between knowledge on IWRM and the practices of the Ng'ombe residents within the river buffer zone. (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 data from 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. These were The Water Resource Management Authority (WARMA) The Zambia Environmental Management Agency (ZEMA) and the Lusaka City Council (LCC). This research found that the majority of the Ng'ombe residents who lived within the riparian buffer zone of the Chamba Stream had little understanding of the current laws and regulations in Zambia, according to this study. In other instances, it was 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. 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 summary, taking into account the aforementioned explanations, the findings demonstrated that there was an inverse link between knowledge and practices within the Chamba stream buffer zone.

**Keywords:** *Water Resource Protection, Riparian Buffer Zone, Knowledge, Practices.*

## I. INTRODUCTION

### ➤ *Background:*

Many rivers have been adversely affected globally by anthropogenic activities such as urbanization, agriculture and mining & industry. Some of the effects of these activities are the weakening of the river beds; sedimentation; compromising of water quality of the resource; shrinking of river areas; channel hardening which has reduced groundwater recharge; including the destruction of the river ecosystem.

The creation of riparian buffer zones is one of the ways used in water resource protection. A riparian buffer zone refers to "land that is directly adjacent to water bodies like lakes, reservoirs, rivers, streams and wetlands" [17]. 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 [9]. Some of the key functions of buffer zones include the maintenance of basic aquatic processes, services and values like flood attenuation and control of micro climate and temperature of water; they help reduce impacts from upstream activities and adjoining land uses on water resources such as the removal of toxins and sediment; they also provide habitats for various organisms; and lastly but not the least they provide some ancillary benefits to the society such as economic benefits, enhancement of visual quality, improved air quality and reduction in the flood risk [9].

Reference [19] cited a number of issues China had 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"[19]. 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% of the country's water body contamination and solid waste (plastic) pollution [12]. Reference [12] also cited deforestation and poor farming methods as factors in 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 [13]. 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 [13].

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 [10]. The Water Resources Management Act no 21 of 2011 (WRM Act) was enacted in 2011 replacing the Water Act of 1964 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 [10].

This research is based on the 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” [18].

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 3 principles namely social equity, economic efficiency and environmental sustainability [8]. The IWRM principles have 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” [6].

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 [1][13] which is the premise of this research.

#### ➤ *Statement of the Problem:*

Reference [13] stated in their research that the development and implementation of policy decisions on water resource management depend on informed attitudes

and behaviors, enhanced awareness, and focused extension support.

It is crucial to manage water resources for both the current and future generations since rivers offer ecological advantages to both the environment and the human population. 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.

Even though Zambia has had laws and procedures in place since 1964 to prevent encroachment on water resources, many rivers nevertheless appear to have been invaded, particularly 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.

This study was created because it appears that there is not enough information in the study area about whether these vices are caused by a lack of understanding that continues to have an impact on the negative practices of the residents who live within river buffer zones. The researcher also agrees that there may be a connection between the widespread incidents of river encroachment and the mandated authorities' failure to adequately regulate the vice by executing the law. With reference to the IWRM Principles as well as the current Zambian laws and policies, this research will solely analyze the knowledge and practices of the Ng'ombe locals who live within the Chamba stream buffer zone with regard to the protection of water resources.

It is hoped that this research will assist the appropriate authorities in creating strategies to promote stakeholder engagement, which will lead to better water management and governance at the local level as a result of an increase in the communities' understanding of why these laws and policies are in place.

#### ➤ *Research Aim:*

This research aims to determine whether there is a relationship between knowledge and practices regarding water resource protection among the residents of Ng'ombe living within the Chamba river buffer zone.

#### ➤ *Specific Objectives:*

- To establish whether the residents of Ng'ombe are aware of the existing laws and policies on water resource protection in Zambia.
- To determine the relationship between knowledge on IWRM and the practices of the Ng'ombe residents within the river buffer zone.
- To determine the role the mandated authorities play in sensitizing local communities on water resource protection.

➤ *Research Questions:*

- How knowledgeable are the residents of Ng’ombe on the existing laws and policies on water resource protection in Zambia?
- How does knowledge on IWRM principles relate to sustainable practices of the residents of Ng’ombe towards water resource protection?
- 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?

**II. MATERIALS AND METHODS**

➤ *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.

➤ *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.

➤ *Study Area:*

The research was carried out on households with activities within 50m of the Chamba Stream buffer zone in Ng’ombe Township. 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 to the Chongwe River contributing about 52 % of water [15].

The Chamba stream sub catchment is approximately 11.54Km in length and has an area of approximately 87.182 Km<sup>2</sup> (please see Fig. 1). 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 Fig. 2, was the study area’s primary emphasis.

