The dynamics of urban water service delivery capacity and the implications for household food security in Gweru, Zimbabwe

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ABSTRACT

Water is a resource on which all human activities, in both rural and urban environments, are anchored. Due to limited social security in developing countries and associated challenges, water is relied upon directly, and heavily, for food security. Several studies focusing on the relationship between water and agriculture have been conducted mostly in rural areas of Zimbabwe. Whilst the water and food relationship was historically associated with rural settings in Zimbabwe, the urban environments are now increasingly identifying with the relationship for survival due to national economic underperformance. Currently, no research has focused on the dynamics of domestic water service delivery system and the implications for household food security in urban areas. Research has been turning 'a blind eye' to the effects of reported water shortages and water affairs on household food security in Zimbabwean cities. In view of this, the present study assessed the urban water service delivery system and its implications on household food security in Gweru, the fourth largest city of Zimbabwe.

Therefore, the capacity of Gweru municipality to supply water to citizens was assessed. Capacities investigated were the availability of water at source as well as the municipality's financial, human and infrastructural capacities to supply water to citizens. The findings revealed that the city had sufficient raw water at source to supply the city. Nonetheless, the infrastructural capacity to pump water to the city was limited. Financial incapacity was identified as the major drawback that crippled the system in terms of both adequate human resources and infrastructure development in the city. Results revealed that the municipality was further financially incapacitated by water debt cancellation that was implemented in the year 2013. The shortfall between supply and demand was assessed. Using World Health Organisation (WHO) guidelines on recommended per capita water per person, results showed a significant difference between the supplied water and projected demand, reporting a shortfall of 30%.

This situation prompted the researcher to investigate the role that water users were playing in the incapacitated system in order to optimise the limited resources. Adequacy of user participation in the water supply system was assessed using a perception study. Results show that despite all the incapacities, the service provider was not capitalising on working with residents in order to maximise conserving the available resources. Gweru municipality and the city's residents had poor communication. This perpetuated a tendency of non-compliance

with water conservation and demand management strategies as respondents felt disregarded. The municipality was seen as dictatorial, imposing decisions to do with water rationing and revenue collection on residents *mutatis mutandis*, without adequate consultation and notices.

It was in the context of the limited water supply and demand management capacities, the widening supply and demand gap as well as inadequate user participation that household food security was assessed. Results show that municipality's efforts to continue providing service sometimes led to serious cost recovery and revenue collection that culminated in excessively high bills and serious follow up on payment that, in most cases, led to disconnections. Residents suffered water cuts and reduced food production prospects from their gardens due to plant wilting. The study further revealed that the municipality allowed backyard farming irrigation, but then capitalised on increased bills that were mostly based on estimates. The high monthly bills also crippled the residents' food buying power, making them more vulnerable to food insecurity. The municipality imposed decisions that make the utility fulfil its mandate of supplying water at the expense of the intended beneficiary, the user. The results show that the measures taken by Gweru city council seriously compromise household food security.

The study further assessed the coping strategies that were devised by respondents and civil society groups to counter water shortages and water related household food insecurity. Results reveal that respondents embarked on both legal and illegal strategies for survival. Due to inherent poor communication between the authority and residents, most of the coping strategies devised by respondents, such as self reconnection to water supplies, exhibited deviant behaviours due to lack of options, further increasing the amount of non-revenue water consumed. Twenty two percent of respondents demonstrated their willingness to cooperate with the municipality through payment plans, although 18% of them revealed the ineffectiveness of the option since bills continued to increase. In order to cushion the residents from water shortages and food insecurity, civil society rolled out boreholes and community garden projects in the city.

The findings of this study demonstrate the importance of capacity building and development in the water service delivery sector. The study highlights the need for stakeholder engagement, in a bid to optimise resource utilisation amid limited capacities. The findings of the study further show the importance of people-centred approaches in resource management in order to achieve sustainability. Lack of an integrated approach in water service delivery in

Gweru led to more disgruntled and vulnerable citizenry that perceives hegemony and prejudice. The findings have demonstrated that lack of engagement breeds an environment that counteracts a conservation ethos, as citizens defend their spaces for survival. The research findings can supply a baseline of information for the formulation of city by-laws and national policies on urban water and household food security.

