FINANCING WATER INFRASTRUCTURE INVESTMENT FOR SUSTAINABLE DEVELOPMENT IN ZIMBABWE

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0715621D

Johannesburg 2021

Research Statement

A research report submitted to the Faculty of Engineering and Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of MSc in Engineering

Declaration

I, Gloria Tariro Mabodza, declare that this research is my own, unaided work. It is being submitted for the Master of Science in Engineering at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature : 

Date : 16/02/2021

Dedication

I dedicate this research to God and Family. I would like to express my sincere gratitude to my entire family who have supported me throughout the research including my dearest mother. A special feeling of gratitude goes toward my loving husband, Eng George Tafadzwa Kalenga and our children who have sacrificed immensely to enable the completion of this research. Lastly, I would like to thank God, who has faithfully strengthened me during the course of this research and has faithfully brought it to completion against a multitude of odds. Thank you.

Philippians 1:6 NKJV

"…being confident of this very thing, that He who has begun a good work in you will complete it…"

Abstract

The economic downturn in Zimbabwe saw the reduction of government financing and foreign investment which were the main sources of funding for water infrastructure. It then becomes of paramount importance for water investment to be portrayed as a viable investment to attract finance. To do this, there is need to investigate Zimbabwe's own country-specific barriers which hinder financing water investment.

Notable barriers discussed include, low-cost recovery, dependence on external assistance and deterioration of the state institutions from a 'brain-drain' of professionals. The legislative environment has also not synchronized water policy and Acts of parliament perpetuating poor service delivery which also further constrains the economy. Zimbabwe needs efficient technical, legal and financial systems in the water sector to find its edge with which it will lure investors. Identifying the problem and the steps to be taken is part of the process to recovering Zimbabwe's water sector.

Acknowledgements

This research would not have been possible without the support of my supervisor, Professor Anne Fitchett. Her knowledge, patience, exacting attention to detail and timely responses have been an inspiration from my first meeting with her. I would also like to thank the Government of Zimbabwe, the World Bank and the African Development Bank for publication of reports and documentations of projects in the Zimbabwean water sector which expand the intellectual horizon by providing the opportunity to research and understand past water projects.

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Glossary of Terms

Bankable Project: This is a "project that has sufficient collateral, future cash flow and high probability of success, to be acceptable to institutional lenders for financing."

Capital Control Measures: represents any measure taken by a government, central bank or other regulatory bodies to limit the flow of foreign capital in and out of the domestic economy. These controls include taxes, tariffs, legislation, volume restrictions and market based forces.

Commitment Technology: a system that allows parties to commit to a limit before engaging in an activity.

Liquidity: this describes the degree to which an asset or security can be quickly bought or sold in the market at a price reflecting its intrinsic value. In other words, the ease of converting to cash.

Concession Period: This is the period which starts from the signing of the concession agreement between the government and the private sector indicating the span of time within which the private sector is responsible for the construction phase and operation phase in Build Operate Transfer (B.O.T.) projects

Creditworthiness: the extent to which a person or company is considered suitable to receive financial credit.

Fit (Financially): the matching of the investor's requirements and needs such as risk tolerance and growth potential preference with a specific investment.

Green Bonds: is a bond whose proceeds are used to fund environment-friendly projects.

Infrastructure: the fundamental systems and facilities serving a country such as roads, sewers, electricity grids, etc. These systems or facilities enable productivity in the economy.

Infrastructure gap: the current need for investments in infrastructure. The difference between the required infrastructure and the existing infrastructure.

Market Sounding: is the communication of information prior to the announcement of a transaction, in order to gauge the interest of potential investors in a possible transaction, and the conditions relating to it such as its potential size or pricing to one or more potential advisors.

Mean Annual Runoff: the average amount of water that flows down a particular river, per year.

Political Risk Insurance: is a type of insurance that can be taken out against political risk such as the risk of revolution or other political conditions that will result in a loss.

Public Private Partnerships: a contractual arrangement between a public agency and a private sector entity. Through this agreement, the skills and assets of each sector are shared in delivering a service or facility for the use of the general public.

Ring-fencing: This is a legal or financial arrangement of separating the activities, assets and liabilities, revenues and costs, and so on, generated by a specific business from the general business of an entity.

Sunk Costs: This is a cost that an entity has incurred, and which it can no longer recover by any means.

Water Footprint: this shows the extent of water use in relation to consumption by people. The water footprint of an individual, community or business is defined as the total volume of fresh water used to produce the goods and services consumed by the individual or community or produced by the business

Abbreviations and Acronyms

AFDB	African Development Bank
BNR	Biological Nutrient Removal
BOT	Build-Operate-Transfer
DAC	Development Assistance Committee
DWAF	Department of Water Affairs and Forestry
ECA	Economic Consulting Associates
EMA	Environmental Management Agency
GDP	Gross Domestic Product
GFOA	Government Finance Officers Association
GHWSI Project	Greater Harare Water & Sanitation Investment Project
GoZ	Government of Zimbabwe
HDPE	High-Density Polyethylene
HLPW	High Level Panel on Water
IISD	International Institute for Sustainable Development
IRMI	International Risk Management Institute
IRWSSP	Integrated Rural Water Supply and Sanitation Programme
IWA	International Water Institute
IWRM	Integrated Water Resources Management
MAR	Mean Annual Runoff
MIGA	Multi-lateral Investment Guarantee Agency
MWRDM	Ministry of Water Resources Development and Management
NRW	Non Revenue Water
OECD	Organisation for Economic Cooperation and Development
O&M	Operation and Maintenance
PPP	Public Private Partnership
PRI	Political Risk Insurance
PIDA	Programme for Infrastructure Development in Africa
PiP	Pensions Infrastructure Platform
SIWI	Stockholm International Water Institute
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia & Pacific

UNICEF	United Nations Children Fund
UWSSR Project	Urgent Water Supply and Sanitation Rehabilitation Project
WASREB	Water Services Regulatory Board in Kenya
WHO	World Health Organisation
WIN	Water Integrity Network
WWC	World Water Council
WWICS	Woodrow Wilson International Centre of Scholars
ZWF	Zimbabwe Water Forum

Financing Water Infrastructure Investment for Sustainable Development in Zimbabwe.

1 Introduction

1.1 Background

During the 1980s Zimbabwe's water and sanitation provision increased as a result of overwhelming support for a new government and an entry of a large amount of foreign investment (Robinson, 2002). This brought about the Integrated Rural Water Supply and Sanitation Programme (IRWSSP) in 1985 whose goal was to improve water and sanitation infrastructure to rural Zimbabweans (Robinson, 2002). Consequently, Zimbabwe had "one of the highest rates of growth in water supply services" (AfDB, 2011). Whilst this is a significant achievement, infrastructure needs are not stagnant, they need to grow with time and population.

A growing population (ZimStat, 2012) has led to pressure to expand and update the country's water infrastructure. Zvobgo & Do (2020) gave population growth and city expansion as one of the causes of irregularities in water supply in Zimbabwe. Tshehla & Mukudu (2020) support this as they found that population growth creates an infrastructure deficit. The economic downturn after 2000, saw the reduction of government financing and foreign investment which are the main sources of funding for water infrastructure. The country's, "poor economic performance, national level politics and international isolation" (Manzungu & Derman, 2016) culminated in limited investment to the much-needed new water infrastructure and insufficient financing of operation and maintenance of the existing infrastructure.

> "*The economic difficulties the country experienced during the hyperinflationary environment resulted in the suspension of most ongoing capital projects as the limited resources could not match programmed works*" (Ncube, 2020).

Sector	2018 Jan – Sep Actual	Exp Outturn by Dec 2018	2019 Proj
Health	318,993,250	379,350,401	280,985,765
Humanitarian	59,437,871	72,035,317	52,274,240
Agriculture	15,960,473	29,229,222	31,447,473
Capacity Building	18,462,001	26,550,480	43,572,667
Governance	42,664,786	66,770,562	75,434,067
Water Supply & Sanitation	6,976,567	10,427,031	17,634,755
Education	17,633,735	22,969,325	25,594,293
Basic Social Services	32,177,837	43,936,646	25,497,879
Transport	3,853,079	7,012,777	37,319,396
Multi - Sector	5,291,178	2,838,726	6,457,861
Power/Energy	-	-	5,471,238
TOTAL	**526,691,777**	**659,279,480**	**606,709,634**

Figure 1: Sectoral Disbursements from the 2019 Zimbabwe Budget Statement (Ncube, 2019)

The table above shows the sectoral disbursement of the 2019 Zimbabwe Budget Statement and the proportion allocated to water supply and sanitation. The country's public sector has reported inadequate capacity to finance water and sanitation investment. Tshehla & Mukudu (2020) stated that, "countries with the highest infrastructure deficit tend to be also the ones that are less able to access finance". With limited resources available to the developing nation, important competing interests were inevitable. In such a scenario, project identification becomes of paramount importance resulting in careful and stringent selection of efficient investments and hence the need for water infrastructure investment to be portrayed as a viable and attractive economic investment to access funds from the private sector, public funds and foreign aid.

The Zimbabwe National Budget Statement for 2018, projected an economic growth estimate of 3.7%, underpinned mainly by the agriculture sector (Chinamasa, 2017). Water directly affects the performance of this key sector of the Zimbabwean economy. The African Development Bank reported: "The largest user of water in Zimbabwe is the agricultural sector which accounts for about three-quarters of total consumption" (AfDB, 2011). Agriculture depends heavily on the reliability of water supply and improving the reliability of water, enhances economic opportunity (Yildiz, 2017). Water is therefore tied to the economic development of the country.

Zimbabwe mainly relies on water resources such as lakes, aquifers and rivers. Investment has been made in water infrastructure such as dams but utilisation of the mean annual run-off

(MAR) is only at about 22% (AfDB, 2011) showing that there is great potential to improve the water security of the nation through investing in water infrastructure.

> *The country's economy is water-dependent: there is a close relationship between annual rainfall and annual Gross Domestic Product (GDP) because of the importance of rainfall-dependent agricultural and hydroelectricity production to the economy, which also affects industry, mining and tourism* (Manzungu & Derman, 2016).

The World Bank reported that, "access to infrastructure services [in Zimbabwe] falls well behind the levels in the developed world," (World Bank, 2004) also indicating that water infrastructure investment in Zimbabwe would further the development agenda. Developing a robust framework for financing water infrastructure remains a challenge.

Two Acts oversee water affairs in Zimbabwe, these are The Zimbabwe National Water Authority (ZINWA) Act of 2000 and The Water Act of 1998. ZINWA is the government parastatal whose mandate it is to make strategic water infrastructure investments that facilitate economic development (ZINWA, n.d.). Under the Water Act, a Water Fund was established to collect fees, levies and any other funds to be used to support water initiatives in the country (AfDB, 2019). Although parastatals are expected to be autonomous, most are mere extensions of government departments (Tshehla & Mukudu, 2020).

Foreign Direct Investment (FDI) is a potential source of finances for water initiatives. FDI has notably increased in Sub-Saharan Africa, however, Zimbabwe has not benefited from this increase (Muzurura, 2019) with private investors hesitant of doing business. "Zimbabwe has struggled to attract Foreign Direct Investment (FDI) as well as project finance, therefore, failing to implement much-needed infrastructure projects" (Tshehla & Mukudu, 2020). The 2019 World Bank Doing Business Report ranked Zimbabwe 155 out of 190 countries, which is lower than neighbouring countries such as South Africa (82) and Botswana (86) (World Bank, 2019). Zimbabwe was also ranked, "155 out of 175 countries by the Corruption Perception Index" (Mutuma & Jambawo, 2017).

> *The share of the project finance for sub-Saharan Africa for the years 2003 – 2013 was only 3% of the world total. During those years, the infrastructure projects for the region benefitted from a debt of $59 billion, whereas the world total was $2 trillion (Dornel, 2014). The leading countries in accessing this project finance in Africa are Nigeria, South Africa, Ghana, and Angola* (Tshehla & Mukudu, 2020).

The 2017 Zimbabwe Budget suggests high cost of utilities such as water is the cause of inhibited development of new businesses (Chinamasa, 2017). Some authors believe, the Zimbabwe indigenisation policy (2008) and the land reform policy brought about uncertainty regarding the direction and implementation of these policies leading to major disincentive for any long-term large private investment (AfDB, 2019).

The above is only one example, there is need to investigate Zimbabwe's country-specific barriers which hinder financing water investment. There is no general pattern to water investment financing as solutions are highly country-specific and a product of the history, geography, culture and economic circumstances of each country. The combination and level of severity of Zimbabwe's water financing barriers informs and influences the required response to strengthen financing water investment in the country and depicting water as a practical and appealing financial venture for all forms of funding. This paper investigates the barriers Zimbabwe faces to financing water investment and provides a mixture of measures born of Zimbabwe's own distinctive features to overcome those barriers. It also provides empirical evidence on the previous use of public finance used to finance water investment, and evidence on the impact of the barriers on the country as a whole.

Notwithstanding the existing barriers to finance, ZINWA continually invites potential investors for engagement pertaining to the development of water infrastructure (ZINWA, 2019) but there is still marked deterioration of infrastructure and limited new investment across the country (AfDB, 2019). Enabling investment in existing and new water infrastructure is a key building block to the sustainable use of water resources thereby promoting their continuation for the future generation and thus the problems surrounding financing investment in water necessitate investigation. This leads to the research question stated in the following section.

1.2 Research Question

What are the barriers to financing water infrastructure in Zimbabwe?

1.3 Specific Objectives

In order to answer the above question, the following specific objectives shall be pursued;

i. Carry out literature review to provide a foundation of knowledge in the water infrastructure investment field.
ii. Provide guidance on the measures necessary to overcome barriers identified.

1.4 Research Aim

The aim of this research is to investigate financing barriers for water infrastructure in Zimbabwe. The investigation is a critical step toward the development of best practices specific to Zimbabwe. Both existing and potential finance streams can be more effectively directed towards investment in water infrastructure by identification of barriers in the hope of developing improvement plans and best practises, specific to the Zimbabwe water and sanitation sector. The research seeks to advance understanding of the challenges faced by financing water infrastructure through a review of literature and the discussion of barriers faced by past water infrastructure projects in the country. Sustainable water infrastructure investment, requires appropriate identification and analysis of the impediments to financing the sector for the purpose of developing strategies to sustain water funding.

In addition, the research aims to provide government authorities, the private sector and any groups or individuals involved in the Zimbabwe water sector a comprehensive list of barriers associated with financing water infrastructure. The research sets the foundation for other studies on financing water infrastructure in Zimbabwe. A key area that warrants further study is the analysis of the effectiveness of suggested mechanisms for barrier mitigation, based on the barriers identified in this study.

2 Literature Review

2.1 Introduction

Financing priorities are a reality where funds are unable to meet all needs. Because water is an important resource socially and economically, a strategy is required to make water a higher priority for investment (Ajami et al, 2018). This Literature Review identifies a broad scope of challenges that need to be addressed to increase investment finance for water infrastructure. Such challenges include: weaknesses in governance; an inadequate general legal framework; low rate of return of projects and resistance to cost-recovery tariffs (Winpenny, 2003) and will be discussed in detail below. Gaining a better understanding on barriers to water infrastructure investment from existing literature is a step toward overcoming them.

2.2 The Value of Water

Determining the value of water is vital to the water financing discussion as it affects the cost benefit equation of water infrastructure. De Groot (1992) explains that "the value [of water] is categorized in terms of the nature of its contribution to human welfare". The determination of this value is difficult. "There are many and diverse potential benefits associated with water… ranging from easily identifiable and quantifiable to the intangible and difficult to measure" (Hutton & Haller, 2004). These benefits include, "improvements in income and in health… adjustments for social objectives such as poverty alleviation, employment generation and food security" (Rogers, et al., 1997), biodiversity (Turner & Postle, 1994), "aesthetic and recreational values, which are becoming increasingly important as incomes and leisure time increases" (Young, 1996). The period over which these benefits are delivered is spread over a number of years and the benefits often cannot be easily monetised. As a consequence, water often ends up being under-valued (OECD, 2018). If water is properly valued and the potential of converting the benefits from water into revenue streams is realised, this may considerably improve the financial case for water investment (OECD, 2018). An improved financial and economic case for water can act as a driver to attract private sector investment.

2.3 Bankable Projects

The G20 Leader's Summit 2014 held in Brisbane, Australia identified that to attract the private sector to infrastructure investment, there needs to be a number of clear and consistent bankable infrastructure projects. A bankable project is a "project that has sufficient collateral, future cash-flow and high probability of success, to be acceptable to institutional lenders for financing" (Business Dictionary, 2019). The private sector called for:

> *…a single, consolidated and standardised global pipeline of projects to provide: advance visibility of upcoming projects to allow early and proper preparation; comparability of projects across countries and clarity on how projects were progressing from conception to start of operations, especially in the pre-procurement phases* (Timbs, 2017).

Projects need to be properly designed and sequenced with contractual arrangements which suitably distributes risks and returns (Ehlers, 2014). Comprehensive sequencing of water infrastructure projects can be used as a map of the water sector's direction in development. This would also be evidence that the particular project in question is part of a water master plan and project identification was done cognisant of the reality that water resources decisions made today will affect tomorrow (HLPW, 2016).

Lining up a number of investable projects will enable large investors to dedicate a greater share of their financial resources to infrastructure (Ehlers, 2014). This also presents the scenario, should an investor's bid fail to be successful on the first project, there will still be the possibility of future engagements. Africa in general has a shortage of bankable infrastructure projects (Andrews, n.d.), however if certain measures discussed below are implemented, this may stimulate the occurrence of investable projects.

2.4 Project Preparation Stage

Project Preparation is the stage where the development of bankable, investment-ready projects occurs (Rana, 2017). Project Preparation is a key driver to the success of a water infrastructure project by ensuring feasibility, mitigating risks and maximising development opportunity and should be financed adequately. PIDA (Programme for Infrastructure Development in Africa) reported project "preparation costs average 7% of the total investment cost" (PIDA, 2012), which reveals how expensive this stage is.

Large water infrastructure projects require a significant amount of capital, have a long gestation period and entail complex feasibility studies. In addition, these projects entail intricate financial, technical and legal arrangements (PIDA, 2012) (Ehlers, 2014). Acquiring the requisite expertise to carry out these arrangements at preparation stage is costly (Ehlers, 2014). The private sector and donors are reluctant to pay such sunk costs with risks of project delay and cancellation being high (Ehlers, 2014).

A possible solution is for the government to set up a revolving water infrastructure development fund, hopefully with the support of international financial institutions and/or donor agencies. The fund will finance project preparation costs and when the project goes to tender, where construction bids are considered from potential construction companies, the winning bidder will repay the fund. Banks should also be involved during project preparation, to allow them to give a timely indication of their willingness to finance the project (UNESCAP, 2015). Banks can be asked by the public party to provide financial commitments documents to attract potential private parties (UNESCAP, 2015).

2.5 De-Risking Projects

"Despite Africa's enormous potential, low-cost labour and vast natural resources, many investors remain wary of investing in the continent" (MIGA, 2013). A number of countries in the region are still viewed as high risk (MIGA, 2013). This negatively affects the dynamics for water infrastructure funding in the continent. Furthermore, "investments in water and sanitation are perceived as having lower returns than in other sectors (for example roads or energy)" (SIWI/WHO, 2004). The water sector, among other measures, needs to improve its risk-return profile if it intends on engaging potential investors over other sectors. De-risking a project is crucial because if the risk is deemed too high, the private sector's interest may dwindle.

