

**ASSESSING THE EFFECTIVENESS OF ENVIRONMENTAL MANAGEMENT
STRUCTURES AND PARTICIPATION PROCESS IN THE UPPER PUNGWE
RIVER BASIN, ZIMBABWE**

by

BEN NYIKADZINO

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SUPERVISOR: DR M. CHITAKIRA

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DEDICATION

To my Dad, Kenneth and Mom, Juliet for bringing me up to be the man that I am

DECLARATION

I **Ben Nyikadzino** hereby submit the dissertation for the degree of **Master of Science Environmental Management** at the University of South Africa is my own work and has not previously been submitted by me for a degree at this or any other institution.

I declare that the dissertation does not contain any written work presented by other persons whether written, pictures, graphs or data or any other information without acknowledging the source.

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ABSTRACT

The study assessed the effectiveness of environmental management structures and participation process in the upper Pungwe River basin. It looked at the interaction of environment and water management institutions and stakeholder structures in environmental management.

A concurrent mixed methods approach was used. Qualitative and quantitative data collection and analysis techniques were employed. Seventeen questionnaires were administered to environmental management committee chairpersons. Interviews were held with three water resources management experts from the ZINWA and PSCC. Another three questionnaires were administered to the EMA, Mutasa RDC and Mutasa District Administrator.

Water quality, sediment load and river runoff data for the Pungwe River was analysed using Mann-Kendal and Regression Analysis Statistics to detect trends and predict future levels. River sediment load showed a negative linear relationship with pH levels. Stakeholder participation still require enhancement. Coordination of land/environment and water management institutions and local stakeholders remains the key to achieving sustainable environmental management.

Key Terms

Environmental management structures, stakeholder participation, water resources management, water quality, runoff

TABLE OF CONTENTS

CHAPTER 1: GENERAL INTRODUCTION TO THE STUDY

1.1	INTRODUCTION	1
1.2	BACKGROUND TO THE STUDY	1
1.3	STATEMENT OF THE PROBLEM	2
1.4	JUSTIFICATION FOR THE RESEARCH	3
1.5	RESEARCH AIM AND OBJECTIVES	4
1.6	RESEARCH QUESTIONS	5
1.7	RESEARCH DESIGN	5
1.8	SCOPE OF THE STUDY	6
1.9	STUDY AREA	7
1.9.1	Physiography and Climate	8
1.9.2	Demography	8
1.9.3	Socio-Economic Activities	9
1.10	TERMINOLOGY	9
1.11	STRUCTURE OF DISSERTATION	11
1.12	CHAPTER SUMMARY	12

CHAPTER 2: LITERATURE REVIEW

2.1	INTRODUCTION	13
2.2	ENVIRONMENTAL MANAGEMENT AND ENVIRONMENTAL MANAGEMENT STRUCTURE	13
2.3	STAKEHOLDER PARTICIPATION IN ENVIRONMENTAL	

MANAGEMENT	13
2.4 INTEGRATED ENVIRONMENT MANAGEMENT	15
2.5 STAKEHOLDER PARTICIPATION AT RIVER BASIN LEVEL	16
2.6 WATER QUALITY AND RIVER SEDIMENT MONITORING	17
2.6.1 Water quality monitoring	17
2.6.2 River sediment monitoring	18
2.7 ENVIRONMENT AND WATER RESOURCES MANAGEMENT FRAMEWORK IN ZIMBABWE	19
2.7.1 Legal Framework	19
2.7.1.1 Environmental Management Act (Chapter 20:27)	20
2.7.1.2 Water Act (Chapter 20:24)	20
2.7.1.3 ZINWA Act (Chapter 20:25)	21
2.7.1.4 Rural District Councils Act	21
2.7.1.5 Traditional Leaders Act	21
2.7.1.6 Urban Councils Act	22
2.7.1.7 Parks and Wildlife Management Act	22
2.7.2 Environmental Management Structures in Zimbabwe	22
2.7.3 Water Resources Management Structures in Zimbabwe	24
2.8 ENVIRONMENT AND WATER MANAGEMENT PRACTICES IN UPPER PUNGWE RIVER BASIN	26
2.8.1 Environmental Management Institutions in upper Pungwe River Basin	26
2.8.1.1 EMA Manicaland Province	27

2.8.1.2	Mutasa RDC	28
2.8.1.3	Nyanga National Park	28
2.8.2	Water Management Institutions in upper Pungwe River basin	28
2.8.2.1	ZINWA Save Catchment	29
2.8.2.2	Save Catchment Council	29
2.8.2.3	Pungwe Subcatchment Council	30
2.9	WATER QUALITY, RIVER SEDIMENT AND WATER LEVEL MONITORING IN THE PUNGWE RIVER BASIN	30
2.9.1	Water Quality Monitoring in the Pungwe River basin	31
2.9.2	River Sediment Monitoring in the Pungwe River basin	31
2.9.3	Water Level Monitoring in the Pungwe River Basin	32
2.10	INTEGRATED WATER RESOURCES MANAGEMENT AND ENVIRONMENTAL MANAGEMENT INTERFACE	32
2.11	CHALLENGES IN PRESENT APPROACHES TO ENVIRONMENTAL MANAGEMENT	34
2.12	CHAPTER SUMMARY	35

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1	INTRODUCTION	37
3.2	PHILOSOPHICAL APPROACHES	37
3.3	RESEARCH DESIGN	38
3.4	POPULATION AND SAMPLING	40
3.5	DATA COLLECTION	41

3.5.1	Questionnaire	41
3.5.2	Interviews	42
3.5.3	Secondary Data (Documents/Records)	43
3.6	DATA ANALYSIS	44
3.7	ETHICAL CONSIDERATIONS	45
3.8	CHAPTER SUMMARY	45

CHAPTER 4: RESULTS AND DISCUSSION

4.1	INTRODUCTION	46
4.2	PROFILE OF RESPONDENTS	46
4.2.1	Stakeholder Structures for Environmental Management in the Pungwe River basin	46
4.2.2	Environmental Management Institutions in the Pungwe River basin	48
4.2.3	Water Management Institutions in the Pungwe River basin	48
4.3	INSTITUTIONAL INTERACTIONS FOR ENVIRONMENTAL MANAGEMENT	49
4.3.1	Ward Environmental Management Committees for Stakeholder Participation in Environmental Management	49
4.3.2	Functions of Ward Environmental Management Committees	49
4.3.3	Institutional Roles and Responsibilities in Environmental Management in the Pungwe River basin	50
4.3.4	Water related environmental management problems in the Pungwe River basin	51
4.3.5	Institutional practices in addressing water related environmental management problems	51

4.3.6	Effectiveness of water and environmental management institutions and stakeholder structures in the Pungwe River basin	53
4.3.7	Engagement of environment and water resources management institutions in addressing water-related environmental problems	54
4.4	WATER QUALITY TRENDS IN THE PUNGWE RIVER	55
4.5	RIVER SEDIMENT LOAD OF THE PUNGWE RIVER	57
4.6	RUNOFF TRENDS IN THE PUNGWE RIVER	59
4.7	RELATIONSHIP OF SEDIMENT LOAD AND WATER QUALITY PARAMETERS AND RUNOFF	61
4.8	CHAPTER SUMMARY	63
 CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS		
5.1	INTRODUCTION	65
5.2	SUMMARY OF FINDINGS	65
5.3	CONCLUSIONS	66
5.3.1	Trends in physical and chemical water quality and sediment load	66
5.3.2	Institutional interactions in environmental management	66
5.3.3	Stakeholder participation in environmental management	67
5.3.4	Effectiveness of environmental management institutions	68
5.4	RECOMMENDATIONS	68
REFERENCES		70

LIST OF TABLES

Table 2.1:	Water quality sampling points in the Pungwe River basin	31
Table 2.2:	Details of the sediment sampling station in Pungwe River	32
Table 2.3:	Digital hydrological gauging stations in the Pungwe River basin	32
Table 4.1:	Gender Aggregation of Respondents	46

LIST OF FIGURES

Figure 1.1:	Catchments of Zimbabwe	7
Figure 1.2	Pungwe River basin	8
Figure 2.1	Environmental Management Structures in Zimbabwe	24
Figure 2.2	Water Management Structures in Zimbabwe	26
Figure 2.3	Map of EMA Manicaland Province	27
Figure 3.1	Concurrent mixed methods research model	40
Figure 4.1	Age groups of Respondents	47
Figure 4.2	Experience in Environmental Management Committees	48
Figure 4.3	Gauging plates silted up at F24 Hydrometric Station	52
Figure 4.4	pH trends in the Pungwe River	56
Figure 4.5	Turbidity levels in the Pungwe River	57
Figure 4.6	Annual sediment load at F22	58
Figure 4.7	Monthly sediment load at F22	59
Figure 4.8	F22 Pungwe Katiyo monthly runoff	60
Figure 4.9	F22 Pungwe Katiyo annual runoff	61
Figure 4.10	Relationship between annual runoff and river sediment load	62
Figure 4.11	Relationship between river sediment load and pH	63

LIST OF APPENDICES

Appendix I: Letter to EMA Manicaland Province	80
Appendix II: Letter to Mutasa District Administrator	82
Appendix III: Letter to Mutasa Rural District Council	84
Appendix IV: Questionnaires for Environmental Management Structures in the upper Pungwe River basin	86
Appendix V: Questionnaires for Environmental Management Committees in the upper Pungwe River basin	89
Appendix VI: Interview Schedule for Water Management Structures in the upper Pungwe River basin	93

CHAPTER 1

GENERAL INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

This chapter presents the background to the study, statement of the problem, research aims, objectives and research questions. The chapter also presents a justification for the study, definition of key terms used in the study, the methods of data collection and analysis and a description of the study area.

1.2 BACKGROUND TO THE STUDY

Environmental issues are taking centre stage the world over. This development prompted world leaders at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 to adopt a comprehensive and sustainable development strategy for the preservation of biodiversity (Berg, 2010). Five years later, through the Kyoto Protocol, the world's largest industrialised countries agreed to reduce or limit gas emissions into the environment (UN, 1998). To this day, several fora and symposia have been held with a major emphasis on environmental sustainability.

Zimbabwe has for a very long time acknowledged the importance of environmental management and sustainability (Feresu, 2010). The country is a signatory to more than 11 major international environmental conventions as well as Agenda 21 which is an action programme that was crafted during the UNCED of 1992 (Nickerson, 1994). Several pieces of legislation which include the Natural Resources Act, Mines and Minerals Act, Forest Act and Water Act were already in place in the 1970's to deal with various components of the environment (Nickerson, 1994). The need to manage the environment as a single unit encouraged policy makers to come up with

an all-inclusive piece of legislation in the form of the Environmental Management Act Chapter 20:27 (EMA Act Chapter 20:27) (Government of Zimbabwe, 2002). The enactment of the EMA Act (Chapter 20:27) saw the repeal in whole or in sections, of the Natural Resources Act (Chapter 20:13), Atmospheric Pollution Prevention Act (Chapter 20:03), Hazardous Substances & Articles Act (Chapter 15:05) and the Noxious Weeds Act (Chapter 19:07) (Government of Zimbabwe, 2002). On the other hand, the Water Act (Chapter 20:24) of 1998 remained in force to complement the EMA Act although some provisions of the Water Act were moved to operate under the EMA Act (Government of Zimbabwe, 1998a; Government of Zimbabwe, 2002).

The enactment of the EMA Act in 2002 and its subsequent operationalisation on 17 March 2003 through Statutory Instrument 103 of 2003 gave birth to the Environmental Management Agency (EMA, 2014). The EMA Act is however a general legislative framework which needs to be complemented by other pieces of legislation not in conflict with it or else the EMA Act takes precedence (ZELA, 2003). As such, the EMA Act allows the EMA to oversee the implementation of various laws and policies under the various government departments and parastatals. Structures for environmental management and stakeholder participation in environmental management are mostly provided for under the Traditional Leaders and Rural District Councils Acts (RDCs) which establish the framework for environmental management committees and subcommittees at ward level (Government of Zimbabwe, 1988; Government of Zimbabwe, 2000).

1.3 STATEMENT OF THE PROBLEM

In Zimbabwe, most activities dealing with planning, development and management of water resources were mandated to the Ministry of Environment, Water and Climate (MEWC) at policy level and the Zimbabwe National Water Authority (ZINWA) at operational level (Government of Zimbabwe, 2013). On the other hand, the EMA which since 2013 has been under the same ministry with ZINWA is mandated with the overall protection of natural resources in the country. The EMA Act provides for the operationalisation of Environment Committees for environmental management

purposes (EMA, 2012a). It is yet to be established how effective these structures are as far as environmental management for the purposes of sustaining water resources is concerned and how these structures relate to catchment and sub-catchment councils provided for under the Water Act to perform similar functions. There is therefore need to investigate how EMA and its related committees interface with other stakeholders in water resources management during environmental management activities. The present research endeavours to assess the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin, that is, on the Zimbabwean side of the border of the watercourse shared with Mozambique. Effectiveness refers to the efficiency of the stakeholder institutions in environmental and water resources management as they advance the equitable, protection and sustainable utilisation of environment and water resources (WaterAid, 2011).

1.4 JUSTIFICATION FOR THE RESEARCH

Environmental management, like water resources management requires a strong element of stakeholder participation for effective management and sustainable use (Nyikadzino *et al*, 2014). Water is one of the major components of the environment. Water and environmental management institutions are expected to operate closely on activities for the preservation and protection of water sources. Siltation of water bodies due to environmentally harmful activities like slope and stream bank cultivation is a major problem in Zimbabwe (Government of Zimbabwe, 2001). Some dams in the country have lost as much as 50% of their original capacity in less than 50 years (Feresu *et al*, 2010). This and other challenges have seen water stakeholders in the Gwayi Catchment Council requesting to participate in water quality monitoring activities which are however much of EMA duties (Manzungu, 2002). The EMA Act further exacerbates the problem by its failure to clearly define the roles and responsibilities of sectorial ministries and other government departments and agencies (Naome *et al*, 2012).

Studies in the Pungwe River basin have mostly been concentrated on integrated water resources management (IWRM) and stakeholder participation in water resources management. Recently Nyikadzino *et al* (2014) interrogated the effectiveness of water management structures in sustainable water resources management in the Pungwe River basin and underscored the importance of stakeholder participation both at individual and institutional level. Of late, environmental management was mostly based on the “polluter pays principle” whereby all those discharging waste into water sources were required to pay to the EMA (Government of Zimbabwe, 2002). Offenders were more than happy to pay offending fines than to practise sustainable environmental management because the fees were low (ZELA, 2003). As such in Zimbabwe, stakeholder participation in environmental management either at individual or institutional level is a new phenomenon which must be closely looked at to see how effective it is. It is therefore prudent to interrogate the water-environment relationship as well as the interactions between the organisations responsible for management of these resources. This study follows up on the area recommended by Nyikadzino *et al* (2014) by interrogating how Mutasa Rural District Council (RDC), EMA, ZINWA, Pungwe Subcatchment Council (PSCC) and Environmental Management Committees operate so as to improve the sustainability of water resources in the upper Pungwe River basin.

1.5 RESEARCH AIM AND OBJECTIVES

The aim of the research is to assess the effectiveness of environmental management structures in water resources management and the participation process in the upper Pungwe River basin. In seeking to attain that goal, the research endeavours to;

- v Evaluate institutional interactions with regards to environmental management issues;
- v Assess historical physical and chemical water quality parameters like pH and turbidity and river sediment load in the upper Pungwe River basin;
- v Compare current and historical physical and chemical water quality parameters and sediment load;

- v Recommend policy interventions for ensuring coordination of water and environmental management structures in the protection and preservation of water resources.

1.6 RESEARCH QUESTIONS

The study seeks to answer the following questions:

- i. How do water and environmental management institutions interact in environmental management?
- ii. What can be done to improve the interaction and coordination of water and environmental management institutions in the protection of water sources?
- iii. How has sediment loading and water quality progressed over time to the current status?
- iv. What is the status of water quality and sediment load in Pungwe River?
- v. What are environmental management institutions doing towards combating sedimentation and safeguarding good water quality in the Pungwe River basin are how effective are their efforts?

1.7 RESEARCH DESIGN

The purpose of the study is to assess the effectiveness of environmental management structures and the corresponding participation process in the upper Pungwe River basin in the sustainable management of water resources. As such, both qualitative and quantitative data were collected. Runoff and river sediment load data were collected from the ZINWA which is responsible for the collection and archiving of such data. Water quality data was collected from the EMA Manicaland Province since Mutasa District in Manicaland Province covers the Zimbabwean part of the Pungwe River basin which is the area of study. Reports from Pungwe Subcatchment Council on the environmental problems they face were also accessed. Self administered questionnaires and interviews were used to collect

additional information and data from the ZINWA, EMA, PSCC, Mutasa RDC officials as well as Ward Environmental Management Committees. A combination of stratified and purposive sampling was used to identify the relevant respondents.

The relevant pieces of legislation and statutes were scrutinised to understand the duties and responsibilities of the water and environmental management institutions in the river basin. Qualitative data collected through interviews and questionnaires was then arranged into themes and presented in tables and figures. Descriptive statistics were then used to interpret the data. The Mann-Kendal Test and Regression Analysis were also used to describe and predict trends in the quantitative data like sediment load and water quality.

1.8 SCOPE OF THE STUDY

The study seeks to assess the effectiveness of environmental management structures in sustainable water resources management and their interactions with the ZINWA and PSCC who are the principal water resources management institutions in the Pungwe River basin. It focused on the upper parts of the Pungwe River basin thus the Zimbabwean part of the river which is shared with Mozambique. The study focused on the activities of the EMA, Mutasa RDC, Mutasa District Administrator (Mutasa DA), ZINWA and PSCC since they are the institutions responsible for environment and water resources management in the basin. The Pungwe River basin has 19 wards all in all; 17 in Mutasa District and two in Nyanga District. However, the two wards in Nyanga fall within the Nyanga National Park hence the focus for the study was on the 17 wards in Mutasa District.

Water and environmental management institutions start from the local/basin level and go all the way up to national, regional and even international level. In this case the research is focused at the river basin level since it is a study on water and environmental management and all the relevant implementing agencies are represented at this level.

1.9 STUDY AREA

Save is one of the country's seven ZINWA Catchments which were established during the water sector reforms of the late 1990s (Government of Zimbabwe, 2001). ZINWA was formed in the year 2000 following the amalgamation of the Regional Water Authority (RWA) and the Department of Water Development (DWD) in the Ministry's of Water through the Water and ZINWA Acts both of 1998 (Makurira and Mugumo 2006). Save Catchment which is to the eastern side of Zimbabwe share boundaries with four other catchments namely; Mazowe, Manyame, Sanyati and Runde (See Figure 1.1). The catchment has three major rivers which cross into Mozambique and these are Save, Budzi and Pungwe.