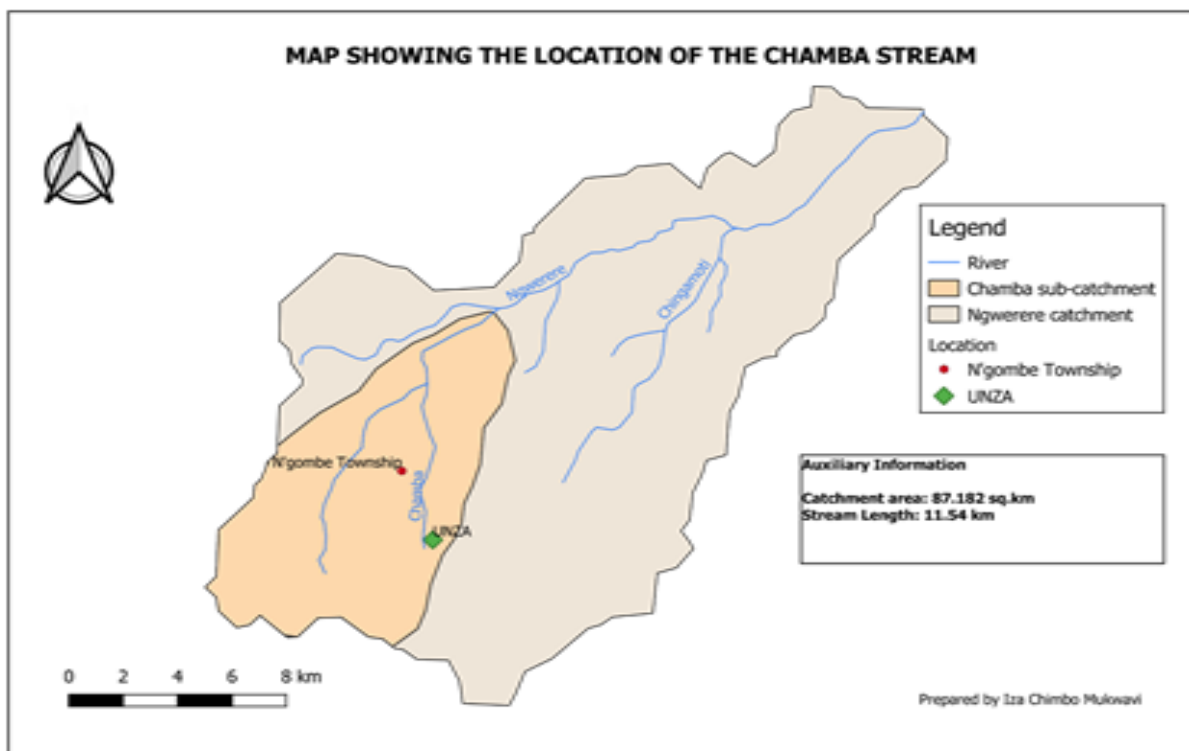


Fig 1 Location of the Chamba Stream  
Source: Author

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 Fig. 2).



Source: Google Earth Pro

Fig 2 Estimation of Sampled Chamba Stream Buffer Zone

➤ *Study Population:*

The study population was calculated using the number of households within the study area because population information of only the households within the buffer zone area was not available at the time of the study. The calculation was done remotely using Google earth pro as a proxy measure by measuring distances of households within 50m from the stream using a bearing of 270 degrees. The households within the estimated buffer zone were then counted and were approximately 233 households from the Google earth imagery of October, 2021. The study population was chosen from households in Ng’ombe that were within 50m from the Chamba stream because the study’s interested in assessing the knowledge and practices of the people that are living within the stream buffer zones contrary to the laws of Zambia [18].

➤ *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:

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

A sample size of a minimum of 147 households based on the calculation above was interviewed in order to collect quantitative data.

➤ *Sampling Techniques:*

Random sampling was used which gave each household within the buffer zone an equal chance of being selected.

➤ *Data Collection Instruments:*

156 respondents who made up the sample population were interviewed using a semi-structured questionnaire 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.

Qualitative data was obtained using key informant interview guides to get information from the Water Resources Management Authority (WARMA), the Zambia Environmental Management Agency (ZEMA) and the Lusaka City Council (LCC) because of their mandates to protect the environment. One official from each of the 3 institutions was interviewed. The qualitative data was obtained to answer objective three, however, information from the household questionnaires was also used to supplement the qualitative data obtained.

➤ *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. The analysis was done using Microsoft Excel.

### III. RESULTS

➤ *Introduction:*

The outcomes of data collecting and data analysis are presented in the following sections. 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.

➤ *Demographics:*

The social and economic characteristics of the sample population surveyed in Ng'ombe, Lusaka, are displayed in Table 1 below. 156 people in all were contacted for interviews using semi-structured questionnaires.