PREFACE

The present study was undertaken with the aim of understanding the dynamics of urban water service delivery system capacity and the implications for household food security in Gweru, Zimbabwe. The study was formulated as a sequence of independent, but interrelated, research articles that form discrete chapters of the thesis. Since the chapters carry a common thread, though stand alone, overlaps in the methods and references of each chapter and to a lesser extent results were inevitable. Notwithstanding the trace of duplication, each chapter has its own distinct focus and the independent articles can be read separately without losing the overall essence The thesis comprises seven chapters in total, with five, that is, excluding the introduction and conclusion, being the aforementioned research articles derived from the study objectives listed in section 1.3. Two of the articles are published (GeoJournal and Review of Social Science) and the other three are in preparation for submission (Journal of Environmental Planning and Management, Environmental Research Journal and Journal of Arts and Humanities). Although all the articles have been co-authored, I am the primary author with the other authors being the supervisor and/or co-supervisor, as indicated.

- Chapter one is the general introduction and contextualisation of the study and serves to provide the background for the papers that follow.

- Chapter two gives an overview of the city of Gweru's water supply chain capacity. The assessed capacities ranged from at source availability of water, financial resources, human resources and infrastructural competence to supply water to the city's multiple domestic water uses. This was important in order to have an inventory of the resources that were at the city's disposal. (**Kusena, W** and Beckedahl, H. R. An overview of the city of Gweru, Zimbabwe's water supply chain capacity" in *GeoJournal*, 81(2), 231-242, published).

- Chapter three assessed the extent of imbalance between water supply and demand in the city of Gweru. It analysed the changes in water volumes in the conveyance system from the stages of Raw Water Treated, Treated Water Pumped to city and then the Estimate Consumed water. This chapter was of paramount significance in establishing the gap between water supply and demand.(**Kusena, W**, Beckedahl, H. R and Desai, S.A. Water Supply and demand balance in the city of Gweru, Zimbabwe, *Journal of Environmental Planning and Management*,In preparation*).*

- Chapter four investigated the adequacy of user participation in the city water conservation and demand management system. (**Kusena, W**, Beckedahl, H. R, Desai, S. A and Chemura, A. Assessing public participation in water conservation and water demand management in water stressed urban areas: insights from the city of Gweru, Zimbabwe, *Review of Social Sciences*, 01(08), 30-43, published).

- Chapter five focused on the implications of the city water service delivery system on household food security. (**Kusena, W**, Beckedahl H. R. and Desai, S. A. Analysing urban water service delivery system and the implications on household food security, submitted to *Environmental Research Journal*, In preparation*).*

- Chapter six investigated the coping strategies that were devised by residents and civil society groups to counter water shortages and household food insecurity. (**Kusena, W**, Beckedahl, H. R and Desai, S.A. Civil society and residents coping strategies to water shortages and water instigated household food insecurity in Gweru, *Journal of Arts and Humanities*, 6(2),30-43, published).

- Chapter seven provides a synthesis of the research work. In this chapter, apparent research gaps that have been exposed by the study were identified and recommendations were subsequently made.

DECLARATION 1

The research work described in this thesis was carried out in the School of Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg, from April 2013 to December **2**016, under the supervision of Prof. Heinrich R. Beckedahl and Dr Sumaiya, A Desai (School of Environmental Sciences, University of KwaZulu-Natal- Pietermaritzburg, South Africa).

I would like to declare that the research work reported in this thesis has never been submitted in any form to any other university. It therefore represents my original work except where due acknowledgments are made.

Winmore Kusena Signed: _____ Date: _____

As the candidate's supervisor, I certify the above statement to be correct to my knowledge and have recommended this thesis for submission.

Prof. H.R. Beckedahl:……Date…….

Dr S.A. Desai:……Date……

DECLARATION 2- PLAGIARISM

I, Winmore Kusena, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.

2. This thesis has not been submitted for any degree or examination at any other university.

3. This thesis does not contain other persons' data, pictures, graphs, or other information, unless specifically acknowledged as being sourced from other persons.

4. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a. Their words have been re-written, but the general information attributed to them has been referenced.

b. Where their exact words have been used, then their writing has been placed in italics and inside quotation marks, and referenced.

5. This thesis does not contain text, graphics, or tables copied and pasted from the Internet, unless specifically acknowledged and the source being detailed in the thesis and in the references section.

Signed_____

DECLARATION 3- MANUSCRIPTS

- **Kusena,** W and Beckedahl, H. R (2016) "An overview of the city of Gweru, Zimbabwe's water supply chain capacity" *GeoJournal*, 81(2), 231-242.