The risks of a water infrastructure project should be shared between the public and the private parties with risks being allocated to the party best equipped to manage it (IISD, 2015). The allocation of risk itself should also be balanced to avoid chasing away any party from the project. If the private sector is asked to carry undue risk by a government, they may raise the cost of finance which will in turn increase the bid price which means ultimately the risk is back with the government (UNESCAP, 2015). It is important to identify, allocate potential risks and to state the planned precautionary measures to lessen the likelihood of damage associated with that risk during project preparation. Risks which must be addressed for an infrastructure project

include, currency risk, demand risk, operational risk, political risk and corruption risk (UNESCAP, 2015).

Currency risk is when the project revenue is in the local currency but the bank loan repayment is in foreign currency. The risk is that, if the local currency devaluates during the project life (infrastructure projects have a long life), revenue generated might not be enough to cover loan repayment (Verdouw, 2015). "Exchange rate volatility poses a big risk for foreign currency financing of infrastructure projects that earn mainly local currency revenues" (Von Klaudy, 2012). A solution to this is for the loan to be in local currency and for the private party to assume the risk (UNESCAP, 2015). However, "most [African] local financial markets have limited capacity to finance infrastructure projects" (Von Klaudy, 2012). Where a local currency loan is not feasible then the public party must consider assuming the currency risk as the private party may be unwilling to assume risk for something, they are totally not in control of (UNESCAP, 2015). Considering the statement on optimal risk allocation where, risks should be allocated to the party best equipped to manage it, with currency risk, this may not be straight forward.

> *A typical private sector developer has no influence over the exchange rate. Although the central bank has some control over the exchange rate through its monetary policies, the government's effective control of the exchange rate may be limited. As a result of the above, unhedged currency risk is largely unmanageable for the private sector and may be beyond the control of the government agency… and may not be easily acceptable for either party* (Verdouw, 2015).

The investors themselves may also reside in a country different from the country of operation. In such a scenario, the income generated by the project for the investors may need to be transferred to the country of the investors. If there is a currency crisis, capital control measures may be implemented, hindering transfers to other countries. The private party would need a government guarantee to protect themselves from that risk (UNESCAP, 2015). Another risk mitigation initiative is to protect project cash flows through a special purpose vehicle. "The success of any financial deal rests upon future cash flows of the project. The creation of the SPV is a way of ring-fencing project cash flows and assets" (Tshehla & Mukudu, 2020).

Demand risk is the possibility of loss of revenue as a result of a difference between predicted and actual demand. Demand forecasting is a major challenge in long duration water projects (Ameyaw & Chan, 2015). The challenge is due to factors affecting water demand projections

such as demographic change, alternative water sources, economic downturn or weather variations, none of which can be predicted with certainty (World Bank, 2006). “The users may also refuse to pay, and the E-tolls in South Africa is a case in point” (Tshehla & Mukudu, 2020). Inaccurate demand forecasting leads to income shortfall and contract renegotiations (Lobina, 2005). To mitigate, the public party may provide a guarantee to secure a minimum revenue stream independent of the number of users or an extension of the concession period may be granted to compensate lower demand (UNESCAP, 2015).

Operational risk, “is the risk of losses arising from problems from internal controls, systems people and external events” (Cruz, 2002). An example of such a risk is when the maintenance of water infrastructure may cost more than anticipated due to increases of salaries or of input prices. Alternatively, service interruptions can result in revenue losses. To improve internal systems, continuous improvement through monitoring and evaluation is an option. However, the occurrence of external events cannot be controlled. The resulting impacts can only be mitigated and risk management strategies may be adopted that minimize the occurrence of the events (Panjer, 2006). To mitigate the above stated example, tariffs may be adjusted to inflation and the use of long-term input supply agreements.

There is also the risk that unforeseeable circumstances or events beyond the control of the parties engaged in the infrastructure project will prevent them from fulfilling their obligation to complete the project. These events may be natural or political, examples of which include war, strike, flood or earthquake. Including a force majeure clause in the project contract documents provides, “a flexible concept that permits the parties to formulate an agreement to address their unique course dealings” (Wright, 2003) in such circumstances. To agree for example on whether a party should receive compensation to prevent default or alternatively if the contract should be terminated or perhaps only delayed. Acquiring Force Majeure Insurance may give an added advantage of coverage for, “financial losses arising out of the inability to bring a project to completion” (IRMI, n.d.) and may put potential investors at ease.

Having Political Risk Insurance (PRI) is another way to manage political risk. “Political risk refers to risk encountered by for-profit water operators as a result of undue governmental disruption, including breach of contract and political instability” (Ameyaw & Chan, 2013). The investor/s may to some extent protect themselves from new government policies, political unrest, social changes and other potential issues by acquiring PRI. Whilst the insurance premium is an extra cost to the project, it should be viewed as a legitimate and strategic use of

funds to de-risk the project and attract investors (Collier, 2013). A study indicated political risk associated with, “change in law, delay in project approvals, permits and land acquisition”, had the one of the highest risk allocation in PPP projects (Karim, 2011). An example of political risk is when residents of an area protest changes to the environment by the infrastructure, causing political pushback of the project. To avert this risk, “stakeholder engagement would help project proponents and communities to identify, prevent and mitigate environmental and social impacts that can threaten project viability” (Dundee, 2014).

Water falls under a public utility and thus needs regulation. “Regulators are empowered to act independently and to make important decisions, and so are given the ability to exercise their own discretion” (Lawrence, 2002). Where discretion is used to make decisions in a poor governance setup, there is an opportunity for corruption (Collier, 2013). “The equation for corruption is defined as monopoly plus discretion minus accountability” (WWICS, 2009). To prevent corruption from water utilities, there is need for the integration of anti-corruption approaches and accountability (World Bank, 2019), for example, drafting an anti-corruption plan during the project preparation phase. It is still prudent to regularly identify the existence of potential corruption drivers throughout all stages of the project.

It is prudent that when project owners or governments are in dialogue with potential investors, they address the risks and provide solutions or mitigating actions and commitment technologies to de-risk the project. Project owners should not attempt to ignore or hide the risks but instead persuade the investors despite the risk. This communicates that the project owner is honest and has done thorough research and preparation for the project.

2.6 Standardisation

At present, infrastructure projects are highly idiosyncratic which inflates the information costs of projects (Collier, 2013). Standardisation and improved data are viewed as great motivators to attract investment. The G20 Infrastructure Financing Seminar hosted in London 2018 defined standardisation as, “the creation of plug and play contracts, documentations and risk allocation for… infrastructure transactions” (Heathcote, 2018) . Standardisation would lead to minimal information necessary to give investors an understanding of a range of investment opportunities in infrastructure. The aim is to avoid bulky project documentation that will only be relevant for that one project which is unattractive because the information entry cost is too high. The work required to standardise should not be underestimated. Bulky documentation is

complex, standardised documents should be simple however, simple can be harder than complex: It requires hard work to make it simple (Jobs, n.d.). It is worth the effort to design a robust simple standard for infrastructure projects (Collier, 2013).

As might be expected, there are some unavoidable limits to standardisation such as geographic location and country-specific laws. However, where possible, if standardisation is embraced processes are streamlined, costs are cut, project timelines and barriers of entry are reduced which will altogether make projects simpler (Collier, 2013). Standards are generally considered as a public good in that they are available for use by all (Kindleberger, 1983) and therefore this standardisation would be best carried out at governmental, regional or at a global level.

2.7 Publicity, Information, Awareness

It is also vital to ascertain the appetite for the proposed water infrastructure project from private investors. An Oxford Analytica report stated efforts to improve infrastructure is partly determined by the appetite for investment (Oxford Analytica, 2016). Determining this appetite can be done by arranging market sounding activities, for example roadshows, where project information with key commercial terms is availed to potential investors, risk matters are addressed and an opportunity for potential investors to obtain clarity on any issues of concern. The roadshow should be part of a broader communications strategy for spreading the link between water and the economy.

The goal is to educate the public, businesses, donors, international finance institutions and all relevant stakeholders to raise their opinion of water on the country's development agenda and to circulate/discuss water infrastructure plans. Other goals include publicising water equity and debt as 'green' investments; and showcasing their good financial performance. The public's willingness to pay for services provided by the infrastructure is important. Positive stakeholder engagement can be a decisive factor on the success of a project (El-Gohary, et al., 2006).

Action Plans can be carried out targeted at local commercial banks to understand the business side of the water sector and support it by providing various financing instruments (Ndaw, 2016). International Finance Institutions can be encouraged to use their catalytic impact to attract other investors to water projects. Some private investors will only get involved with a project because of the involvement of an international finance institution (WWC & OECD, 2015). Businesses can be encouraged to quantify their dependence on water in order to stimulate participation in water issues. They can participate through co-funding, corporate

social responsibility programmes or direct investment. Sometimes private companies may be interested in providing water services where legislature and regulation allow (WWC & OECD, 2015).

2.8 Technology

Information technology reduces the use of discretion, enables community engagement to monitor projects and empowers stakeholders to participate in the decision-making process to reduce incidences of corruption (Selamawitt, 2015). Technology is also a key contributor to better cost recovery. Cost recovery is a fundamental pre-requisite for sustainable development in the water sector (Katko, 1989). It is crucial in the endeavour to finance water infrastructure, without which financially strained government departments are unable to fund water infrastructure expansion and maintenance of existing infrastructure (Cardone & Fonseca, 2003). Governments should promote research and development funding in the water sector and create an environment where innovation flourishes to support the search for new technologies, which will improve service delivery and cost recovery.

A good example is a smart water meter, which stores and transmits consumption data remotely (Hauber-Davidson & Idris, 2006). It has a number of benefits such as reduction in water leakage, improved billing, and better asset management (Marchment Hill, 2010). These benefits reduce non-revenue water thereby unlocking a reasonable percentage increase of revenue. The 2017 Zimbabwe budget statement sought to contain non-revenue water in line Ministries, Departments, and public entities, by enforcing instalment of pre-paid metering for water (Chinamasa, 2017).

A study in South Africa reported that Non-Revenue Water (comprising leaks, illegal diversions, and water not billed) approximated 36% of water supplied (Seago & McKenzie, 2007). Other smart water technologies include matching certain water quality with certain users thereby saving on water treatment cost, or predictive maintenance technology based on monitoring the probability and consequence of failure of components of the water network thereby achieving cost savings by eliminating unnecessary and nonessential preventive maintenance (WWC & OECD, 2015).

2.9 Improving Cash Flows and Cost Recovery

Potential investors weigh reward against risk when deciding to make an investment (Little, 2019). The reward side of the equation can be improved by increasing cash flows and by achieving greater efficiencies in water operations. Cash raising options include user charges, contributions in kind and water vending (WHO, 1994).

Improving cash flows by increasing tariffs to recover the cost of providing the water is more often than not met with opposition from users. "Basic economics requires that the price of a service be at least as high as the cost of providing that service" (Rogers, et al., 2002). Poor cost recovery in the water sector may result in an inability to carry out operation and maintenance, wastage of the scarce resource and even health risks (Cardone & Fonseca, 2003). Uneconomically low tariffs lead to:

> *insufficient income for the efficient and effective operation and management of the service. This implies a poor ability to invest in the sector, whether through human investment or capital investment. As a result, poor service ensues, leading to the dissatisfaction of users thus decreasing willingness to pay, which, on top of already poor cost recovery, further exacerbates the system* (Cardone & Fonseca, 2003).

This leads to a cycle of water poverty illustrated below and fuels the perception that the water sector is inefficient and does not generate sufficient funds to recoup expenditure, thus making water unattractive to repayable finance to fund infrastructure. Also included in the diagram are pathways to change from that cycle.

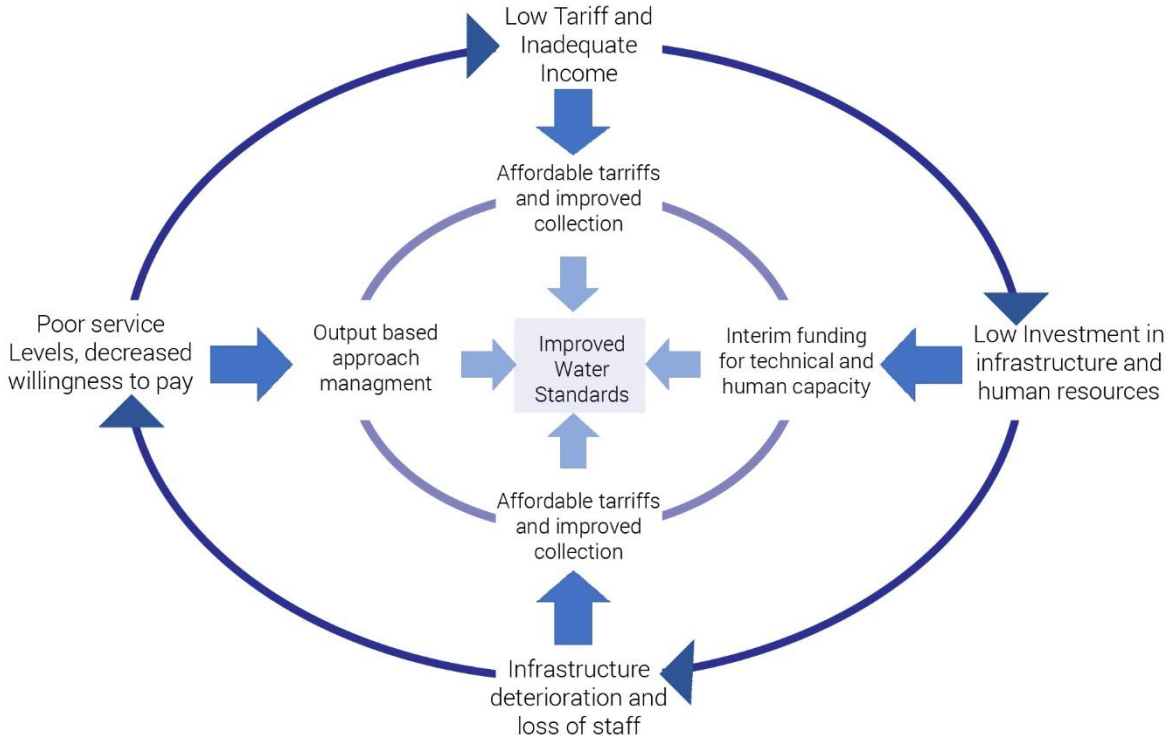

Figure 2: Cycle of Water Poverty (Cardone & Fonseca, 2003) citing (DFID, 2001).

The reason for uneconomically low tariffs is the widely accepted argument that governments should provide water free because it is essential to life (DFID, 2001) and in some cases where water is not free there exist accusations of exploiting peoples basic need for water (Kjellen & Gordon, 2006). Rogers (Rogers, et al., 2002) argued, for the sustainability of water use, the water tariff must meet cost of supply, opportunity cost, environmental externality cost and economic externality cost. Economical tariffs can generate revenue, manage demand, facilitate economic development, improve efficiency and promote social inclusion (Potter, 1994). Some governments have resorted to cross subsidising from other sectors such as energy. Others use increasing block tariffs where the first block of water is provided at a low price. The price is increased if additional blocks of water are used (Whittington, 1992) This provides access to water for the poor (Rogers, et al., 2002).

Low levels in water tariff collections further accentuate problems in the water sector (Tortajada, 2007). Efficient water tariff collection is another area that can potentially increase funds for water investment. A number of water utilities have poor tariff collection. A study of water supply in Khandwa City, India revealed water tariff collection efficiency of 50% (Kacker et al, 2014). Reasons of poor collections include delays in billing, manipulation of meters and

illegal connections (WWC & OECD, 2015). Keeping the tariff fixed and focusing on efficient tariff collection can set in motion a cycle of improved revenue. The additional funds obtained would lead to better quality of services leading to users being more willing to pay increased tariffs in the future.

Another method to increase cash inflow in the water sector is through the treatment of wastewater to produce economically valuable by-products such as heat, nutrients for agriculture, biogas and the re-use of water. Wastewater should not be viewed as a costly problem but a valuable resource in the water agenda (UN Water, 2017). This changes the dynamic for wastewater treatment as it can now not only generate funds by selling these by-products but also cut cost by being energy efficient. A wastewater treatment plant in Aarhus, Denmark generated 70% surplus energy by extracting carbon from sludge and wastewater to make electricity and heat (Mis, 2017). This made the plant energy self-sufficient, pumping freshwater to the community from energy generated from the plant and the excess energy being sold to the local grid. (Mis, 2017) This can be a profitable business for utilities or private individuals where the regulatory climate allows for it.

"There is a positive relationship between infrastructure investment and land property values" (Savills, 2018). Providing water infrastructure on vacant land increases the property value of that land. This principle can be used to encourage developers to co-fund or fully fund local water infrastructure. Municipalities can opt to either sell the land or lease the land and the profits can be used for further water infrastructure development.

Additional methods of saving or generating funds includes for small towns to pool their resources together to reach economies of scale and achieve efficiencies. Particular water functions become viable at a larger scale (WWC & OECD, 2015), incorporating operation and maintenance within loan packages, using targeted risk-based maintenance and by using life cycle costing. Water utilities can also take advantage of climate funding and Green Bonds for energy efficient processes (WWC & OECD, 2015).

2.10 Water Governance

Governance is said to be the key to unlocking finance for water (Ajami et al, 2018). Experience has shown that infrastructure investments alone do not produce the necessitated results. Investments in governance systems are also key to the sector (Zvobgo & Do, 2020). Good governance attracts investment by ensuring the efficient use of that investment (OECD, 2015).

Ijewereme (2015) states that corruption is detrimental to a conducive environment for potential investors to invest in an economy. To bolster the economic growth of the country, it is pertinent that corruption across all sectors is managed effectively (Mutuma & Jambawo, 2017). Improving water governance will in turn improve the enabling environment for investment. (Rees, et al., 2008). "Developing countries must work on creating stable and predictable policy frameworks to not only attract foreign and private sources of capital investment, but also enable sustainable well-designed projects" (Corfee-Morlot et al, 2016).

Good governance will facilitate the selection of sound infrastructure projects and promising efficient execution of the projects and the resultant infrastructure. Where this is lacking, corruption may influence selection of water infrastructure projects, raising costs where better use of those funds could be found. Corruption and unclear decision-making exacerbate the water crisis and affects the distribution of the benefits realised from the water sector. Integrity Pacts/Contracts suggested by the Water Integrity Network can help governments/businesses fight corruption in public contracting (WIN, 2010). The contract would be between a government and all bidders for a public sector contract, setting out the rights and obligations of all parties and a declaration neither side will pay, offer, demand or accept bribes, nor will the bidders collude with others to win a contract" (WIN, 2010).

Water governance related to financing water must also facilitate the generation of water finance and provide monetary resources transparently and efficiently through the following ways:

- Promoting all government water institutions to amass the requisite funds to meet their mandates, by using user-pays or polluter-pays principles where appropriate or through payments for environmental services;
- Determining operational and investment needs through annual strategic financial planning and continuous sector reviews. The annual strategic plans should speak to the annual budgets and government priorities. Furthermore, steps must be taken to avail the requisite funds in a sustainable manner.
- Foster the use of good practices in accounting and budgeting that encourage transparency such that the state of affairs for water activities such as water infrastructure investment is evident to all stakeholders.
- Keeping at a minimum non-essential and unwarranted administrative burdens pertaining to public expenditure but maintaining fiscal and fiduciary safeguards (OECD, 2015).