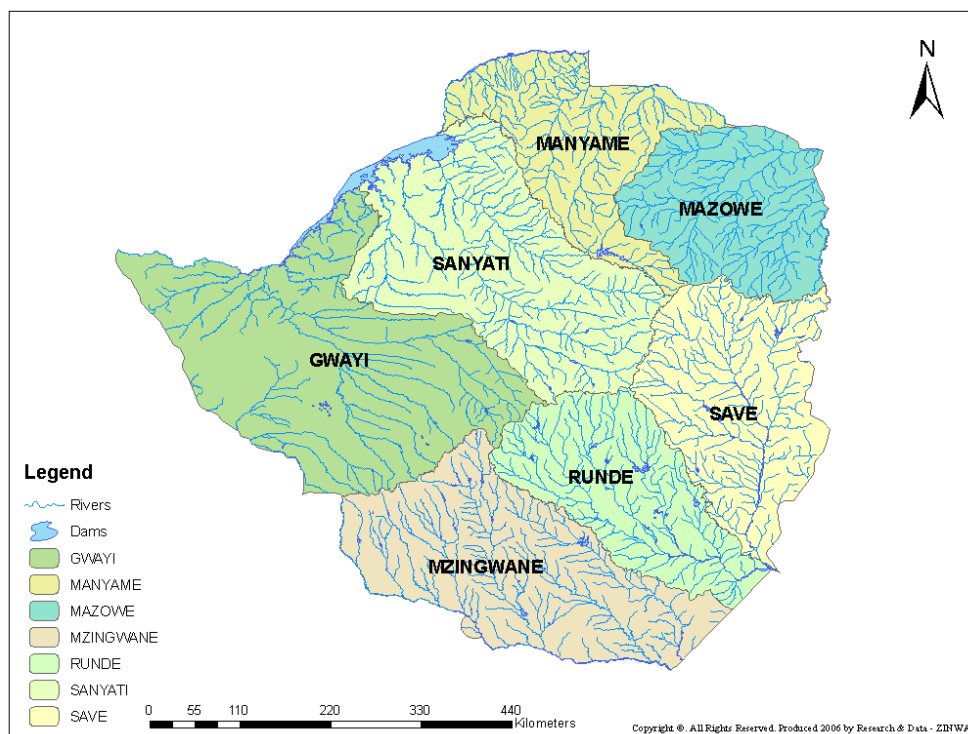


Figure 1.1: Catchments of Zimbabwe (Source: ZINWA, 2006)

The study shall be confined to the upper part of the Pungwe River basin which is on the Zimbabwean side of the border with Mozambique and covers mostly Mutasa District of Manicaland Province. Mutasa is one of the seven districts of Manicaland Province and is located to the eastern side of the country sharing the border with Mozambique (Zimstat, 2012).

1.9.1 Physiography and Climate

Zimbabwe covers an area of 390,757 km² of which 85% is used for agriculture with the remainder being shared among national parks, state forests and urban areas (Shoko, 2010). Seventy five percent of the country's communal lands fall within agro-ecological regions IV and V which are semi-arid regions and receive rainfall of 600mm or less per annum (Mugabe *et al*, 2002). The upper Pungwe River basin, which is the current study area, is found in the Eastern Highlands physio-geographic region which receives rainfall of above 1000mm per annum (Feresu *et al*, 2010). The study area constitutes the upper part of the Pungwe River basin; which is the Zimbabwean part of the basin as shown in Figure 1.2 below:

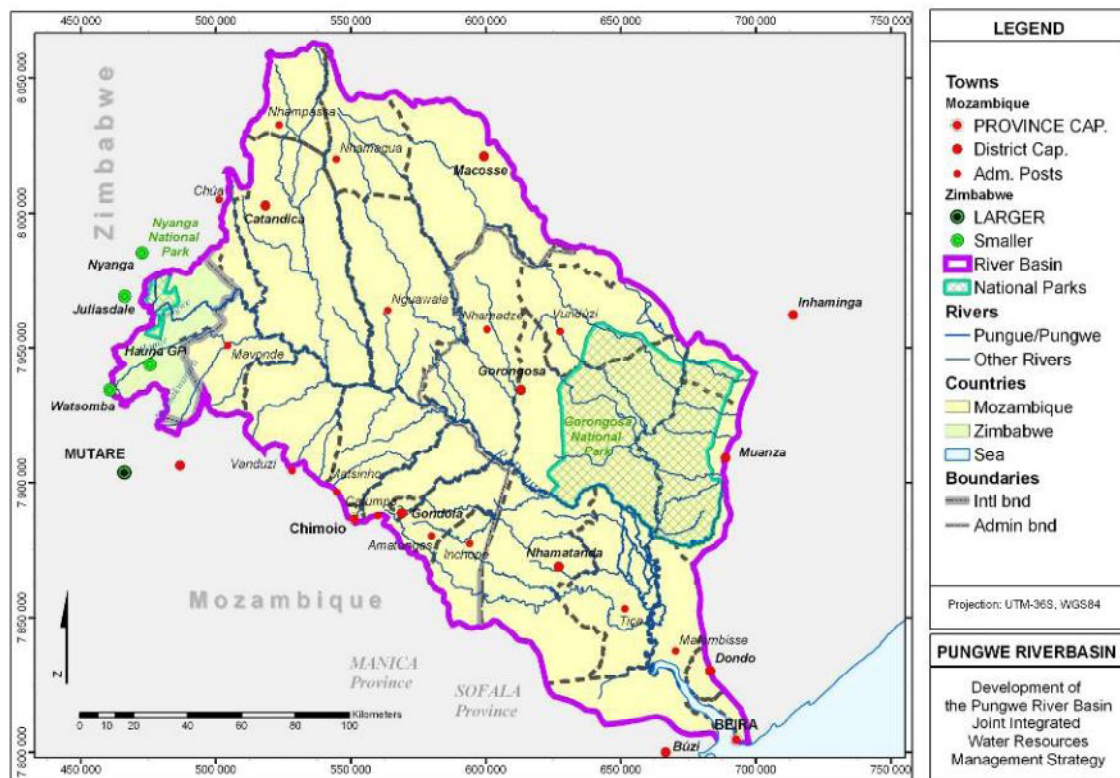


Figure 1.2: Pungwe River Basin (Source: Sweco, 2008)

1.9.2 Demography

The study area has a population of 103,198 inhabitants according to the country's population census conducted in 2012 (Zimstat 2012). While the average national

population density for Southern Africa is 21.6 persons per square kilometre, for Zimbabwe it is 30 persons per square kilometre. Manicaland (the study area) has an even higher average national population density of over 43 persons per square kilometre which is however very close to the world average of 44.2 persons per square kilometre (Shoko, 2010).

1.9.3 Socio-Economic Activities

Economic activities in the Pungwe River basin are largely based on agricultural production, small scale farming and commercial livestock production, wildlife and forestry resources utilisation, and fishing (Sweco, 2004). Alluvial gold mining and gold panning activities are largely concentrated along Nyamukwarara River close to the border with Mozambique (Nyikadzino *et al*, 2014).

1.10 TERMINOLOGY

The following terms are defined in the context in which they were used in the study:

1.10.1 Catchment

All areas whose water naturally drains into a particular river or watercourse (Government of Zimbabwe, 1998).

1.10.2 Catchment Council

A catchment council established in terms of Section 20 of The Water Act (Chapter 20:24) to manage water in a particular catchment area (Government of Zimbabwe, 1998).

1.10.3 Environment

Land, water, plants and animal characteristics that surrounds humans as expressed physically, socially and economically (Ministry of Mines, 1997; Chiwandamira and Mbengo, 1999).

1.10.4 Environmental management

The management of the natural life supporting systems and their utilisation to ensure sustainability (Chiwandamira and Mbengo, 1999).

1.10.5 Environmental management structures

Institutional framework put in place by the various pieces of legislation to enable effective and sustainable environmental management

1.10.6 Integrated environmental management

Is the integration of the various aspects of the environment like land, water, air and animals and then tackle the related issues together cognisant of the resultant burdens of environmental impacts of the other (EU, 2007).

1.10.7 Integrated water resources management

“A process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (GWP, 2004)

1.10.8 Stakeholders

Persons, groups or institutions with a vested interest in a particular programme or project whose decisions or actions taken might affect them in either a negative or positive way (Government of Zimbabwe, 2001).

1.10.9 Water stakeholder participation structures

Catchment and Subcatchment Councils put in place by The Water Act (Chapter 20:24) to allow for the participation of stakeholders in the management of water in a catchment or subcatchment of their jurisdiction.

1.10.10 Subcatchment Council

A Subcatchment Council established in terms of Section 21 of The Water Act (Chapter 20:24) to manage water in a particular subcatchment area (Government of Zimbabwe, 1998).

1.10.11 Water management structures

Government, quasi-government and stakeholder institutions designated by the Water Act (Chapter 20:24) and ZINWA Act (Chapter 20:25) to manage the development and management of water resources in the country

1.11 STRUCTURE OF THE DISSERTATION

This dissertation comprises of five chapters.

Chapter One introduces the study and contains a background, problem statement and research aims and objectives. The justification and demarcation of the study are presented. Methods of data collection and analysis are briefly discussed. A structure of the dissertation is presented before a summary of the chapter.

Chapter Two is a literature review chapter that looks at water and environmental management from the global perspective down to the local levels. Efforts to link integrated water resources management with environmental management are also discussed. The participation processes and the challenges thereto are also discussed. The chapter also looks at environment and water management structures in Zimbabwe. The legal and institutional framework responsible for water and environmental management as well as the environmental management practices in the Pungwe River basin are also discussed.

Chapter Three describes the research design, instruments of data collection, population and research sample. Methods used in data collection and analysis are described as well.

Chapter Four presents the data and research findings. Tables and figures are used to show the findings. Statistical equations will also be presented as part of the research findings. These will be interpreted and clarified in line with the research objectives.

Chapter Five makes the wholesome conclusion of the research study. Recommendations on the environment and water management structures are proffered. Areas where further research is required are also suggested.

1.12 CHAPTER SUMMARY

This chapter introduced the study and discussed the problems in water and environmental management both globally and locally. Research objectives for the study were also discussed. The area of study was introduced and the focal area was clearly clarified. The next chapter shall review literature relating to water and environmental management as well as the participation process.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews literature on water resources and environmental management, environmental management structures and related issues. In particular, the issues reviewed include water quality, runoff and river sediment monitoring, the institutional framework, legal provisions for such institutions, and challenges of these approaches to water and environmental management.

2.2 ENVIRONMENTAL MANAGEMENT AND ENVIRONMENTAL MANAGEMENT STRUCTURES

Manjengwa *et al* (1999) notes that the environment is not just a physical entity but embodies its political, economic and social interactions with its inhabitants. Generally environmental management is concerned with the conservation of natural systems for present outputs and long term use (Chiwandamira and Mbengo, 1999). Pahl-Wostli (2007, p 561) defines environmental resources management as "...a purposeful activity with the goal to maintain and improve the state of an environmental resource affected by human activities." Environmental management can be seen as the management of environmental systems for a sustainable objective (Chiwandamira and Mbengo, 1999). Environmental management structures in this study refers to the government departments, agencies and stakeholders involved or interested in the management of the environment and its natural resources as per the prevailing legal provisions.

2.3 STAKEHOLDER PARTICIPATION IN ENVIRONMENTAL MANAGEMENT

Shoko (2010) states that Zimbabwe uses three main approaches in managing the environment. "These include legislation, regulations and enforcement; using and

creating markets and application of incentives to encourage self-regulation” (Shoko, 2010: 48). At policy level the EMA Act provides for the formation of the National Environment Council (NEC) as well as the Standards and Enforcement Committee composed of 13 and 15 line ministries respectively (Government of Zimbabwe, 2002). One of the principles of environmental management is to encourage and promote the participation of all people affected by or interested in environmental governance to acquire the necessary skills and understanding for effective participation (Government of Zimbabwe, 2002). While at implementation level the EMA promotes the establishment of environmental committees; the responsibility, composition and terms of reference of such committees are referred to rural district councils to be administered under the Section 61 of the Rural District Councils Act Chapter 19:13 (EMA, 2002b; Government of Zimbabwe, 2002).

Government of Zimbabwe (2009) contends that environmental issues are local problems and occur within communities hence the local leadership should be afforded a chance to be involved in postulating solutions to such problems. In rural areas, women take centre stage in environmental use and management as such; they should take a leading role in the development and implementation of environmental policies, programmes and plans (Shoko, 2010). The involvement of key stakeholders in decision making goes a long way in ensuring the successful long term conservation of the environment (Sherpherd, 2008). Dresch-Langley (2012) points to a *vulnerability-versus-responsibility* situation adding that vulnerable groups and decision makers always have conflicting interests in environmental management. As such there is great need to emphasise much on stakeholder participation during both decision and policy making processes (ibid). The dysfunction of structures for community based resources management has subsequently led to the resource degradation in rural areas (Chigwenya and Chirisa, 2007). The involvement of various stakeholders in natural resources management therefore enhances social sustainability of the resources and management processes (Myllyviita *et al*, 2011).

Stakeholder participation in environmental management seems to be lagging behind in terms of implementation despite acknowledgement from scholars that there is great potential among local people of contributing to sustainable natural resources management (Sherpherd, 2008). Where such implementation has been done, it looks as if it hinged more on fulfilling agreed formalities so that the resulting projects were widely accepted by policy makers, donors or funders. There is therefore an urgent need to sincerely engage local people, line ministerial departments, agencies and other stakeholders so as to achieve sustainable environmental management.

2.4 INTEGRATED ENVIRONMENTAL MANAGEMENT

Integrated Environmental Management (EIM) is basically the integration of the various aspects of the environment like land, water, air and animals and then tackle the related issues together cognisant of the resultant burdens of environmental impacts of the other (EU, 2007). The world over, the EIM approach has either been misunderstood or even not implemented at all (Naome *et al*, 2012). This is despite the fact that Integrated Environmental Management promotes the sustainable management of natural and physical resources as well as efficiency, equity and transparency (ibid).

The management of water resources in Zimbabwe since the 1990's when the country introduced water sector reforms took a stakeholder driven dimension (Manzungu, 2002). It however remains to be seen how the collaboration of environmental management structures and their water management counterparts shall improve water resources management through integrated environmental management due to its perceived bias towards land as opposed to water resources. Government of Zimbabwe (2001) has however proffered the Integrated Catchment Management (ICM) as an alternative approach to both IWRM and IEM concepts/approaches. Integrated Catchment Management is defined as "...a holistic natural resources management system comprising interrelated elements of land and water in a river basin" (Government of Zimbabwe, 2001: 59). ICM focuses more on a river catchment since it relates to natural resources or environmental management

from the perspective of a water manager. Generally though it appears both IEM and ICM approaches are applicable in sustainable integrated water resources management.

2.5 STAKEHOLDER PARTICIPATION AT RIVER BASIN LEVEL

Esmail (1997) recognises that the sustainability of natural resources management is by involving local level stakeholders in the management and decision making processes. Since water use, development, allocation and sustainable utilisation is a complex process, all decisions taken should therefore respect the interests of the water users (Rogers and Hall, 2003). The major purpose of water sector institutional reform is to make sure that there is decentralised decision making structure that goes down to low levels of local committees (Saleth and Dinar, 1999). Effective water governance can therefore be achieved through open social structures allowing the participation of all stakeholders including civil society, private companies and media (Rogers and Hall, 2003).

Management of water along river basins with increased stakeholder participation results in more sustainable water resources management (Webster *et al*, 2003). The government should be seized with the responsibility of establishing and nurturing stakeholder institutions up until they have enough capacity to carry out their mandates (Esmail, 1997). In the early 2000s, Zimbabwe introduced subcatchment and catchment councils which at inception were supported by funds from the Swedish International Development Agency (SIDA) (Kujinga and Manzungu, 2004). These stakeholder structures were put in place conscious of the social and economic costs so that development was not hindered (Rogers and Hall, 2003). As such, the institutions were made up of two members of staff in charge of administrative and stakeholder outreach activities as is the case for the PSCC. This might create capacity gaps within the institutions as the two staff members were required to deal with diverse and highly technical issues in the fields of accounting, water resources, environment, agricultural and land resources management. The operational challenges of stakeholder institutions are compounded by government departments

and agencies who are normally reluctant to hand over certain powers and functions at the formation of stakeholder institutions thus creating gaps and overlaps in environmental and water resources management (Ribot, 2002). In most cases, these local institutions remain under tight scrutiny by the central governments (ibid). While the PSCC and Environmental Management Committees are the local level institutions for stakeholder participation in the Pungwe River basin, other central government departments and agencies involved in environmental and water resources management includes ZINWA, Mutasa RDC, Mutasa DA, EMA, Forestry Commission, Agritex and Department of Irrigation.

Esmail (1997) notes that sustainable natural resources management is directly related to agricultural productivity as such, failure in agriculture often results in land, water and forest degradation. As such; to make sure that there is collaboration among institutions, the Water Policy should be crafted to fit into the general policy framework and should be closely linked to policies for agriculture, fiscal and trade (Saleth and Dinar, 1999). However, in the quest to achieve stakeholder participation at lower levels, there is a risk of these institutions becoming elitist through dominance by organised groups (Ribot, 2002). To boost capacity as well as improve their efficiency and effectiveness, ZINWA provides technical support to catchment and subcatchment councils (Kujinga and Manzungu, 2004). Other specialists like those from Agritex and EMA attended all full council meetings as resource persons (ibid).

2.6 WATER QUALITY AND RIVER SEDIMENT MONITORING

2.6.1 Water quality monitoring

Water has for a long time been used as a natural method of waste disposal (Feresu *et al*, 2010). Pollution has a very adverse effect on the quantity of water available for use suitable for the various water needs for both humans and the environment (WMO, 2012). Sources of water pollution can be classified as point or non-point. Point source pollution is when the pollutants are released directly into a watercourse from an identified source (Feresu *at al*, 2010). “Non-point sources are a result of

diffuse percolation of pollutants from a large area into a waterway...” (Feresu *et al*, 2010: 152).

The quality of water is basically reflected by its physical, chemical and biological characteristics (Vučijak *et al*, 2011). Physical characteristics of water include temperature, taste and odour, turbidity, suspended solids, electrical conductivity and radioactivity while chemical characteristics include pH, oxidation-reduction potential, alkalinity, acidity, hardness, dissolved oxygen, oxygen demand, nitrogen and chloride (ibid). pH reflects the levels of dissolved carbon dioxide in water and pH values of 5.5 and below are a sign that the river concerned is under threat (Gasim *et al*, 2007). “Turbidity can be defined as a decrease in the transparency of a solution due to the presence of coloured suspended and dissolved substances ...” (Petus *et al*, 2010: 2).

In order to analyse the quality of water in a river, a representative sample of the water is collected. Water quality sampling techniques used to collect river water samples include; grab sampling, composite sampling, continuous sampling and stratified sampling (DWAF, 2006). Grab sampling is the most commonly used water sampling technique since it is easy and does not require expensive equipment. However, there is a chance of missing certain changes in quality of the water and requires a lot of data for a trend to be established (ibid). A grab sample which is also referred to as a spot or snap sample is regularly taken at a designated monitoring point and certain depths and prescribed times (Bartram *et al*, 1996)

2.6.2 River sediment monitoring

Sediment in a stream is composed of soil eroded along the stream and from across the river catchment (Sadeghi *et al*, 2012). River sediments are sometimes regarded as “pollutant sinks” and studies by Islam *et al* (2014) have revealed that sediment particles may contain pollutants like metals. The level of water in the river is recorded so that the amount of sediments can be related to the amount of water flowing at the

time of sampling (Kuusisto, 1996). Generally the sampling techniques are similar to those used for water quality sampling though, grab samplers and dredgers are mostly used for collecting these sediment samples (IAEA, 2003). Sediment sampling can also be done through the use of an automatic water sampler normally at the same position where river discharge measurements are taken (Lapong *et al*, 2012).