Table 1 Social and Economic Demographic Information of Sample Size

Variable	Count	Percent (%)
<b>Sex of respondent</b>		
Male	55	35.3
Female	101	64.7
<b>Head of house</b>		
Yes	56	35.9
No	100	64.1
<b>Marital Status</b>		
Single	47	30.1
Married	94	60.3
Separated	2	1.3
Divorced	2	1.3
Widowed	11	7.1
<b>Age of respondent</b>		
11- 23 years	35	22.4
24-29 years	31	19.9
30- 35 years	22	14.1
36- 41 years	18	11.5
42- 47 years	18	11.5
48-53 years	7	4.5
above 54 years	25	16
<b>Level of education</b>		
Tertiary	9	5.8
Secondary school	81	51.9
primary school	59	37.8
never been to school	7	4.5
<b>Source of livelihood</b>		
Formal	24	15.4
Informal	88	56.4
None	44	28.2
<b>Land lord of the house</b>		
Yes	61	39.1
No	95	60.9
<b># of years lived in Ng'ombe</b>		
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
<b>Sample population (n)= 156</b>		

Source: Author

Among the 156 individuals interviewed, 65% of the participants were women and 35% were men. Most of the participants, as seen in Table 1 above, were between the ages of 18 and 29. The majority of the people shown in Table 1 claimed to have completed primary school (37.8%) and secondary education (51.9%). Informally employed respondents made up 56.4% of the sample, while formally employed respondents made up 15.4% and unemployed respondents made up 28.2%.

60.9% of the 156 respondents said they rented the homes they lived in, as compared to 39.1% who said they owned the homes they occupied.

The majority of those surveyed (55.8%) said they had resided in Ng'ombe for more than ten years.

➤ *Analysis Of Data By Objectives:*

- *Specific Objective 1:* To establish whether the residents of Ng'ombe are aware of the existing laws and policies on water resource protection in Zambia.

- *Research Question 1:* How knowledgeable are the residents of Ng'ombe on the existing laws and policies on water resource protection in Zambia?

The data showed that of the total respondents, 74% said they had heard of the term 'river buffer zone' while 26% said they had not as shown in Table 2. Table 3 shows that of the 156 sample population interviewed, 13% had good knowledge on the importance of river buffer zone protection, while 87% of the sample had sparse knowledge on its importance. Most of the respondents mentioned that they were supposed to keep the stream clean by not throwing in garbage and sewer. However, when asked why they thought a buffer zone was important, only 13% of the respondents indicated reasons that protect the buffer zone as shown in Fig. 3. Table 4 shows that 60% of the 115 respondents that said they had heard of a river buffer zone reported that it was important because it helped prevent houses from collapsing due to the stream overflowing into people's houses thereby weakening the house structure. Only 4.3%, 1.7% and 6.1% of the 115 respondents gave reasons that related to the conservation of the environment which is 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 2 Responses to Whether Respondents had Heard of a River Buffer Zone

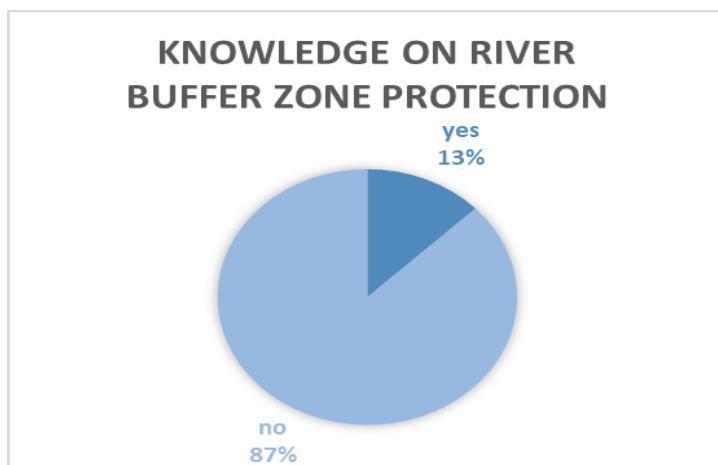
Heard of the term River buffer zone		
	Count	%
Yes	115	74
No	41	26
<b>Total</b>	<b>156</b>	<b>100</b>

Source: Author

Table 3 Percentage Distribution of Respondents who had Knowledge on the Importance of a River Buffer Zone

Have knowledge about importance of river buffer zone protection		
Response	Frequency	%
Yes	20	13
No	136	87
<b>Total</b>	<b>156</b>	<b>100</b>

Source: Author



Source: Author

Fig 3 Percentage Distribution of the Respondents who Understood the Importance of a River Buffer Zone in Water Resource Protection

Table 4 Responses to why a River Buffer Zone is Important

<b>Why do you think a river buffer zone is important</b>			
<b>No.</b>	<b>Response</b>	<b>Count</b>	<b>%</b>
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
<b>Sampled population that indicated knowing what a river buffer zone was (n)=115</b>			