2.11 Water Policies

Formulation and adoption of policies that communicate the long-term vision and strategy of water investment in the country will send a clear message to potential investors of the public administration's intention to establish a number of continuous bankable water infrastructure projects."Policies that allow sustainable water resources development and their implementation are vital in regions lacking water access" (Zvobgo & Do, 2020).

The policies should address matters including the objective of attracting investment in the water sector, the targeted parties such as the private investors, the type of investment foreseen and implementation strategy (OECD, 2018). A good, coherent, comprehensive and clear water policy will guide decision making to promote investment in the water sector.

Water policies should constitute the institutional framework which should in turn spell out the means of regulation and include issues to deal with consumer protection, water tariffs, water quality and competition. The economics of water service provision should be framed by cost recovery instruments (IWA, 2015) and also acknowledge social responsibility towards users below the poverty line and outline how they will be catered for as poor water management exacerbates poverty (Newborne, 2004). Examples of cost recovery instruments incorporates water tariffs and taxes and should cover total cost of service e.g., operation and maintenance, financial costs, cost of new infrastructure, resource costs and environmental costs (IWA, 2015).

To ensure viability of water policies, stakeholders must be appropriately engaged. The participation of citizens to influence decision making is crucial to success (UNDP & UNICEF, 2015). Improving stakeholder access to information facilitates participation and promotes transparency (UNDP & UNICEF, 2015). The Lisbon Charter (IWA, 2015) however prescribes there should be a balance of confidentiality (where needed) and information to be made available to the public. Notwithstanding, integrity and transparency must be inherent across the policies for trust in decision-making (OECD, 2015).

Policy changes in the middle of water infrastructure projects is a risk to investment. Large infrastructure projects are typically long term therefore the horizon for political interference due to altering public opinions is also long (Collier, 2013). There is also the possibility of supervening governments opposing policies adopted by previous governments. Firm and consistent support from the public and policy makers across political parties and a compatible legal and regulatory framework will avert such risks (UN ESCAP, 2015).

2.12 Legal and Regulatory Framework

The legality of all infrastructure projects (not only water) should never be called into question. It is so important that, "the most widespread feature of infrastructure reforms in developing countries… has been the establishment of new regulatory laws, institutions, contracts, regimes and processes." (Eberhard, 2007). If the legal framework is not robust, parties will seek to terminate contracts legally without due cause which may probably lead to the failure of the water project. "A legal framework provides a systematic set of auditing as well as severe repercussions for people involved" (Mutuma & Jambawo, 2017). Zvobgo & Do (2020) stated water financing in developing countries is constrained by regulatory barriers. For this and other reasons, the legal and regulatory frameworks should hold relevant parties accountable and allow independent officials to investigate water related issues where necessary including corruption (UN ESCAP, 2015).

> *Seventy-nine percent of the service providers feel that the legal system in Zimbabwe must be helping to curb corruption… Zimbabwe has a concrete legal and constitutional framework to fight corruption but lacks the political will to address the problem. The Prevention of Corruption Act 1983 criminalises all forms of active and passive corruption in both the public and private sectors. This legislation punishes guilty agents through hefty fines, or imprisonment* (Gan Integrity, 2017). *Other legislations that deal with corruption offences include the Anti-Corruption Commission Act 2004 and the Criminal Procedure and Evidence Amendment Act 2004* (Chene, 2015). *Given that Zimbabwe's legal system is made up of common law, the country must be having lower corruption like other countries using the same system* (Mutuma & Jambawo, 2017).

Due to the long-term nature of large water infrastructure projects, disputes are highly likely. Mechanisms exist to reduce uncertainty during this time, which include dispute resolution mechanisms and clauses within the contract that frame the discussion of future issues (Kauffmann, 2008). Such mechanisms act as a guarantee that parties' rights are protected, which is a major concern of potential private investors.

> *The risks that concern investors and lenders often relate to low confidence in the judiciary system and the regulatory framework, poor governance, corruption, limited rule of law, lack of enforcement of contracts, political instability and macroeconomics* (MIGA, 2013).

Changes in a country's legislation may also affect the proceeds generated by a water infrastructure project such as tax increases. A possible solution is to include a "change in laws" provision in the contract documents (UN ESCAP, 2015). However, it is better for the country's legal system to be viewed as stable and changes do not happen haphazardly. Tshehla & Mukudu (2020) reported three success factors to project finance, these are, the political and economic stability of the country, an effective market for the project outputs and the social acceptability of the project.

> *This study also concluded that the legal environment of a country has a bearing on access to project finance. Investors and lenders prefer to go to countries where there is a strong legal framework that is enforced* (Tshehla & Mukudu, 2020).

Another major concern of potential investors is tariff setting as it is connected to project profitability. The legal and regulatory framework or in the contract should answer questions on who collects tariffs, how the tariffs are set and adjusted over time. Tariff revision formulas may be included in the contract documents or government guarantees for the setting of tariffs may be obtained. This avoids unilateral reduction of tariffs by government or from the private sector profiteering. "Resentment against private water monopolies is growing... many western companies are accused of profiting from the poor and raising prices above what they can afford" (Vidal, 2005).

The public is a key stakeholder capable of hindering the progress of a project and they have the right to information. Such rights must also be protected within the legal and regulatory framework by adoption of multi-stakeholder approaches and action plans which address transparency gaps and promotes water integrity (OECD, 2015). Transparency creates trust and when citizens trust they are more inclined to pay (GFOA, 2017). Addressing transparency gaps and clear explanation about how revenues are collected and used may improve willingness to pay for water services and management.

Regulatory issues such as weak procurement laws, lack of competition and inefficient or non-transparent tendering processes that result in disputed or cancelled tenders impede private sector investment in infrastructure in Africa (Muzenda, 2009). Procurement regulations should ideally incorporate transparency, fairness and competitive bidding process. There exists a relationship between the cost of services to governments and the extent of competition (Anderson, et al., 2011). Competition tends to generate lower prices and/or higher quality for a given price. There are however some disadvantages of competitive bidding, for example,

bidders may end up using poor quality material and cheap labour to lower costs, win the tender and keep satisfactory profit margins (Van Rooyen, 2018).

Conscientizing stakeholders on procurement regulations and best practices would aid to lessen inefficiencies. Often, water providers enjoy a monopoly (Hadipuro, 2010) and this is when service tends to become unsatisfactory and the service provider becomes incapable of coping with the growing demand from new and existing consumers. Competition encourages efficiency and stimulates innovation (WWC & OECD, 2015). This can minimise water risks and enhance services related to water, and can generate investment opportunities. Competition is also much perceived as an indication of good governance. If the bidding process is deemed biased this may dissuade potential investors.

In other circumstances legislature may need to be altered to include private investor involvement. The framework must address questions which include who may enter into an investment opportunity, who approves such an opportunity and whether there are any investment limits (UN ESCAP, 2015). Water sector regulation should establish clear methodologies. The legal and regulatory framework must be set up in such a way to protect water resources against exploitation for the benefit of all stakeholders (DWAF, 1998). That means protecting public funds used for water, ensuring they are used effectively and efficiently to attract other forms of funding such as aid and the private sector financing.

An institutional investor is an organisation that trades securities in large quantities on behalf of its members for example, pension funds. It is believed that large institutional investors with a low-risk appetite and long-term liabilities are well matched to invest in infrastructure (Sharma, 2013).Currently institutional investors are wary of water investment in emerging markets (McNamara, 2018). However, some countries such as Peru have had regulators give conditions for institutional investors to invest in infrastructure (WWC & OECD, 2015). Consequently, Peruvian institutional investors have been significant investors in infrastructure such as hydropower and urban water (French & Requena, 2009). The United Kingdom Government established a Pensions Infrastructure Platform (PiP) to facilitate investment into UK infrastructure by UK pension funds (PiP, 2017). Government regulation may stipulate investment in infrastructure by institutional investors and a meeting of the two, to determine the best way forward.

2.13 Water Utility Creditworthiness

Creditworthiness is defined as, "the extent to which a person or company is considered suitable to receive financial credit…" (Segal, 2019) A water utility's creditworthiness is an important factor most private investors consider before providing finance (World Bank, n.d.). The determination of the creditworthiness rating includes factors such as utility management and operation, community participation in decision making and finance. It is advisable to carry out regular creditworthiness assessments which would show transparency, integrity and accountability. Such assessments would identify among other things, corporate governance, operational and financial matters that the utility must address to improve or maintain its creditworthiness (W.I.N., 2018). Water utilities who gain financial independence to source private financing, depending on their own creditworthiness, achieve long term sustainability (Baietti & Curiel, 2005).

The water regulator in Kenya, WASREB (Water Services Regulatory Board), designed and implemented a system for their water sector that would see the publishing of an annual report named, '*Impact*', which contains operational ratios, technical efficiencies governance indicators and creditworthiness indices for 25 utilities and 7 public sector boards in their country (WASREB , 2016). By mandating water utility creditworthiness assessments and providing the obtained information publicly, water regulators can play crucial roles to lead a country's water sector to better creditworthiness which will in turn attract commercial funding and facilitate private finance (National Treasury, 2008).

2.14 Conclusion to Literature Review

This literature review has identified a number of barriers to financing water infrastructure. The level of contribution of the barriers to lack of investment is debatable and largely determined by the prevailing circumstances of the local water sector. The identified barriers include:

- Water is difficult to accurately value because it has such diverse benefits which cannot be easily monetised. As a consequence, water often ends up being under-valued.
- Lack of data from bankable projects leading to investors lacking a consistent basis to assess water investments.
- Water infrastructure often requires large amount of capital and a long period of time to recoup the initial investment.

- Lack of adequate project preparation as this is expensive and requires diverse expertise to carry out complex contractual arrangements.
- Africa is deemed to be a high-risk market with risks including, political instability, currency fluctuations and poor liquidity.
- Water infrastructure projects tend to be idiosyncratic which raises information and transaction costs.
- Water services are usually under-priced, resulting in an unattractive record of cost recovery for water investments.
- lack of a supportive enabling environment characterised by good governance, policy interventions and a robust legal and regulatory framework

However, most authors concur on the two main barriers being the last two mentioned, poor cost recovery and lack of an enabling environment. There is no perfect solution to the water infrastructure investment problem. The Roundtable on Financing Water, suggests blended finance as a strategic use of public and private funds together, to mobilise capital flows to water infrastructure (WWC, OECD, 2017). Ajami (Ajami et al, 2018) recommends, "transparent and robust stakeholder engagement to balance affordability and cost-recovery in setting water tariffs".

A summary of the measures that may be implemented to overcome the above-mentioned barriers comprise determining the value of water more accurately by incorporating its diverse benefits to make a strong economic case for water investment as an essential requisite for national economic growth and as an investment that is capable to generate good financial returns. Water projects need adequate project identification and preparation to ensure feasibility and maximising development opportunity.

This would generate a number of bankable water infrastructure projects ready for investment. Comprehensive project sequencing of these projects would provide investors with advanced visibility and a map of the water sector's direction in development. Standardisation of the water infrastructure projects where possible would reduce information costs and give investors a better understanding of the opportunities before them. Project risks must be minimised and well managed to present to investors, a better balance of risk and reward.

Improving the efficiency of water utilities would go a long way in altering the perception of water as an unattractive investment. Investigating all opportunities for water utilities to obtain better cash in-flows and improve water services. This would altogether give the water utilities

better creditworthiness and financial independence to source private financing to achieve long term sustainability. Having dealt with the above, another crucial issue is to establish an environment where the rights of all stakeholders are protected through policies, legislation and promoting stakeholder participation to ultimately achieve good governance and better accountability.

The research question seeks the identification of barriers to financing water infrastructure in Zimbabwe. The literature review has broadly provided foundational knowledge of the barriers that affect water infrastructure in general and the suggested solutions literature has provided. Some issues are global and others are local. Different countries are subject to different water financing challenges. The combination and level of severity of domestic water financing challenges may vary from the global perspective resulting with some countries being more vulnerable than others (Sadoff et al, 2015). A country's hydrology, institutional capacity, its economy, and level of water infrastructure are crucial determinants of its vulnerability to water challenges (Sadoff et al, 2015). The solution needs to be diverse or a hybrid of solutions because the affordability for the population is also different (Naughton, 2017).

> *From a global perspective, there is no general pattern of water infrastructure financing. Models and solutions are highly country-specific, and characteristically eclectic. This is not surprising, since the management of water is the product of the history, geography, culture and economic circumstances of each country, and the way it is financed reflects this diversity* (HLP, 2014).

This research seeks to determine Zimbabwe's own country-specific barriers to water investment. The research will also generate new knowledge by devising a mixture of measures and policy responses born of Zimbabwe's own distinctive features to overcome those barriers. This will be carried out by case study research of past water infrastructure projects as, "there is much we can learn from an improved understanding of past water infrastructure projects in regional economic development…at country level" (WWC & OECD, 2015).

3 Research Method

This chapter seeks to give a description of the methods used in this research. The Journal of Engineering Education published that neither quantitative, qualitative or mixed research methods is superior over the other in engineering research. The choice of method must be driven by the research question (Borrego, et al., 2009). The subject of this research is to understand the barriers to financing water infrastructure and determine the measures necessary to overcome them. To achieve the afore-mentioned entails gaining an understanding of underlying reasons, opinions and motivations. It requires providing insight into the problem and seeking to develop ideas. These attributes point to a qualitative research design (DeFranzo, 2011), which is defined as, "a scientific method of observation to gather non-numerical data" (Babbie, 2014). Daly (2013) asserts that qualitative research methodologies are less familiar to engineers but can provide unique scientific insights into engineering, enabling findings not obtainable via quantitative methodologies.

The research philosophy adopted is an interpretive one as Saunders et al (2009) state, "Interpretivism advocates that it is necessary for the researcher to understand differences between humans in our role as social actors". The study incorporates human interest and interpretation of elements of the research may be necessary. The research takes an inductive approach as it seeks to build theory rather than test it (Saunders et al, 2009) by understanding and formulating theories on barriers to water infrastructure. The research does not begin by developing a theory but seeks to arrive at one after analysing collected data. It qualifies as an explorative study because it aims to find out what is happening and acquire new insight (Robson, 2002) to the hurdles water infrastructure investment faces. 'Exploratory studies are particularly useful if you wish to clarify your understanding of a problem, such as if you are unsure of the precise nature of the problem' (Saunders et al, 2009) which is well suited to this research problem.

A systematic approach was used to review literature in order to provide a transparent and thorough summary of existing articles relevant to a research question by use of pre-determined inclusion criteria thereby limiting partiality.

> *By using explicit and systematic methods when reviewing articles and all available evidence, bias can be minimized, thus providing reliable findings from which conclusions can be drawn and decisions made* (Snyder, 2019).

A search for articles on water infrastructure investment was conducted from top-tier journals, from published peer reviewed papers and from reputable periodicals. The coverage strategy employed was, "of presenting material that is representative of most other works in the given field" (Lau & Kuziemsky, 2016). The identified articles were then screened for inclusion. Levi & Ellis (2006) recommend testing for applicability to determine whether the literature is included or excluded from the study. This was carried about by use of answering two main questions:

- Is the article from a reliable source? Reliability determined by availability of the source of data.
- Does the article fall within the scope of the study?

Articles with negative responses to either questions were excluded. Articles which responded positively to both questions were further assessed for quality. This assessment involves, "appraising the rigour of the research design and methods" (Lau & Kuziemsky, 2016). The research methods of the selected articles were evaluated to determine how the methods affected the interpretation of the findings and if the research methods were validated by other peer reviewed research articles. After an article satisfied the criteria for inclusion and the quality assessment, it was then incorporated in the literature review. The literature review was concluded when no new papers introduce familiar discoveries and contentions (Leedy & Omrod, 2005).

The case study is defined as "a strategy for research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence" (Robson, 2002). The case study approach was used in this research. Although some authors argue that the case study approach lacks scientific rigour, it is best suited when dealing with a complex real-life activity in great depth (Noor, 2008). Employing this approach affords a comprehensive, thorough and clear understanding of barriers to financing water investment associated with the cases and allows for a rigorous investigation of the phenomenon of investment in water infrastructure in Zimbabwe within its real-life context.

The research selected two water infrastructure projects to carry out an in-depth investigation of the barriers the projects faced to financing. Because the research investigated two water projects, it is a multiple case study which seeks to "establish whether the findings of the first case occur in other cases..." (Saunders et al, 2009). This makes a multiple case study preferable

to a single case study (Yin, 2003). The phenomenon of investment in water infrastructure in Zimbabwe is studied at one point in time. This suggests the study is cross-sectional with a 'snapshot' time horizon (Cherry, 2019).

3.1 Data Collection

The data collected was secondary which refers to data that has already been collected by others. Secondary data expands the intellectual horizon by providing opportunity to research and understand past events (Smith, 2006) in this case past water infrastructure projects. It is a viable source of data in research provided a systematic procedure of analysis is followed (Johnston, 2014). "Existing data sets can be an efficient, powerful and readily available resource for addressing developmental science" (Greenhoot et al, 2012). Whilst secondary data has many advantages such as accessibility and generating new insight from previous research, disadvantages also exist such as inappropriateness of data and lack of control over quality (Xaquin et al, 2013). Therefore, caution is given to ensuring that data collected has the following characteristics:

- Reliability of data: information on the data itself is recorded. This information includes the source of the data, methods used to collect the data, time data was collected, potential bias of the compiler of the data, etc.
- Suitability of the data: the scope and nature of the original purpose of the data must be considered.
- Adequacy of the data: the data is considered inadequate if it pertains to a wider or narrower area than that of the research (Wisdom, 2018).

3.1.1 Case Selection

The criteria used to select a case study was based on the following:

- It had to be a project in the water sector in Zimbabwe
- It must have been carried out within the last ten years i.e., 2009 onwards.
- Project information must be readily available. Unfortunately, there are a lot of projects where the documentation is either restricted or unavailable making them ineligible for this research.

Two case studies were selected, one being a water infrastructure project and the other being a water investment plan project. Each of the case studies satisfied all of the above-mentioned criteria. The water infrastructure project is centred around six urban areas in Zimbabwe, which are; Harare, Chitungwiza, Mutare, Kwekwe, Chegutu and Masvingo. The project represents water infrastructure in Zimbabwe to a large extent, as the urban areas are from different geographical regions in Zimbabwe. The second project is the development of an investment plan for water supply and sanitation for Harare, Chitungwiza, Norton, Epworth and Ruwa.

Data collection from the case studies was achieved by collecting documentation or reports from the administrator of the project or from the financier of the project and general project literature. To fully understand the identified barriers, it is at times beneficial to understand the circumstances that form the setting of the case studies. "When using multiple case studies, a typical format is to first provide a detailed description of each case study" (Vohra, 2014). In that regard, below is the project description and a description of the state of the country's water sector at the time of each project to provide case study background and context.