Soil erosion and sedimentation have brought with them immense suffering to humans since river beds and water lakes get silted up as well as degradation of land upstream (Saeidian *et al*, 2009). Suspended sediment is often viewed as a non-point source pollutant hence studying it helps in the understanding of its source and causes within the catchment (Sadeghi *et al*, 2012).

2.7 The ENVIRONMENT AND WATER RESOURCES MANAGEMENT FRAMEWORK IN ZIMBABWE

Though Zimbabwe is endowed with many natural resources, the country can only benefit from them if they are managed and exploited sustainably (Chidavaenzi *et al* 2010). The Government of Zimbabwe has put in place legal instruments and relevant institutions for the management of its natural resources. Institutions that start from the local up to the national levels have been installed for the management of the environment and water resources. While issues of stakeholder participation in water resources management have taken root especially after the introduction of The Water Act of 1998, it remains to be seen how environmental management structures fare (Makurira and Mugumo, 2006).

2.7.1 Legal Framework

There are more than 18 pieces of legislation relating to environmental and water management in Zimbabwe (Chiwandamira and Mbengo, 1999). However, for this study about seven pieces legislation were selected due to their relevance to the research focus and study area.

2.7.1.1 Environmental Management Act (Chapter 20:27)

The Environmental Management Act (Chapter 20:27) of 2002 is the principal law for environmental management in Zimbabwe. It sets the general framework for environmental management and takes precedence to any other law in conflict with it on issues to do with the environment (Government of Zimbabwe, 2002). The EMA Act provides for the;

- v establishment of the Environmental Management Agency
- v sustainable management of the country's natural resources
- v protection of the environment
- v prevention of pollution
- v prevention of environmental degradation
- v preparation of a National Environmental Plan for the management and protection of the environment (Government of Zimbabwe, 2002).

2.7.1.2 Water Act (Chapter 20:24)

The Water Act (Chapter 20:24) was enacted in 1998 to replace old Water Act of 1976 so as to allow for equitable access to water by all the country's citizens (Makurira and Mugumo, 2006). The Water Act is the principal water resources management legislation as it established the relevant water management institutions like ZINWA, subcatchment and catchment councils (Manzungu and Kujinga, 2006). The Water Act provides for the;

- v development and utilisation of the country's water resources
- v establishment and conferment of powers to catchment and subcatchment councils
- v granting of permits for water use
- v protection of the environment
- v prevention and control of water pollution
- v control of water use during times of water shortages
- v establishment of roles and responsibilities for the ZINWA through the office of the Catchment Manager (Government of Zimbabwe, 1998a)

2.7.1.3 ZINWA Act (Chapter 20:25)

The ZINWA Act (Chapter 20:25) was enacted in 1998 setting the way for the establishment of the Zimbabwe National Water Authority, a key institution in the water resources management sector (Manzungu and Kujinga, 2006). The Act provides for the;

- v establishment of the Zimbabwe National Water Authority and its functions
- v charging for providing water and other services offered by ZINWA
- v establishment and collection of a water levy (Government of Zimbabwe, 1998b).

2.7.1.4 Rural District Councils Act

The Rural District Councils Act (Chapter 29:13) of 1988 provides for the;

- v declaration and establishment of Rural District Councils
- v administration of areas under their jurisdiction
- v establishment of environmental committees and subcommittees
- v establishment of rural district and ward development committees
- v empowerment of RDCs on matters of sewerage and drainage (Government of Zimbabwe, 1988)

2.7.1.5 Traditional Leaders Act

Traditional leaders thus Chiefs, Headman and Villages Heads have been central to the issues of environmental management and resource exploitation for a very long time though in an undocumented manner. This has been formalised as they now derive their mandate from the Traditional Leaders Act Chapter (29:17) of 2000 (EMA, 2012c). The Act provides for the;

- v appointment of Chiefs, Headman and Village Heads
- v establishment of village and ward assembly and development committees
- v setting of village boundaries
- v allocation and disposal of rights of communal land

- v resettling people on communal land
- v ensuring sustainable management and utilisation of natural resources to avoid over-cultivation, over-grazing and degradation of natural resources (Government of Zimbabwe, 2000b).

2.7.1.6 Urban Councils Act

The Urban Councils Act (Chapter 29:15) of 1995 provides for the;

- v establishment of towns and councils
- v conferring of powers on the council to supply water
- v controlling of public streams in areas of their jurisdiction
- v mandating of urban councils to remove any obstructions on public streams that might hinder the flow of water
- v empowerment of Urban Councils on matters of sewerage and drainage (Government of Zimbabwe, 1995)

2.7.1.7 Parks and Wildlife Management Act

The Parks and Wild Life Act (Chapter 20:14) of 1975 provides for the;

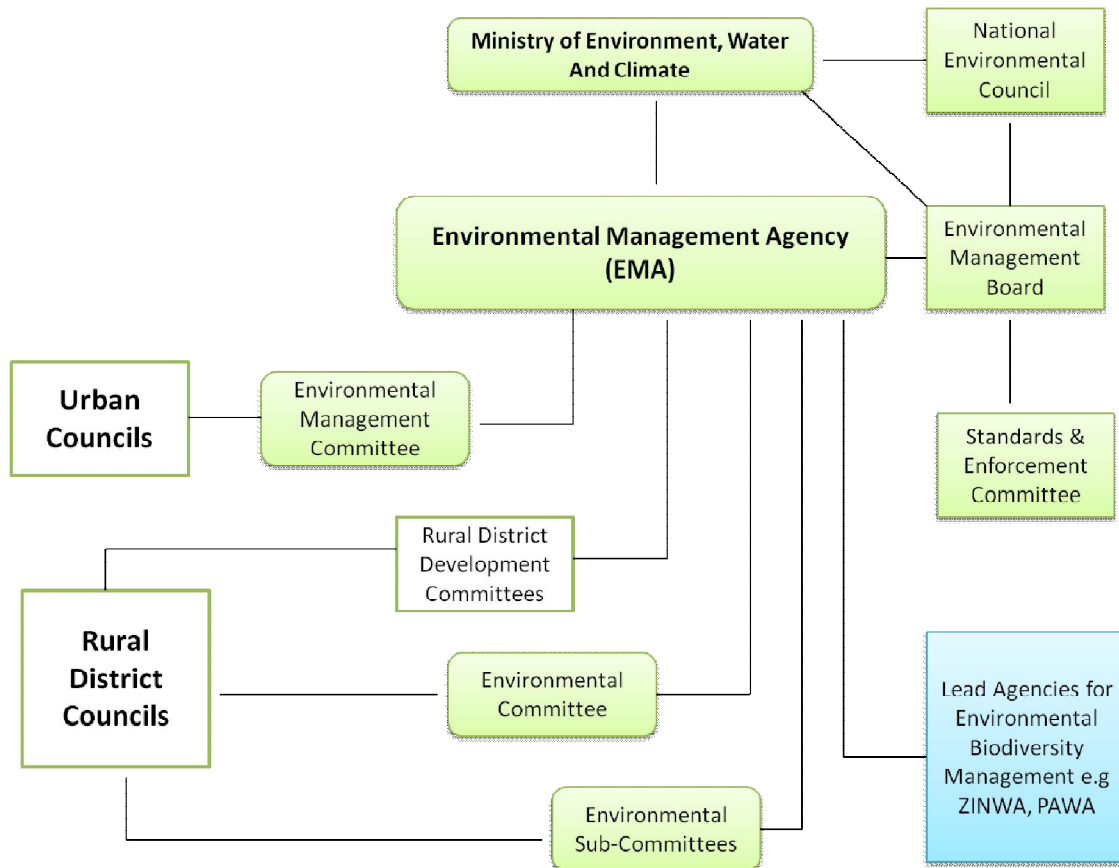
- v establishment and functions of the Parks and Wild Life Management Agency
- v conferring powers on conversation area committees
- v protecting, conserving, preserving as well as controlling of wildlife, fish, plants and the natural landscape
- v establishment of national parks and botanical gardens/reserves for the preservation of the country's flora and fauna (Government of Zimbabwe, 1975).

2.7.2 Environmental Management Structures in Zimbabwe

The Environmental Management Agency is the lead agency for environmental and natural resources management in Zimbabwe. At higher levels, EMA reports to the

Environmental Management Board and the Ministry of Environment, Water and Climate (Government of Zimbabwe, 2002) on all environmental issues.

The Environmental Management Act (Chapter 20:27) is the principal environmental management legislation and it is administered by EMA. Three approaches are used in Zimbabwe in managing the environment and these are; legislation, regulations and enforcement; the creation of markets and giving companies and institutions incentives so as to encourage self-regulation (Chidavaenzi *et al*, 2010). At lower levels there are environmental management committees and environmental sub-committees which are institutions under the Urban Councils and Rural District Councils. As such, the Urban and Rural District Councils are at the core of environmental management in Zimbabwe as they deal with both potable and waste water as well as solid waste (see Figure 2.1 below). Lead agencies for water and wildlife management like ZINWA and Parks and Wildlife Management Authority also feed into EMA if they encounter any environmental problems (Chidavaenzi *et al*, 2010).



2.7.3 Water Resources Management Structures in Zimbabwe

Water resources in Zimbabwe are managed through the Water Act (Chapter 20:24) of 1998. The Water Act propagates the notion of integrated water resources management and thus puts in place the various water management structures for its sustainable management and effective stakeholder participation (Government of Zimbabwe, 2001).

Water resources management in Zimbabwe starts at the lowest appropriate level which is the subcatchment council level (Government of Zimbabwe, 2001). Subcatchment councils are composed of various stakeholder representatives who

include local authorities, farmers (both communal and commercial), mines and estates (Government of Zimbabwe, 2000a). The subcatchment councils report to the catchment council which is the apex water management institution at catchment level. The catchment councils preside over all water management issues in the catchment including granting of permits for water use and catchment protection (Government of Zimbabwe, 2000a). The catchment councils report; through ZINWA who is their secretariat, all water issues and take policy directions on water management from the Department of Water Development (DWD) under the Ministry of Environment, Water and Climate (see Figure 2.2).

ZINWA supplies both raw water and treated water to local authorities, farmers and industries (Government of Zimbabwe, 2001). The organisation which provides secretarial services to both catchment and subcatchment councils is one of the major players in water resources management (Government of Zimbabwe 1998a and 1998b). ZINWA liaises with the Department of Water Development on catchment council business as well as its own. The authority advises both the Minister and catchment councils on issues to do with hydrology, hydrogeology, water tariffs and many other issues (Government of Zimbabwe 1998a).

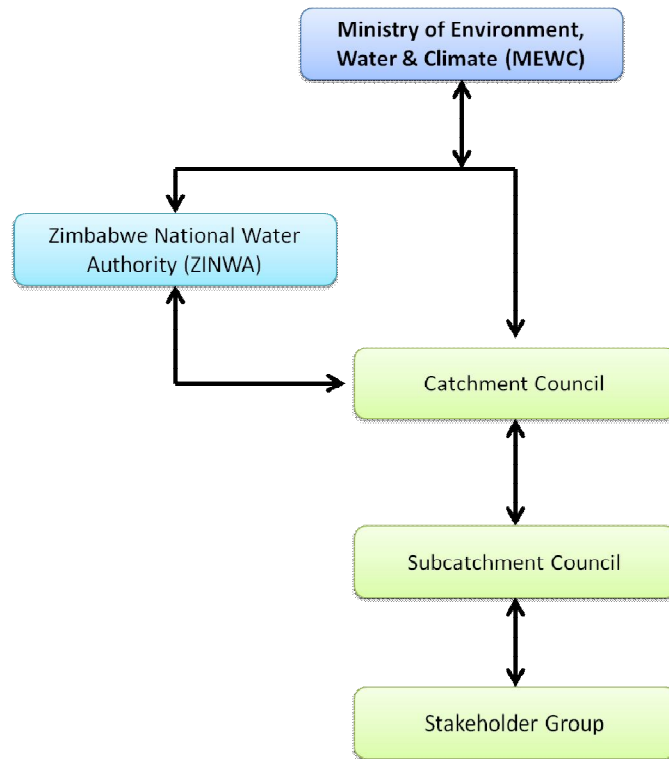


Figure 2.2: Water Management Structures in Zimbabwe. (Source: Government of Zimbabwe, 1998a)

2.8 ENVIRONMENT AND WATER MANAGEMENT PRACTICES IN UPPER PUNGWE RIVER BASIN

Environment and water management structures starts from the local levels up to the national levels. Most of these are either government or quasi-government departments deriving their mandates from an Act of Parliament. Environment and water management practices are basically driven by these institutions with the participation of other relevant stakeholders who are either government or non-government.

2.8.1 Environmental Management Institutions in upper Pungwe River basin

The Pungwe River basin which falls under Manicaland Province has three major environmental management institutions namely; EMA Manicaland, Mutasa RDC and

Nyanga National Park which is run by the Parks and Wild Life Management Authority (PWMA). Other institutions include Forestry Commission, Traditional Leaders such as headman and chiefs and environment committees.

2.8.1.1 EMA Manicaland Province

EMA Manicaland Province is one of the country's ten provincial offices for the Environmental Management Agency in Zimbabwe. The province is estimated to have a population of 1,752,698 (ZimStat, 2012). The province covers an area of 36,459km² and is made up of seven districts (see Figure 2.3) namely; Nyanga, Makoni, Mutasa, Mutare, Buhera, Chimanimani and Chipinge (PRFT, 2013).

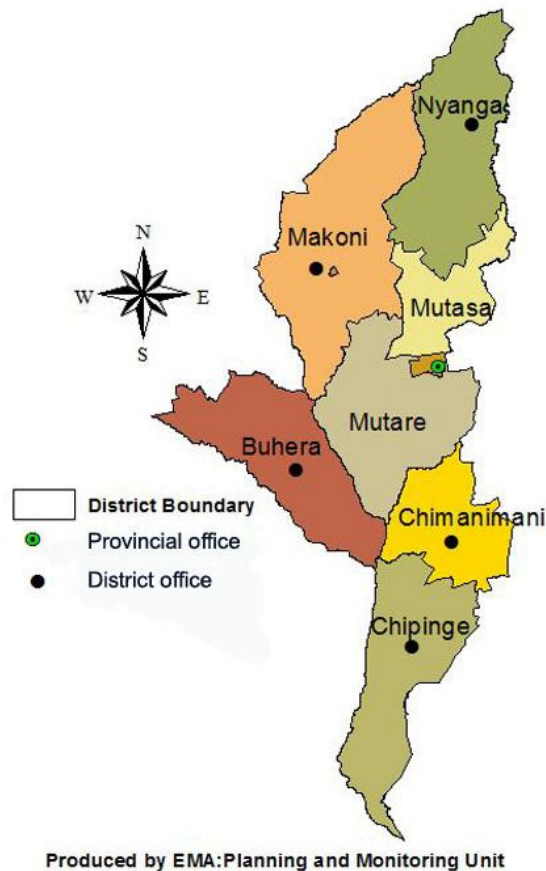


Figure 2.3: Map of EMA Manicaland Province (Source: EMA, 2014)

EMA Manicaland administers the EMA Act (Chapter 20:27) in the seven districts and any other legislation that promotes sustainable environmental management such as

the operationalisation of environmental management committees which are established under the RDCs Act (Chapter 29:13). Their duties and responsibilities are as stated before under the EMA Act.

2.8.1.2 Mutasa RDC

Mutasa Rural District Council (Mutasa RDC) is one of the seven rural district councils in Manicaland Province in charge of the local governance of the districts deriving their mandate from the RDCs Act (Chapter 29:13). The district has one growth point and it has a population of 168,747 (ZimStat, 2012). Mutasa RDC is a very key member of the environmental management structures as they establish ward environmental committees which are used by EMA in improving environmental management.

2.8.1.3 Nyanga National Park

Nyanga National Park is one of the country's national parks run by the Parks and Wildlife Management Authority of Zimbabwe. The national park contains the source of the Pungwe River and in that area the river is in an undisturbed state (Sweco, 2004).

2.8.2 Water Management Institutions in upper Pungwe River basin

There are basically three major institutions responsible for water resources management in the Pungwe River basin and these are; ZINWA Save Catchment, Save Catchment Council and Pungwe Subcatchment Council. Other institutions with a role to play in water resources management includes; EMA, Traditional Leaders and other government and non-governmental departments.

2.8.2.1 ZINWA Save Catchment

Save Catchment's roles and responsibilities in the upper parts of the Pungwe River basin include;

- v monitoring of surface runoff
- v monitoring of groundwater recharge and corresponding abstractions
- v assisting Pungwe Subcatchment Council in surface and groundwater allocation
- v ensuring effective dam safety and competent borehole drilling
- v participating in issues of water resources planning and development. Protection, exploitation as well as ensuring that water resources are well conserved and sustainably utilised
- v water resources management (Government of Zimbabwe, 1998b).

2.8.2.2 Save Catchment Council

Save catchment Council is the highest level stakeholder institution responsible for representing the interests of its members in issues of water resources management at catchment level. The council is made up of Chairpersons and Vice-Chairpersons of the catchment's eight subcatchment councils (Dube and Swatuk, 2002). The Catchment council is responsible for;

- v granting of water permits on applications for water use and any operations in the river
- v resolving of water disputes and conflicts resulting from water use
- v supervision of subcatchment councils on the regulation and exercise of water permits
- v preparation of a catchment outline plan for the Save River system
- v ensuring that the provisions of the Water Act are being complied with (Government of Zimbabwe, 1998a)

2.8.2.3 Pungwe Subcatchment Council

Pungwe Subcatchment Council is the lowest appropriate level of stakeholder participation in water resources management in the Pungwe River basin (Dube and Swatuk, 2002). The subcatchment council is composed of representatives of various water users who are elected to defend their stakeholder interests (Nyikadzino *et al*, 2014). Pungwe is one of the eight subcatchment councils in the greater Save Catchment and is responsible for;

- v supervision and regulation of water use within Pungwe River and its tributaries for both surface and groundwater permits
- v levying and collecting subcatchment rates from all water permit holders
- v collecting water fund levies (also called ZINWA levy) on behalf of the Ministry of Environment, Water and Climate
- v propagating and promoting the sustainable use of water resources and catchment protection
- v monitoring the discharge of waste water into the Pungwe River and its tributaries
- v participating in activities of catchment planning and collection of data
- v monitoring of surface water flows and the corresponding abstractions (Government of Zimbabwe, 1998a).

2.9 WATER QUALITY, RIVER SEDIMENT AND WATER LEVEL MONITORING IN THE PUNGWE RIVER BASIN

Water quality monitoring and river sediment sampling are done in the Pungwe River basin thus the main Pungwe River and its tributaries. This is done to make sure that the quality and security of water being abstracted for potable use in the basin is clearly understood. The two institutions involved in sediment and water quality monitoring in the Pungwe River on the Zimbabwean side are ZINWA and EMA.