Source: Author

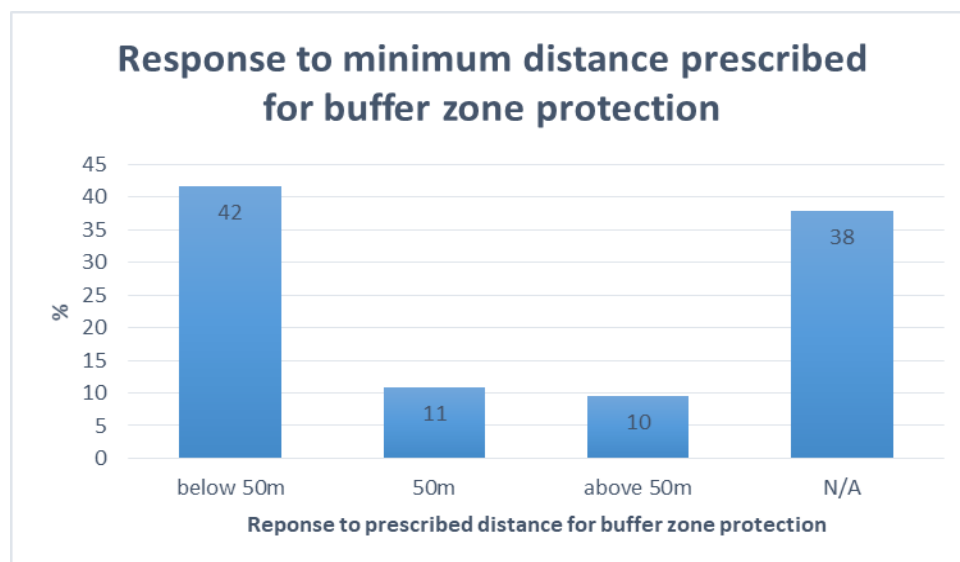
Table 5 shows that 62% of the respondents indicated that they knew what the minimum the distance from either side of a river that is required to be left undisturbed according to Zambian law while 38% indicated that they did not know. When the 62% were asked what they believed the legal minimum distance for a river buffer zone in Zambia

should be, the respondents' responses are depicted in Fig. 4 below. Of those who said they knew what the legal minimum distance was, 42% said it should be less than 50 meters, 11% said it should be 50 meters, and 10% said it should be more than 50 meters.

Table 5 Percentage Distribution of Respondents who Indicated that they knew the Prescribed Buffer Zone Distance

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

Source: Author



Source: Author

Fig 4 Percentage Distribution of Responses to what the Respondents thought the Prescribed Minimum Distance for a Buffer Zone Was

Table 6 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% had attained a secondary level of education, and 11.8% tertiary level of education, 11.8% primary level of

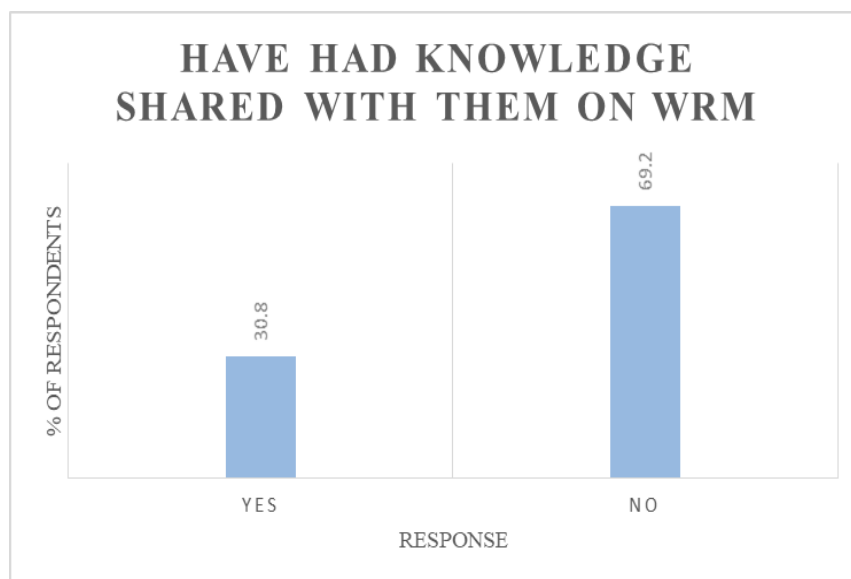
education and 5.9% had never been to school. Of the 65 who had indicated that the prescribed distance is below 50m, the majority which was 50.8% had attained a secondary level of education. For the respondents who had indicated that the prescribed distance is above 50m, the majority being 66.7% of the 59 had attained a secondary level of education.

Table 6 If Yes, what is the Distance \* Highest Level of Education Cross Tabulation

			Highest Level Of Education				Total
			Tertiary Education	Secondary Level	Primary Level	Never Been To School	
<b>If yes, what is the distance</b>	Below 50m	Count	2	33	27	3	<b>65</b>
		%	3.10%	50.80%	41.50%	4.60%	<b>100.00%</b>
	50m	Count	2	12	2	1	<b>17</b>
		%	11.80%	70.60%	11.80%	5.90%	<b>100.00%</b>
	Above 50m	Count	0	10	5	0	<b>15</b>
		%	0.00%	66.70%	33.30%	0.00%	<b>100.00%</b>
N/A	Count	5	26	25	3	<b>59</b>	
	%	8.50%	44.10%	42.40%	5.10%	<b>100.00%</b>	
<b>Total</b>		<b>Count</b>	<b>9</b>	<b>81</b>	<b>59</b>	<b>7</b>	<b>156</b>
		<b>%</b>	<b>5.80%</b>	<b>51.90%</b>	<b>37.80%</b>	<b>4.50%</b>	<b>100.00%</b>

Source: Author

Fig. 5 further shows that most of the respondents (69.2%) did not have knowledge on WRM shared with them by anyone or organisations while 30.8% indicated that they had knowledge on WRM shared with them.