3.1.2 Case Study 1: The Urgent Water Supply & Sanitation Rehabilitation Project

Political instability is known to negatively affect the economy (Aisen & Veiga, 2013). Zimbabwean politics in 2008 had impacted on all sectors of the economy including infrastructure. Water infrastructure in particular, had deteriorated and fallen into disuse throughout the country due to limited resources for maintenance. This resulted in the decline of water services and water quality. The state of water infrastructure was a contributing factor to the 2008/9 cholera outbreak which led to 4300 deaths and 98000 cumulative cases (WHO, 2009). Manzungu (2016) described the outbreak to be the worst in the last 15 years. The outbreak prompted the beginning of dialogue between donors and the Zimbabwe Government on the modalities of relief efforts (Alemseged et al, 2010).

Donors established the Multi Donor Trust Fund (ZimFund), administered by the African Development Bank to provide resources required for rehabilitation works necessary to restore the services in the country (Dorner et al, 2014). By 2008, water supply and sanitation infrastructure were working below capacity because of an extended period of inadequate operation and maintenance. As a result, water quality and services declined (Alemseged et al, 2010). A portion of the ZimFund was used to implement the Urgent Water Supply and Sanitation Rehabilitation Project (UWSSRP) to improve the water supply and sanitation infrastructure in Zimbabwe.

Following consultations amongst stakeholders, the project works were prioritized because of funding constraints with consideration being given to project characteristics, such as the magnitude of the necessary intervention and the number of potential beneficiaries. This led to the project providing support to six geographically dispersed urban areas which are; Harare, Chitungwiza, Mutare, Masvingo, Kwekwe and Chegutu impacting approximately 4.15 million beneficiaries.

3.1.2.1 Project Description

The project scope is to improve the capacity of the above-mentioned urban areas in the operation and management of water supply and sanitation services. Corporate governance and financial sustainability of services is also addressed by the project, as well as community sensitisation. The project work includes:

> *urgent repairs and rehabilitation of critical installations including pumping stations, electro-mechanical works, treatment plants, and water supply distribution system. For sanitation, the urgent repairs include critical trunk and outfall sewers, booster pump stations and treatment works as well as treated effluent disposal facilities* (Alemseged et al, 2010).

3.1.3 Case Study 2: The Greater Harare Water & Sanitation Investment Project

The Greater Harare region encompasses Harare, Chitungwiza, Epworth, Ruwa and Norton. In 2014, the City of Harare sought to develop a strategic plan to manage the water and wastewater infrastructure system for the region as a single entity. The City then solicited the assistance of The World Bank which prompted the Greater Harare Water and Sanitation Investment Plan Project.

The main aim of the project is to produce detailed water supply and sanitation investment plans to satisfy infrastructure needs until 2020 (medium term) and until 2030 (long term) The plan will guide infrastructure investment and institutional development for sustainable services in the water sector.

3.1.3.1 Project Description

The project scope includes the complete supply chain of the water sector. This encompasses, development of water resources, treatment of both water and wastewater, water transmission, water distribution, sustainability and institutional development. The general activities followed for each urban area began with data collection from available data such as plans, drawings, census data, maps and reports. This was followed by population and water demand forecasting

in order to determine the required capacity. Then there was engagement of local authorities to carry out an institutional assessment and an assessment of the existing water and wastewater infrastructure. This was concluded by the development of the investment plan, preparation of cost estimates and a financial analysis. Environmental and social management was also considered during the development of the investment plans.

Components of the investment plan include:

- water demand management and non-revenue water reduction
- water supply service improvement
- extension of water supply services
- sanitation service improvements
- extension of sanitation services
- accompanying measures.

3.2 Data Analysis

Analysis of the data occurs both during and after collection (Kvale, 1996), this gives the research direction as to what the barriers are in water infrastructure. “The interactive nature of data collection and analysis allows you to recognise important themes, patterns and relationships…” (Saunders et al, 2009). Related data is integrated from the different notes and identified patterns are further explored. From the apparent patterns, theories are developed and tested leading to drawing conclusions” (Kvale, 1996; Miles et al, 1994).

The approach used for data analysis in this research is the thematic analysis. Braun and Clarke (2006) define thematic analysis as, “a method for identifying, analysing and reporting patterns (themes) within data”. The goal is to identify themes in water infrastructure investment and use the same themes to build theory on barriers to investment. There are differing theme levels such as, “manifest level (directly observable in the information) or latent level (underlying the phenomenon)” (Boyatzis, 1998).

Thematic data analysis focuses on interpreting and explaining data (Maguire & Delahunt, 2017) which brings clarity and understanding to the nature of the problem in the water sector. Yin (2003) states, “the best preparation for conducting case study analysis is to have a general

analytic strategy." The six-step strategy to thematic data analysis provided by Braun and Clarke (2006) has been adopted for this research. Below are the steps followed:

3.2.1 Step 1: Familiarise with the data

The first step was reading the data repeatedly and in an active way (Braun & Clarke, 2006), active in that one is constantly searching for early impressions, themes or meanings in the text. Themes are shaped and more recognizable as the entire body of data is read many times over in this manner. At this stage information of the data was also recorded, such as source of data and potential bias of the source.

3.2.2 Step 2: Generate Initial Codes

As familiarisation of the data took place, a list of initial ideas was noted, which led to the second step, generation of initial codes. Codes identify an attribute of the data that the researcher finds interesting (Braun & Clarke, 2006). According to Boyatzis (1998), "a 'good code' is one that captures the qualitative richness of the phenomenon". Codes form the foundation from which themes emerge and should thus be clear and concise. Coding was carried out manually by writing notes on the text and using highlighters to indicate potential themes (Braun & Clarke, 2006). Even after coding, the data was read and re-read to ensure consistency and validation of codes, whilst some codes were modified.

3.2.3 Step 3: Search for themes

In this stage, data was analysed at the broader level of themes. Codes were examined to understand how they fit together to, "form an overarching theme" (Annerieke, 2018). Codes were sorted into main themes or subthemes determined by factors such as significance and frequency of occurrence. Other codes which did not seem to belong were labelled miscellaneous (Braun & Clarke, 2006). This stage was concluded with portions of data coded to themes and sub themes.

3.2.4 Step 4: Review Themes

The generated themes from Step 3 were further developed by reviewing and modifying them. Themes were checked if they have enough supporting data and if the data fit together meaningfully. The development of the themes happened in two phases. The first phase required reviewing the theme's coded data extracts (Braun & Clarke, 2006). All data extracts pertaining to a particular theme were read again to ascertain whether the extracts form a coherent pattern. The second phase required reviewing the theme as it relates to the entire data set (Maguire &

Delahunt, 2017). The themes were assessed to check if they, “accurately reflect the meanings evident in the data set as a whole” (Braun & Clarke, 2006). After the assessment, the complete data set was again re-read to determine whether any re-coding was necessary.

3.2.5 Step 5: Define and Name Themes

This was the last stage, to refine themes. At this step, the goal was to, “identify the essence of what each theme was about and determine what aspect of the data each theme captured” (Braun & Clarke, 2006). The analysis also checked for an overarching theme embedded in the other themes and/or relationships between themes. This step’s analysis includes naming and organising themes with accompanying narratives identifying what is interesting about the theme and how it relates to the broader message and to the research question.

3.2.6 Step 6: Write-Up

The task at this stage was to convey the complex account of the data in a compelling manner which would satisfy the reader of the validity and merit of the analysis (Braun & Clarke, 2006) the endpoint being a report, dissertation, assignment or journal article. The written report should be more than just summarising data, it must link back to existing literature (Annerieke, 2018) and make an argument toward the research question.

4 Findings

4.1 Introduction

This chapter gives findings to the research question, "what are the barriers to financing water infrastructure in Zimbabwe?" The research had certain limitations, including the limited project documentation available and the potential bias of the author of the documentation. There is the possibility that some barriers were not highlighted in the project documents even though the project faced them. The broad scope of the research may lead to potential generalisations of country specific barriers, whereas a city-to-city focus would be more suitable for implementing solutions, as water is a highly context-specific issue.

The research did not examine in particular the positive aspects of the Zimbabwean Water Sector. Therefore, neglecting to call to attention positive attributes of the country's water sector does not necessarily indicate absence. The main focus was on the barriers the sector is faced with and addressing those identified barriers for a financially sustainable future for water in the country.

The research identifies a number of barriers to increasing investment finance for water infrastructure. Such barriers include: vandalism; poor cost recovery; lack of coordination; and political interference. Overcoming these challenges depends on all stakeholders being convinced of the necessity of water investment, and persuaded by the social, economic and financial returns from that investment. The challenges identified are in no particular order and are given in greater detail below.

4.2 Barrier 1: Deficient Water Quality

The Environmental Management Act (2002, 20:27) seeks to ensure the protection of the environment, prevent pollution and the sustainable management of natural resources. Water is an essential natural resource and waste water has the potential of polluting the environment. This makes the Act very relevant in issues concerning water and waste water. It sets out regulation on the disposal of waste such as;

> *70(1) No person shall discharge or dispose of any wastes, whether generated within or outside Zimbabwe, in such a manner as to cause pollution to the environment or ill health to any person. 70 (5) (a) Any person who discharges or disposes of any wastes*

in contravention of any measure shall be guilty of an offence and shall be liable to imprisonment for a period of not more than five years or to a fine of not more than five million dollars or to both such fine and such imprisonment (GoZ, 2002).

Some urban areas in Zimbabwe have been developed on the same catchment as they receive water. These urban areas have abstraction points downstream of waste water treatment plants resulting in limited natural attenuation time. Harare, the capital city of Zimbabwe, is one such example. Lake Chivero is the main source of water for Harare and other satellite towns that surrounds it. Sewage intrusion is a major problem facing Harare and Zimbabwe at large. The 2020 National Budget Statement reported,

> "*most local authorities are discharging raw effluent into rivers resulting in contamination of major sources of water, especially for urban areas, increasing the cost of water purification. The situation is compounded by some private companies that are also discharging their waste into the same*" (Ncube, 2020).

The Urgent Water Supply and Sanitation Rehabilitation (UWSSR) project reported that the failure of most sewer treatment facilities across the country has led to detrimental impacts on the environment including water resources (Alemseged et al, 2010). For example, The Greater Harare Water and Sanitation Investment (GHWSI) project reported that in Harare, towards the western part of Crowborough,

> "*the steel [sewer] pipes on the pipe bridge are severely corroded and damaged, and all the influent from one of the 900mm Ø is surcharging into the stream. Consequently, about 5,000 m of the 900 mm Ø does not convey any waste water and is in effect, abandoned*" (Dorner et al, 2014).

Figure 3: Surcharging Sewer Pipe (Dorner et al, 2014).

In Kwekwe, the UWSSR project noted malfunctioning pumping equipment at booster stations resulting in the raw sewage ponding and forming wetlands. The effluent eventually flows in streams. In Masvingo, breakdown of the BNR (Biological Nutrient Remover) plant results in partial treatment of effluent discharged into surface water. In addition, rapid urban growth also contributes to water quality deficiencies, which has been recorded in Harare.

> *The rapid increase in population in the lake's catchment area coupled with the shortage of funds to extend and rehabilitate water supply and wastewater treatment infrastructure form a sustainability threat to Harare in terms of water quality and quantity* (Nhapi, 2009).

Urban agriculture in cities also poses the risk of siltation and leaching nutrients and pesticides causing freshwater pollution. Heavy enforcement of the Environmental Management Act penalising anyone or entity polluting water resources is needed to deter pollution. The greater the pollution of rivers which feed into water sources, the more expensive it is treat.

> *Too many different types of chemicals are being used for the treatment of the water, a total of 8 in all. Being used in ever larger quantities at the main treatment works, MJ [name of treatment plant] due to poor quality of raw water from the dams* (Alemseged et al, 2010).

The more expensive it is to treat, the harder it is to make a financially strong business case for water investment. The challenges faced from failing waste water infrastructure may deter investors from the water sector as it seemingly causes its own demise. The "polluter pays" principle is a one possible solution "by including real deterrents and real incentives not to pollute and by adopting a zero tolerance approach towards combating pollution" (MWRDM, 2012). The "polluter pays" principle will aid in controlling pollution (Makurira, 2003). Ambient water-quality monitoring and discharge licences are critical for enforcing the principle. Such monitoring is unfortunately lacking because EMA lacks financial and human capacity (Manzungu & Derman, 2016).

Another problem has occurred due to deficient water quality: residents of some towns and cities have resorted to depending on alternative sources of water even when municipal (primary) water is available, perceiving municipal water to be unsafe. This distorts demand projections and leads to loss of revenue.

These perceptions have a direct implication on their acceptance of primary water sources and usage of water, which ultimately may lead to unwillingness to pay for the water, due to challenges with water quality. Results from the evaluation indicate that a large proportion of residents feel that the water they receive from the Municipalities is 'unsafe' (GRM, 2017).

Figure 4: Perceptions as to whether the water is safe to drink or not (GRM, 2017)

Harare and Chitungwiza were reported to have 89% of households consider water from local authorities as unsafe. The reasons for this included, visible suspended solids, smell or a greenish colour. The most common reason was suspended solids. Households preferred secondary sources of water. Where that was not possible, residents would resort to further treatment of the municipal water. This sentiment is not shared across the whole country. Alternatively, 65% and 55% from Chegutu and Masvingo respectively considered the water is safe. Kwekwe and Mutare did quite well with 88% and 89% of residents believing water provided by the municipalities is safe (GRM, 2017).

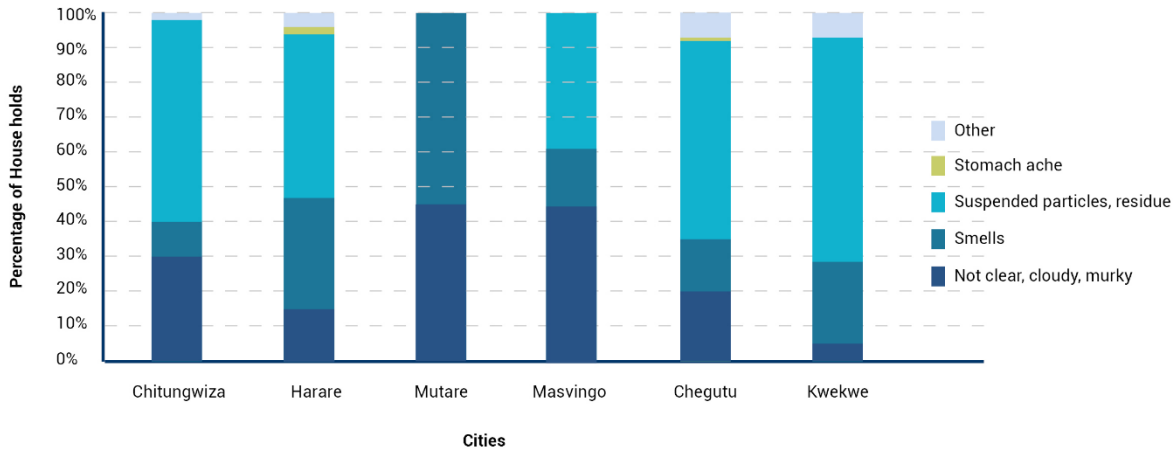

Figure 5: Basis of Perceptions for Residents Feeling Water is Not Safe for Drinking (GRM, 2017).

All six local authorities covered by the UWSSR project confirmed that water was of acceptable turbidity standards at the outlet point of the water treatment plant. This brings about the notion that the problem may lie with the distribution network through introduction of pollutants in the system. Municipalities need to manage the perception of their service provision as it affects revenue collection from consumers and negatively impacts the financial case of water investment projects. Interventions to deliver good quality water at the consumer's tap are necessary.

4.3 Barrier 2: Lack of Maintenance

Maintenance is a key determinant to sustainability. Its purpose is to ensure optimum efficiency of infrastructure. The cost of regular maintenance is relatively lower than the cost of a major breakdown. Neglect of maintenance leads to premature obsolescence of water infrastructure which in the end grieves consumers. The 2018 Zimbabwe Budget Statement found that the recovery of water and sanitation services in most urban settlements faces the challenges of ageing infrastructure (Chinamasa, 2018). The UWSSR Project reported that,

> *with limited resources for maintenance, most of the infrastructure including that of water supply and sanitation has fallen into disuse with inevitable deterioration of the services. As a result, the quality of both water supply and sanitation services has seriously been compromised.* (Alemseged et al, 2010).

Failure to carry out routine maintenance is a barrier to water investment as it increases the risk of failure to operate and maintain infrastructure which results in failing to realise benefits from the infrastructure such as revenue collection and health benefits. Deterioration of services causes the breakdown of trust between the service provider and the users. This results in unwillingness to pay and hence a reduction in revenue collection. The same project stated,

> "*Many of the boreholes which were the main means of supply have also broken down. Currently, the communities are drifting back to open water sources for their water supply needs*" (Alemseged et al, 2010).

This dissuades potential investors in that not only might a water infrastructure project fail financially but it may fail to improve the quality of life of the targeted beneficiaries.

A potential solution is to incorporate funding for operation and maintenance in the infrastructure project loan application if the project is funded by a bank loan. The disadvantage of this solution is that it does not encourage achieving sustainability through cost recovery. Ensuring collected revenue is adequate to cover recurrent operation and maintenance cost is an approach cognisant of the long-term financial security of the project. That said, revenue collection through water tariffs is not a simple task as discussed further in this research. Another potential solution is employing optimal maintenance procedures which would reduce maintenance costs by making the best use of available funds through risk assessment of assets.

4.4 Barrier 3: Location Specific Challenges

There were some location specific barriers identified. These barriers were largely due to the hydrology of the area or the existing infrastructure of the area. For instance, there was a drought reported during the UWSSR Project. This resulted in dwindling raw water sources and water treatment plants such as at the Green Sykes Dam were not operating at full capacity. This limits expansion of existing infrastructure and rather necessitates capital for new water infrastructure works.

In some cases, there is no technical or economical solution to the barrier. An example of this on the GHWSI Project. The project area is in the upper Manyame sub catchment, which has a reasonable amount of water owing to a MAR (Mean Annual Rainfall) of around 750mm. Granitic rock is the prominent type of rock in the area. These rocks have poor groundwater potential as they have no primary permeability and porosity (Dorner et al, 2014). This poses

challenges for Epworth, a town about 12km from Harare. The town's rate of growth has not been matched with the provision water services.

> *It is technically and economically not feasible to construct an own water source for Epworth. The yield for ground water sources is very poor and there is no surface water source within the vicinity of Epworth.* (Dorner et al, 2014).

Another such example is Chitungwiza, a town located 25km from Harare. There is limited ground water potential around the town. There are plans to construct Muda Dam to be Chitungwiza's source of water. This solution has been reported to be more expensive than buying bulk water from Harare. At present, the feasible solution for both towns is to rely on water supply from Harare and work on expanding Harare's water supply.

4.5 Barrier 4: Aid Dependency

We live in a culture of aid, where countries which are economically and financially developed are believed to be morally obligated to give aid to poorer countries (Moyo, 2009). Aid has certainly opened doors of opportunities to countries who would have otherwise been unable to afford certain infrastructure. However, the possibility of over reliance of donor funds is an important condition to consider. "Many argue that international assistance paradoxically poses a barrier to recipient country development and sustainable economic growth" (Stanford, 2015).

Below is a figure showing the proportion of aid from development partners in the Zimbabwe Water and Sanitation sector. Comparing the various sectors, water receives most of donor funds. Analysing the water sector alone, loan financing does not contribute to the sector neither do statutory funds and the sector's own resources. Aid from development partners also makes up the larger part of the total funds for the sector.