- **Kusena,** W, Beckedhal, H. R and Desai, S. A "Water Supply and demand balance in Gweru" In preparation.

- **Kusena, W**, Desai, S.A, Beckedhal, H.R and Chemura, A (2016) "Assessing Public Participation in Water Conservation and Water Demand Management in Water Stressed Urban Areas: Insights from the City of Gweru, Zimbabwe, *Review of Social Sciences,* 01(08), 30-43.

- **Kusena,** W, Beckedahl H.R and Desai, S. A "Analysing urban water service delivery system and the implications on household food security" In preparation.

- **Kusena, W,** Beckedahl H.R and Desai, S. A "Civil society and residents coping strategies to water shortages and water instigated household food insecurity in Gweru", *Journal of Arts and Humanities,* 6(2),30-43.

Signed_____

DEDICATION

To my precious daughter Rutendo, Charlene Mtetwa

ACKNOWLEDGEMENTS

My heart blesses the Lord for I can do all things through Christ who strengthens me. Praise will ever be on my lips for all His benefits I have received and still to receive.

I want to thank my promoters Professor Heinz Beckedahl and Dr Desai, S. A for their insightful guidance. They gave their best to make my research a success. I am so grateful for their warm, loving and always welcoming deportment that lifted my confidence and enthusiasm to soldier on to the end.

A special acknowledgement is extended to the University of KwaZulu Natal for Financial Assistance in my article publication and tuition exemption. I am also indebted to Midlands State University for funding my travel and subsistence during the first year of my studies. I wish to thank Gweru City Council and Zimbabwe National Water Authority for availing data for the study.

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ACRONYMS

WHO	World Health Organisation
GCC	Gweru City Council
ZINWA	Zimbabwe National Water Authority
JMP	Joint Monitoring Programme
MDP	Municipality Development Programme
UNDP	United Nations Development Programme
Zimstats	Zimbabwe National Statistics Agency
UN	United Nations
DMS	Department of Metrological Services
GIZ	Germany Technical Corporation
ESDR	Engineering Services Department Report
NRW	Non-Revenue Water
ZESA	Zimbabwe Electricity Supply Authority
PSIP	Public Sector Investment Programme
TRW	Treated Raw Water
TWPC	Treated Water Pumped to City
CE	Consumption Estimate
BWR	Basic Water Requirement
ANOVA	Analysis Of Variance
WHO	World Health Organisation
NGOs	Non-Governmental Organisations
WC	Water Conservation

WDM	Water Demand Management
FAO	Food and Agriculture Organization
DWAF	Department of Water Affairs and Forestry
PSU	Primary Sampling Units
GRRA	Gweru Residents and Rates Association
MMM	Mangaung Metropolitan Municipality
USA	United States of America
HD	High Density
MD	Medium Density
LD	Low Density
GoZ	Government of Zimbabwe
ZIMDEF	Manpower Development Fund
NSSA	National Social Security Authority
SASSA	South African Social Security Agency
BCC	Bulawayo City Council
RUAF	Resource Centre for Urban Agriculture & Forestry
IMF	International Monetary Fund
IFAD	International Fund for Agricultural Development

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background

Water is a precursor of all sustainable social and economic activities. However, water shortage is already a critical concern in most parts of the world (Fedoroff et al., 2010). The global water demand is projected to rise at almost three percent annually due to population growth and rainfall variability (McDonald et al., 2011 and Vörösmarty et al., 2000).

In light of the emerging forces that include economic crises and climate change, food security has been unfavourably affected especially in the sub-Saharan African countries (Mujere and Mazvimavi, 2002). Expectation is that the economic situation and climate change will negatively impact on individuals' livelihoods due to lack of buying power and rainfall deficit for irrigation (Thompson et al., 2009). Zimbabwe is no exception. The country is generally a semi-arid area with low annual rainfall reliability. The average annual rainfall is 650mm, but geographically it ranges from around 350 to 450 mm per year in the southern lowveld to 1000 mm per year in the highveld (IUCN, 2006). Most farmers in Zimbabwe have already moved from rain-fed agriculture to irrigation, making water harvesting an imperative and urgent avenue in order to ensure food security (Mujere and Mazvimavi, 2002).