Source: Author

Fig 5 Response to Whether Respondents had Knowledge on WRM Shared with them

Based on the responses above, the majority of the respondents who were residents of Ng’ombe 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.

- *Specific Objective 2:* To determine the relationship between knowledge on IWRM and the practices of the Ng’ombe residents within the river buffer zone.
- ✓ *Research Question:* How does knowledge on IWRM principles relate to sustainable practices of the residents of Ng’ombe towards water resource protection?

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

Table 7 below shows which activities in this research will be considered non-impacting and those that are negatively impacting to the river buffer zone. Based on Table 1, the researcher found that 39.1% of the respondents interviewed were the land lords of the households they lived in and 60.9% 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 7 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 8 below shows that 48% of the respondents indicated that water in natural water bodies like rivers can deplete if not properly managed while 52% reported that it was an infinite resource. However, despite the 48% acknowledging that water in natural water bodies is a finite resource, 17% of the respondents were still practicing negatively impacting practices. Of the 52% that indicated

that water from natural water bodies was an infinite resource, 12% were practicing negatively impacting activities. The ratio of the respondents that had knowledge on IWRM principle one but still practiced negatively impacting activities to those that did not have the knowledge and practiced negatively impacting activities was 0.4 to 0.2.

Table 8 Cross Tabulation Showing the Responses to Whether Respondents Considered Water from Natural Water Bodies as Finite Resources Against the Practices

Do you consider water from natural bodies like rivers as a resource that can be depleted? * What type of activities are done within the river buffer zone other than infrastructure development Cross tabulation									
		What type of activities are done within the river buffer zone other than infrastructure development							
			None	River bank cultivation	Bri-ck making	Water used for irrigation	Washing in the stream	Fish ponds	Total
<b>Do you consider water from natural bodies like rivers as a resource that can be depleted?</b>	yes	Count	48	15	0	0	11	1	<b>75</b>
		% of Total	31	10	0	0	7	1	<b>48</b>
	no	Count	63	11	1	1	5	0	<b>81</b>
		% of Total	40	7	1	1	3	0	<b>52</b>
		<b>Count</b>	<b>111</b>	<b>26</b>	<b>1</b>	<b>1</b>	<b>16</b>	<b>1</b>	<b>156</b>
		<b>% of Total</b>	<b>71</b>	<b>17</b>	<b>1</b>	<b>1</b>	<b>10</b>	<b>1</b>	<b>100</b>

Source: Author

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

Table 9 shows that the majority of respondents (61%) thought there was no participatory approach in managing the Chamba stream. 44% 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% of the respondents thought

the management should be done by all stakeholders while 16% indicated that it should be done by the government and the community and 15% 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% 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 9 Cross tabulation showing who they respondents thought should manage water against whether there is a participatory approach in managing the stream

		Who do you think should manage water?								
			The Governme nt (GOVT)	The communi ty	Water users	All of the above	People who leave near the stream	GOVT and commu nity	GOVT and water users	GOVT and NGOs
Is there a participatory approach in managing the stream	Yes	Count	0	7	0	0	0	0	0	0
		% of Total	0	5	0	0	0	0	0	0
	No	Count	23	61	12	20	2	25	3	2
		% of Total	15	39	8	13	1	16	2	1
<b>Total</b>	<b>Count</b>	<b>23</b>	<b>68</b>	<b>12</b>	<b>20</b>	<b>2</b>	<b>25</b>	<b>3</b>	<b>2</b>	
	<b>% of Total</b>	<b>15</b>	<b>44</b>	<b>8</b>	<b>13</b>	<b>1</b>	<b>16</b>	<b>2</b>	<b>1</b>	

Source: Author

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

Table 10 shows that the majority (94.9%) of the respondents indicated that they thought women could play an important role in managing water resources in Zambia while 5.1% 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% indicated that they actually played a role and 81.4% indicated that women did not play a role in the community.

Some of the reasons that were given are that women were reported to pollute the stream more than men by throwing in garbage and washing in the stream. In addition, those who said they did clean the stream indicated that they cleaned the portions near their homes which proved futile as unknown people still dumped garbage during the night which discourages them. Those who thought women could not play a role gave reasons that it was a man’s job and the job of the government.