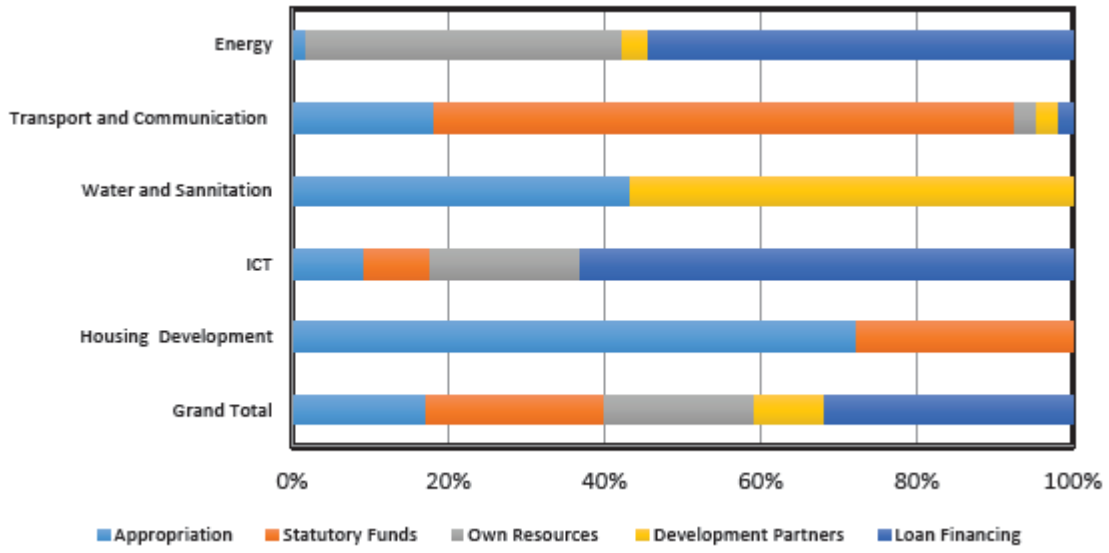

Figure 6: Sectoral Finance Matrix from the 2017 Zimbabwe Budget Statement (Chinamasa, 2017)

Makurira (2003) stated, "the water sector reforms in Zimbabwe were largely donor-driven". This presented a window of opportunity for philanthropists to introduce implementation of water resources management strategies through donor-funded programs (Manzungu & Derman, 2016). In the early 2000's, donor support to Zimbabwe nearly disappeared during the political struggles the country faced. At this time, the Cholera outbreak occurred partly due to the state of water infrastructure (Alemseged et al, 2010). The international community then offered, "water supply and sanitation support as part of humanitarian assistance" (Manzungu & Derman, 2016). Western countries were provided an opportunity to widen their support for the country.

Project documentation for both projects (UWSSR and GHWSI) has noted a number of donor funded emergency repairs for water systems. Ideally, recurrent costs such as maintenance and repairs should be funded by water revenues for sustainability issues. This encourages the notion that water investment is safe and is not dependant on an aid bail-out.

> "*Continued dependence on external assistance has made services vulnerable to funding cycles, and communities have lost a sense of ownership and control of community infrastructure*" (ZWF, 2013).

The Zimbabwe National Water Policy addresses reliance of donor funded WASH programmes and seeks to resolve the barrier by accessing more diverse form of finances which includes the private sector.

> *In order to reduce over-dependence of rural WASH on external financing, government financial allocations will be used to leverage greater external, private sector and user financing to rehabilitate, develop and maintain rural WASH infrastructure* (MWRDM, 2012).

4.6 Barrier 5: Vandalism and Theft

Vandalism was reported on water valves, manhole covers and at public water points. This contributes to poor service delivery (Dorner et al, 2014). A total 24% of meters were stolen in Harare (GRM, 2017). Some sewage pump stations are not fenced and are thus susceptible to theft and vandalism. Adequate security of infrastructure should be employed where possible. Municipalities continue to attempt to provide replacement and repairs of the network however, it is crucial for the community to participate in the upkeep of assets. The populace can aid in policing vandalism. Public awareness campaigns may be used a vehicle to facilitate this.

4.7 Barrier 6: Demand Uncertainty

Water infrastructure is designed to provide service requirements to a population. Hence the population determination and projection is a key parameter in calculating water demand. Inaccurate demand forecasting is a major challenge in long duration water projects leading to project income shortfall. It is due to factors such as demographic change or alternative water sources being used by the target population.

Rapid population growth has negatively affected Zimbabwe's water sector (Nhapi, 2009). Greater Harare grew in population four-fold in 43 years with a population of 352,000 in 1967 to close to 1,475,000 in 2010 (Macrotrends, 2020) citing (UN, 2019). Recently urban growth in Harare has largely been due to worsening poverty in the rural areas rather than new opportunities. This poses a challenge to demand forecasting.

> *A key limitation to projecting urban population is the unpredictability of some of the population change factors, especially net migration. While births and deaths could potentially be estimated from historical trends, since they take some time to change significantly, net migration can be influenced by and can quickly respond to short-term changes such as economic swings and patterns of investment* (Dorner et al, 2014).

Poor service delivery has also led to Harare City Residents seeking non-municipal sources of water which also skews demand forecasting. “Household connections to piped water is high, above 90%, but use of secondary water sources also remains high (80%), due to residents perceiving piped water to be unsafe” (GRM, 2017). This certainly affects projected demand, as consumers may be unwilling to use existing water infrastructure resulting in loss of revenue. Other issues reducing consumption of water were, “water rationing induced by high network leakages and reduced water production” (Dorner et al, 2014). Non-reticulated informal settlements in parts of Epworth were not included from the water demand calculations for GHWSI project. These will need to be included in future as the Zimbabwe Water Policy prescribes access to water for all.

4.8 Barrier 7: Housing Development Expansions Ahead of Water Services

Whilst the country’s water sector faces challenges, city expansion has not ceased. Housing developments continue to be built. Some settlements are formal whilst others are informal however both increase the city’s demand for water which may result in further challenges for the city. The 2019 National Budget Statement reported, “many new urban settlements are not connected to municipal water supplies, whilst in older settlements, supplies are erratic forcing residents to seek alternative and unsafe water sources” (Ncube, 2019).

The GHWSI Project recorded the following new development areas in Norton: Ward 6; 12 and 13. These wards have been connected to the existing water network and have received little or no water because the network has no capacity to supply these new areas, confirmed by water network modelling.

> *Thus under the existing condition areas of the old town which used to have adequate supply now suffer from low pressures and short supply hours but do receive water. New development areas receive little or no water at very low pressures. As a result, many people, especially in the new development areas now rely on shallow wells for their water supplies* (Dorner et al, 2014).

Glen View, Budiriro, and Ruwa are other suburbs which have had expansions and now experience poor availability of water. Below is a table showing that majority of residents did not have water for 8-14 days in the month. The average number of days that residents had no water was 11 days per month and only 15 percent of residents reported that they had no water cuts (Mutuma & Jambawo, 2017).

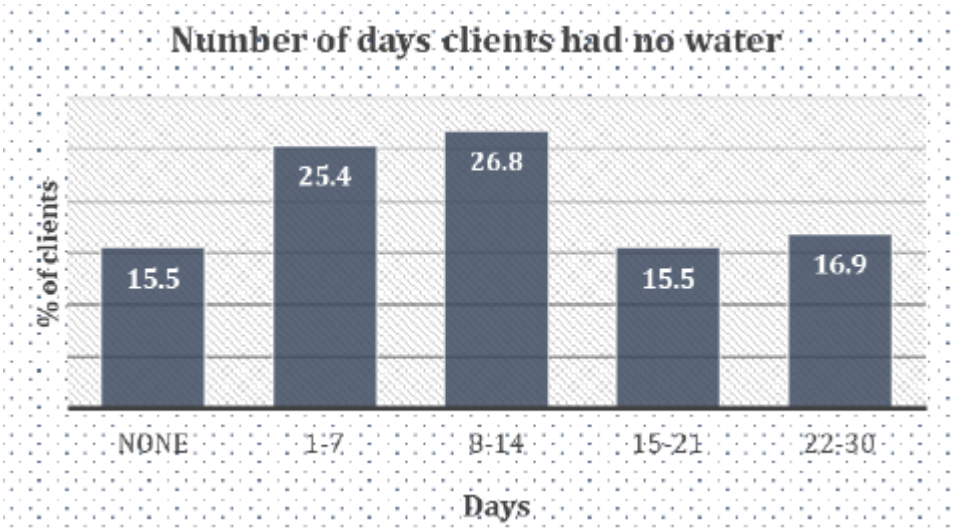

Figure 7: Number of days clients had no water in Glen View, Budiriro and Ruwa

The expansion of housing developments ahead of water services has resulted in poor service delivery for the entire network. Water supply provision problems are exacerbated by, "the continuous development of disordered informal network" (Zvobgo & Do, 2020). Where service delivery is poor, revenue collection reduces and the confidence of consumers and potential investors is affected. Protocols must be in place to protect existing water infrastructure from detrimental connections thereby protecting water investment. "All new developments should be co-ordinated and their impact on water quantity and quality assessed" (Nhapi, 2009).

Where funds are lacking for water services to meet housing development infrastructure demands, then municipalities can approach developers to co-fund or fully fund the needed water infrastructure considering that the value of land with water infrastructure is more than without. Housing developments without the requisite water infrastructure should not be commissioned.

4.9 Barrier 8: Lack of Continued Stakeholder Involvement

Water management in Zimbabwe is decentralized to the catchment level to enable stakeholders to have greater input in the management of water in their area (Makurira, 2003). Sustainability in potable water supply requires extensive social awareness and altering of household water use behaviour (Zvobgo & Do, 2020). A research was conducted in Cape Town (Sorensen, 2017) proved that residents are capable of making unprecedented behavioural shifts in household water usage to produce a significant decrease in water use (Zvobgo & Do, 2020).

Residents reduced water usage per household from 540 to 280 L/day between January 2015 and January 2018 (Booysen, et al., 2019). Stakeholder campaigns and consultations are useful tools in water management but lack of funding has been cited as a problem.

> *When finances became scarce, the frequency of meetings was reduced, and user groups were merged to cut down on expenses. This meant that stakeholders could not meet as often as was desirable to discuss water management issues* (Makurira, 2003).

Both projects analysed in this research gave great importance to stakeholder consultations. Sensitization of community was carried out on a wide range of topics including the importance of water revenue, using water wisely and siltation of sewers from using sand to scrub pots.

Consultations were also carried out with stakeholders before commencing the UWSSR Project to identify priority interventions the project should carry out. This fosters ownership of the project by the stakeholders. This should be carried out cautiously as different stakeholders may have different priorities resulting in competing demands. This often occurs when stakeholders pursue short term self-interest as opposed to shared long term goals.

The consultations were also an opportunity for private companies to become aware of their need to invest in water. After completion of the project, local authorities attest to the occurrence of stakeholder consultation however, due to economic hardships, there has been minimal change. This change does not usually happen instantly but takes time, local authorities might not have the luxury of time.

> *The project successfully delivered the training in all the towns, but from the findings we conclude that this component did not result in the desired expected changes. The intended behaviours should be nurtured throughout the project rather than a once-off training; key health extension staff should have taken on this role and promote further group formations until these WASH groups are mature* (GRM, 2017).

Stakeholder involvement should be carried on throughout a project to gain continual support from the community and carry on the sense of ownership. Lack of follow ups could cost the project success. Investors are encouraged by a good history of successful bankable projects. Failing to succeed due to lack of continued stakeholder involvement threatens investment. Carrying out follow ups, having good customer relations, would better instil the behavioural change desired and improve willingness to pay. Non-payment of water tariffs is a barrier to the sustainability of water infrastructure projects.

4.10 Barrier 9: Inadequate Institutional Capacity

The GHWSI project concluded that government institutions, including parastatals which are related to water, need to be strengthened in training personnel, transportation of teams, acquiring equipment and IT. Capacity building in the water sector is crucial for sustainability. There is "need for its further update in order to address the current issues and challenges facing the sector, and in keeping with the international trend of the sector development" (Alemseged et al, 2010).

The reason for the deterioration of the state institutions is due to lack of resources and the 'brain-drain' where, "most of the qualified staff, like in all other professions, sought greener pastures when the country's economic performance took a nosedive" (Alemseged et al, 2010). The incoming professionals need support to efficiently deliver water services satisfying the demand of the community and to prioritise information gathering without which IWRM would be negatively affected (Manzungu & Derman, 2016). It is not only a matter of expertise but whether staff have been given adequate resources to work with. Inadequate capacity in human resources and equipment results in a high risk of weak project implementation. Low salaries contribute to high levels of corruption (Mutuma & Jambawo, 2017). When ZINWA faced dwindling funds in the country's Water Fund, Makurira (2003) reported

> *ZINWA cannot provide sufficient personnel to provide commercial services, nor can it provide statutory functions with funding sourced from the Water Fund. With staffing levels inadequate and depth of expertise questionable, it is uncertain if sufficient funds from the Water Fund would have made much difference to this situation* (Makurira, 2003).

To re-gain operational capacities and efficiencies, workshops can be held to educate staff. Operation and maintenance staff can be attached to prominent local contractors to gain priceless experience and knowledge transfer. Other staff can be attached to local NGOs for training in community sensitisation and mobilisation. Where possible the international community can also assist in providing technical assistance as opposed to funds, by way of temporary assignment of industry experts to improve water systems.

Harare and Kwekwe Municipalities have been reported by consumers to have low response rate and lack of urgency. Outsourcing water services is a legal option in Zimbabwe while municipalities build their capability to do so themselves.

> *The [Zimbabwe Water] policy also acknowledges the fact that operations can be provided by private service providers and that capacity building and investments in operation and maintenance equipment are necessary for sustainable service provision* (Dorner et al, 2014).

This solution is however a challenge as municipalities are reluctant to give up the power or influence associated with water to private organisations.

4.11 Barrier 10: Lack of Coordination

There were a number of institutions involved in the Zimbabwean water sector at the time of the projects. These institutions include, The Ministry of Water Resources Development and Management; Zimbabwe National Water Authority (ZINWA); The Ministry of Local Government, Urban and Rural Development (through the local authorities); The Ministry of Health and Child Welfare; District Development Fund; The Rural Capital Development Fund (RCDF); Ministry of Transport, Communications, and Infrastructure Development. The UWSSR project reported that there are, "too many institutions involved in the water and sanitation sector" (Alemseged et al, 2010). Chitungwiza has been cited as a case in point of this.

> *The current water supply situation in Chitungwiza reflects how lack of inter- and intra-governmental coordination within and between central and local governments across sectors can exacerbate inefficiencies and delay response. This concurs with Nyikadzino and Nhema* (2015) *findings that Chitungwiza's poor water supply services are attributed to the lack of coordination between the council and the central government. Immediate government intervention is required to address water issues in Chitungwiza to protect thousands from the COVID-19* (Zvobgo & Do, 2020).

There is a reasonable argument to streamline water sector institutions to bring about better coordination resulting in improved management of resources, doing more with sector financing and sustainability of services. Institutions should have easily comprehensible, distinct and unambiguous objectives which are not duplicated. There should be a clear separation of functions where possible. This does not mean institutions cannot work together but that roles and responsibilities should be clear and separated while the institutions work together. The principle of subsidiarity would be useful in streamlining efforts.

> "*The principle of subsidiarity means that nothing that can be done by a smaller, more local and simpler organization should be done by a larger complex organization. Any activity that can be performed by a decentralized institution should be*" (MWRDM, 2012).

With regard to the Greater Harare region, each town has had a unique pattern of development and little has been done in the way of coordinated planning between the towns. Coordinated master plans communicate the long-term vision and strategy of water investment in the area and will send a clear message to potential investors of the intention to establish a number of continuous bankable water infrastructure projects.

> *There has never been any comprehensive planning carried out for the whole of the Greater Harare Metropolitan Area and none of the component towns have an updated master plan (although for Chitungwiza, JICA has completed a detailed study on future water Sanitation)* (Dorner et al, 2014).

There is infrastructure which cannot be used due to lack of coordination which goes against the Integrated Water Resource Management principle of promoting coordinated development. Epworth has a set of ponds that were never commissioned and is now overbuilt. Currently the ponds are being used as a sports field and so can definitely never be commissioned. Ruwa has a pond system for waste-water treatment that is not in use due to land wrangles with Epworth Local Board.

Incompletion of projects is another indicator of lack of coordination. Norton embarked on a project to bring raw water to their own water treatment plant. Project funds were intermittent and later suspended. GIZ considered completing the project but concluded the costs were too high and the quality of the water too low and therefore decided not to finance completion. Intermittent funds hamper the success of a project introducing discontinuity of staff and vision. An incomplete project is a big deterrent of investment as revenue from the initial investment is not realised. Norton is reported to also be in possession of a partly completed digester for wastewater treatment. Epworth possesses a sewer reticulation network not commissioned because the waste water treatment plant was never built.

4.12 Barrier 11: Zimbabwe's Economic Decline

The economic decline in Zimbabwe has severely affected the water sector and the state of all infrastructure. Zvobgo & Do (2020) concluded years of economic meltdown in Zimbabwe has caused municipalities to fail to reliably supply water to residents. "Inadequate funding was a severe setback to the infrastructure restoration and limited what could possibly be achieved" (Alemseged et al, 2010). The prevailing economic hardships have hampered municipalities from realising the results of efforts on improving service delivery. Manzungu reported the following as the cause of implementation of IWRM:

> *A combination of poor economic performance (due to poor or wrongly implemented social and economic policies), national-level politics as political parties jostled for power, as well as waning international support due to poor international creditworthiness, and donor withdrawal at the behest of Western countries on allegations of democratic and human rights violations in the country* (Manzungu & Derman, 2016).

Stabilization of the economy would positively influence the financial performance of municipalities and make strides in restoration of basic services. Zimbabwean municipalities often struggle in the provision of water supply due to "numerous and institutional bottlenecks, rapid population growth and poorly maintained and aging infrastructure" (Zvobgo & Do, 2020). Adequate financial resources would assist in solving such problems issues. "The long-term financial viability of service provision will depend largely on the financial well-being of consumers and their ability to pay in full for the services their use" (MWRDM, 2012).

Zimbabwe suffers from a high risk of electricity power outages due to unreliable electricity supply which affects availability of water as energy is required to treat and distribute water in some areas. Lack of accurate valuation of benefits for water projects forms a barrier for preparing a viable financial case. The economic life of the UWSSR project investment is approximately 25 years. The business case for the project was found to be economically sound by making the following assumptions:

- Reduction of Non-Revenue Water to 10%
- Incremental health, water and sanitation benefits
- Benefits due to reduced water treatment costs (resulting from improved raw water quality)
- Incremental operations and maintenance costs to be 30% of incremental water revenue

Infrastructure investment projects typically involve foreign currency, therefore project revenue will be in local Zimbabwean currency while project loan repayment would be in foreign currency. “Zimbabwe has been facing severe foreign currency shortages and government allocations can no longer be guaranteed” (Nhapi, 2009). If the local currency devaluates during the project life, the revenue generated from water projects might not be enough to cover loan repayment.

Currently Zimbabwe is ineligible for funding from international financial institutions as a result of its debts (Samaita, 2020) and the local currency inflation rate is estimated at 300% (Muronzi, 2019) . This makes it complicated for the private sector to safeguard their investment. A possible solution is the Zimbabwe-China currency swap deal. “A currency swap involves the exchange of money in one currency for the same in another currency” (Samaita, 2020). This arrangement would allow existing Chinese investors to provide local currency to new Chinese investors and in return receive foreign currency from the new investors. The agreement’s success is yet to be seen.