However, water supply challenges have not been only confined to rural and farming areas only. Urban environments are also experiencing serious domestic water supply challenges. The causes of the situation have been ascribed to factors ranging from insufficient water resource, personnel, aging infrastructure, lack of funds and poor rainfall (Gumbo and Van de Zaag 2002; and Mangizvo and Kapungu, 2010). However, these reports have been so generalised for the country as a whole. Significantly, the spatial and ecological characteristic differences of cities must certainly have distinct explanations that require 'tailor-made' solutions. Although the referred farming activities were rain-fed, the study by Hungwe (2006) and Mougeot (2005) brought to light the food crisis in cities, with Harare and Bulawayo as the studied cases. Nevertheless, the 'eye opener' was not followed by relevant policies to organise and facilitate the farming movement for the food-insecure citizens in cities. Plainly stated, Zimbabwe was slow in responding to the nexus between available urban water and household food security. Water service providers are not coming up with integrated water and food policies that simulteneuosly protect the available water and household food security in a sustainable manner.

Namibia, for instance, is an arid country, but its water service delivery is well advanced because of a 'dual system' where treated expensive water is never wasted. Activities that

require lower water quality are not sustained by the same expensive potable water source (Herbertson and Tate, 2001). On another note, South Africa is already reviewing the Lesotho Highlands Project as a result of the implementation of effective water saving strategies that incorporate water users (Tromp, 2006).

1.2 The 'evils' of Zimbabwe's Economic meltdown: stating the problem

Ironically, Zimbabwe is reported to have reached plus or minus 90% domestic water supply coverage in the 1990s (Joint Monitoring Programme, 2006). However, the new millennium brought about a phase of economic challenges that saw grants from the central government to municipalities dwindling. To further complicate the issue, new water needs are emerging in urban areas. Chigumira and Mujere (2009) state that coupled with general population increase, economic hardships have seen most low income urbanites resorting to urban farming (Hungwe 2006), a phenomenon that is likely to exert more pressure on the already strained resource. The economic collapse and in particular, the decline in formal-sector employment and incomes has contributed to the increase in on-plot farming (ENDA-Zimbabwe, 1996). Unfortunately, urban agriculture at household level relies more on municipal water. A large proportion of the urban population is unemployed and urban agriculture has become a source of livelihood for the struggling urbanites. The new millennium has witnessed a 'shutdown or downsizing' of almost all industries in Gweru along the Bristol heavy industrial site. These industries include ZimAlloys, ZimCast, Bata, Zimglass and Boc Gases. The industries used to provide employment to more than 70% of Gweru residents (Sithole, 2013). Sadly, the economic drawback affected business with ripple effects that extend to the water sector. The urban poor were left with no alternative sources of livelihood but to resort to urban agriculture as it became clearly imperative that any livelihood potential was to be explored. The phenomenon has been so evident especially in the high density urban areas of Zimbabwe (Mbiba, 2000). Agricultural activities are now widespread in the suburban areas of Gweru. Most open spaces and gardens are being turned into agricultural plots, this time around not for greening or beautification but to create a food secure urban population.

There is acknowledgment by municipalities of the effectiveness of urban agriculture for poverty alleviation and household food security, given the national economic situation (Municipality Development Programme (MDP), 2002). Many authors have written about the significance of urban agriculture towards household food security and how extensive it has

been successfully practised in many cities of the world (Bryceson and Potts, 2005; Bryld, 2003; Mougeot, 2000; RUAF, 2007; and United Nations Development Programme (UNDP), 1996). Likewise, parallel researches on water supply challenges in Zimbabwe have been carried out in urban areas and they reported water shortages (Mangizvo and Kapungu, 2012; and Matsa, 2012) although the extent of water shortages was not examined. Besides mere acknowledgement of the importance of urban agriculture, very little has been done by municipalities in recognition of the relationship that urban water supply circumstances have on household food security and the role of water users in the growing relationship. Acknowledging the significance of urban agriculture alone without providing its corresponding facilitation in terms of adequate inputs may not add value. Urban agriculture, particularly backyard gardens, falls under the municipality and it is acceptable according to most Zimbabwean cities by-laws (Gweru included) although it requires a lot of monitoring. Nonetheless, recognising the worth of urban agriculture for household food security mainly for the urban poor (human right) and at the same time the treating of water as an exclusively 'economic good' is tantamount to 'dancing to two tunes' that are bound to create discord. Therefore, the aim of this present study is to fill the gap that research to the best of my knowledge has not interrogated before, that is, the relationship between urban water supply system and household food security. This study is purely geographical in the sense that it explores water, a critical component of the environment and its interactions with human life. Thus, inquiring into societies from the perspective of a case study approach and by investigating problems of spatial organisation.