Table 10 Do Women Play a Role in Managing Water Resources \* Do you think Women can Play an Important Role in Managing Water Resources in Zambia Cross Tabulation

		Do you think women can play an important role in managing water resources in Zambia			Total
			Yes	No	
Do women play a role in managing water resources	Yes	Count	21	0	<b>21</b>
		% of Total	13.5%	.0%	<b>13.5%</b>
	No	Count	127	8	<b>135</b>
		% of Total	81.4%	5.1%	<b>86.5%</b>
<b>Total</b>		<b>Count</b>	<b>148</b>	<b>8</b>	<b>156</b>
		<b>% of Total</b>	<b>94.9%</b>	<b>5.1%</b>	<b>100.0%</b>

Source: Author

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

Table 11 shows that 79% of the respondents agreed that they could pay for water in the streams in order to ensure it was managed well while 21% 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. Therefore 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.

Despite having knowledge on the integrated water resource principles, the residents of Ng’ombe did not practice them. The results have shown that irrespective of knowledge or lack of knowledge on the respective IWRM principles, the respondents still involved themselves in practices that were against the principle except for principle four which could not be analysed against any practice.

Table 11 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
<b>Total</b>	<b>156</b>	<b>100</b>

Source: Author

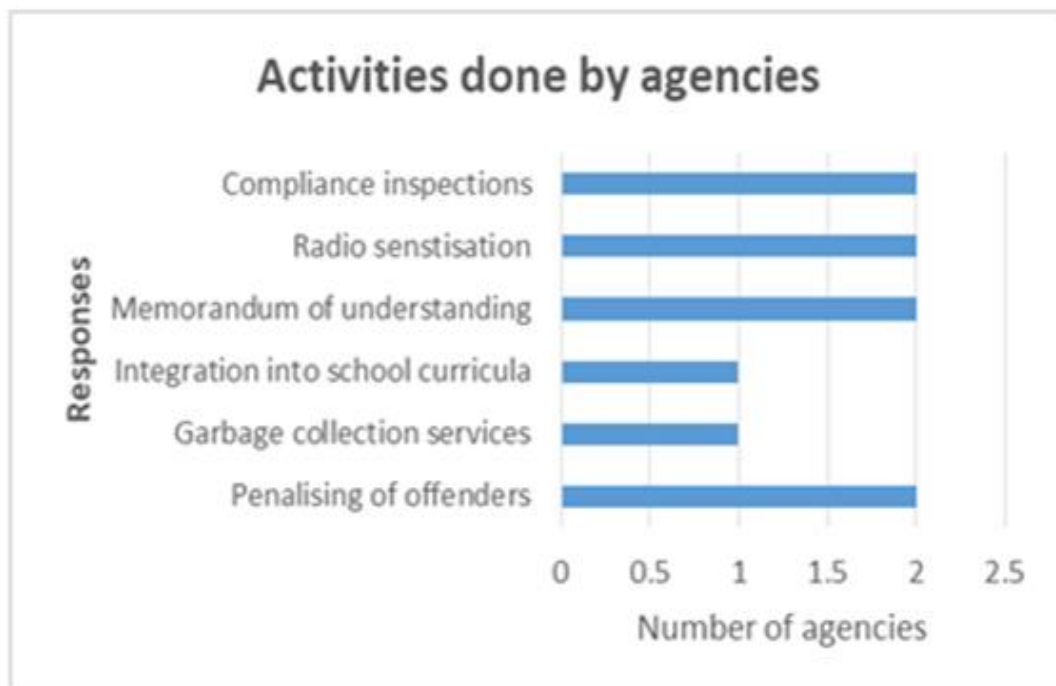
- *Objective 3:* To determine the role the mandated authorities play in sensitizing local communities on water resource protection.
- ✓ *Research Question:* How proactive are the existing relevant authorities in the sensitization and disseminating of knowledge to encourage sustainable attitudes and practices towards water resources amongst communities?

The researcher had separate key informant interviews with officials from the WARMA, LCC and ZEMA. In contrast to LCC, ZEMA and WARMA were not extremely active in the research area. However, according to both WARMA and ZEMA, the main initiatives carried out in local areas to safeguard water bodies included penalizing offenders, raising awareness among the public via radio, and conducting compliance checks to ensure that the legislation is adhered to. ZEMA also indicated that they integrated their laws into the Zambian School curriculum.

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.