Both projects analysed had limited local private sector involvement recorded. Established private sector companies seem unaware of their dependence on the depleting resource therefore leading to the limited investment. Three private pump stations were recorded to be privately funded at Donnybrook, Philadelphia and Mariadale. Mandating private sector involvement is a potential solution:

> *Private Sector Organizations who exploit resources within rural areas such as mineral resources and/or commercial wild life management will be required to invest part of their proceeds into developing Rural WASH* (MWRDM, 2012).

There is room to improve private sector involvement by conscientising the companies of their water footprint and potential financial losses should water not be available of adequate quality and quantity. Improved water supply will enable industries to operate at higher production capacities.

4.13 Barrier 12: Political Interference

The majority composition of the government is from the Zimbabwe African National Union Patriotic Front (ZANU PF) party whilst Harare City Council is run by the main opposition party, Movement of Democratic Change (MDC). To be effective in water service delivery in Harare, the City and the Government need to work together to achieve common goals. When party divisions are apparent, accusations of mismanagement come from both directions. Political dynamics add another layer of complexity to water affairs (Manzungu & Derman, 2016).

One party will be reluctant to help the other as it may be perceived as furthering the agenda of a rival party. The needs of the people need to take priority over party loyalty. Firm and consistent support of water initiatives across political parties would aid in giving investors confidence in the success of water projects in the sector. Unifying programmes can be set up to show that both parties are involved in successful water programmes to quash notions of dissentions. The recorded problems facing the water sector linked to political interference are as follows:

> *First, political patronage started taking precedence over technical competency, resulting in in-fighting and low worker morale. Second, divisions in the workforce resulted in suspicions, forcing the council to guard closely information about its operations… Third, civic groups led by the Combined Harare Residents Association (a group considered to be inclined to the opposition) have lobbied against payment of rates, claiming "no taxation without representation"* (Nhapi, 2009).

Water tariffs attract political interest. "The political will necessary for tariffs to be set to fully recover costs will be difficult to maintain in an election year" (ZWF, 2013). Politics is important for the people to have a say on issues related to water. Unfortunately, at times political interference is had at the expense of efficiency. Manzungu (2016) reported implementation of the Integrated Water Resources Management (IWRM) was disarticulated because of national level politics. In Zimbabwe, "bribery is the most common form of corruption whereas extortion is the least form of corruption" (Mutuma & Jambawo, 2017). An example of compromising political favours is as follows:

> *Greenfuel is, a company involved in sugar-cane production for ethanol production in the southeast part of Zimbabwe. It managed to get a discount on the price of water through a ministerial intervention and not through ZINWA or catchment councils,*

> *which are the relevant formal channels. A well-placed source revealed that it was not even paying the discounted price! The circumstances are so sensitive that the details of the irregular dealings were not availab*le (Manzungu & Derman, 2016).

"Monitoring and enforcement of [water] regulations in Harare is poor because of economic hardships and lack of political will to deal with offenders" (Nhapi, 2009).

> *In a bid to retain popularity, politicians aimed to keep the price of water as low as possible. Politicians frustrated the implementation of the pricing policy, which cannot afford to subsidize water service provision to maintain standards in good water service delivery. Defaulters of payments for water permits were protected against disconnection through the political influence of politicians* (Makurira, 2003).

Water utilities must be protected from undue political disruptions and be apolitical and the same utilities should be held accountable to the community they provide a service to. Transparency is key to achieving this.

The kind of transparency that is required is that which continually provides information even before that information is requested. Users should be aware of what the tariff covers and what is does not cover. ZINWA produces annual reports which is a good step towards transparency. However, the common person who pays water tariffs does not read an annual report. The water authority needs to be proactive in getting the knowledge to the consumers, through media or campaigns.

A complex investment environment exists in Africa due to political power imbalances leading to weak private sector involvement If corruption takes root in the water and sanitation sector, financial resources will not translate into realization of water rights (CWA, 2017). A study conducted in 2017 revealed the main factors that cause corruption.

> *Poor governance, economic hardship, and weak accountability are the main factors that cause corruption. Corruption leads to economic stagnation and poor foreign investments. Organisations such as the Zimbabwe National Water Authority must improve systems and structures, enhance the auditing process, and educate staff on good ethical standards and effective governance to effectively fight against corruption and improve service delivery. They must also put in place strong governance and accountability frameworks and work closely with communities and policy makers to eradicate corruption.* (Mutuma & Jambawo, 2017).

Investors may choose to appoint an independent Project Implementing Entity (PIE) to reduce political, corruption and financial risk to ensure protection of investment by separating politics and corruption from project finances instilling accountability. UWSSR Project employed this, the implementing agency was the AFDB and they ensured international standards were used for the project. The duties of the PIE included to ensure acceptable financial management arrangements such that:

- *project funds are used only for the intended purposes in an efficient and economical way*
- *are capable of correctly and completely recording all financial transactions relating to the project resources*
- *the preparation of accurate, reliable and timely periodic financial reports and*
- *the assets are safeguarded. The financial statements will be prepared in line with the International Public Sector Accounting Standards* (Alemseged et al, 2010).

In addition, an annual audit may be carried out by an external auditing firm.

4.14 Barrier 13: Asynchronous Water Policy and Acts

In Zimbabwe, water is governed mainly by the Water Act Chapter 20:24 of 2002. There are other acts of parliament and national policies which have input on the laws and regulations that govern the resource. These acts and policies include:

- The Zimbabwe National Water Act (ZINWA Act) Chapter 20:25 1998
- Urban Councils Act Chapter 29:15
- Environmental Management Act Chapter 20:27 2002
- The Public Health Act (Chapter 15:09)
- National Water Policy 2012
- National Environment Policy 2009.

The National Water Policy has been drafted with sustainability in mind. There is a school of thought that the international re-engagement after Zimbabwe had been isolated in the early 2000's paved the way for the development of the new Water Policy (Manzungu & Derman, 2016). It is a set of guidelines on how water is to be managed, clearly stating government commitments. The policy calls for funding to ZINWA and catchment councils to ensure their

mandates are discharged effectively (Manzungu & Derman, 2016). Legislation has not yet been synchronised between the Policy and the Acts of parliament, hence some guidelines have not yet been executed and there is no consequence attached to non-execution. “While the legal systems in Zimbabwe are sound, they are not always applied consistently to provide confidence in their impartiality” (Tshehla & Mukudu, 2020).

The ZINWA Act (1998) set up the formation of The Zimbabwe National Water Authority (ZINWA) as a self-sustaining institution that will generate the funds it needs to carry out its mandate.

> *The new water law accorded a smaller role for the state in the planning and management of water resources and water financing. The expectation was that commodification of water and related services, through the application of the user pays principle, would pay for the planning and management of water resources* (Manzungu & Derman, 2016).

The ZINWA mandate is to plan the development, protection and conservation of water resources (GoZ, 1998). Its source of revenue is from provision of raw water services, groundwater investigation and sale of water agreements.

> *During the past decade ZINWA, Catchment Councils and Sub-Catchment Councils have failed to function as provided for in existing legislation due to low revenues. A similar situation has prevailed in local authorities. Although water tariffs in Zimbabwe compare favourably within SADC, they do not reflect the cost of producing potable water (high electricity and chemical costs) hence services have not been sustainable because the revenue from users is less than the cost of running the services.* (MWRDM, 2012)

The cost of electricity in the country has been said to go against competitiveness (Bungane, 2017). The high chemical cost comes from deteriorating water quality from dams which is not only difficult to treat by conventional methods but expensive too. In addition to the above, the country experienced changes in the commercial farming communities after the Land Reform Programme. This unfortunately led to a reduction of ZINWA’s agricultural water revenue. ZINWA makes use of the catchment system approach, which leads to increased operational costs and inefficiencies from the long distances involved to monitor stations. The change in revenues compromised ZINWA’s ability to carry out its mandate.

> *There are also policy areas that have been left grey, which have allowed some users to benefit from hidden subsidies. A World Bank-sponsored paper found that some people paid for storing water (storage permits) while others do not and yet others paid at a rate or lower price than abstracting water from a public stream on the understanding that farmers would have invested in storage facilities* (Manzungu & Derman, 2016).

The National Water Policy has stated that tariffs will be set to cover both capital repayment and recurrent costs to ensure the financial viability of service providers and also considering social responsibilities to the poor. "Subsidies will be targeted to users who are not in a position to pay the full cost of the service or where national interests would be compromised" (MWRDM, 2012). Tariffs covering both capital and recurrent costs will make investment in infrastructure desirably self-funding and in line with the "user pays" and "polluter pays" principles that state policy recommends.

> *But by far the biggest subsidy went to the government, which refused to pay for storage permits for all ZINWA dams. By law, sub-catchment councils can charge ZINWA for storing water in their areas of jurisdiction as ZINWA, like any other applicant, is issued a storage permit for each dam. But the government refused arguing that this would mean paying for stored water which was not being used* (Manzungu & Derman, 2016).

The 2019 National Budget Statement prescribes the use of the User–Pay-Principle across all water using subsectors to attain sustainability of water service delivery (Ncube, 2019). There is the danger however, that some water projects which are not financially viable may be socially necessary and therefore the user pays principle cannot be strictly implemented (Manzungu & Derman, 2016). The capital investment of such projects will be funded by the government (public finance) and recurrent costs borne by the beneficiaries of the project to ensure sustainability.

User affordability has not been ignored in policy. The economic state of the country at the time of drafting water policy necessitated the creation of a 'recovery phase'. At this time, affordability of tariffs to users was of concern, therefore tariffs would cover the recurrent costs only. The recovery phase was envisaged to be five years but has since exceeded this. The problem with making provisions such as a 'recovery phase' in policy to some extent compromising high service level standards for a limited time period is that the compromise itself can give birth to other problems and perpetuate a cycle of water poverty making it difficult

to declare an end to the 'phase'. Instead promotion of sustainable service level standards should be employed.

> *Promotion of conservative standards for water production, storage, use and treatment, which consider recent environmental sound technologies and sustainable approaches can be suggested, which do not contradict high service level and improved living standards* (Dorner et al, 2014).

Having said that, the water policy recognises the duty to provide water to all but is aware of the difficulties that comes with that commitment and hence tries to achieve a balance by relaxing some standards.

> *The new policy is weak on social agenda… in urban areas, primary water needs were to be based on lifeline tariffs, and it is only in cases where people cannot afford to pay, that a free life-saving water per household of 10 m3 per month can be supplied. Since it was realised it would be difficult to establish who could not pay, there was the provision of a two- or three-stage rising block tariff regime. This position was a compromise because urban municipalities had argued this would constitute a substantial revenue loss on their part* (Manzungu & Derman, 2016).

The water policy supports improved stakeholder participation and a more equitable water distribution system. The Water and Wastewater Services Regulatory Unit (WWSRU) was envisaged in the 2012 water policy but the reality on the ground is that the regulatory unit is yet to materialise. This is a challenge for private sector involvement in the water services sector, as the operation of an independent regulator would aid to reduce political risk and ensure fair processes. The WWSRU should ensure stakeholder consultations and transparency prior to tariff adjustment. WWSRU responsibilities include:

- *Monitor all Water Supply and Sanitation Services;*
- *Receive and assess tariff applications in collaboration with relevant ministries such as MLGRUD and MAMID*
- *Oversee the licensing of Water Service Providers by Water Services Authorities.* (MWRDM, 2012)

Inability to pay water tariffs is often confused with unwillingness to pay, resulting in disconnections. Access to safe and clean water was declared a human right in 2010 by the United Nation General Assembly. This entitles everyone to water for basic needs. Regulatory

frameworks therefore need to be put in place to incorporate procedural fairness mechanisms as water disconnections are largely seen as a violation of the human right to water and sanitation (CWA, 2017). Transparency of tariff setting and what the tariffs are paying for will hopefully build confidence and willingness to pay. Accountability should be fostered. Users are required to pay for services hence service providers should be accountable to users and government. Accountability must come with consequence or enforcement such as prosecution where applicable.

The water sector is always changing, always evolving. Research to understand the environmental, social, technical and economic changes is essential including on some key topics such as policy formulation and tariffs setting. State policy provides for a National Water Research Fund to advance the much needed research through a levy from EMA (Environmental Management Agency) and ZINWA water revenue.

> *No country can develop without carefully targeted and nationally-funded research. The lack of dedicated funding for water research in Zimbabwe leads to ad hoc and often externally funded research in the sector* (MWRDM, 2012).

Unfortunately, the National Water Research Fund is also yet to materialise. Literature is silent as to the reason for its non-existence. The National Water Policy has been well written however a few components are yet to be implemented. This gives the impression that the water policy is practised more as guidelines or recommendations. Updating legislation to accommodate the water policy will give the policy recommendations more weight as they would now be considered as law.

> *The Director of Water Resources acknowledged that since the approval of the new policy, there has been little progress because of financial constraints, worsened by the fact that there is no longer any donor support – the support was now being channelled toward physical infrastructure in the water supply and sanitation subsector…. He also observed that the Water Act would have to be reviewed to cater for the policy changes and the new constitution* (Manzungu & Derman, 2016).

4.15 Barrier 14: Insufficient Metering

Zimbabwe made use of the water district metering system but the GHWSI Project reported, "the district metering system is no longer functional because (a) the meters are not working,

and (b) there have been interconnections among district metering areas that are not metered" (Dorner et al, 2014). Metering is strongly supported in the Zimbabwe National Water Policy. It is an important tool for demand management, the reduction of unaccounted for water and overall efficient operation of the water system and by doing this, it unlocks finances for investment and re-investment in infrastructure.

Improved demand management and overall efficiency gained through installation of meters maximises usage of a given volume of water and therefore reduces the water infrastructure gap (The difference between the required water infrastructure and the existing water infrastructure.). Unaccounted for water at the time of the UWSSR project was estimated to be over 40%. This translates to 40% lost income for investment. District metering will provide the necessary information to enable surgical interventions to reduce unaccounted for water loss. None of the cities or towns studied under the project quantified the physical losses. Non-revenue water is reported without breaking it down into components. The lack of bulk and block meters coupled with inconsistent water supply makes determination of physical losses difficult. Metering aids in protecting water investment by efficiency in delivery of service and efficiency in billing.

There is a breakdown of trust in the Zimbabwe water sector. Consumers are sceptical of flat rate billing resulting in some not paying water bills. Using meters for billing will be acting to restore that trust, ensuring the public that they are not paying for leaks in an unmaintained distribution system but for what they have consumed. Water billing using meter readings manages demand and encourages conservation.

The local authorities reported that the majority of users either have a meter that is not working or a meter that has never worked. There is also no bulk or block metering, for example, "the water flowing to Redcliff Town is not metered making it difficult to bill for the bulk supply" (Alemseged et al, 2010). "Lack of instruments to measure bulk water delivered in different locations mean that bulk data is based on estimates" (GRM, 2017). If there is no meter, the wastage leads to high non-revenue water because an average is used for flat rate billing. If there is a meter, the wastage results in high water bill for the user.

The GHWSI project recorded that significant amount of water is lost after the meter leading to wastage of water. This water loss is due to dilapidated house connections which need replacement. The photos below show heavily corroded household connections.

Figure 8: Corroded Household Connections (Dorner et al, 2014).

Education and awareness programmes can be used to initiate and motivate rehabilitation of household installations, water conservation actions and the associated financial benefits. Alternatively, municipalities can fix leaking household installations and transfer the cost to the water user. It should not also end with installing meters as the UWSSR project recorded that where meters were working, some cities rarely took meter readings.

> *In Chitungwiza, 23% of households indicated that their meter readings were conducted less often than every 3 months, whilst in Chegutu 42% were not aware of any meter readings taking place and 19% reported the frequency as less often than 3 months* (GRM, 2017).

Municipalities maintain that lack of resources (such as fuel and manpower) inhibit regular meter readings, however this may only lead to greater income shortfall from failed revenue collection. Smart meters, as discussed before, enable the retrieval of information remotely with no fuel cost and limited manpower. The drawback to district metering is that the water sector is already financially strained and meters are expensive. Furthermore, they will ultimately become faulty and need replacement at some time.

The UWSSR project stated, “the poor status of the distribution system in most of the urban areas also makes it difficult to have a serious metering system” (Alemseged et al, 2010). The distribution system itself requires rehabilitation and maintenance. Installing water meters is only part of the interventions needed. The water sector needs to, “quantify and deal decisively with water losses through a comprehensive leak detection and water loss reduction programme” (Nhapi, 2009).

4.16 Barrier 15: Low Cost Recovery

Water revenue sources in Zimbabwe comes from either water stored in government dams or permits granted to abstract surface water and groundwater. Sub-catchment revenue streams come from flow water and ZINWA sells water in government dams. This unfortunately disadvantages sub-catchments in dry regions of the country; they consequently have minimal water revenue. “The result is that there are many financially unviable sub-catchments, whose operations have been crippled since they are solely funded by water revenue” (Manzungu & Derman, 2016).

The Zimbabwe national water policy stipulates that a portion of the land taxes collected by Rural District Councils should be directed towards water services. In addition, local authorities are to implement cost accounting and to ring-fence proceeds from water sales. However, “it is also a common practice by nearly all municipalities to use revenue from water services to cover other municipal expenditures” (Alemseged et al, 2010). This leads to underfunding and consequently failure of water services.

Local Authorities argue that to enable them to deliver various services to residents, revenue from accounts that generate surplus (such as water) is at times transferred to accounts that are in need of support (Kayizzi-Mugerwa, et al., 2014). “Local governments rely heavily on water revenues to support the costs of providing other municipal services” (ZWF, 2013). It was reported that 40 - 60% of Bulawayo City revenue was from water (Kayizzi-Mugerwa, et al., 2014). But when water funds are used for other sectors, water becomes over-shadowed by other seemingly immediate issues leading to reduced budgets. This necessitates a dedicated structure and account for water.

Ring-fencing water income will drive other sectors to be efficient with the funds they have and government may give assistance where further action is required. Ring fencing is key to re-investment of proceeds to water infrastructure projects. The water sector is constantly requiring maintenance work and expansion for current and future generation. The work needed to be done in water is more than the available funds can achieve.

The Urban Councils Act grants municipal and town councils powers in relation to water supply, sewerage and drainage as well as producing separate income and expenditure accounts as may be needed., “or if the Minister so directs, balance sheets that reflect a true and fair view of (iii) the water account” (GoZ, 2002). Technically, there is no direct official instruction for

municipalities to ring fence the water account. Whilst the water policy encourages ring-fencing, legislature is yet to enforce it.

A joint initiative between the Zimbabwe Government and the World Bank, saw the preparation of a Service Level Benchmarking (SLB) exercise in 32 urban local councils, targeting a reversal of the deterioration in service delivery. The urban councils identified performance gaps and developed improvement plans, particularly for the high water losses of around 60% (Chinamasa, 2018). "Implementation of identified interventions remain a challenge, due to the limited financial capacity of Councils" (Chinamasa, 2018). Low water tariffs have contributed to the limited financial capacity of Councils.