In order to fully understand the stated problem, a focused and detailed interrogation that brings out the spatio-temporal dynamics between water supply and household food security was carried out . This was achieved within the context of the city of Gweru, Zimbabwe. The study included high , medium and low density suburbs as they are a reflection of residential classes found in developing countries. This cross cutting analysis contributes to an understanding of society by unveiling the existing yet under researched but important relationship between urban water supply and household food security. The temporal element of the study is also reflected in the careful analysis of water volume changes at source over a period of ten years and how these changes ultimately affects people in Gweru, Zimbabwe.

The study dissects Gweru's water supply system in terms of the city's capacity to supply and respond to shortages (conservation and demand management) as well as the implications that all the water supply dynamics have on household food security streams.

1.3 Conceptual Framework

The study is premised on a participatory paradigm, a critical concept of "good water governance" (Meissner, 2016; Araral and Yu, 2012; De Stefano et al., 2014). Water governance is inherently political, and is ultimately the responsibility of national, regional and local governments, working with their own citizens and with each other, to make improvements. It is important to acknowledge that the theoretical foundations for describing the dynamics of water governance are diverse and fragmented. Therefore, this analysis contributes to the building of a conceptual framework of water governance system for cities within developing countries. Meissner (2016) also recognises the existence of different paradigms in water governance. However, of interest to the current study is the participatory paradigm as a possible panacea to the achievement of good water governance. The recognition that individuals play a pivotal role in water governance with feedback into policy process is pertinent for sustainable water management (Phumpiu, 2008).

The research problem portrays a complex challenge of a 'wicked problem' that requires concerted effort from all parties in order to achieve good water governance. Ritchey (2013) defines a 'wicked problem' as a challenge that manifests itself in different ways and is difficult to resolve. According to Horn (2001) these circumstances are unstructured realities. A 'wicked problem' creates several other challenges, especially during the course of trying to solve the seemingly major ones. Solutions are not an easy, quick, or solitary exercise but demands interdisciplinary collaboration. Moreover, the engagement and cooperation of all stakeholders is pivotal. It should also be appreciated that governance systems are not static (Meissner, 2016). Therefore, water governance discourse needs to be dynamic to cope with inevitable changes as societal systems evolve. Therefore, water governance systems in cities should have a transformative capacity.

Transformative capacity is the ability of a governance system to adapt or transform structural elements as a response to current or anticipated changes in the social or natural environment. Societies have inherent heterogeneous classes and these require consideration in order to achieve good water governance. The imbalances in beneficiation and power that may occur in societies are loudly echoed in the political ecology theory (Adams 2001, Wolf 1972). The theory explains the interaction of humans and the environment. Political ecology indicates the importance of social and political dimensions that are seldom considered and more often than not downplayed in water governance. Bryant and Bailey (1997) give an example of power

struggles in decision making, for instance 'hard' scientists may despise the reasoning and insights of 'soft' anthropologists; urban business people seek to ignore the views of the 'mere' consumers or recipients of services; and likewise men downplaying the knowledge and understandings of women. Therefore, political ecology emphasises that the exercise of power must be understood at the discursive as well as the material level. Political ecology in essence seeks to give and integrate explanations across spatial scales (Blaikie and Brookfield 1987). This is done in an endeavour to achieve both environmental protection and social justice in water governance (Rasul and Jahir, 2010).

1.4 Aim and objectives

The aim of this study was to analyse the dynamics of domestic water supply and demand management capacities, and the implications for household food security across residential suburbs of Gweru, Zimbabwe.

The specific objectives of this study are to:

1. assess the domestic water supply chain capacity of the city of Gweru.
2. examine the water supply and demand gap in the city of Gweru
3. analyse the adequacy of user participation in water conservation and demand management processes in Gweru.
4. investigate the implications of the existing water supply situation on household food security systems in Gweru.
5. analyse the coping strategies devised by residents and civil society organisations to deal with water and food shortages.