2.9.1 Water Quality Monitoring in the Pungwe River basin

Water quality monitoring in the Pungwe River basin is conducted by the Environmental Management Agency Manicaland Province branch. There are seven water quality sampling points in Mutasa District which encompasses the Pungwe basin. The grab sampling method is used for collecting water samples from the river. Table 2.1 shows the water sampling points:

Table 2.1: Water quality sampling points in the Pungwe River basin

Station Reference Number	River
ER103	Honde
ER104	Pungwe
ER106	Nyamhingura
ER107	Ruda
ER108	Nyamukombe
ER109	Pungwe
ER110	Nyamukwarara

(Source: EMA Manicaland, 2014)

2.9.2 River Sediment Monitoring in the Pungwe River basin

ZINWA Save Catchment is the institution in charge of water sediment monitoring in the Pungwe River basin. There is one sediment sampling station in the basin which is located at the last hydrological gauging station on the main Pungwe River. Below are the details of the station as indicated in Table 2.2:

Table 2.2: Details of F22 sediment sampling station in the Pungwe River

Sediment sampling station location details			
Station Name: Pungwe Katiyo		Date opened:	05 Feb 1997
Station No.	F22	Catchment Area:	644km ²
Location:	Katiyo Country Club	Hydrological zone:	FP
River:	Pungwe		
Latitude:	18.22° S	Longitude:	33.03° E

(Source: ZINWA, 2014)

2.9.3 Water Level Monitoring in the Pungwe River Basin

ZINWA Save Catchment monitors river runoff in the upper Pungwe River basin and has four digital hydrological stations and many other analogue stations which are used to collect water level data. The four stations are presented in Table 2.3 below.

Table 2.3: Digital hydrological gauging stations in the Pungwe River basin

Station Ref	Station Name	River	Year opened
F14	Pungwe Falls	Pungwe	1970
F22	Pungwe Katiyo	Pungwe	1997
F23	Honde	Honde	2011
F24	Pungwe Murara	Pungwe	2011

(Source: ZINWA, 2014)

2.10 INTEGRATED WATER RESOURCES MANAGEMENT AND ENVIRONMENTAL MANAGEMENT INTERFACE

Integrated water resources management is defined as, "...a process which promotes the coordinated development and management of water, land and related resources,

in-order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (GWP-TAC, 2000: 22). Integrated water resources management is based on four principles which were crafted at the International Conference on Water and Environment held in Dublin in 1992 and these are;

- v “Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment
- v Water development and management should be based on a participatory approach involving users, planners and policy makers at all levels
- v Women play a central part in the provision, management and safeguarding of water
- v Water has an economic value in all its competing uses and should be recognised as an economic good” (Xie, 2006: 5).

Manzungu (2002) therefore argued that integrated water resources management cannot be discussed outside the context of environmental management. Government of Zimbabwe (2000) stresses that one of the main functions of catchment councils for water resources management is to develop and oversee the implementation of catchment protection programmes in accordance with the EMA Act. The degradation of watersheds has resulted in the drastic reduction of the quantity and quality of land and water resources in the Pungwe River basin (Chifamba, 2011). Sustainable development and environmental management is therefore underpinned by the provision of adequate and safe water for both social and economic activities.

It is quite evident from the available literature that water resources management and environmental management structures are closely related. This then calls for environmental management institutions to recognise the close relationship between water and environment so that they adopt an all inclusive approach or to intensify it if already in existence.

2.11 CHALLENGES IN PRESENT APPROACHES TO ENVIRONMENTAL MANAGEMENT

Environmental management in the past has been focused on specific natural resources with a plethora of organisations within and outside government developing different plans and management strategies (Murwira and Tevera, 2010). A change in mindset saw Zimbabwe adopting an ecosystems approach which brings together all systems of the environment as well as embracing an environmental impact assessment policy for the utilisation of natural resources (Government of Zimbabwe, 2001). The ecosystems approach dispels historical notions of viewing water-environment relationships as one of conflict where the environment was viewed as an "...unfortunate but necessary victim of development" (Coates *et al*, 2013, p 31).

The participation of a wide array of stakeholders in issues of natural resources conservation is now acknowledged at both local and national level (Mortimore *et al*, 2008). Most River Basin Organisations (RBOs) recognise that the ecosystems approach is very important to sustainable basin management (Roy *et al*, 2011). In the Papua Province of Indonesia, stakeholders are pressing for legal and institutional framework reforms to enable the decentralisation of forest resources management so that local communities are firmly in charge (Kayoi *et al*, 2008). In the Nigeria-Niger border ecosystem there are functioning environmental management institutions which goes down to village/district levels and communicate well between levels (Sherpherd, 2008). However; generally at national level in both Asia and Africa, sectorial representatives of various ministries that are concerned with land-use planning, agricultural extension services, forestry and others are not even consulted even though they are units of management in the ecosystem approach (Sherpherd, 2008).

Environmentally harmful activities like slope and riverbed cultivation loosen soils and contribute significantly sediments which may eventually lead to reduction in capacity or siltation of dams and rivers (Mutepfa *et al*, 2010). Government of Zimbabwe (2001) is therefore clamouring for the adoption of an Integrated Catchment

Management (ICM) approach to water and natural resources management as this would facilitate easier integration of institutions and agencies of government involved in water and environmental management. Integrated Catchment Management (ICM) is defined by Manzungu (2002: 166) as “...a holistic natural resources management system comprising interrelated elements of land and water in a river basin managed on an ecological and economic basis.” Integrated management of water resources and the environment as postulated by Somura *et al* (2008) is very crucial to sustainable use of natural resources in all river basins. There is a general consensus among experts that there is need for greater collaboration in environmental management between environment and water institutions in issues that affect water. The Government of Zimbabwe supports the fusion of functions of subcatchment councils together with those of natural resources sub-committees as a way of improving natural resources management (Government of Zimbabwe, 2001). Sustainable environmental management should therefore integrate all those involved in rural development who include government departments, Non Governmental Organisations (NGOs), political parties, churches and communities (Naome *et al*, 2012). Environmental monitoring needs to be adopted as an approach to rural development to protect against further environmental degradation as this greatly affects watershed management (Chifamba, 2011).

2.12 CHAPTER SUMMARY

In this chapter, water and environmental management from a global to the local perspective was discussed. Sediment and water quality monitoring was looked at as these are very relevant to water resources and environmental management. Issues of integrated water resources management and integrated environmental management were closely looked at to see how they are linked.

Governments in developing countries have tended to prioritise more the derivation of economic benefits at the detriment of the environment. This has seen environmental management issues being politicised to great lengths. Though ecosystems approaches seem to result in greater environmental sustainability, their adoption and

implementation has been marred by inconsistencies. According to Manzungu (2002), the Integrated Environmental Management (IEM) approach favours land as opposed to water resources. As such, there was a proposal to adopt Integrated Catchment Management as an alternative to both IWRM and IEM (Government of Zimbabwe, 2001). Naome *et al* (2012) however noted that all over the world, the IEM approach has either been misunderstood or rather ignored despite its many benefits. Most researchers were in agreement with the notion that stakeholders in environmental management have not been afforded enough opportunities to participate in the management of the environment. There is however, recognisable effort by most countries to move from compartmentalised environmental management to a broad based approach that treats the whole environment as a single ecosystem. There was general consensus among authors that whichever approach might be adopted; there was still need for discussion and compromise among all stakeholders involved in environmental management to achieve sustainability. Researchers from other countries contend that catchment protection and environmental management seem to be plagued by several challenges. Among them, environmental management has been affected by overlaps and gaps in legislation and institutional responsibilities, legislation that is too technical, lack or poor enforcement of environmental legislation, lack of adequate manpower and lack of awareness among the public and project implementers (Ngah and Othman, 2010). It has also been noted among many researchers that there was very little interaction and coordination between sector ministries and departments responsible for the environment.

Researchers in integrated water resources management highlighted how stakeholders played their role towards achieving sustainable water resources management through the IWRM concept. There is however, a study gap on the IWRM-Environmental Management nexus as well as the meeting point of these two concepts. The study therefore strived to bridge the gap between environmental management and water resources management so as to enhance their management at river basin level. Very few researchers have studied the environment-water institutional and stakeholder interactions hence this study is of great importance to the study area and country at large.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter presents the data collection and analysis techniques employed in the study. The chapter firstly looks at the research paradigms and then the methodological approach for the study. The concurrent mixed methods design as well as an adapted relevant model are discussed. Sampling, data collection and data analysis techniques employed in the study are also explained. The chapter also discusses the ethical considerations which were observed while conducting the research as required by the Policy on Research Ethics of the University of South Africa.

3.2 PHILOSOPHICAL APPROACHES

Philosophical approaches to research are referred to as; worldviews, paradigms, epistemologies and ontologies and rather broadly conceived research methodologies (Creswell, 2009). It is important to understand that there is a motivation behind every research. Gwimbi and Dirwai (2003) note that philosophy helps in providing a theoretical basis on which findings are justified. Some of the most popular philosophical approaches; defined by Creswell (2009) as a basic set of beliefs that guide action are postpositivism/positivism, constructivism, advocacy/participatory, pragmatism and feminism (Gwimbi and Dirwai, 2003; Creswell, 2009). Postpositivists employ a deterministic philosophical approach in which they believe that causes determine effects or outcomes. As such, they make use of empirical observation, measurement and theory verification through tests and experiments (Creswell, 2009). Gwimbi and Dirwai (2003) state that Participatory Action Research (PAR) seeks to address power and representativeness issues to make sure that the subjects become part of the research process. The pragmatism worldview or philosophical approach was very appropriate for this study since it is real-world

practice oriented and problem centred (Creswell, 2009). This approach is ideal for both quantitative and qualitative research techniques hence exhaustive in seeking to answer the research problem (Creswell, 2009).

3.3 RESEARCH DESIGN

Research design is defined as “...systematic and organised effort to investigate a specific problem that needs a solution” (Sekaran, 1992, p 4). The three main research designs are quantitative, qualitative and mixed methods (Creswell, 2009). Quantitative research designs employ quantitative and statistical methods in data collection and analysis while qualitative ones are sometimes referred to as mere descriptive (Gwimbi and Dirwai, 2003). However, Silverman (2007) argues that qualitative research allows the revealing of local practices after having assembled end products which include descriptions and files. The technique was therefore very relevant to the study of local practices in environmental management at river basin level.

There are about six kinds of qualitative studies that are covered under the qualitative research design. These include case studies, ethnographies, phenomenological studies, grounded theory studies, content analysis and historical research (Leedy and Ormrod, 2005). Some of the studies are described by (Leedy and Ormrod, 2005;) as:

- v A case study is an in-depth study of a particular individual, program or event for a particular period of time.
- v In ethnography, the researcher studies an entire group especially a cultural one. The studies are done in the natural setting for lengthy periods of time
- v Phenomenological studies endeavour to understand through in-depth and lengthy interviews, subjects' perceptions and perspectives of a situation or event.
- v Grounded theory studies essentially start from a point where the researcher has no theory on the subject and then collects and analyses data to come up with a theory.

- v Content analysis is a very detailed study that examines contents of data and material in order to identify patterns, themes or any form of bias.

A mixed methods design employs both qualitative and quantitative approaches in data collection and analysis (Creswell, 2009). Mixing research methods improves the quality of research outputs through limiting bias which is unavoidable in both qualitative and quantitative research designs (Creswell, 2007). Creswell (2009) describes the three general strategies used in mixed methods design as:

- v Sequential mixed methods procedures are used when the researcher wishes to elaborate results obtained through one method. The researcher can start with either the qualitative or quantitative method. It is important for testing a theory or concept or for the generalisation of research results to a wider population.
- v Concurrent mixed methods design is when the researcher mixes both qualitative and quantitative data at the same time so as to better analyse the research problem or understand the outputs.
- v Transformative mixed methods procedures are used when the researcher employs a theoretical lens to look at the topic, data collection methods and expected research outcomes. The data collection method would involve either a sequential or concurrent approach.

A concurrent mixed methods design was therefore employed for this study as the research looked at both quantitative and qualitative data. Mixed methods design allows for the triangulation of data, methods and theories of research thereby allowing convergence of research findings and hence boosts research credibility (Hesse-Biber and Leavy, 2011). The approach makes maximum benefits of each method while reducing their shortcoming as well as allowing for the clarification and explanation of results of quantitative data through the use of narratives and dialogue (O'Leary, 2010).

This study involved the collection and analysis of river sediment load and physical and chemical water quality parameter data as well as qualitative data (collected through questionnaires and interviews) from water and environmental management institutions and stakeholders. As such, it was prudent in this study to employ both qualitative and quantitative techniques for data collection and analysis. The research

problem and results were better understood since the qualitative and quantitative designs complement each other under the mixed methods research design (Hesse-Biber and Leavy, 2011). The study therefore followed the model in Figure 3.1 below:

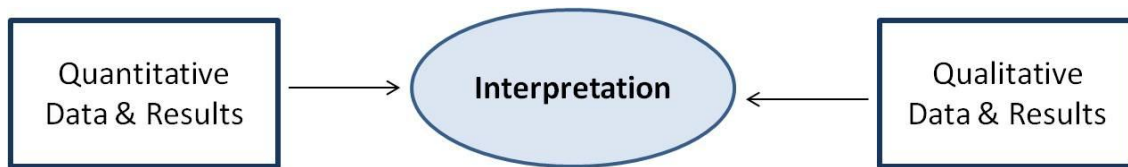


Figure 3.1: Concurrent mixed methods research model (Source: Creswell and Clark, 2011)

3.4 POPULATION AND SAMPLING

Melville and Goddard (1996) define a population as a group that is being researched on and a sample as a subset which is representative of the population concerned. O’Leary (2010: 161) defines a population as; “The total membership of a defined class of people, objects and events.” Respondent groups are often numerous and diverse hence there is need to choose the right respondents for a study and this can be done through sampling from a population so that there is representation of the whole population or group (O’Leary, 2010). Sampling is a very important step in conducting research since the researcher cannot analyse the whole population and cannot be in more than one place at any given time (Leedy and Ormrod, 2005).

The Pungwe River basin covers 17 wards in Mutasa District and two other wards in Nyanga district (Zimstat, 2012). The study therefore targeted the 17 wards in Mutasa district since the other two wards in Nyanga district are within the Nyanga National Park. This was due to the reason that wards in the national park had no environmental management committees since there were no villagers staying in the park. The study firstly used the stratified sampling technique. Research subjects were classified under groups like water management structures, environmental management structures and ward environmental management committees. Thereafter purposive sampling was used to identify appropriate respondents from the various groups. Chairpersons of ward environmental management committees,

PSCC Outreach Officer, ZINWA Hydrologist, ZINWA River Inspector as well as Natural Resources and Environmental Officers from Mutasa RDC, Mutasa DA and EMA were identified as respondents from the water and environmental management institutions. The purposive sampling technique was very useful as it allowed for a balance among these various groups of respondents to be selected (Black, 2009). Interview respondents were therefore selected from those with the knowledge, experience and expertise in a field relevant to the study (O'Leary, 2010).

3.5 DATA COLLECTION

Both primary and secondary data were collected for the study. The data were collected through tools like questionnaires, written documents, interviews and databases of historical data (Leedy and Ormrod, 2005). Primary data sources included interviews conducted with ZINWA Catchment Hydrologist and Coordinator, River Inspector and PSCC Outreach Officer. Self administered questionnaires were used to collect primary data from Mutasa DA, Mutasa RDC, EMA Manicaland Province and Ward Environmental Management Committee Chairpersons (Kumar, 2012). Secondary data in the form of written documents and databases were obtained from PSCC, ZINWA, Mutasa RDC and EMA which are the main water and environmental management institutions in the study area.

3.5.1 Questionnaire

According to Melville and Goddard (1996), a questionnaire is a printed list of questions which respondents are requested to answer. Questionnaires were very beneficial to the study since they could be left with the respondent and hence afforded the respondent an opportunity to complete them in their own spare time. Both structured and unstructured questions were used for the study. Questionnaires were used to collect information relating to the roles and responsibilities of water and environmental management institutions. They sought to establish the interface of these organisations and how they interacted in their day to day operations. One questionnaire was used to collect specific information or data from Ward Environment Committee Chairpersons about the roles and responsibilities of the 17

ward environmental management committees, their terms of reference, composition, objective, reporting structure and their interface with ZINWA and PSCC who are the water management institutions for the Pungwe River basin. Another questionnaire was administered to EMA, Mutasa DA and Mutasa RDC who are seized with the task of implementing the EMA Act either directly or through their environmental management and natural resources committees. This questionnaire which was administered to three key respondents collected information regarding the roles and responsibilities of these institutions, their mandates and how they interact with other stakeholders in their operations. All questionnaires were self-administered. A total of 20 questionnaires were therefore administered to environmental management institutions targeting the Ward Environmental Management Committee Chairpersons and experts from the three environmental management institutions in the basin. Respondents were drawn from across the whole basin hence the sample was very representative of the population of study.

3.5.2 Interviews

Asking the right questions always help in avoiding distortions in collected data (Holstein and Gubrium, 1997). Interviews are defined as special forms of highly structured, standardised, qualitative oriented surveys and semi-formal conversations (Holstein and Gubrium, 1997). Leedy and Ormrod (2005) mentioned that interviews in most cases do yield a great deal of important information. Interviews were used to collect additional data as well as corroborate trends emerging from the analysis of secondary data contained in reports and databases. Two face to face and one telephone interviews were held with officials from ZINWA and PSCC which are the two main water management institutions in the Pungwe River basin. Among its roles; PSCC is also responsible for catchment planning, monitoring of waste discharge and promotion of catchment protection (Nyikadzino *et al*, 2014). On the other hand ZINWA is mandated to practice integrated water resources management consistent with environmental approaches (Government of Zimbabwe, 1998a). So the interviews were also used to collect information on the roles of ZINWA and PSCC as well as their expectations from EMA and Mutasa RDC who deal with environmental management in Mutasa District. The interviews also looked at the challenges or

successes of environmental management structures and the general framework for addressing environmental problems with an impact on water quality and quantity. The respondents to the interviews were specialists in their areas of operations and as postulated by O'Leary (2010); they added value to the area of study due their experience. Three interviews were therefore held with water management institution experts from ZINWA and PSCC who work with stakeholders in water resources management on a daily basis. The three respondents were best suited to present the challenges water management institutions faced in their quest to achieve sustainable water resources management in the basin.

3.5.3 Secondary Data (Documents/Records)

Documents are standardised artefacts which might appear in many formats that include; notes, case reports, statistics, annual reports etc (Wolff, 2004). One very good way of understanding how organisations work can be achieved through reading written documents like minutes of meetings and reports (Atkinson and Coffey, 1997). Data contained in documents like water quality, sediment sample and river runoff databases were consulted for this study. River sediment load database for the Pungwe River basin was obtained from ZINWA's Research and Data Department which collects and archive such data. Water quality test results for the same river system were provided by EMA while reports of environmental problems and interventions applied were provided by Mutasa RDC, PSCC, ZINWA and Ward Environmental Management Committees since they are the ones dealing with water and environmental management on the ground. Acts and other pieces of legislation providing for the establishment and functions of both water and environmental management structures were obtained from The Government Printer through Printflow who distributes such documents. These Acts include; Water Act, ZINWA Act, EMA Act, Traditional Leaders Act, Urban Councils Act, Parks and Wildlife Management Act and RDCs Act.