Zimbabwe's economic decline has led to water tariffs remaining fairly stagnant in the interest of user affordability. Revenue collection is however still poor. With regard to farmers, the inability to pay was a result of low profitability of agriculture, as well as due to unresolved ownership/usage arrangements regarding the use of water in dams, irrigation infrastructure, undermined implementation of the permit system (Manzungu & Derman, 2016). This resulted in a significant reduction of ZINWA revenue.

> *There was also tension between individual farmer interests (who now include the who is who in Zimbabwe) and public interest. Water institutions favoured high water levies because these equalled more revenue while farmers lobbied for low water levies. In the end, farmer interests prevailed because in 2013 water levies across the country were reduced to USD1/megalitre from USD3* (Manzungu & Derman, 2016).

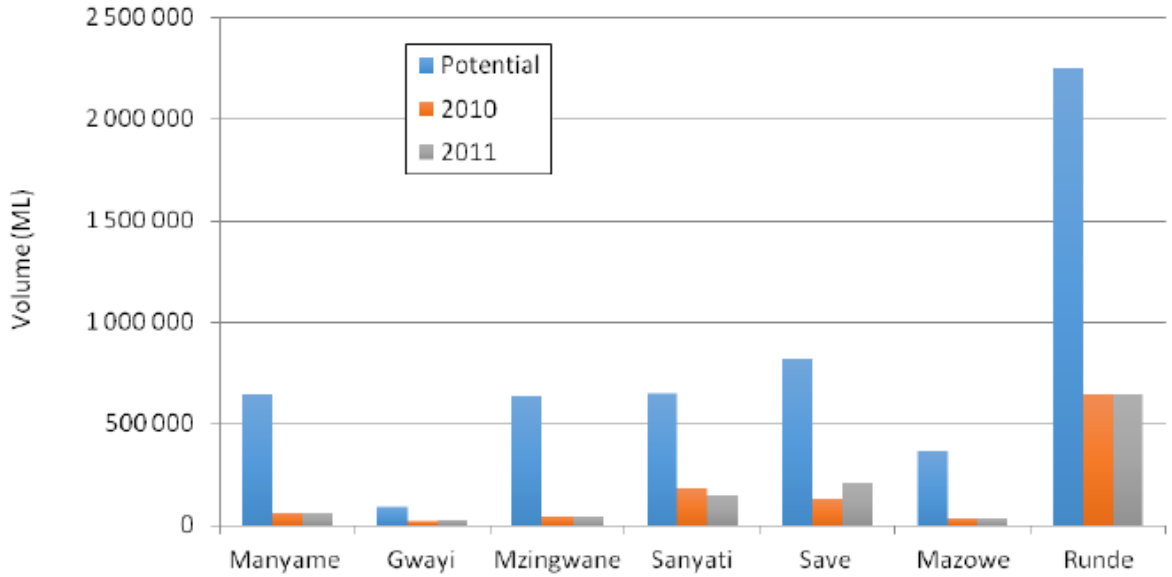

Figure 9: Status of agricultural water use in Zimbabwe's catchment areas as of 2011.

> *Zimbabwe National Water Authority (ZINWA) argues that a substantial amount of unpaid water bills by individuals, mines, agricultural estates, government departments and local authorities are crippling the operations of the parastatal and preventing equitable access to essential water by all* (Muvundusi, 2015).

The UWSSR project reported that residents had high water debts which crippled operation and maintenance of water infrastructure. The figure below shows the reasons given by households for not making water payments.

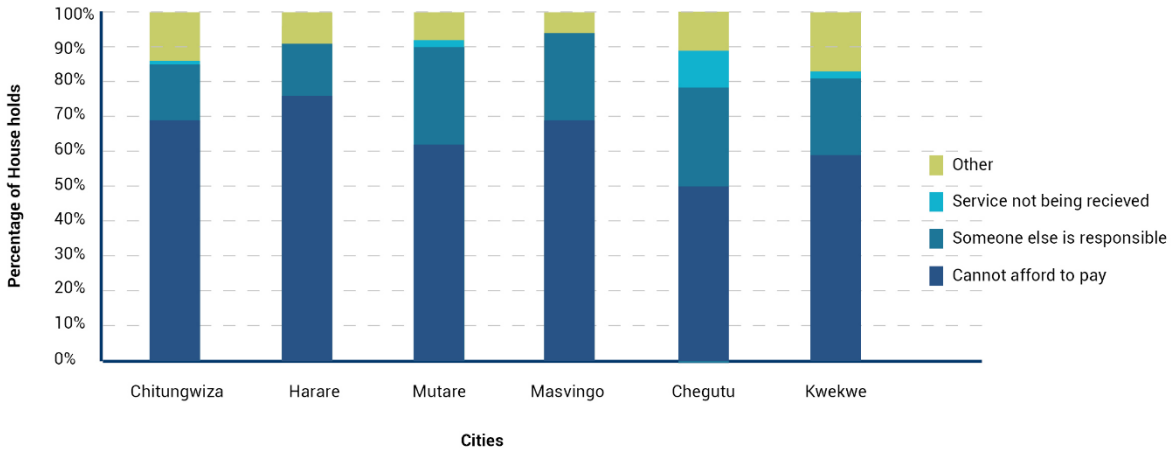

Figure 10: Reasons for Not Paying Water Bills (GRM, 2017)

Inability to pay water bills was the most common reason given for not paying water bills. A portion of Chegutu uniquely claimed they did not receive water services and hence do not pay. Chitungwiza households claimed they received erratic meter readings and poor service delivery from their local authority. Other households across cities claimed the responsibility of paying water bills was with the landlord and not with themselves. Local authorities once carried out an exercise that saw large old water debts being written off. Some residents were not paying the water bill expecting this would once again be the case.

To achieve sustainability, water prices must be at least as high as the cost of providing that water. That includes both capital and recurrent costs. Both private and public water should be paid for to limit abuse of the resource. Stakeholder consultation should take place to communicate the important reasons why cost recovery is important and for transparency of water funds to give consumers confidence and improve willingness to pay. The consumers will also have an opportunity to raise concerns where they see fit.

The ZINWA Act confers ZINWA power to prescribe water tariffs for bulk raw water sales. The tariffs must be approved by the Minister overseeing water. ZINWA is the vendor of raw water to municipalities who provide water services to households. The ZINWA Act makes no mention of consultations with residents when setting tariffs, nor does it mention full cost recovery for providing the water. The Urban Councils Act does not prescribe any system for setting water charges. There is no independent water regulator in Zimbabwe to whom the municipal council, ZINWA and the Minister can refer any contentions.

ZINWA used the “blend price” system. This meant that the price of water is the same across all the catchments. This opposed the alternative option for water tariffs to differ per catchment reflecting the different market of water demand in each catchment. This alternative was not accepted with the anticipation being, blend price protected public interest (Manzungu & Derman, 2016).

> *The intention of the blend price system is to ensure that costs of water from dams built for newer and smaller communities is not too high, but there have in the past been perverse side-effects of a price not related to costs, impacting particularly on urban investment decisions* (ECA, 2011).

Where users are not able to afford the full cost recovery price then basic primary water should be provided either free or at a price that at least recovers the operation and maintenance cost, that is the recurrent cost. The Water Act of Zimbabwe gives the Minister overseeing water the

responsibility, “to ensure the availability of water to all citizens for primary purposes and to ensure the equitable and efficient allocation of the available water resources” (GoZ, 1998).

The use of government subsidies is another option which will be targeted at consumers who are unable to pay the full cost of water tariff or where national interests would be compromised. This life saving water is a human right in Zimbabwe and has been deemed to be $10m^3$/month/household. The price of water will also be a demand management tool to influence efficient use of depleting resource. This is in keeping with the Water Act which sates the Minister shall:

> *Ensure the provision of affordable water to consumers in underprivileged communities and promote efficiency and economy in the utilization of water resources and to encourage the use of water saving technologies* (GoZ, 1998)

For those who can afford to pay but are unwilling to do so, a regulatory framework needs to be put in place to incorporate procedural fairness mechanisms as water disconnections are largely seen as a violation of the human right to water and sanitation. There needs to be at least some consequence to deter people from simply not paying. Effecting a full cost recovery tariff might cause some residents to desist from paying altogether and there being no consequence to those actions would only encourage non-payment even from groups who can afford the tariffs.

Strategy must also be employed when effecting full cost recovery tariffs as these can cause dissension among residents. It is advisable for the local authority to take the first step by improving service delivery and then continue to effect sustainable tariffs. This may be received better by residents. What is broken in the system needs to be repaired first to assure residents that the additional money paid through full cost recovery tariffs will not fall through the holes of a broken system. Donor or government funds may be used for the initial service delivery improvement.

Long term financing of local water projects should be undertaken by local authorities. The idea behind this is to unburden government funds as these are always scarce. Therefore, relying on government funds would be unsustainable. Giving this responsibility to the local authority will require the local authority to have acceptable financial management arrangements to carry out water projects, hence the importance of ring-fencing water revenues to enable local authorities to carry out this function. The Government may furnish deserving local authorities with subsidies where necessary.

The Water and Wastewater Regulatory Unit should be created and part of its obligations should be mandating local authority credit worthiness assessments and having the assessment results available to the public. This is to encourage local authorities to be financially fit to leverage private financing for water projects. Such transparency in creditworthiness reports, may also encourage residents to pay water bills, improving revenue collection and restoring confidence in the water sector. When a local authority requests funding from government, or residents or the private sector, they are also asking for the government/residents/private sector to be confident that they can successfully carry out the project to completion. One must be confident in oneself before requesting another's confidence. Hence, local authorities should be confident enough to commit themselves to creditworthiness assessments to prove to all that they are worth the confidence.

Local authorities should receive the needed institutional support to identify challenges and prepare a pathway leading to ring fencing water accounts. Training of staff should be carried out to improve financial management and revenue collection systems to strengthen the local authorities' capacity to sustain good service provision. Public education awareness campaigns will also aid in creating a cooperative community.

4.17 Barrier 16: Poor Service Delivery

Poor service delivery constrains the economy. It is detrimental to business growth and may cause businesses to consider investing elsewhere. In the interest of maximising investment opportunities, the service delivery must improve. Water service delivery in most parts Zimbabwe has been, "erratic and unreliable" (Ncube, 2019), despite water infrastructure coverage estimated at 98.4% in urban areas and 67.5 % in rural areas (Ncube, 2019).

This shortcoming in the urban water supply has caused residents to seek alternative sources of water such as boreholes (Manzungu & Derman, 2016). Mutuma & Jambawo (2017) discovered that corruption and lack of accountability and transparency were among the main causes of poor service delivery. Mutuma & Jamabwo (2017) explained that, "employees in the public sector create delays to manufacture a crisis, which often leads to a bribe being paid by clients to speed up various processes or to get services". Better service delivery will result in better water revenues as the UWSSR project reported.

> *Besides the many other problems being faced, lack of reliable water supply and sanitation services is undermining consumers' confidence and hence willingness to pay*

> *for the services. This inevitably reduces revenue collection and adversely impacts on O&M and hence the quality of the services. Increased and stable water supply and better services will mitigate this and improve the relationship between the Municipalities and their customers* (Alemseged et al, 2010).

The Greater Harare Water and Sanitation Investment Project highlighted some areas in the water sector contributing to poor service delivery, such as the old steel pipes in the water reticulation. The Asbestos-Concrete (AC) pipes are still in good condition. Local authorities have not reported enough AC pipe failures to indicate these require replacement urgently. PVC pipes have only started being installed some 30/40 years ago approximately account for 22% of the reticulation. "Deterioration of the steel pipe is a major source of leakage" (Dorner et al, 2014). Leakages increase unaccounted for water which was estimated to be over 40%. That is over 40% of missed water income for investment. High network leakages result in less water reaching the consumers causing user discontent.

Water rationing occurs across the country. Epworth town does not have a storage reservoir which greatly affects demand management. All water valves inspected in the GHWSI project were not in good condition, either rusty or leaking or both. Valve chambers were damaged. Some chambers had no covers and were prone to vandalism. Network appurtenant fittings required replacement. The nominal hydraulic capacity of Harare water treatment works is 219,000 m^3/d as opposed to estimates of the treatment capacity at the time of the GHWSI project which was 26,000 m^3/d. The difference was attributed to the dilapidated state of the treatment facility in the report.

Structural integrity of manholes has been generally good. However, sewer pipes have been reported surging and collapsed. In some areas there is silt and solid accumulation caused by inadequate flow. Narira sewage pump station in Norton had no stand-by power arrangements and hence in times of power failures, the station would overflow. Runyaro sewage pump station in Ruwa is mechanically reliable however has no standby power facilities. Power failures result in overflow spilling in to Ruwa stream and ultimately Manyame river. All sewage from Ruwa is designed to arrive at Ruwa main sewage pump station where it should be pumped to waste stabilised ponds. The situation reported is that:

> *the station is currently inoperable with one pump failed, two motors failed and one panel failed. With no pumps running, all of Ruwa's sewage discharges untreated into the Manyame catchment* (Dorner et al, 2014).

Estimated wastewater flow in Chitungwiza is 38000m^3/d. The town has one sewage treatment works which has two schemes of operation, that is, the Modified Conventional Treatment Works (MCTW) and the Biological Nutrient Removal (BNR) treatment works. The anaerobic and maturation ponds for the MCTW were reported to be filled with sand sludge and weeds. Furthermore:

> *Chitungwiza has a 20,000 m^3/d BNR plant which has not been operational since 2005 and a 35,000 m3/d modified conventional plan which is partially operational. Hence, most of the wastewater from Chitungwiza is discharged to the water courses untreated* (Dorner et al, 2014).

The UWSSR project also reported blocked sewage pipes. Chegutu residents attributed the blockages to sewers improperly laid and backflow at sewer junctions. Toilets were also reported to be blocking due to lack of water to flush.

> "*Municipal officials explained that where sewage spillages have become a permanent eyesore in residential areas, the main issue was due to collapsed sewers or the very design of the sewer system in a given area*" (GRM, 2017)

These are only some of the service delivery challenges stated in the project reports. Generally, lack of proper maintenance due to limited resources owing to the country's economic decline has led to dilapidated infrastructure which in turn has resulted in deterioration of services. The guarantee of good service delivery is necessary to provide a foundation for economic recovery and improved water revenue collection thereby bolstering water investment in the sector.

Efforts were made to rehabilitate infrastructure but benefits in some cases were not fully realised. An example is Harare's water treatment works that were refurbished but other water sector challenges such as old reticulation infrastructure and failing water pumps inhibit closing the water gap as envisioned. A structured plan of interventions would be necessary to maximise potential of realising benefits, such as rehabilitating the water reticulation system before the water treatment plant.

The required interventions include the rehabilitation and expansion of water production, storage facilities, pumping stations, and the reticulation system. This will improve reliability of supply through greater storage capacity and expansion of services to be able to cater for existing and new developments. Installation of telemetry systems for monitoring of reservoir levels can reduce wastage of water and lead to the reduction of maintenance cost (Dorner et al,

2014). Provision of water quality monitoring equipment is required to ensure high level of service for consumers. Water and sanitation services need to be regulated. Zimbabwe needs to establish an independent water regulator to ensure adequate and reliable services to consumers. The consumers also have a part to play.

> *Strengthening of community support for Service delivery to close the gap on households' unwillingness to pay. This can be achieved through projects which instil good customer care and good citizen relations, which, it is assumed, would, in the long term, increase willingness to pay for the services* (GRM, 2017).

When residents do not pay water charges, this threatens the sustainability of the water sectors leading to allocation of low budgets, limited operations and maintenance resulting in sustained poor service provision.

4.18 Conclusion to Findings

Having reviewed the barriers found in this research, Zimbabwe is currently ensnared in a cycle of water poverty that fuels the perception that the water sector is inefficient and does not generate sufficient funds to recoup expenditure, thus making water unattractive to repayable finance to fund infrastructure. The findings point to a cycle because of the interconnectedness of the problems faced in the water sector affecting water investment.

This adverse cycle seemingly began with the country's economic downturn as before the economic decline, Zimbabwe had "one of the highest rates of growth in water supply services" (AfDB, 2011). The downturn led to water tariffs remaining fairly stagnant in the interest of user affordability but to achieve sustainability, water prices must be at least as high as the cost of providing that water. Limited resources from poor cost recovery leads to neglect of maintenance resulting in premature obsolescence of water infrastructure. Deterioration of the state institutions is also due to lack of resources and the 'brain-drain' where qualified water professionals within institutions sought greener pastures after the economic decline. The incoming professionals need support to efficiently maintain existing water infrastructure and deliver water services. The legislative environment where the above mentioned barriers persist, has not synchronized water policy and Acts of parliament regarding water. Hence some guidelines which may solve the above mentioned issues have not yet been executed and there is no consequence attached to non-execution which perpetuates deterioration of services. Poor service delivery further constrains the economy, which is where the cycle starts.

Being trapped in this cycle does not point to inescapable ruin but there are pathways to change leading to a sustainable future for water investment. Based on the research findings, below is an illustration showing Zimbabwe's cycle of water poverty, the prominent barriers to water investment found through this research and the pathways to a sustainable end.

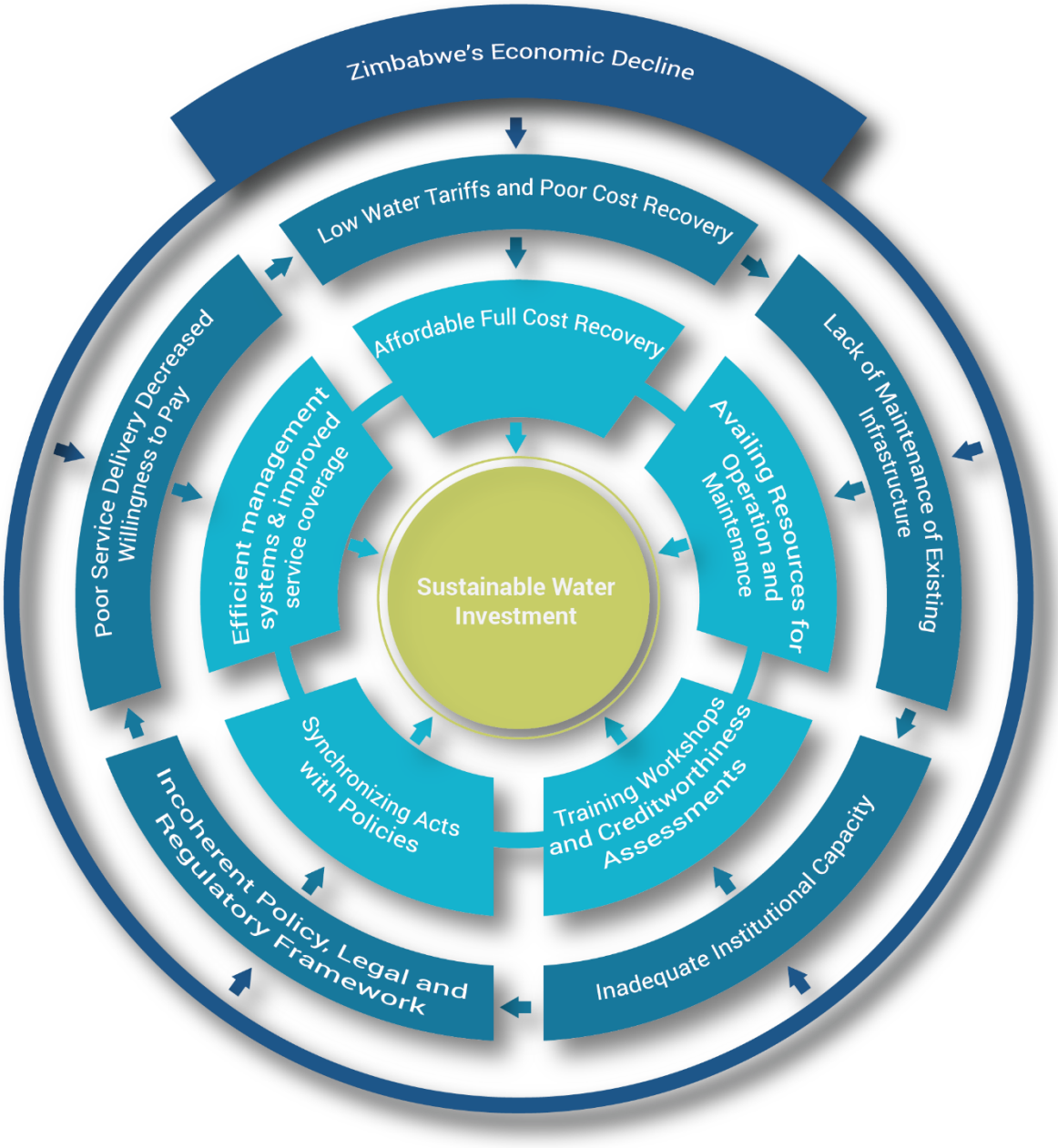

Figure 11: Zimbabwe's Water Investment Cycle of Poverty

The barriers illustrated above are not the only barriers to water investment as detailed in the Findings chapter. Recommendations will therefore address all the barriers identified in the previous chapter.