1.5 Description of the study area

The study was conducted in the city of Gweru, Zimbabwe. Gweru is the country's fourth largest city. It is located at 19°25′S 29°50′E and lies about 285 km south of the Capital City, Harare (Figure 1.1). The city lies on Zimbabwe's central watershed which stretches from Rusape, through Harare to Bulawayo and is located at an altitude of about 1 422 m above sea level. Gweru has a total population of 158 233 (Zimbabwe National Statistics Agency (Zimstats), 2012). Gweru residential areas are classified as low, medium and high. High density suburbs include Mkoba 1-20, Ascot, Senga, Mtapa, and Nehosho. Medium density suburbs include Northlea, Southdowns, Ivene and Nashville, whilst Brakenhurst, St Annes',

Kopje, Daylesford, Ridgemond and Habern Park constitute some of the low density areas. Most of these suburbs receive potable water from Gwenhoro dam. The other supply dams are Whitewaters and Amapongokwe. Whitewaters is situated about 13 km along Mvuma Road in the north east direction from the city. The dam has a capacity of 33 mega litres. It supplies mainly the north-eastern part of the city which includes Thornhill Airbase, Harben Park and Ridgemont suburbs, as well as Hwahwa prison and Anderson schools outside the city. Main soil types in Gweru are black basaltic soils, red loams, sands and gravel. The average annual total rainfall for the city is 684mm (Vincent and Thomas, 1960).

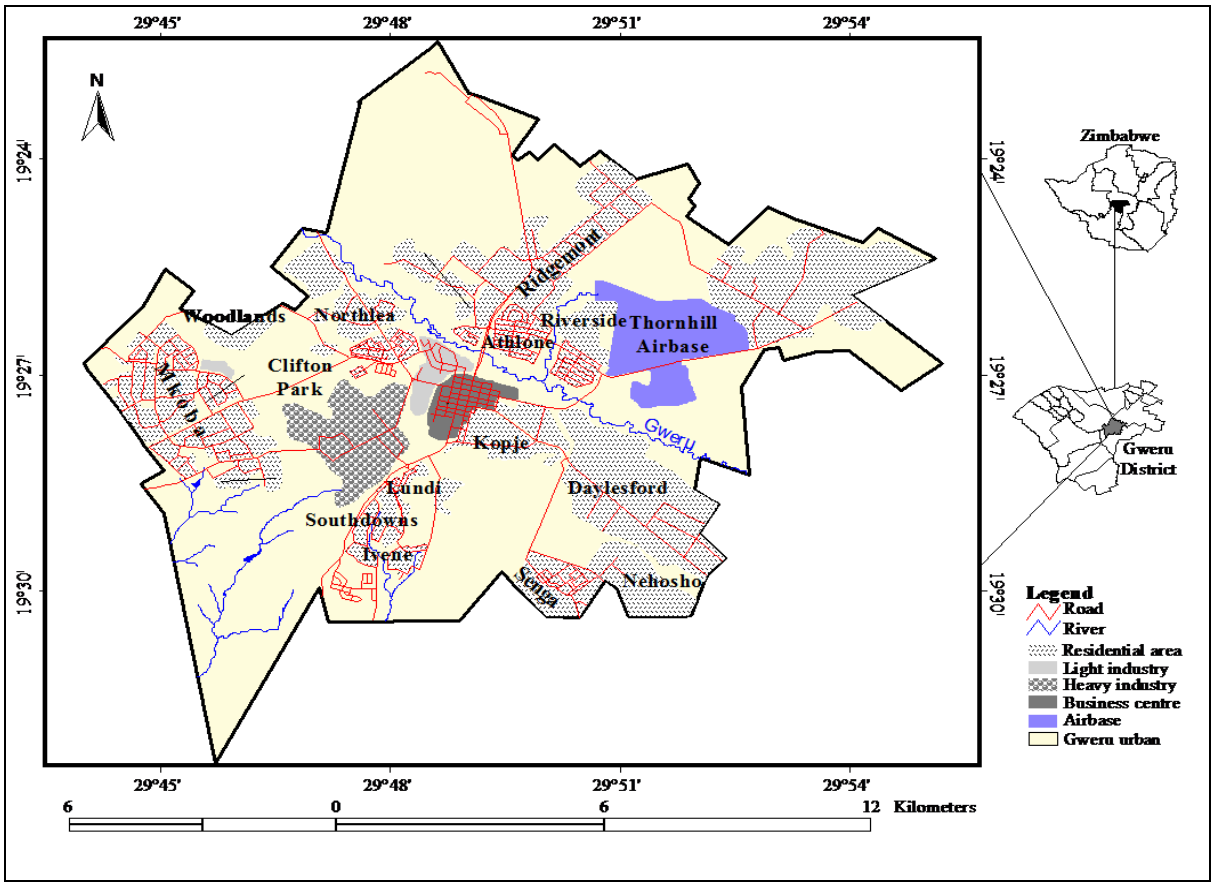

Figure 1.1: The City of Gweru showing residential areas

Similar to many other areas in Zimbabwe, Gweru's climate is a subtropical one, which experiences a summer season of about six months (October to March). The average daytime temperature during summer period is 30^{o}C. The City is also punctuated with warm dry days and extremely cold nights from June to August and the average temperature is around 20^{o}C (Vincent and Thomas, 1960). The city of Gweru was chosen as an area of study for purposes of describing and explaining the dynamics of water governance on household food security for the benefit of other Zimbabwean cities. Research on household food security in