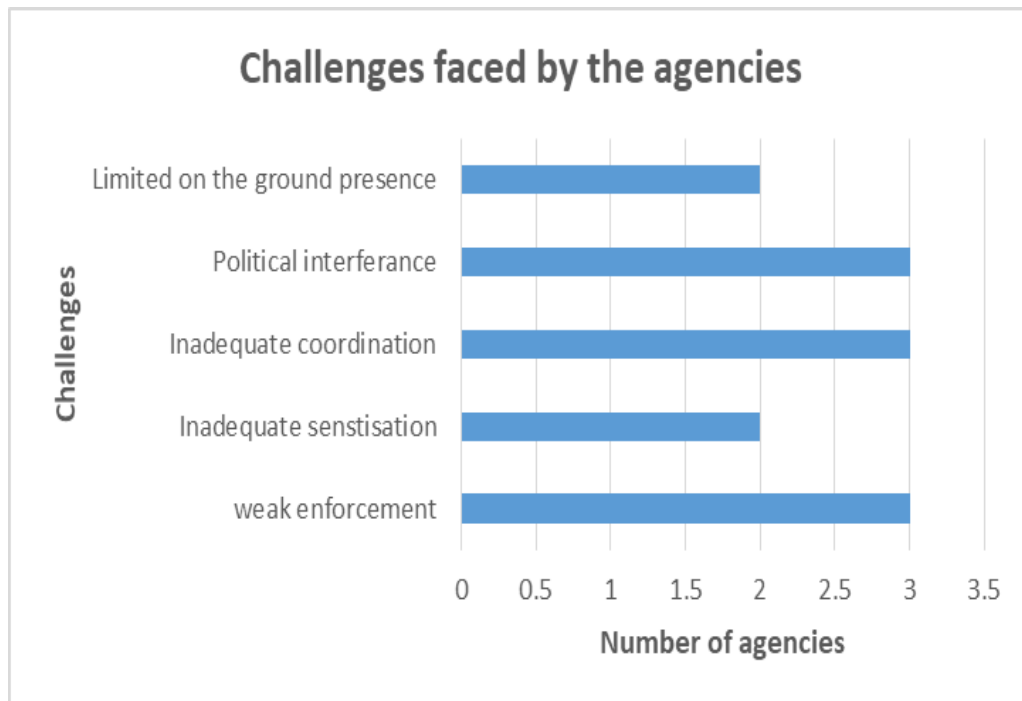
Furthermore, The LCC reported that their organization provided garbage collection services to the communities at a monthly fee of 75 Zambian Kwacha (ZMW) per household to deter them from disposing garbage into the stream. This was affirmed by the respondents who indicated that people who were seen throwing 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. Despite the reported efforts made by the authorities questioned, they acknowledged that they face a variety of difficulties, as shown in Fig. 7. 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 rural areas was also reported as a constraint.



Source: Author

Fig 6 Activities Reportedly Done by the Agencies Responsible for Water Resource Management



Source: Author

Fig 7 Challenges Reportedly Faced by the Responsible Agencies in Charge of Water Resource Management

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.

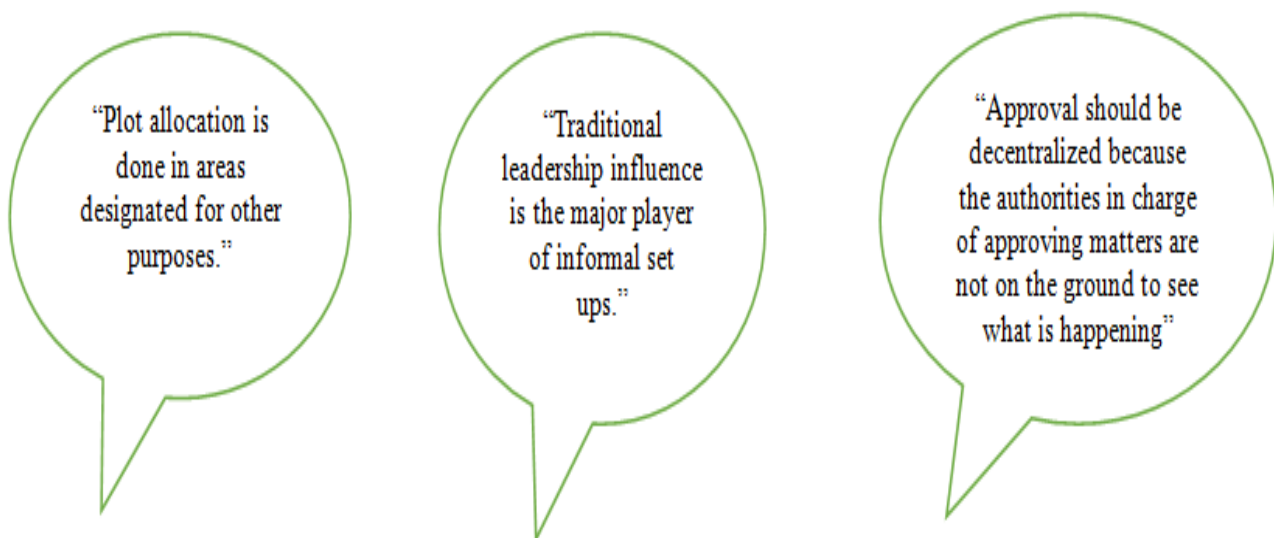


Table 12 below shows that 55% of the respondents indicated that they knew who was responsible for the management of water resources in Zambia while 45% said they did not know who was responsible.

Table 12 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
<b>Total</b>	<b>156</b>	<b>100</b>

Source: Author

Table 13 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 and Sewerage company (LWSC) shown in Table 14.