3.6 DATA ANALYSIS

Pieces of legislation that deal with environmental management were reviewed and the provisions of each analysed. However, much emphasis was placed on the EMA and Water Acts which are the principal laws on environment and water resources management. Available literature on the composition and terms of reference of environmental management committees were analysed in-order to clearly understand their responsibilities and limitations being faced in their endeavours to combat the deterioration of the country's water resources.

Qualitative data need first to be carefully prepared and organised before being arranged into themes by putting codes on the various fields (Creswell, 2007). Data collected through questionnaires and interviews; which was mostly qualitative was after coding, condensed under various themes for presentation in tables, figures as well as in discussion form (Creswell, 2007). Descriptive statistics which include numerical count of frequencies, percentages, measures of central tendency (i.e. mean, mode and median) and measures of variability (i.e. range, standard deviation and variance) were used since they are commonly used for describing raw data (Taylor-Powell, 1996).

Data on environmental problems collected from environmental and water management authorities were also analysed. Physical and chemical water quality parameters i.e. pH and turbidity were analysed from secondary data obtained from EMA to trace over time the deterioration or non-deterioration of water quality in the river basin. The data on river sediment load in the Pungwe River as it exits Zimbabwe gave an idea of landuse practices upstream. These data were analysed using the Mann-Kendall test which is a widely used rank based non-parametric statistical test for trend analysis (Gumindoga *et al*, 2012). Regression analysis was then used to understand/predict the trends in environment and water quality. Results of the analysed data were presented through the use of tables, graphs, charts and equations. Water quality and river sediment load data were very important in bringing to the fore the effectiveness of stakeholder institutions in averting and

addressing environmental and water resources management problems. Leach *et al* (1999) adds that environmental degradation reflects the failure of local communities in managing their natural resources.

3.7 ETHICAL CONSIDERATIONS

The study observed ethical research practices and complied with the research ethics approved by the University of South Africa (UNISA). Ethical clearance was granted by the College of Agriculture and Environmental Sciences of UNISA and was duly awarded the green light to proceed with the study. The study was therefore conducted following guidance of the Policy on Research Ethics of the University of South Africa.

3.8 CHAPTER SUMMARY

This chapter outlined the research design and the methodology for the study. The sampling techniques and data collection tools like questionnaires and interviews were discussed, as well as source of secondary data which include written documents, databases and pieces of legislation. The next chapter will present and analyse results of the study.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents results and discussions of the responses from environmental management institutions, water management institutions as well as data from water quality and sediment load databases. The results are presented in the form of tables, graphs, charts, equations and in discussion form. An effort to reveal the relationship between water quality parameters and sediment load is made at the end of the chapter.

4.2 PROFILE OF RESPONDENTS

4.2.1 Stakeholder Structures for Environmental Management in the Pungwe River basin

Stakeholders in Environmental Management in the Upper Pungwe River basin are grouped under ward environmental committees. Of the 17 Ward Environmental Committees, 12 are properly constituted and hence functional. The other five committees have not been operational since the beginning of the year and as such there were no responses received from those wards.

Table 4.1: Gender Aggregation of Respondents

Male	Female	TOTAL
6	6	12

(Source: Survey results)

There were six male and six female respondents to the questionnaires. There was therefore equal representation between men and women among the chairpersons of environmental management committees in the basin (see Table 4.1).

The committees were chaired by both the young and elderly as the chairpersons included those below 25 and above 50 years of age (Figure 4.1). Six Committee Chairpersons had been with the environmental management committees for less than two years while five had been in the committees for between two and five years (see Figure 4.2). One Chairperson had stayed beyond five years as indicated on Figure 4.2). The committees therefore make use of both youths and experienced persons in environmental management in the Pungwe River basin. While the committees had an equal representation of men and women as well as the incorporation of the youth within their structures, this research was limited in that it did not examine how those special interest groups were catered for.

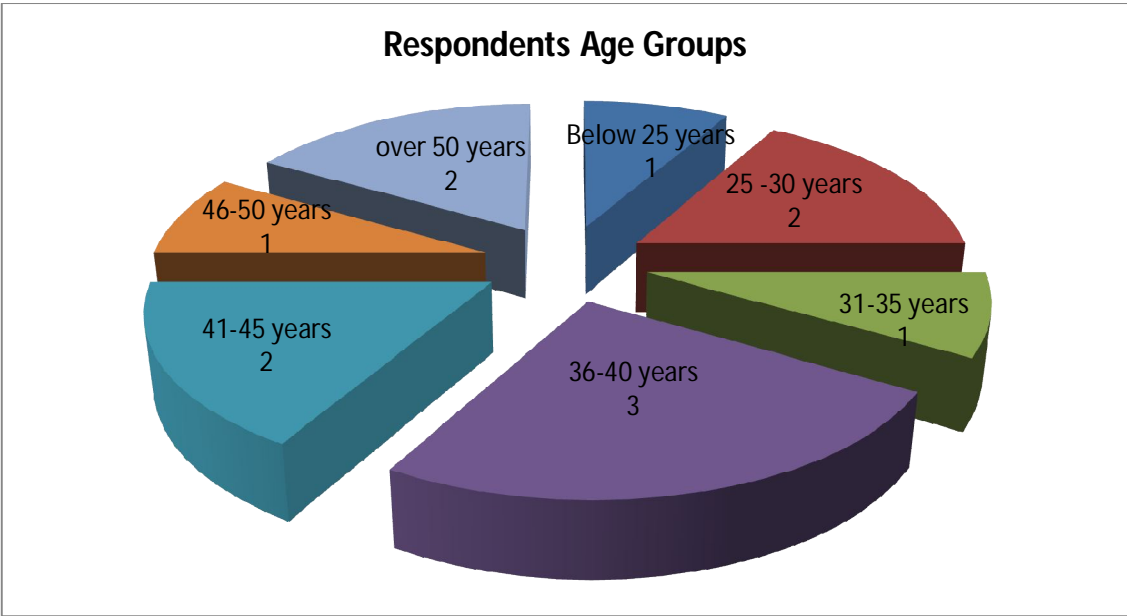


Figure 4.1: Age groups of respondents (Source: survey results)

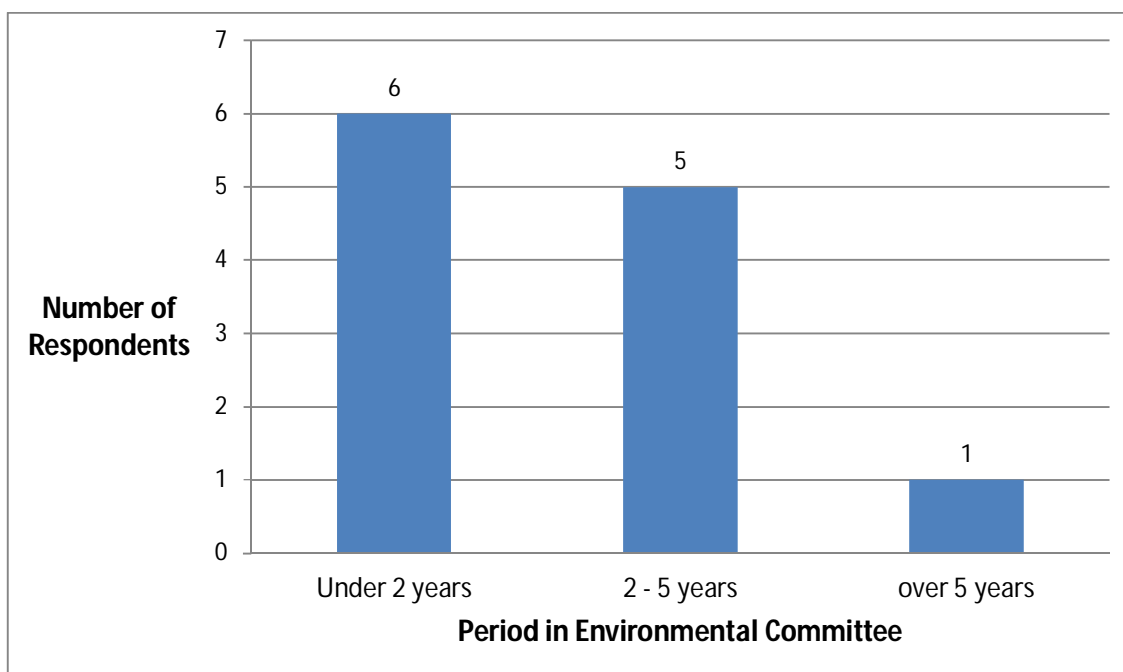


Figure 4.2: Respondents' Experience in Environmental Committees (Source: survey results)

4.2.2 Environmental Management Institutions in the Pungwe River basin

Three questionnaires were self-administered to environmental management experts from Mutasa Rural District Council, EMA Manicaland Province and Mutasa District Administrator. All the questionnaires were received back from the respondents. The respondents from the three Environmental Management Institutions in the Upper Pungwe River were all male with at least 10 years experience in environmental management.

4.2.3 Water Management Institutions in the Pungwe River basin

Three integrated water resources management experts from the ZINWA, Save Catchment and Pungwe Subcatchment Council were interviewed. The respondents from water resources management institutions in the basin were all male composed of both new and long serving employees. The Hydrologist had been with the

organisation for four years while the River Inspector and PSCC Outreach Officer both had over 10 years of experience.

4.3 INSTITUTIONAL INTERACTIONS FOR ENVIRONMENTAL MANAGEMENT

4.3.1 Ward Environmental Management Committees for stakeholder participation in environmental management

Chairpersons indicated that they were seconded by their relevant stakeholder groups or institutions to ward environmental management committees. Ninety percent of the Chairpersons responded that they represented a particular stakeholder group in the ward environmental management committees. The stakeholders who were said to have seconded members included Local Authorities, Traditional Leaders, Government Departments and Communities or Villages in the wards. Two respondents did not however complete the question. Generally there was consensus among the environmental management committee chairpersons that they became members of these committees after being nominated or elected by their stakeholder groups.

4.3.2 Functions of Ward Environmental Management Committees

The respondents indicated that Environmental Management Committees in the wards were responsible for various purposes. Eleven out of 12 chairpersons responded that the committees were there for environmental and natural resources management. The 11 chairpersons clearly spelt out the purpose of ward environmental management committees as for; environmental advocacy, policy formulation and action planning, protection of natural resources and overall environmental management.

4.3.3 Institutional Roles and Responsibilities in Environmental Management in the Pungwe River basin

The EMA's role was given as that of ensuring sustainable management of the Pungwe River basin through combating pollution and land degradation. Mutasa RDC gave their role as that of educating the community on sustainable management of the river basin as well as issuing out permits for "sustainable" mining. The Ministry of Local Government's District Administrator's Office indicated that the role of the department was that of coordinating, monitoring, evaluating, regulating as well as advising institutions and all the people on programmes and projects in the basin.

The Pungwe Subcatchment Council was at the centre of both environmental and water resources management in the basin. The PSCC liaised with the EMA, Mutasa RDC, Mutasa DA, the ZINWA, the AREX and other government departments or agencies in their day to day operations. The PSCC could resolve any problems with the relevant department or agency and could fully enforce laws on illegal water abstraction without referring the issue to any government department. The PSCC also indicated that it first of all conducted some awareness campaigns to the people before invoking the provisions of the law. The PSCC was said to be representing stakeholders in integrated water resources management so as to achieve sustainability.

The ZINWA and Save Catchment Council worked hand in hand with the same institutions the PSCC engaged with. They also engaged with the EMA, the AREX, the Ministry of Lands and other government departments though at a provincial level to make sure that the said environmental problems were addressed.

The ZINWA's duty in environmental management in the basin was given as that of catchment protection and to ensure effective management and utilisation of water resources. Management and utilisation of water included monitoring water flows, permitting for water use, equitable distribution of water and flood and drought monitoring.

4.3.4 Water-related environmental problems in the Pungwe River basin

Environmental management experts concurred on the most common environmental problems in the basin and these were given as:

- v Siltation
- v Stream bank cultivation
- v Gulleys
- v Eutrophication
- v Water pollution

Stream bank cultivation was identified as the catalyst for the other environmental problems as it resulted in high rates of erosion and sedimentation, eutrophication and water pollution. Due to the rocky and mountainous environment of the river basin, there was a very high population on the land thus people tend to farm very close to the streams disregarding the recommended minimum distance of 30m as stipulated by Statutory Instrument 7 of 2007 (Government of Zimbabwe, 2007). Human activities on the land were pointed out as the major cause of water resource degradation. This has been compounded by shortage of land, need to cultivate closer to the water source and search for fertile soils by villagers in the river basin.

4.3.5 Institutional practices in addressing water-related environmental problems in the basin

Water resources management institution experts identified pollution and siltation of especially the Nyamukwarara and main Pungwe Rivers as being caused by stream bank cultivation and alluvial gold panning. These harmful activities were being said to be driven mostly by poverty in the community and a perceived lack of alternative livelihoods since not much had been done to lure people away from these land degrading activities. Climate change and the opening of more land for irrigation were given as the reasons for declining river flows and water shortages. Water shortages resulted in another problem of water conflicts with the PSCC recording on average 12 conflicts in a year thus one conflict every month. These problems were normally handled by the relevant government department or agency responsible for the resource. These include the EMA, the ZINWA, the PSCC, Traditional Leaders with

the active participation of stakeholders and development partners like Pungwe Programme.

Receding river flows and change of course by rivers is a manifestation of most of these environmental problems (See Figure 4.3). The ZINWA monitor water flows at strategic points through the use of gauging stations and these gave an indication of water flow trends. A general rise in water conflicts could also be an indication to a rising water shortage problem. On the ground the PSCC had two Outreach Officers who patrolled the main Pungwe River and its tributaries monitoring water use and any harmful activities.



Figure 4.3: Gauging plates silted up at F24 Hydrological Station (*Source: Field surveys*)

The EMA indicated that it had Environmental Monitors who moved around the whole basin looking for any signs of environmental degradation. The Water Quality Section under the EMA also conducted periodic sampling at designated ambient water quality monitoring points in the basin. The Environmental Management Agency felt that the EMA and the ZINWA should together address all water-related environmental problems through the PSCC.

Mutasa DA received environmental problems from various stakeholders who included the EMA, Traditional Leaders, Mutasa RDC, Conservation Officers, Ward Enforcers, Forestry Commission, Estates, the ZINWA, PSCC, Department of Agriculture and Extension Services and Department of Irrigation. Since the District Administrator supervised all government departments in the basin, all the water and environmental management institutions reported to the department. The District Administrator being the Local Government head in the district addressed all environmental problems through the various stakeholders which included the local traditional leadership and the relevant government departments. The District Administrator was therefore responsible for mobilising all government departments, parastatals and other stakeholders and encouraging them to be pro-active and play their roles as expected by government.

4.3.6 Effectiveness of water and environmental management structures and institutions in the basin

The three main environmental management institutions in the Pungwe River which are the EMA, Mutasa RDC and Mutasa DA indicated that their institutions were very effective in combating siltation and pollution of the river. The environmental awareness campaigns conducted by these institutions as well as enforcement of regulations were said to be directed towards addressing water-related environmental problems.

Water management institution experts indicated that environmental management structures were very effective as they were platforms for stakeholders to present their environmental concerns to the various government departments and agencies. They also contended that these structures allowed for reporting environmental problems by stakeholders though not much action was then taken by environmental management institutions to address the raised problems. They preferred to have these issues addressed under one institution. One water resources management expert who was interviewed said;

“Having water resources management including level monitoring and allocation in one organisation and then water quality monitoring in another seem not to be very

effective in advancing sustainable water resources management” (Interview Respondent).

4.3.7 Engagement of environmental and water resources management institutions in addressing water-related environmental problems

Due to the fragmentation of environmental regulations in Zimbabwe, there was need to engage a number of stakeholders in environmental management so that all identified problems could be attended to. Seven out of 12 (58%) chairpersons of ward environmental management committees responded that they engaged all environment and water management institutions in the basin. More chairpersons engaged environmental management institutions than those who engaged water management institutions. Ten Chairpersons engaged both the EMA and Mutasa RDC while the ZINWA and PSCC were engaged by nine and seven chairpersons respectively. The results showed that there was much engagement between the EMA and Mutasa RDC; and the ZINWA than with the PSCC. Institutional engagement for improved environmental management was therefore less intensive at lower levels of the environmental management structure.

Only two out of nine chairpersons of ward environmental management committees indicated that they would refer water related problems to water management institutions. Seventy eight percent of the Chairpersons who answered the question responded that they either deliberated the issue at their committees or referred it to environment and land management institutions that include AREX, the EMA, Forestry Commission and Mutasa RDC. The lack of consistency in the handling of water related problems by stakeholder institutions could be attributed to the multiplicity of water and environmental management institutions in the upper Pungwe River basin thus creating overlaps and gaps in the implementation of environment and water regulations. This could also be due to lack of clarity or understanding among the stakeholder institutions of the roles and responsibilities of the other institutions in the basin.

The ZINWA indicated that there was constant engagement between themselves and Mutasa RDC. Mutasa RDC was a member of the Pungwe Subcatchment Council to which ZINWA was the secretariat. They therefore engaged with each other during full council meetings held in the basin. The issues of environmental management with a water impact were then tabled and discussed. PSCC added that apart from Mutasa RDC, EMA was also engaged as problems arose and was religiously expected to attend all PSCC full council meetings as resource persons. There seemed to be constant engagement between environmental management and water management institutions. Water management institutions felt that much should be done in terms of collaboration to enhance water and environmental management in the basin.

Mutasa RDC recognised the importance of PSCC and ZINWA for addressing water-related environmental problems. Generally there was consensus among the respondents on how water-related environmental problems were handled in the basin. Mutasa RDC stated that they carried out awareness campaigns through meetings as well as enforcement of the provision of SI 7 of 2007 in combating water resource degradation. This was the same method that the EMA mentioned that they used. Water management institutions in the basin which were said to be consulted or engaged were the ZINWA and the PSCC.

4.4 WATER QUALITY TRENDS IN THE PUNGWE RIVER

Water quality data covered the period January 2003 to March 2013. However, there was more data coverage on pH results than for turbidity. There were no data available for the period 2007 to 2009. This was the period when water quality monitoring activities were transferred from the ZINWA to the EMA after the enactment of the EMA Act (20:27) and the coming into operation of the Environmental Management Agency in 2007 (EMA, 2014).