Zimbabwe was mainly based on the results of the Harare (combined with Chitugwiza, now third largest) (ENDA-Zimbabwe, 1996 and Mougeot, 2005) and Bulawayo assessments (Hungwe, 2006), the first and second largest cities, respectively. Therefore, the case study of Gweru, the fourth largest city, investigates the aspect of food security as well but takes a new dimension that correlates urban water service delivery capacity with household food security. The poverty rate of the city of Gweru is at 46% (Zimstats, 2015). The poverty circumstances around the city of Gweru further prompted the researcher to investigate the contribution that water supply dynamics have on the potentially struggling households food security system.

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CHAPTER TWO

AN OVERVIEW OF GWERU'S WATER SUPPLY CHAIN CAPACITY: TOWARDS A DEMAND-ORIENTED APPROACH IN DOMESTIC WATER SERVICE DELIVERY

This chapter is in effect the paper:

Kusena, W and Beckedahl, H. R (2016) An overview of the city of Gweru, Zimbabwe's water supply chain capacity *GeoJournal*, 81(2), 231-242.

2.1 Abstract

Following complaints about water shortages in some areas of Gweru, the research assessed the availability of enabling capacities to efficiently and sufficiently deliver water to the residents of Gweru in line with the existing level of demand. The aspects that were assessed were the state of infrastructure, human resources, finance and physical availability of raw water at source. Purposively selected informants from Zimbabwe National Water Authority (ZINWA) and Gweru City Council (GCC) provided data on the infrastructural, financial and human resource situation of GCC. Dam levels data for Gweru's three supply dams were obtained from ZINWA records through the assistance of Sanyati Catchment Hydrologist. Raw water availability was assessed with the aid of Mann-Kendall test using a 10 years period data set from 2003 to 2012 for trend analysis. Findings revealed that the water sources were not experiencing major changes in levels, to be precise; the changes were not statistically significant. However, given the increase in population and demand, any slightest negative change in supply would further widen the gap between supply and demand. The study also uncovered that GCC had challenges with regards to infrastructure, mainly due to financial constraints. Notably, GCC was not experiencing high staff turnover, but it was however, seriously under-staffed and failing to effectively monitor water use in the city. Therefore, strong financial injection is required to support staff and resuscitate the reticulation system. Given the perpetual water shortages in Gweru and the status quo in the supply chain, water demand management strategies, rainwater harvesting and consumer education are consequently proposed as measures that would ensure continuous water supply for all needs in the city.

Keywords: Water supply sources; infrastructure capacity; dam levels; financial capacity, urban areas

2.2 Introduction

The UN's Committee on Economic, Social and Cultural Rights in the General comment 15 stated: "The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights." Water is not an optional consumer good. Rather, it is essential for human life and its availability represents a key resource for all economic activities (Gillespie, 2005; Tekken, 2012). Globally, water resources are increasingly under pressure, mainly due to inter alia, changing lifestyles and population growth (Amell, 2004). It is therefore imperative that enabling capacities are built and developed to ensure sustainable water supply for citizens. Governments and local authorities world over have put unwaivering effort to improve infrastructural and human resource capacities in the water supply chain. However, reports have been pointing towards at-source water reduction due to changes in climatic conditions (Khan and Hanjira, 2009). Negative changes in the water levels due to any given cause further cripples the chances of meeting the increasing demand for the resource, especially in Sub-Saharan Africa. Identified with unfavourable rainfall patterns (Hebertson and Tate, 2001) the region struggles when it comes to general developmental issues that require financial backup. This implies that not only water supply issues are likely to manifest as a result of financial limitation and water shortages but the problems are rather complex.