Table 13 Response to who is Responsible for WRM in Zambia

<b>If yes, Please state who is responsible for the management of water resources in Zambia</b>		
	<b>Count</b>	<b>Percent</b>
WARMA	2	1
The Lusaka City Council	43	28
The Department of Water Affairs	3	2
ZEMA	1	1
other (specify)	37	24
N/A	70	45
<b>Total</b>	<b>156</b>	<b>100</b>
<b>Sample population=156</b>		

Source: Author

Table 14 Response to other Specify on the Agencies Responsible for WRM

<b>Specify other responsible agency/ person</b>		
	<b>Count</b>	<b>Percent</b>
Community chairperson	7	4
Food and fisheries	2	1
LWSC	21	13
Ministry of Health	5	3
N/A	119	76
Police	1	1
Water and fisheries	1	1
<b>Total</b>	<b>156</b>	<b>100</b>

Source: Author

#### IV. DISCUSSION

➤ *Introduction:*

This section will interpret and discuss the results presented in the previous chapter. The discussion will be done in sub sections by objective.

- *Objective 1:* To establish whether the residents of Ng’ombe were aware of the existing laws and policies 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 laws and policies 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, the results reviewed that the majority of the respondents who knew the prescribed distance 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 [7] 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 [2], [11], [16]. References [7] [2] have attributed the prevalence in the vice to the lack of environmental management awareness of the communities. A study by [1] showed that 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.

This research suggests that there is need for deliberate efforts to ensure that the public is sensitised on water resource protection through various media. Reference [14] showed that an increase in the level of education would influence the level of environmental education, this was also alluded to by [13]. However, the level of education alone cannot guarantee that the public will have knowledge on water resource protection. The low awareness on water resource protection if not addressed 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.

- *Objective 2:* To determine the relationship between knowledge on IWRM and the practices of the Ng'ombe residents within the river buffer zone.

This section will be further sub divided into the analysis done for the four IWRM principles respectively. The discussion will be based on if the respondents had knowledge on the IWRM principles and if they practiced the knowledge, if any.

- ✓ *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 reasons that were given as to why the Chamba Stream was considered to be a stream that could not deplete were that streams are created by God; because the source being the UNZA Goma lakes does not deplete; because its replenished by the rains; because 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. These responses indicate that there is little knowledge and understanding on water resource protection with regards to IWRM principle one 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 to 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 [14] attributed poverty as the leading cause of environmental degradation while [7] found that the lack of alternative livelihoods were also reported to cause the degradation of buffer zones. The results affirm the findings of [14] and [7] 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 at a cost.

- ✓ *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 Tables 13 and 14, it is possible that the relevant authorities are not doing as much to inform the community about water resource protection. The one's that said they knew which organization was responsible indicated that it was the LCC seconded by the LWSC. Most of the respondents 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" [19]. Therefore it is important to engage the grassroots for effective management. WARMA has a provision to create Water User Associations (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 [13].

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.

- ✓ *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. Some 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. Reference [1] 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 environmental education. 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 [7].

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 one's reported to be contributing the most to the poor quality of the water in the stream.

✓ *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 its 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.

▪ *Conclusion on objective 2:*

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. This suggests that increasing actions for protecting water resources involves

more than just raising community awareness through environmental education. Aspects of behavioral change, provision of environmentally sustainable alternative livelihoods, and enforcement by the appropriate authorities are imperative in WRM in communities.

- *Objective 3:* To determine 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.

In addition, there would be need to increase the enforcement of the laws that surround WRM in the communities because as the results have shown, despite having knowledge, the respondents still engaged in negative practices. References [7] and [1] 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 WRM. Most of the respondents indicated that the LCC was responsible for WRM 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, 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 WRM. Perhaps ZEMA may consider revisiting the curriculum to ensure it adequately addresses the environmental knowledge imparted in the pupils in primary and secondary school.

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.

## V. CONCLUSION AND RECOMMENDATIONS

### ➤ *Conclusion:*

The overall aim of this research was to assess whether there was a relationship between knowledge and practices towards water resource protection amongst the 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 laws and policies 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 WRM 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 there was an inverse relationship between the knowledge and the practices.

This research further established that there are many other factors involved in ensuring water resource protection in communities such as behavioral change of the communities, ensuring the communities are empowered somehow to have sources of livelihood that do not promote the degradation of buffer zones as well as enhanced education levels.

The enforcement of the existing laws and policies of the Zambian laws on water resource protection as well as the engagement of communities by the authorities responsible for WRM is also imperative to ensure our buffer zones are protected from degradation.

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.

### ➤ *Recommendations:*

- *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.

- *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.

- *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 WRM in Zambia. This can be done by comparing how the compliance levels regarding the WRM Act have improved after its implementation as well as if the degradation to the buffer zone has also improved.

- *Incorporating all Relevant Stakeholders in the IWRM Plan:*

An the integrated water resource management plan should also include working with not only the organisations whose core purpose is to manage the environment but also organisations that look at the social and economic aspect of a community. Most importantly the communities should understand why they are being required to protect buffer zones and the relevant authorities should enforce the law in order for the protection to be effective.

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