Between the year 2003 and up to the beginning of 2006, pH levels were generally below seven thus were on the acidic side (See Figure 4.4). This could be attributed to harmful agricultural practices in the catchment area. From 2012 to late 2013, pH levels steadily moved above seven however, the trend analysis was affected by lack

of data between the years 2007 and 2009 as shown in Figure 4.4. Turbidity levels ranged from 12.1 to 0.09 for the period 2005 to 2013. Turbidity rose from 2.15 in the year 2003 to 12.1 in the year 2005 (See Figure 4.5). Turbidity in the Pungwe River then started declining to 0.09 which was recorded in the year 2013 as shown on Figure 4.5. The drop in turbidity levels could be attributed to lower river runoff levels recorded towards the end of the study period (See Figure 4.9). Mann-Kendal analysis ($p>0.05$) performed on both turbidity and pH data indicated that there was no statistically significant trend detected in the data.

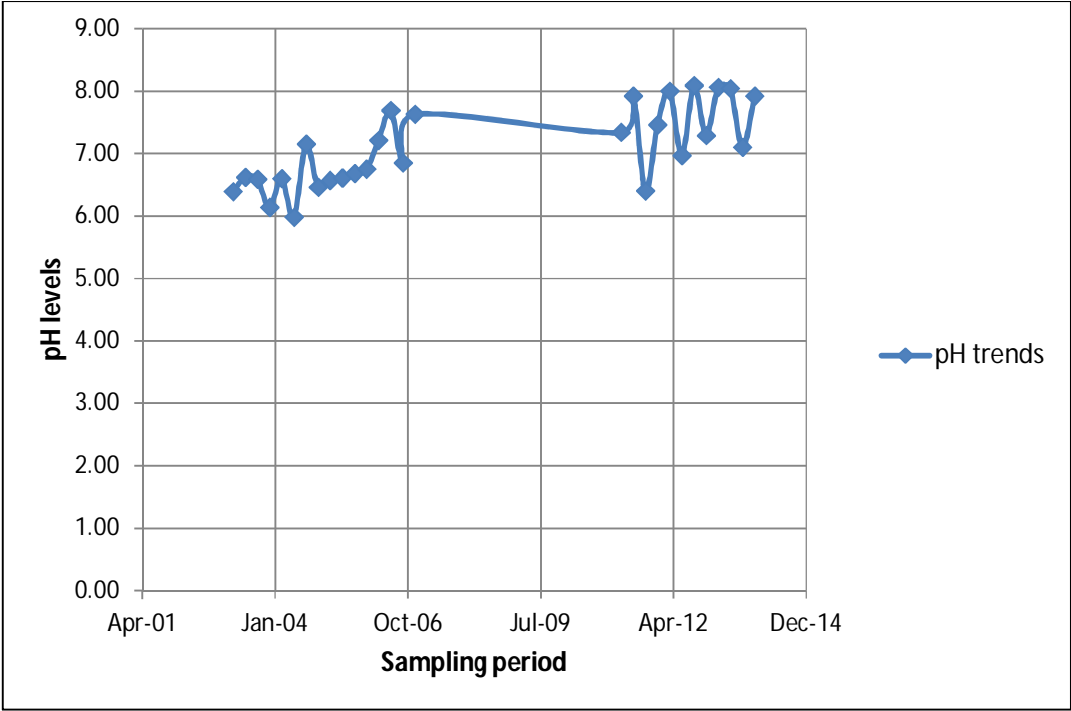


Figure 4.4: pH trends in the Pungwe River
Database, 2015)

(Source: EMA Water Quality

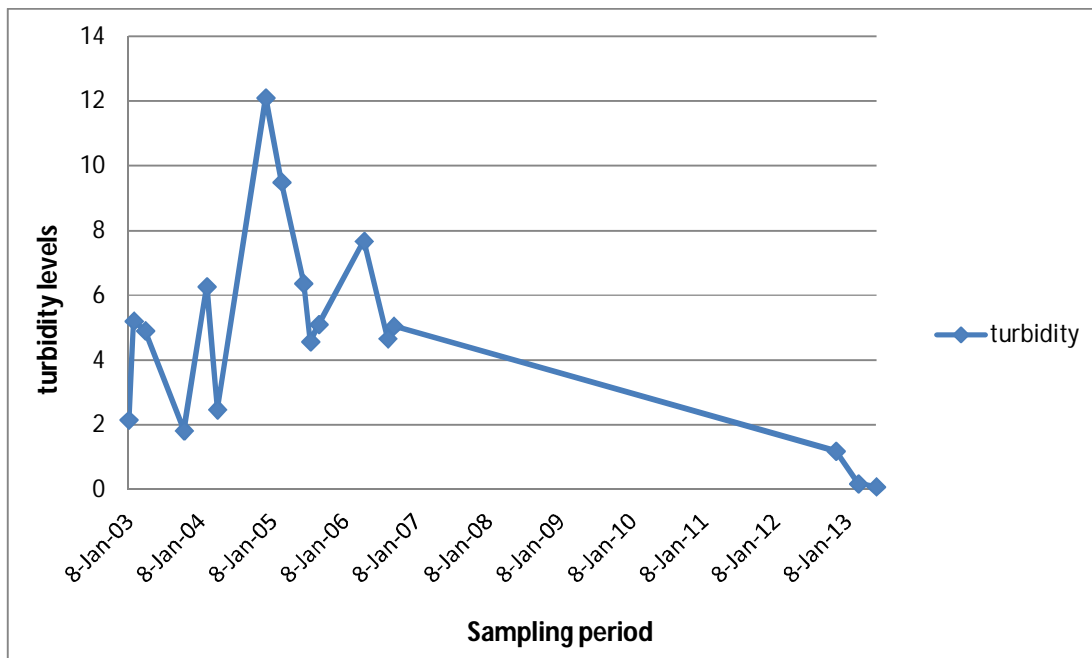


Figure 4.5: Turbidity levels in the Pungwe River (Source: EMA Water Quality Database, 2015)

4.5 RIVER SEDIMENT LOAD OF THE PUNGWE RIVER

Sediment load data for the F22 hydrological station were collected as from the 2001/02 up to the 2012/13 hydrological season. The available dataset for the station had no data as from the 2008/09 up to 2011/12 season.

Annual sediment load in Pungwe River as recorded at F22 Hydrological gauging station peaked to 131,720 tonnes during the 2005/06 hydrological season (See Figure 4.6). The lowest level of 1,352 tonnes was recorded the following year during the 2006/07 season. Generally the sediment loads were between 10,000 tonnes and 40,000 tonnes in five seasons hence there were three outliers of 118,681; 131,720 and 1,352 tonnes. The mean river sediment load for the station was 45,366 tonnes and the standard deviation was 50,576 tonnes.

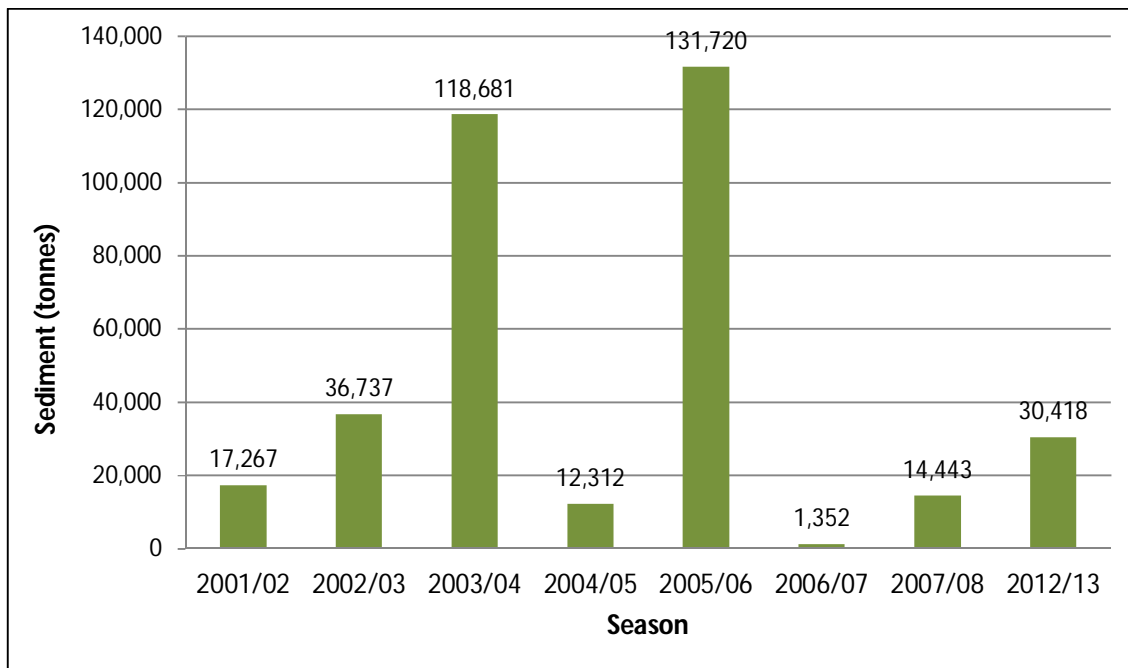


Figure 4.6: Annual sediment load at F22

(Source: ZINWA Sediment

Load Database, 2015)

Monthly sediment load reveals the same trend with the annual one (See Figure 4.7). The monthly sediment loads for the eight seasons have levels of below 40,000 tonnes however, as the same with annual loads; there were two figures of 102,407 and 118,568 tonnes for seasons 2003/04 and 2005/06 respectively which distorted the general trend of the graphs (See Figure 4.7). The high sediment level for the 2005/06 season could have been as a result of flash flooding as 280,000m³/sec which was 85% of the annual runoff of 330,000m³/sec passed through the F22 station in the month of March 2006 only (See Figure 4.8). The mean monthly sediment load for the six month sampling season was 7,561 tonnes with a standard deviation of 22,832 tonnes. Mann-Kendal analysis ($p > 0.05$) indicated that there was no statistically significant trend detected in the data

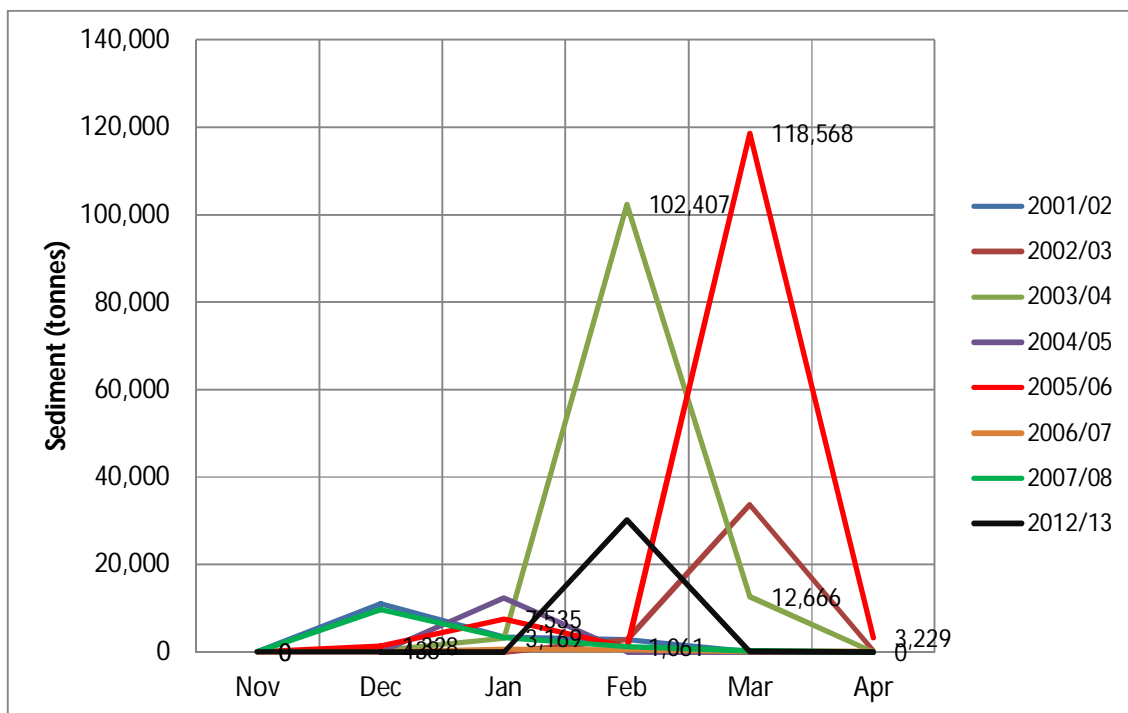


Figure 4.7: Monthly sediment load at F22

(Source: ZINWA Sediment

Load Database, 2015)

4.6 RUNOFF TRENDS IN THE PUNGWE RIVER

The runoff database had data for 17 hydrological seasons. The data covered the period 1996/97 up to 2012/13. The dataset had less than 10% gaps and covered all the high and low flows in the period of study.

F22 Pungwe Katiyo hydrological gauging station showed the monthly runoff totals for the period 1996/97 to 2012/13 as shown in Figure in 4.8 below. The season starts in October and ends in September of the subsequent year. Flows for season 1996/97 only covered two months since it is when the station was opened.

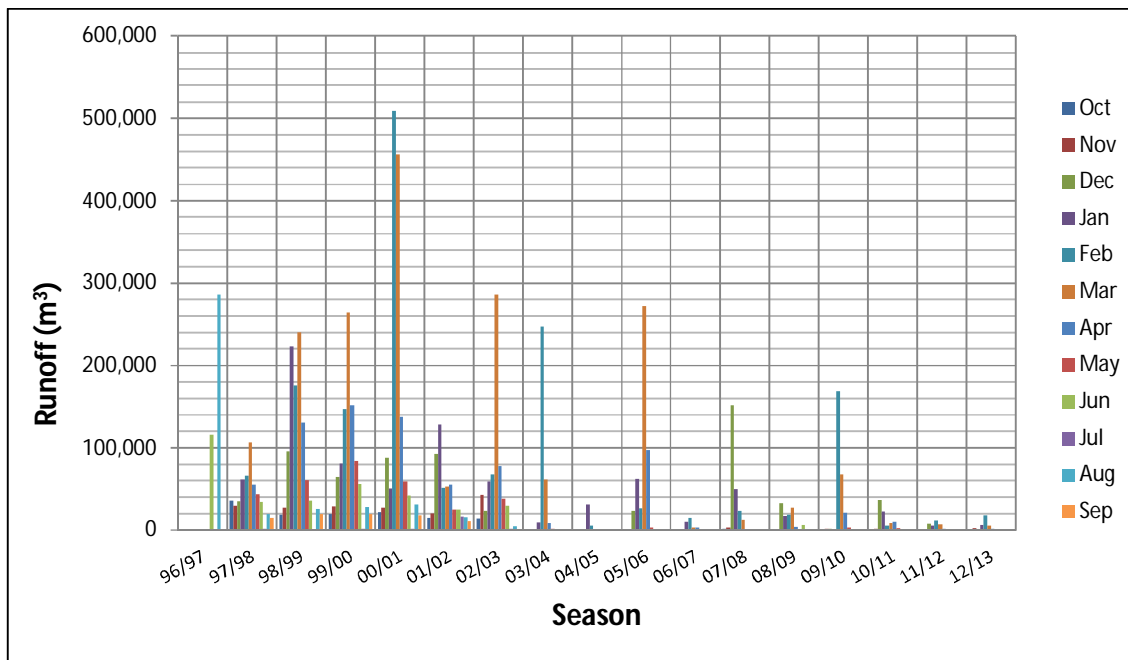


Figure 4.8: F22 Pungwe Katiyo monthly runoff *Source: (ZINWA Runoff Database, 2015)*

Figure 4.8 shows that since 1996/97 hydrological season when the station was opened, flows had been receding. The long term hydrograph also indicated a slump in the magnitude of peak flows from one season to another due to the changing rainfall patterns.

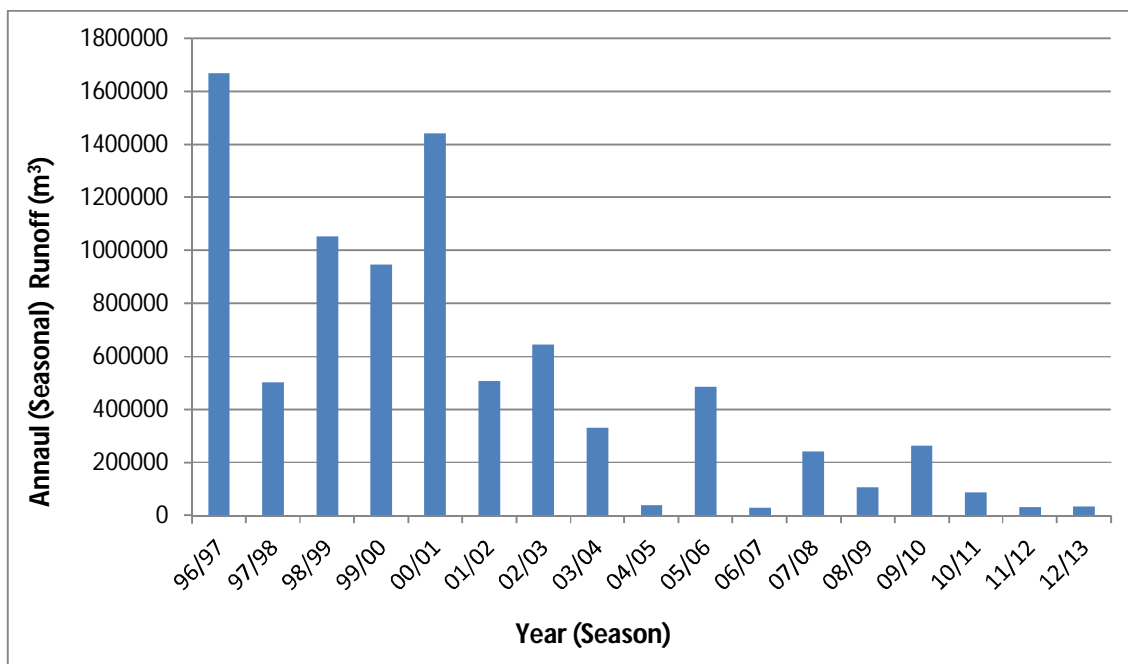


Figure 4.9: F22 Pungwe Katiyo annual runoff **Source: ZINWA Sediment Load Database 2015**

Annual flows for the 17 seasons recorded at the station peaked during the 1996/97 season and have been receding ever since (See Figure 4.9). The flows exhibited a similar trend to that of monthly flows. The maximum annual flow recorded was 1,669,338m³ while the minimum was 31,306m³. The mean annual flow was 495,613m³ while the Standard Deviation for the flows was 507,692m³.

4.7 RELATIONSHIP OF SEDIMENT LOAD AND WATER QUALITY PARAMETERS AND RUNOFF

Figure 4.10 presents a regression line and equation of the relationship between runoff and sediment load in the Pungwe River as recorded at F22 hydrological gauging station. The Figure reveals a positive linear relationship between the amount of runoff and the corresponding amount of sediments contained by the running water. With a coefficient of determination (r^2) of 0.1718, the equation cannot however predict very accurate results. The regression equation was greatly affected by two very high values of sediment load amounts in the 2003/04 and 2005/06

seasons. The figure showed that an increase in river runoff also resulted in a corresponding increase in sediments in the water.