5 Discussion

Zimbabwe has seen a reduction in government financing which culminates in limited resources available for water investment. In light of this, the initial step to breaking the cycle is to engage in pathways which require limited funding. The first recommendation is creating an enabling environment in the water sector.

The country's legislation needs to support the sustainability principles that are set up in the Zimbabwe National Water Policy by incorporating them into the regulatory regime and the Water Act as law. Furthermore, consequences should be stipulated when these principles are not adhered to, as some important guidelines promoting sustainability in the National Water Policy are yet to be practised. The Acts of Parliament associated with water also need to corroborate with state policy on how to manage water. For example, the Zimbabwe National Water Policy states, "local Authorities will undertake cost accounting and will ring-fence revenue from water sales" (MWRDM, 2012), but the Urban Councils Act does not give direct instruction for local authorities to ring fence the water account. Ignoring legal and regulatory matters is detrimental to project finance. Tshehla and Mukudu (2020) found that:

> *there is a low uptake of PPP in Zimbabwe as a result of the lack of legal and institutional structures for PPP. There have been attempts in Zimbabwe to put up the necessary framework to facilitate the employment of PPP. These efforts have not gone far enough and remain largely unimplemented according to the research.*

Governments must guarantee that municipalities and potential private investors can depend on clear institutional and regulatory frameworks. The establishment of the Water and Wastewater Services Regulatory Unit (WWSRU), free from political influence, envisaged in the 2012 water policy but still yet to be created is crucial and should be prioritised to ensure stakeholder consultations, fairness, dispute resolutions and transparency.

Offenses committed in water utilities should be disciplined to restore trust. Corrupt activities must be reported to the relevant authorities and/or pursuing civil claims from companies or individuals who have profited from water contracts unlawfully. Corruption is one of the causes investors become bearish and risk averse in the water sector (Mutuma & Jambawo, 2017). Selamawit (2015) put forward that corruption in the public service inhibits both foreign and domestic investors from investing in the country's economy.

> *The obstacles that staff face in fighting corruption effectively include lack of commitment, lack of combined effort by all stakeholders, nepotism, late payment of salaries, low salaries, kickbacks, fear of victimisation and lack of modern management systems* (Mutuma & Jambawo, 2017).

"Prevention of corruption requires the integration of anticorruption approaches during project design" (World Bank, 2019) such as drafting a plan during the water project preparation phase on how to manage unsolicited proposals and detail implementation of initiatives to combat corruption during the project. The message should be that there is no room for corruption in the water sector. The water sector should build on values such as transparency and accountability to attract investors.

Firm and consistent support of water projects before commencement across political parties would aid in giving investors confidence in the success of these projects (UN ESCAP, 2015). Where investors are still hesitant of political interference when it comes to project finances, a Project Implementing Entity may be established to manage the project and reduce political, corruption and financial risk. Investors may also choose to acquire political risk insurance to protect themselves from new government policies, political unrest, social changes and other potential issues.

The ease of doing business in Zimbabwe needs to be improved by removing uncertainty regarding the implementation of the Indigenisation and Economic Empowerment Act (2007) [Chapter 14:33] and the Land Acquisition Act (1992) [Chapter 20:10]. The acts should be coherent, comprehensive, clear, address matters on attracting investment in the country and have an implementation strategy. This would improve Zimbabwe's ranking from 155 in the World Bank "Doing Business Report" (2019).

Augmenting institutional capacity is key to sustainability. "All government institutions and parastatals that deal directly with water services need to be strengthened" (Dorner et al, 2014). Continuous training of personnel in areas such as asset management, maintenance, customer support service, IT, demand management and new technologies in the water sector is crucial. This can be achieved through workshops and internships to industry leaders. This will improve the capacity of a municipality to execute financial and technical operations. International partnerships can also assist in providing technical experts on temporary assignment to improve water systems. State funded research should be prioritised to better understand the

environmental, social, technical and economic changes in Zimbabwe's water sector including key topics such as policy formulation and tariff setting.

Municipalities should carry out regular creditworthiness assessments and make the results available publicly, demonstrating transparency, integrity and accountability. The assessments would identify among other things, corporate governance, operational and financial matters that the municipality needs to address to improve or maintain its creditworthiness (W.I.N., 2018) thereby gaining financial independence to source private financing and achieve long term sustainability. Local municipalities should finance local water projects. The government can set up a concessional loan facility for municipalities that are creditworthy.

> *Concessions are crucial to encourage huge investments needed to expand and improve water infrastructure supply and related services. These long-term planning investments in water, like elsewhere in developed regions, improves water services efficacy* (Zvobgo & Do, 2020).

Strong water management is needed within municipalities and the ability to leverage the private sector. Senior management should be trained to negotiate possible contracts with the private entities. All departments in municipalities should have long term plans and implementing strategies of those plans with progressive short-term deadlines which the department will be accountable to. Plans should incorporate the long-term needs of the economy, environment and national strategic interests.

> *Municipalities can also partner with the private sector to form public private partnerships (PPPs) to fund both immediate and long-term water investments. Municipalities should implement structural and transformational reforms that enhance investments both around water infrastructure and governance to allow flexible planning. This can cushion residents against future pandemic outbreaks* (Zvobgo & Do, 2020).

Water sector institutions should be streamlined to bring about better coordination resulting in improved management of resources (Alemseged et al, 2010). Better management of resources will encourage doing more with available sector financing, thereby also improving sustainability of services. The remaining institutions should have easily comprehensible, distinct and unambiguous objectives which are not duplicated. A clear separation of functions should be instituted where possible.

Rigorous and prudent project identification should result in sequenced water infrastructure projects to give a map of the water sector's direction in development and to give investors advanced visibility. It is important to ensure adequate project preparation funds. The government can set up a revolving water infrastructure development fund, hopefully with the support of international financial institutions and/or donor agencies. The fund would finance project preparation costs and when the project goes to tender, where construction bids are considered from potential construction companies, the winning bidder will repay the fund. Banks should also be involved during project preparation, to allow them to give a timely indication of their willingness to finance the project (UNESCAP, 2015). Project preparation should include a business case which does not only focus on financial returns but on the multiple returns the water project will result in.

Market sounding activities should be arranged, where project information with key commercial terms is availed to potential investors, risk matters are addressed and an opportunity for potential investors to obtain clarity on any issues of concern. These activities should be part of a broader communications strategy for spreading the link between water and the economy. Local private sector should be encouraged to participate in water investment, for example a merger of entities in the local private sector can make a significant contribution to safeguarding the water sector. Local commercial banks can be informed on the business side of the water sector and given financial instruments to encourage their involvement (Ndaw, 2016). International Finance Institutions can be encouraged to use their catalytic impact to attract other investors to water projects.

Overcoming the barrier of lack of maintenance may require significant funding. The idea that maintenance can be delayed or postponed is what leads to infrastructure deterioration and it should be given high priority status. Initially directing resources from donors or government financing to operation and maintenance before raising water tariffs to full cost recovery is crucial to dealing with willingness to pay. The residents need to visibly see the changes in service delivery before considering full cost recovery tariff and improving operation and maintenance (O&M) is one of the pathways to better service delivery. Before full cost recovery tariffs are effected, funding for O&M on new infrastructure projects should be included in the loan application package.

Once service delivery is improved, O&M funding should come from water revenue collected. Ensuring collected revenue is adequate to cover recurrent operation and maintenance cost is an

approach cognisant of the long term financial security of the project. Resources such as fuel and maintenance vehicles should be available for transportation of teams. Optimal maintenance procedures should be followed which would reduce maintenance costs by making the best use of available funds through risk assessment of assets (WWC & OECD, 2015). Preventive maintenance as opposed to reactive maintenance should be employed to ensure reliability.

Addressing poor service delivery requires increased water supply by the rehabilitation and expansion of water production, storage facilities, pumping stations, and the reticulation system. In addition, installation of telemetry systems for monitoring of reservoir levels would reduce wastage of water and maintenance cost (Dorner et al, 2014).

Water quality monitoring needs to be strengthened to avert pollution of water sources and enforcing compliance with the Environmental Management Act. Routine cleaning of the sewerage network should be strictly carried out and the necessary equipment acquired. Sufficient flow must also be maintained in sewers by consistent water supply services. Municipalities need to manage the perception of water quality provided at user outlets, looking at attributes such as turbidity, as this affects revenue collection from consumers.

Response times to complaints about water bursts or wastewater blockages should be decreased. Providing accessible customer relation interfaces such as real time communication through social media platforms can significantly reduce response times. These times can be publicly compared across different zones to ensure fairness and transparency in service delivery. Water service teams should be armed with adequate resources such as tools and equipment to respond to any infrastructure problems and reduce down time.

Poor cost recovery is a major hurdle to water investment but it is best not tackled by abrupt water tariff increases. Improved service delivery should precede tariff increments and stakeholder consultations should be introduced to clearly explain why the increment is necessary and to foster trust and transparency. The public needs visible assurance that the money will not perpetuate mismanagement and/or corruption. Water revenues should be ring-fenced to encourage water project re-investment. Another method of improving cost recovery is keeping the tariff fixed and focusing on efficient tariff collection can set in motion a cycle of improved revenue. The additional funds obtained would lead to better quality of services leading to users being more willing to pay increased tariffs in the future.

“Basic economics requires that the price of a service be at least as high as the cost of providing that service” (Rogers, et al., 2002) and thus the water tariff must be as high as the cost of

providing the water. All water must be paid for whether used by government or privately. The government should target vulnerable groups who cannot afford full cost tariffs for subsidies. Water for basic need should continue to be supplied. Unwillingness to pay for water beyond the stipulated basic need amount must be addressed. Regulatory frameworks need to be put in place to incorporate procedural fairness mechanisms as water disconnections are largely seen as a violation of the human right to water and sanitation (CWA, 2017).

The water sector should take advantage of every opportunity to make water savings and every opportunity to make money. The GHWSI project reported two situations where this might be possible. The first case is at Morton Jeffrey Treatment Plant Harare:

> *A backwash water treatment plant was installed approximately 10 years ago to treat dirty backwash water and recycle treated dirty backwash water to the head of the works. At nominal plant design capacity and depending on filter backwashing frequencies, the plant could easily result in a water savings of around 12,000 to 15,000 m^3/d. However, due to lack of funding for the final completion of the works by ODIS Filtering Ltd., of Israel, the plant was never commissioned* (Dorner et al, 2014).

The cost per m^3 of the water saved is less than the cost per m^3 of water from a new infrastructure project. It is makes financial sense to complete the works given that no further repairs are necessary. The second case was reported at Zengeza Sewage Treatment Works, Chitungwiza:

> *The ponds are surrounded by 150 mm diameter A.C. pipes, which supply recycled effluent from the outlet of the biological trickling filters by means of the effluent pumping station back to the ponds for scum breaking purposes. The recycled effluent is distributed on top of the ponds by making use of numerous jet pipes (50 mm diameter). However, these jet pipes are heavily corroded and not operational* (Dorner et al, 2014).

New developments should not be commissioned without approved water infrastructure in place. Before approval, an assessment of the development's impact on water quantity and quality should be carried out. Where funds are lacking, municipalities can require developers to co-fund or fully fund the necessary water infrastructure.

Stakeholder involvement should be carried throughout a project (GRM, 2017) to gain continual support from the community and carry on the sense of ownership. This should be carried out cautiously as different stakeholders may have different priorities resulting in competing demands. Water investment roadshows can be hosted for residents and potential investors. This

is where project information with key commercial terms is availed to potential investors, risk matters are addressed and an opportunity for potential investors/residents to obtain clarity on any issues of concern. The goal is to educate the public, businesses, donors, international finance institutions and all relevant stakeholders to raise their opinion of water on the country's development agenda and to circulate/discuss water infrastructure plans. Positive stakeholder engagement can be a decisive factor on the success of a project (El-Gohary, et al., 2006).

To reduce demand risk on water projects, population growth rates should be estimated using historical data, regional data and through discussions with local authorities. Where necessary, the government can provide potential investors with an extended concession period if the actual demand for the project is lower than anticipated.

Adequate security of infrastructure should be employed where possible to avoid vandalism. The residents can also assist by policing vandalism. Public awareness campaigns may be used a vehicle to condemn vandalism and educate others of its detrimental effects to everyone.

Water billing should also be transparent using water meter readings, thereby managing demand and encouraging conservation. Faulty house connections should be replaced. HDPE house connections is a durable option owing to corrosion resistance. District metering should be reinstated to provide the necessary information to enable surgical interventions to reduce unaccounted for water loss. Non-revenue water should be investigated and broken down into components to identify critical water intervention. Identification of illegal connections should also be carried out.

Where funds permit, smart meters that allow for the storage and transmission consumption data remotely (Hauber-Davidson & Idris, 2006) therefore making use of limited fuel and manpower expense should be used. A monitoring and repair programme should be implemented. Education and awareness programmes should include advantages of meters to promote acceptance of installation of meters by residence. Re-investment in the replacement of water meters should be scheduled after 5 years of operation

The National Water Research envisioned in the Water Policy should be formulated and should facilitate research to understand the environmental, social, technical and economic changes affecting water in Zimbabwe. The economic viability of all proposed solutions is very important. Service levels depend on the affluence of consumers. The development level of solutions must be consistent with what Zimbabwe can afford to operate and maintain. The infrastructure services must be affordable. The above recommendations aim to ultimately

improve service coverage and delivery, create an enabling environment and enhance revenue generation.

6 Conclusion

Zimbabwe has an important task, to be a steward of its own resources which includes continual investment in managing, maintaining and expanding available water resources and infrastructure. The current water investment climate is regrettable but it is the country's responsibility to find ways to fundamentally alter this condition or at a minimum create a firm basis to begin building the investment climate needed. A total of 16 barriers to water investment were identified in this research. The identified barriers include:

- Deficient Water Quality
- Lack of Maintenance
- Location Specific Challenges
- Aid Dependency
- Vandalism and Theft
- Demand Uncertainty
- Housing Development Expansions ahead of Water Services
- Lack of Continued Stakeholder Involvement
- Inadequate Institutional Capacity
- Lack of Coordination
- Zimbabwe's Economic Decline
- Political Interference
- Asynchronous Water Policy and Acts
- Insufficient Metering
- Low Cost Recovery
- Poor Service Delivery

The barriers discovered confirm some barriers stated in the literature review for example poor cost recovery as evidenced below:

> *Besides the many other problems being faced, lack of reliable water supply and sanitation services is undermining consumers' confidence and hence willingness to pay for the services. This inevitably reduces revenue collection and adversely impacts on O&M and hence the quality of the services* (Alemseged et al, 2010).

The literature review also highlighted the importance of water meters for data collection. The research findings corroborated that water meters are essential in the determination and reduction of Non-Revenue Water (NRW).

> *There has not been a specific attempt to quantify the physical losses in all the towns. Data on total NRW (physical and commercial losses) is generally reported by the councils without breaking it down into the two components. Without carrying out appropriate measurements in the field, it is virtually impossible to determine the current physical water losses… the non-functional bulk and domestic water meters makes it very difficult to determine current physical losses* (Dorner et al, 2014).

However, some barriers for example, aid dependency and some hydrologic challenges were only discovered when taking a closer look at Zimbabwe's water sector in particular. Determination of net migration was a challenge due to Zimbabwe's economic circumstance and presented the barrier of demand uncertainty.

> *A key limitation to projecting urban population is the unpredictability of some of the population change factors, especially net migration. While births and deaths could potentially be estimated from historical trends, since they take some time to change significantly, net migration can be influenced by and can quickly respond to short-term changes such as economic swings and patterns of investment* (Dorner et al, 2014).

The barriers brought to light apparent linkages: for example, they seemed to be propagated by Zimbabwe's economic downturn. Deterioration of the state institutions was found to be caused partly by the 'brain-drain' where qualified water professionals within institutions emigrated after the economic decline. The same economic situation led to water tariffs remaining fairly stagnant in the interest of user affordability, unfortunately resulting in poor cost recovery and lack of funds to carry out necessary maintenance. Neglect of maintenance promotes premature obsolescence of water infrastructure and poor service delivery, which constrains the economy thereby accelerating further economic decline.

The prevailing economic climate impedes investment in all sectors within the country. No organisation alone can solve the country's water investment problems. A partnership approach is required, to work together as a country in a collaborative and constructive way for all stakeholders to contribute to the turnaround of the water investment climate in Zimbabwe. The solutions employed must be sustainable to position the water sector for success. The solutions proposed include:

- Affordable full cost recovery water tariffs employing government subsidies for deserving communities.
- A strong commitment to operation and maintenance, managing available resources to ensure O&M is consistently carried out.
- Mandating water utility creditworthiness assessment to foster transparency and identify areas of weakness which may be addressed partly by training and capacitating departments in those areas.
- Institute and adhere to policies and legislature that supports private sector involvement and sustainability. Penalties for lack of adherence should be faithfully carried out.
- Water needs to be efficiently managed to increase water supply for both current and future consumers. Attention to consumer satisfaction and water quality monitoring are key contributors to better service delivery.

Sudden water tariff increments are not the answer to poor cost recovery. Improved service delivery should precede any increase to water charges. Community involvement is key to gaining public approval. Stakeholder consultations should clearly explain why increments are necessary and to foster trust and transparency. The public needs visible assurance that the money will not fall in the holes of the old system and perpetuate mismanagement and/or corruption.

Zimbabwe needs efficient technical, legal and financial systems in the water sector to find its edge with which it will lure investors. Transparency, accountability, predictability and reliability should be inherent in all water systems. Sustainability is reached by managing consumption, refraining from unnecessary spending and generating money. The country needs to be proactive in fixing the current investment climate and in determining future threats and responding to them quickly. Identifying the problem and the steps to be taken as this research has done is part of the process to recovering Zimbabwe’s water sector.

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