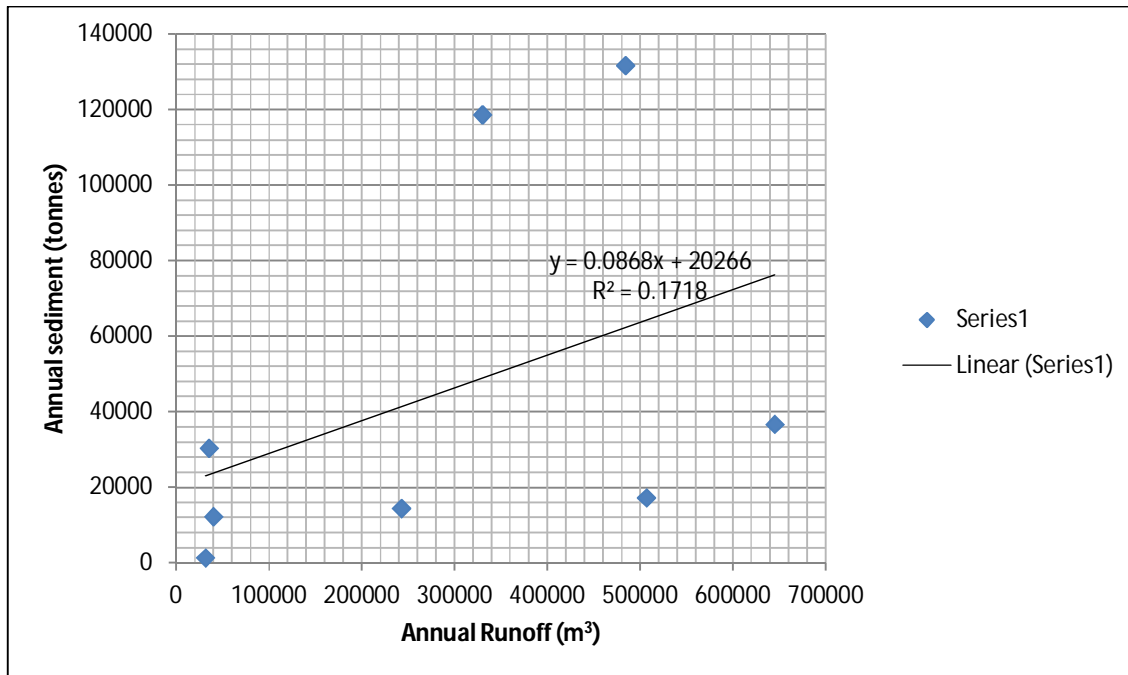


Figure 4.10: Relationship between annual runoff and river sediment load
(Source: ZINWA Sediment Load Database, 2015)

Figure 4.11 presents a regression line and equation of the relationship between pH and sediment load in the Pungwe River water. The Figure presented a negative linear relationship between pH and sediment load meaning that an increase in the amount of sediments in the river resulted in a reduction in pH values for the water. The reduction in pH towards the acidic range could be as a result of fertilisers being washed away from fields in the catchment of the river. This corroborated reports from water and environmental management institution experts of high rates of stream bank cultivation. The equation also has a very low coefficient of determination (r^2) value of 0.0329. The huge data gaps and short water sampling period greatly affected proper analysis of the water quality trends.

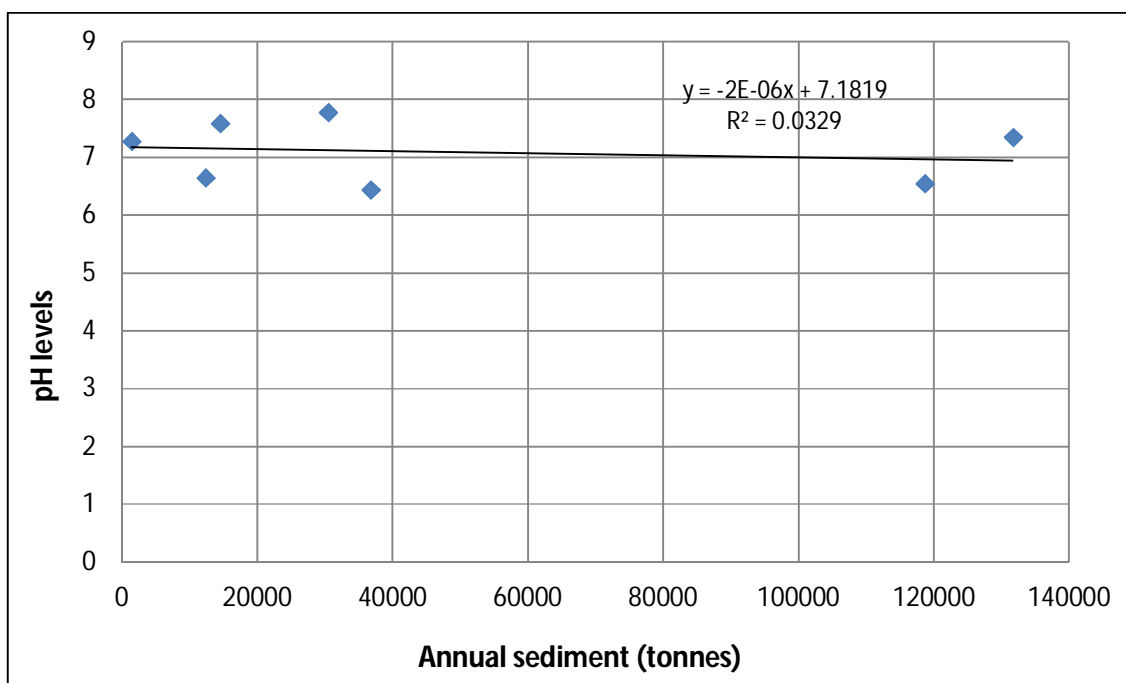


Figure 4.11: Relationship between annual sediment load and pH (Source: ZINWA Sediment Load Database, 2015)

4.8 CHAPTER SUMMARY

It is realised that ward environmental management committees in the Pungwe River basin have made great strides in addressing gender balance issues. Chairpersons of these institutions included among ordinary villagers both men and women; traditional leaders and technocrats. However, there was still need to formulate and put into operation environmental management committees in the other five wards. There was fair representation and good mix of the different age groups and experience among the environmental management committee chairpersons in the basin. Overall, the chairpersons of ward environmental management committees understood the roles and responsibilities of their committees though ZINWA and PSCC were sometimes not advised or engaged on some water-related environmental problems which some committees either handled on their own or referred to environmental management institutions.

Water and environmental management experts in Pungwe River basin concurred that the major environmental problems included; stream bank cultivation, siltation, water pollution, deforestation and water shortage. They all agreed that they engaged each other on all issues of environmental management. However, there seemed to be greater engagement of water and environmental management institutions at higher levels than at lower levels since environmental management committees' collaboration with the PSCC was mostly through either the EMA or Mutasa RDC.

Water quality data collected by EMA indicated an improvement in the quality of water in the Pungwe River. The pH levels rose from around six in late 2003 to levels of above seven in late 2013. Turbidity levels also exhibited a similar trend to that shown by pH. Sediment load levels had a positive linear relationship with runoff hence as runoff increased so did sediment load in the Pungwe River. However, land use and agricultural practices in the catchment had a great effect on the ultimate sediment load in the river. Collection of data for water resources required the institutions to be consistent in their data collection exercises.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents conclusions and recommendations of the study, summarises the research findings and suggests possible courses of action to improve environmental management in the upper Pungwe River basin. An area of further research was also suggested.

5.2 SUMMARY OF FINDINGS

The research findings have shown that local stakeholders composed of both men and women were very active in environmental management in the upper Pungwe River basin. Stakeholder structures were made up of nominated/elected individuals who represented particular stakeholder interests. Stakeholder structures were there to complement environmental management institutions like the EMA and Mutasa RDC in natural resources and environmental management.

Stakeholder structures were put in place for environmental management in the upper Pungwe River basin however, not much engagement with water management institutions was done at lower levels. The PSCC carried out both water and environmental management duties as such; it was expected to collaborate with the ZINWA and EMA in managing the upper Pungwe River basin. While the PSCC concentrated much on water resources management, the EMA focused much on environmental management as such; there was not much integration between the two institutions.

Stream bank cultivation in the upper Pungwe River basin resulted in erosion, siltation and sedimentation of water courses. High levels of stream bank cultivation and

runoff also resulted in low pH and high turbidity levels between the years 2003 and 2006. It was found that pH and turbidity levels improved especially between the years 2012 and 2013 due to low annual runoffs received during the 2012 and 2013 seasons as compared to flows for the period between 1997 and 2010.

Sediment level and water quality monitoring by water resources and environmental management institutions lacked consistence and hence presented challenges in evaluating the impact of strategies being employed. There was a lack of integration among the land/environment and water resources management institutions like the Mutasa RDC, the EMA, Mutasa DA, Forestry Commission, AREX, Department of Irrigation, Department of Physical Planning, the PSCC and the ZINWA. The lack of coordination of activities of the institutions often resulted in harmful environmental practices like stream bank cultivation and pollution to continue unabated.

5.3 CONCLUSIONS

5.3.1 Trends in physical and chemical water quality and sediment load

There was no consistency in the collection of water quality and sediment load data in the Pungwe River basin. There was a period between 2007 and 2013 when the two institutions responsible for water and the environment did not collect any data. Lack of sediment load and water quality data compromised the assessment and comparison of current and historical trends of water quality in the Pungwe River.

5.3.2 Institutional interactions in environmental management

The EMA did not take an active role in water resources management albeit as a resource person to the PSCC when attending Full Council meetings. Land resources management institutions like AREX, Ministry of Lands and Forestry Commission worked in close collaboration with the EMA and Mutasa RDC. However, there was need to improve their interaction with water resources management institutions so as to arrest stream bank cultivation, deforestation, gold panning and water pollution.

Environmental management committees tended to handle some water related environmental problems without reference to the water management institutions especially PSCC. The Office of District Administrator for Mutasa District supervised all government departments and agencies in the district hence played a central role in the coordination of water resources and environmental management institutions.

There was limited interaction among water and environmental management institutions at river basin level. This was evidenced by the constant engagement between the EMA, ZINWA and Mutasa RDC in environmental management in the Pungwe River basin while there was not much interaction between the PSCC and ward environmental management committees as shown from survey results. Institutional interactions with regards to environmental management were therefore stronger at provincial level and weaker at lower levels where the environmental resources were utilised.

5.3.3 Stakeholder participation in environmental management

Local level stakeholders were eager to ensure effective environmental management through their active participation since they lived off the environment. Women were heavily involved in environmental management as shown by their 50% representation among the committee chairpersons. Traditional leaders had a keen interest in environmental management. However, in these committees the traditional leaders tended to apply their powers according to the Traditional Leaders Act which puts all natural resources in their custody. This was observed from responses on questionnaires from environmental management committees. There was therefore need for the separation of powers and segregation of duties between these two important institutions. Local level stakeholders were therefore very much active in environmental management though it was not clear on how they engaged with the PSCC in addressing water-related environmental problems.

5.3.4 Effectiveness of environmental management institutions

Some environmental management committees were not yet established due to institutional delays and logistical challenges hence the respective wards were at a disadvantage. There was an overlap between the duties of stakeholder institutions for water resources and environmental management as evidenced by the roles for PSCC and ward environmental management committees. Zimbabwe's environmental management legislation was also marred by overlaps especially concerning the roles of institutions like the EMA, PSCC, environmental management committees, ZINWA and Catchment Councils (Naome *et al*, 2012).

Institutional roles in environmental and water resources management in Zimbabwe were too segmented with one institution responsible for quantifying water sediment load and another testing for water turbidity. This created gaps and discordance in data due to non convergence of sampling periods and institutional priorities. There was no legal and institutional framework for coordinating water and environmental management activities from a central point in the upper Pungwe River basin.

5.4 RECOMMENDATIONS

The environment/land-water relationship needs to be recognised as a very important factor in water resources management in a river basin. There is need to make sure that the institutions responsible for environment and water resources management worked close together at lower levels to ensure sustainable water and environmental management. The following recommendations are made:

- v Water resources and environmental management activities should be done under the same institution so that water quality and river sediment level monitoring is done by one institution. This would help reduce the discordance in the water level and water quality datasets
- v Legal and institutional framework for environmental management was hinged mostly on stakeholder participation hence there should be some concerted efforts to make sure that these stakeholder structures were in place down to the lower levels where much more interaction with environment and water resources takes place

- v Environmental management institutions should work closely with water management institutions like catchment and subcatchment councils which, by law, are responsible for catchment protection in the respective river basins to improve lower level interaction of water and environmental management institutions.
- v The Environmental Management Agency should take a prominent role in water resources management as it is mandated with the overall management and protection of environmental resources
- v The Environmental Management Agency should bring in material, financial and logistical support to subcatchment councils since it collects revenue through the “polluter pays principle” and should not leave subcatchment councils burdened with polluted water
- v The national Government is encouraged to institute policy revision to ensure the wholesome water-environment management including flow measurement, sediment sampling, pollution control and catchment protection is done under the same institution
- v Water quality, water level and sediment load monitoring should be the responsibilities of national governments. This can help to improve efficiency and effectiveness in data collection. The Government should avail funding towards water level and water quality data collection activities as it constitutes valuable data for the country.
- v Stakeholder participation in environmental management should be seriously supported by environmental management institutions like the EMA and the central government to improve the sustainability of resources and the management process.
- v Further research could assess and review the current legal framework for environmental management with a view to remove all gaps and overlaps.
- v Further research could also look at the benefits of combining the water and environmental management stakeholder structures to operate as one institution.

REFERENCES

Atkinson P and Coffey A 1997: Analysing documentary realities. Qualitative Research: Theory, Method and Practice. London: Sage.

Bartram J, Makela A and Maliki E 1996: Field Work and Sampling in Water Quality Monitoring. In Bartram J and Balance R (eds): A Practical guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. UNEP and WHO: Geneva, 63-83.

Berg L 2010: UN Convention on Biological Diversity – Information leaflet from the Ministry of Environment. Stockholm: Government of Zimbabwe.

Black RT 2009: Doing Quantitative Research in the Social Sciences: An Integrated Approach to Research Design, Measurement and Statistics. London: Sage

Chidavaenzi M, Kwenda G, Mashava R, Moyo K, Mpala T, Tagwirei C and Zanamwe L 2010: In Feresu SB (ed): Zimbabwe Environment Outlook: The Socio-Economic Environment: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, 19-52.

Chifamba E 2011: Integrated Watershed Management for Minimizing Land Degradation and Enhancing Livelihoods of Resource Poor Farmers: A Case of Pungwe River Watershed, Zimbabwe. *Journal of Sustainable Development in Africa*: Volume 13 Number 8, 107-119

Chigwenya A and Chirisa C 2007: Structures Without Processes: An Analysis of the Institutional deficiencies in Community Based Forest Resource Management in Seke Resettlement Scheme. *Journal of Sustainable Development in Africa*: Volume 9 Number 4, 16-47.

Chiwandamira L and Mbengo I 1999: Environmental Management. Harare: Zimbabwe Open University.

Coates D, Pert LP, Baron J, Muthuri C, Nguyen-Khoa S, Boelee E and Jarvis ID 2013: Water-Related Ecosystem Services and Food Security. In Boelee (ed): Managing Water and Agroecosystems for Food Security: Comprehensive

Assessment of Water Management in Agriculture Series. CAB: Wallingford, 10, 29-41.

Creswell JW 2007: Qualitative inquiry and research design: Choosing among five approaches. 2nd Edition. California: Sage.

Creswell JW 2009: Research design: Qualitative, quantitative and mixed methods approaches. 3rd Edition. California: Sage.

Creswell JW and Clark P 2011: Designing and conducting mixed methods research. California: Sage.

Dube D and Swatuk AL 2002: Stakeholder participation in the new water management approach: A Study of the Save Catchment, Zimbabwe. *Physics and Chemistry of the Earth*: Elsevier. 27, 867-874

Dresp-Langley B 2012: Responsibly Managing Risks to the Environment: Stakeholders and their Communication Contract. The Open Environmental Journal: Bentham Open. 2012, 5, 19-26

DWAF 2006: Best Practice Guidelines G3: Water Quality Monitoring Systems. Pretoria: Department of Water and Forestry Affairs South Africa.

Environmental Management Agency 2012a: Training Manual for Environment Committees. Harare: Environmental Management Agency.

Environmental Management Agency 2012b: Training Manual for Environmental Monitors. Harare: Environmental Management Agency.

Environmental Management Agency 2012c: Resource Handbook for Traditional Leaders. Harare: Environmental Management Agency.

Environmental Management Agency 2014: Accessed from <http://www.ema.co.zw> on 31st August 2014.

Esmail T 1997: Designing and Scaling Up Productive Natural Resources Management Programmes: Decentralisation and Institutions for Collective Action. Washington DC: World Bank.

European Commission 2007: Integrated Water Resources Management: Guidance in Relation to Thematic Strategy on the Urban Environment: Technical Report-2007-013. Luxembourg: European Commission.

Feresu SB 2010: Introduction. In Feresu SB (ed): Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, 3-6.

Feresu SB, Madamombe EK, Mtetwa SD, Musariri M, Sunguro S and Tererai F 2010: Water. In Feresu SB (ed): Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, 131-165.

Flick U 2004: Triangulation in Qualitative Research. In Flick U, Kardoff E and Steinke E (Eds): A Companion to Qualitative Research: Sage: London, 178-183.

Gasim BM, Ismail BS, Toriman E, Mir IS and Chek CT 2007: A Physio-Chemical Assessment of the Bebar River, Pahang, Malaysia. Global Journal of Environmental Research: IDOSI Publications, 1 (1), 7-11

Global Water Partnership-Technical Advisory Committee (GWP-TAC) 2000: Integrated Water Resource Management. Global Water Partnership Technical Advisory Paper No. 4. Stockholm: GWP.

Global Water Partnership 2004: Integrated Water Resource Management. TAC Background Paper No. 4. Stockholm: GWP.

Government of Zimbabwe 1975: Parks and Wild Life Act (Chapter 20:14). Harare: Government Printers.

Government of Zimbabwe 1988: Rural District Councils Act (Chapter 29:13). Harare: Government Printers.

Government of Zimbabwe 1995: Urban Councils Act (Chapter 29:15). Harare: Government Printers.

Government of Zimbabwe 1998a: Water Act (Chapter 20:24). Harare: Government Printers.

Government of Zimbabwe 1998b: ZINWA Act (Chapter 20:25). Harare: Government Printers.

Government of Zimbabwe 2000a: Water (Catchment Councils): Statutory Instrument 33 Of 2000. Harare: Government Printers.

Government of Zimbabwe 2000b: Traditional Leaders Act (Chapter 29:17). Harare: Government Printers.

Government of Zimbabwe 2001: Towards Integrated Water Resources Management: Water Resources Management Strategy for Zimbabwe. Harare: Ministry of Rural Resources and Water Development. Government of Zimbabwe.

Government of Zimbabwe 2002: Environment Management Act (Chapter 20:27). Harare: Government Printers.

Government of Zimbabwe 2007: Environment Management (Environmental Impacts Assessments and Ecosystems Protection) Regulations: Statutory Instrument 7 of 2007. Harare: Government Printers.

Government of Zimbabwe 2009: The National Environment Policy. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe.

Gumindoga W, Shekede MD, Rientjies HTM and Rwasoka DT 2012: Incorporation of Land Use and Land Cover into Hydrological Dynamics of the Mukuvisi and Marimba River Catchments. *Hydrology: Thirteenth Waternet/WARFSA/GWP-SA. International Symposium on Integrated Water Resources Management*. Johannesburg.

Gwimbi P and Dirwai C 2003: Research Methods in Geography and Environmental Studies. Harare: Zimbabwe Open University.

Haller T 2002: The Understanding of Institutions and their Link to Resource Management from a New Institutionalism Perspective: IP6 Institutional Change and Livelihood Strategies: Working Paper No.1

Hesse-Biber and Leavy 2011: The Practice of Qualitative Research: 2nd Edition. Los Angeles: Sage.

Holstein AJ and Gubrium FJ 1997: Active Interviewing. Qualitative Research: Theory. Method and Practice. London: Sage.

IAEA 2003: Collection and preparation of bottom sediment samples for analysis of radionuclides and trace elements. Vienna: International Atomic Energy Agency.

INBO and GWP 2012: The Handbook for International Water Resources Management in Transboundary Basins of Rivers, Lakes and Aquifers. International Network of Basin Organisations and Global Water Partnership.

Islam S, Han S, Ahmed K and Masugana S 2014: Assessment of Trace Metal Contamination in Water and Sediment of Some Rivers in Bangladesh. Journal of Water and Environment Technology, Vol 12, No. 2, 2014

Kayoi M, Wells A and Shepherd G 2008: Indonesian Papua: Poverty and Natural Resources – Reconciling Growth and Social Justice through an Ecosystem Approach. In Shepherd (ed): The Ecosystem Approach: Learning From Experience. IUCN. Switzerland, 163-190.

Kujinga K and Manzungu E 2004: Enduring Contestations: Stakeholder Strategic Action in Water Resources Management in the Save Catchment Area, Eastern Zimbabwe. In: Eastern Africa Social Science Research Review, Vol XX No.1

Kumar R 2012: Research Methodology. A step-by-step guide for beginners. Third Edition. London: Sage

Kuusisto E 1996: Hydrological Measurements. In Bartram J and Balance R (Eds): A Practical guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. UNEP and WHO: Geneva, 284-293.

Lapong E, Fujihara M, Izumi T, Kobayashi N and Kakihara T 2012: Suspended Load Estimation in Rivers in Agricultural Areas Using Regression Analyses with Data Stratification. Journal of Water and Environment Technology, Vol 10, No. 4, 2012

Leach M, Mearns R and Scoones I 1999: Environmental Entitlements: Dynamics and Institutions in Community Based Natural Resources Management. In: World Development Vol 27: No.2 pp 225-247

Leedy PD and Ormrod JE 2005: Practical Research: Planning and Design. 8th Edition. New Jersey: Prentice Hall.

Makurira H and Mugumo M 2006: Water Sector Reforms in Zimbabwe: The importance of policy and institutional coordination on implementation. In: Proceedings of the African Regional Workshop on Watershed Management. FAO: Nairobi, 167-174.

Manjengwa J, Price L and Stiles K 1999: Environmental Education. Harare: Zimbabwe Open University.

Manzungu E 2002: The Theory and Practice of Governance of Water Resources in Zimbabwe. In: Proceedings of the African Regional Workshop on Watershed Management. FAO: Nairobi, 167-174.

Manzungu E and Kujinga K 2006: The destination of Zimbabwe's water reforms: Integrated water resource management or integrated catchment management? In: Manzungu E (ed): The Processes and Dynamics of Catchment Management in Zimbabwe. Save Africa Trust: Harare, 161-172.

Melville S and Goddard W 1996: Research Methodology. Kenwyn: Juta.

Merrey DJ, Drechsel P, Penning de Vries FWT and Sally H 2005: Integrating Livelihoods into Integrated Water Resources Management: Taking the Integration Paradigm to its Logical Next Step for Developing Countries. Pretoria: IWMI

Ministry of Environment and Tourism 1997: Environmental Impact Assessment Policy. Harare: Ministry of Environment and Tourism

Mortimore M, Ariyo J, Bouzou MI, Mohammed S and Yamba B 2008: Niger and Nigeria: The Maradi-Kano Region – A dryland case study of local natural resources management. In Sherpherd (ed): The Ecosystem Approach: Learning From Experience. IUCN: Switzerland, 1-22.

Mugabe TF, Senzanje A and Hodnett M 2002: Understanding catchment hydrology as a means to improve rural water resources use and management in Masvingo Province. In Manzungu E (ed): The Processes and Dynamics of Catchment Management in Zimbabwe. Save Africa Trust. Harare, 91-98.

Murwira A and Tevera DS 2010: Ecoregions – A Second Approximation. In Feresu SB (ed): Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, 241-253.

Mutepfa F, Marongwe N, and Matondi P 2010: Land. In Feresu SB (ed): Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, Harare, 89-129.

Myllyviita T, Hujala T, Kangas A and Leskinen P 2011: Decision Support in Assessing the Sustainable Use of Forests and Other Natural Resources – A Comparative Review. The Open Forest Science Journal, 2011, 4, 24-41

Naome R, Rajah D and Jerie S 2012: Challenges in Implementing an Integrated Environmental Management Approach in Zimbabwe. *Journal of Emerging Trends in Economics and Management Sciences (JETSMS)*, 3(4), 408-414.

Ngah CYSM and Othman 2010: Water Catchment Management: A Malaysian Perspective. *Global Journal of Environmental Research*. IDOSI: 4(1), 31-39

Nickerson JB 1994: The Environmental Laws of Zimbabwe: A Unique Approach to Management of the Environment.

Nyikadzino B, Chibisa P and Makurira H 2014: Exploring the effectiveness of sustainable water resources management structures in the Upper Pungwe river basin. *Physics and Chemistry of the Earth*: Elsevier. 67-69, 173-179.

O'Leary Z 2010: The Essential Guide to Doing Your Research Project. London: Sage

Pahl-Wostli P 2007: The Implications of Complexity for Integrated Resources — The Second Biannual Meeting of the International Environmental Modelling and Software Society: Complexity and Integrated Resources Management. *Environmental Modelling and Software*: Elsevier, 22, 561-569.

Petus C, Chust G, Gohin F, Doxaran D, Froidefond JM and Sagarminaga Y 2010: Estimating turbidity and total suspended matter in the Adour River plume (South Bay of Biscay) using MODIS 250-m imagery: Elsevier, Issue 30, Issue 5, 379-392.

PRFT 2013: Study on Rural Poverty in Manicaland: The Case of Mutare Rural. Mutare: Poverty Reduction Forum Trust.

Ribot J 2002: Democratic Decentralisation of Natural Resources: Institutionalising Popular Participation. Washington DC: World Resources Institute.

Rogers P and Hall AW 2003: Effective Water Governance. Stockholm: Global Water Partnership

Roy D, Barr J and Venema HD 2011: Ecosystem Approaches in Integrated Water Resources Management (IWRM): A Review of Transboundary River Basins. UNDP and IISD.

Sadeghi SHR, Harchegani KM and Younesi AH 2012: Suspended sediment concentration and particle size distribution, and their relationship with heavy metal content. *Journal of Earth System Sciences: Indian Academy of Sciences*, 121, No. 1, 63-71

Saeidian F, Sulainman BANW and Rad AM 2009: The Investigation of the Sediment Yield Potential Using Hydro-Physical Method in the Drainage Basins: Case Study in Kardeh Drainage Basin-Iran. *Journal of Environmental Research: IDOSI Publications*, 3 (3), 178-186

Saleth M and Dinar A 1999: Evaluating Water Institutions and Water Sector Performance. Washington DC: World Bank

Sekaran U 1992: Research Methods for Business: A Skills Building Approach. New York: Wiley.

Sherpherd G 2008: Overview: In Sherpherd (ed): The Ecosystem Approach: Learning From Experience. IUCN. Switzerland, 1-22.

Shoko P 2010: The Socio-Economic Environment. In Feresu SB (ed): Zimbabwe Environment Outlook: Our Environment, Everybody's Responsibility. Harare: Ministry of Environment and Natural Resources Management. Government of Zimbabwe, 19-52.

Silverman D 2007: Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction: Third Edition. London: Sage

Somura H, Nakayama D, Aizaki M, Seike Y, Okumura M and Nishikata K 2008: Spatial Distribution of Water Quality and Load Units in the Iinashi River Basin, Shimane Prefecture, Japan. The Open Hydrology Journal, 2008, 2, 15-24

Sweco 2004: The Pungwe River Monograph. Stockholm: Sida.

Sweco 2008: Training Material in Integrated Water Resources Management for River Basin Organisations: Case Study: Pungwe River Basin in Mozambique. Stockholm: Sida & Capnet.

Taylor-Powell E 1996: Analysing Quantitative Data: Program Development and Evaluation. University of Wisconsin: Cooperative Extension: Madison.

United Nations 1998: Kyoto Protocol to the United Nations Framework Convention on Climate Change. New York: UN.

Van der Zag P 1997: From Appropriating Water to Sharing It: Water Sector Reform in the Nyachowa Catchment Area. In: Derman B and Nhira C (eds): Towards

Reforming the Institutional and Legal Basis of the Water Sector in Zimbabwe. Harare: CASS

Vučijak B, Ceric A, Silajdzic I and Kurtagic MS 2011: Water for Life: Fundamentals of Integrated Water Resources Management. Hydro Engineering Institute Sarajevo: Sarajevo.

WaterAid 2011: Policy Guidelines: Water Resource Management. Nepal: WaterAid

Webster P, Merrey D and De Lange M 2003: Boundaries of Consent: Stakeholder Representation in River Basin Management in Mexico and South Africa. In: World Development, Vol 31, Issue 5, May 2003, pp797-812

WMO 2012: Technical Material for Water Resources Assessment: Technical Report Series No. 2: WMO-No-1095. Geneva: World Meteorological organisation

Wolff S 2004: Analysis of Documents and Records. In Flick U, Kardoff E and Steinke E (Eds): A Companion to Qualitative Research: Sage: London, 284-289.

Xie M 2006: Integrated Water Resources Management (IWRM): Introduction to Principles and Practices. World Bank Institute.

ZELA 2003: Summary of the Environmental Management Act (Chapter 20:27) for use by Community Groups. Harare: ZELA and Ford Foundation.

Zimstat 2012: Zimbabwe Population Census 2012: Manicaland Provincial Report. Harare: Zimstat.

APPENDIX I: LETTER TO EMA MANICALAND PROVINCE

Number 9 Palm Avenue
Sauerstown
Bulawayo
Zimbabwe

29th September 2014

The Provincial Manager
EMA Manicaland Province
P. O Mutare
Mutare
Zimbabwe

Dear Sir!

Ref: Application for authority to carry out an academic research in your district

I am a student with the University of South Africa (UNISA) student number 51542013 studying for a Masters in Environmental Management degree in the Department of Environmental Sciences. I hereby seek your authority to carry out a research on the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin which falls largely within your district.

The study shall closely look at how the Environmental Management Agency (EMA) interact with the Zimbabwe National Water Authority (ZINWA) and Mutasa Rural District Council (Mutasa RDC) through the Environment Committees and Pungwe Subcatchment Council (PSCC) for combating environmental hazards with an impact on water resources in the Pungwe River basin.

Looking forward to a favourable response for you

Regards

Ben Nyikadzino

APPENDIX II: LETTER TO MUTASA DISTRICT ADMINISTRATOR

Number 9 Palm Avenue
Sauerstown
Bulawayo
Zimbabwe

29th September 2014

The District Administrator
Mutasa District
P. Bag J7116
Mutare
Zimbabwe

Dear Sir!

Ref: Application for authority to carry out an academic research in your district

I am a student with the University of South Africa (UNISA) student number 51542013 studying for a Masters in Environmental Management degree in the Department of Environmental Sciences. I hereby seek your authority to carry out a research on the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin which falls largely within your district.

The study shall closely look at how the Environmental Management Agency (EMA) interact with the Zimbabwe National Water Authority (ZINWA) and Mutasa Rural District Council (Mutasa RDC) through the Environment Committees and Pungwe Subcatchment Council (PSCC) for combating environmental hazards with an impact on water resources in the Pungwe River basin.

Looking forward to a favourable response for you

Regards

Ben Nyikadzino

APPENDIX III: LETTER TO MUTASA RURAL DISTRICT COUNCIL

Number 9 Palm Avenue

Sauerstown

Bulawayo

Zimbabwe

29th September 2014

The Chief Executive Officer

Mutasa Rural District Council

P. Bag J7116

Mutare

Zimbabwe

Dear Sir!

Ref: Application for authority to carry out an academic research in your district

I am a student with the University of South Africa (UNISA) student number 51542013 studying for a Masters in Environmental Management degree in the Department of Environmental Sciences. I hereby seek your authority to carry out a research on the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin which falls largely within your district.

The study shall closely look at how the Environmental Management Agency (EMA) interact with the Zimbabwe National Water Authority (ZINWA) and Mutasa Rural District Council (Mutasa RDC) through the Environment Committees and Pungwe Subcatchment Council (PSCC) for combating environmental hazards with an impact on water resources in the Pungwe River basin.

Looking forward to a favourable response for you

Regards

Ben Nyikadzino

APPENDIX IV: QUESTIONNAIRE FOR ENVIRONMENTAL MANAGEMENT STRUCTURES IN THE UPPER PUNGWE RIVER BASIN

INTRODUCTION

My name is Ben Nyikadzino, a student with the University of South Africa (UNISA) in the Department of Environmental Science studying for a Master of Science in Environmental Management degree. As part of my studies, I am undertaking a research titled: ***Assessing the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin***. I wish to evaluate how water and environmental management structures as well as other stakeholders interact for the preservation of water resources. I therefore kindly request you to factually answer the questions below. The information provided in this questionnaire is for study purposes only and the identity of respondents shall be treated with utmost confidentiality. Results of this study shall be availed to you at your request.

Instructions

- v Kindly answer questions that follow
- v Please mark with an X in appropriate box or write in the spaces provided.

SECTION 1: RESPONDENT ORGANISATION

1. Gender: Female ☐ ☐

2. Institution

EMA ☐ Mutasa RDC ☐ Other (Specify)

3. How long have you been working for the organisation?

0-5 years ☐ 6-10 years ☐ over 10 years ☐

SECTION 2: ENVIRONMENT MANAGEMENT STRUCTURES

4. What is the role of your organisation in Environmental Management in the Upper Pungwe River basin?

.....

.....

.....

5. What are the most common water-related environmental problems in the Upper Pungwe River basin?

.....

.....

.....

6. What are the causes of the water-related environmental problems mentioned in (5) above?

.....

.....

.....

7. Who addresses water-related environmental problems mentioned in (5) above?

.....

.....

8. How are the problems listed in (5) above detected by your institution?

.....

.....

.....

9. How are the problems listed in (5) above addressed by your institution?

.....

.....

.....

10. Do you engage water management institutions in addressing such problems and how?

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11. In your opinion, how effective is your organisation in addressing water related environmental problems like siltation of rivers and water pollution in the Upper Pungwe River basin?

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Thank you for your valuable time!

APPENDIX V: QUESTIONNAIRE FOR ENVIRONMENTAL MANAGEMENT COMMITTEES IN THE UPPER PUNGWE RIVER BASIN

INTRODUCTION

My name is Ben Nyikadzino, a student with the University of South Africa (UNISA) in the Department of Environmental Science studying for a Master of Science in Environmental Management degree. As part of my studies, I am undertaking a research titled: ***Assessing the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin***. I wish to evaluate how water and environmental management structures as well as other stakeholders interact for the preservation of water resources. I therefore kindly request you to factually answer the questions below. The information provided in this questionnaire is for study purposes only and the identity of respondents shall be treated with utmost confidentiality. Results of this study shall be availed to you at your request.

Instructions

- v Kindly answer questions that follow
- v Please mark with an X in appropriate box or write in the spaces provided.

SECTION 1: ENVIRONMENT COMMITTEE RESPONDENT

1. Gender: Female ☐ Male ☐

2. Age ☐ 3. Location Ward ☐

3. How long have you been a member of the environment committee?

0-2 years ☐ 2-5 years ☐ over 5 years ☐

SECTION 2: ENVIRONMENT COMMITTEE COMPOSITION AND ROLES

Please note the following abbreviations

EMA	Environmental Management Agency
Mutasa RDC	Mutasa Rural District Council
ZINWA	Zimbabwe National Water Authority
PSCC	Pungwe Subcatchment Council

4. What is an Environment Committee?

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5. Who can be a member of an Environment Committee?

.....

.....

6. How do you become a member of an Environment Committee?

.....

.....

.....

7. In your ward, how many members do you have in your Environment Committee?

Female

Male

8. What is the purpose of an Environment Committee?

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.....

9. Who do you report to as an Environment Committee?

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.....

10. What business do you do and how do you conduct the business as an Environment Committee?

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.....
.....

11. What is your role in sustainable environmental management?

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.....
.....

12. How do you deal with water related environmental problems?

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.....
.....

13. In your day to day activities do you engage with the following institutions?

	EMA	Mutasa RDC	ZINWA	PSCC
Yes/No	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Explain, why?

.....
.....

.....
.....

14. In your opinion how effective are environment committees in environmental management especially looking at water issues?

.....
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Thank you for your valuable time!

APPENDIX VI: INTERVIEW SCHEDULE FOR WATER MANAGEMENT STRUCTURES IN THE UPPER PUNGWE RIVER BASIN

INTRODUCTION

My name is Ben Nyikadzino, a Hydrologist with the Zimbabwe National Water Authority (ZINWA). I am a student with the University of South Africa (UNISA) in the Department of Environmental Science studying for a Master of Science in Environmental Management degree. As part of my studies, I am undertaking a research study titled: ***Assessing the effectiveness of environmental management structures and participation process in the Upper Pungwe River basin***. I wish to evaluate how water and environmental management structures as well as other stakeholders interact for the preservation of water resources. I therefore kindly request you to factually answer the questions below. The information provided in this questionnaire is for academic research purposes only and the identity of respondents shall be treated with utmost confidentiality. Results of this study shall be availed to you at your request.

SECTION 1: WATER MANAGEMENT INSTITUTION RESPONDENT

1. Gender:
2. Institution
3. How long have you been working for your organisation?

SECTION 2: WATER MANAGEMENT INSTITUTIONS' ROLES AND EXPECTATIONS

4. What is the role of your organisation in Environmental Management in the Upper Pungwe River basin?

5. What are the most common water-related environmental problems in the Upper Pungwe River basin?
6. What are the causes of the water-related environmental problems mentioned in (5) above?
7. Who addresses water-related environmental problems mentioned in (5) above?
8. How are the problems listed in (5) above detected by your institution?
9. How are the problems listed in (5) above addressed by your institution?
10. Do you engage environmental management institutions (EMA & Mutasa RDC) in addressing such problems and how?
11. In your opinion, how effective are environmental management institutions in addressing water related environmental problems like siltation of rivers and water pollution in the Upper Pungwe River basin?
12. How do you prefer water related environmental problems to be handled?

Thank you for your valuable time!