In particular, increased water demand in urban areas of Zimbabwe is always outstripping the supply (Manzungu and Machiridza, 2005). The Zimbabwean urban water supply situation was reported to be in a worse state than ever before (Matsa, 2012). Water problems have been worsening by the day and the situation continues to become unbearable. There is a scramble for the available limited water for different uses. The year 2010 was punctuated with a cholera outbreak that claimed more than 4000 people and that was one huge symptom of water shortage (The Standard, 2014). As the population continues to grow, increased demand for water is inevitable. Population growth represents a major cause of water stress especially if it is not accompanied by measures to increase supply and demand management capacity (Falkernmark and Molden, 2008). The United Nations Development Programme (2006) observes that the current high demand for water is likely to increase water scarcity as most people in both urban and rural areas directly compete for water for livelihood. Bogardi (2012) asserts that the combination of growing water demand and increasingly limited raw water availability will lead to severe water supply problems if not compensated by innovative

approaches, mainly through investments in water technologies and water demand management.

Demonstrating the need for innovation, Musingafi (2013) paradoxically points out that there could be sufficient freshwater in the world for everyone's essential personal, domestic and agricultural needs but cited lack of distribution networks and working systems to extract groundwater or harvest rainwater, exclusion from these services or facilities, inequitable allocation of water resources and pollution as factors that limit people's access to sufficient water. The subject of inadequate capacity was reflected in the 2010 report on Gweru's water situation, where residents in the high density suburbs of Mkoba 19 and Senga experienced water shortages during the peak of the rainy season and Gwenhoro, the largest supply dam was almost full (Shava, 2013). Therefore, challenges in water supply cannot solely be attributed to water shortages at sources as the problem might be embedded in other facets of the system.

Nonetheless, COHRE (2007) posits that the main challenge to water provision is neither water stress nor the scarcity of water. The major problem is the governance of potable water and the attitudes of the consumers during utilisation. Gracia-Ruiz et al., (2011) puts forward that an effective water resource management depends on supporting and enabling governance structures and the enforcement of policy frameworks. However, strategies for the protection of water resources are still insufficient to account for challenges that result from the water demand of the growing population (Sowers et al., 2011), especially in Zimbabwe and Africa in general. However, the notion that water shortage is a product of poor governance is controversial as other scholars and empirical evidence make it irrefutably visible that water, formerly assumed unlimited in supply, is now scarce (Falkernmark and Molden, 2008; Lobell et al., 2008; Matsa, 2012; Rosegrant and Cai, 2000). Many localities now acknowledge the limited carrying capacities of the resources they use and appreciate the complexity of challenges that emanate from increasing demands and that they require not only simplistic solutions.

Domestic water supply in urban Zimbabwe has been a challenge since the mid-90s with so much concerted efforts from the central government, donor community and the local authorities to try and improve the situation. A report on Bulawayo 24 News (2014) highlighted that the Criterion waterworks in Bulawayo was dilapidated and the authorities have been in a number of negotiations with potential investors to try and resuscitate the

system. In a different case, Rwakurumbira (2011) observed that since 2000, Harare City faced challenges in providing water and sanitation services to its residents. The infrastructure was aged and needed urgent rehabilitation, yet the council had no financial resources to rehabilitate the sewer system as well as the water production and distribution systems. The aforementioned challenges are still a pointer towards incapacitation in the water supply chain in the urban areas of Zimbabwe. Gweru urban is not immune to some of the abovementioned ills (Matsa, 2012).

Given the economic situation of Zimbabwe from the early 2000 to 2008, the water sector failure was inevitable. However, the water shortage situation seems to have been exacerbated by the traditional supply-oriented approach which is more consumptive yet many local authorities still lack adequate data on the general water supply chain for their particular cities. The urban water system requires a paradigm shift to a demand oriented management because concentrating on expensive water production without essential accurate water demand forecasting is rather suicidal as water use ought to be monitored as well. Hebertson and Tate (2001) indicate that strategies and data on water demand are limited in many southern African countries. There are a lot of uncertainties especially in the demographic assumptions for water demand forecasts.

Batchelor et al., (2003) argue that knowledge of the current status quo in water resources and trends in demand is a precondition to successful water management. Communities have insufficient knowledge of their water resources in terms of quantity at any given time and lack a clear management strategy. In most cases, crisis management is then employed when shortages are apparent. In the case of Zimbabwe, particularly Gweru, the climate is predominantly tropical with three seasons that constitute the hot dry, hot wet and cold dry seasons. The greater part of the year, though sometimes cold or hot, is dry, hence the need to properly manage the available water in order to ensure year round water supply for citizens

Literature on the capacity of the city of Gweru to provide water for citizens has been scarce. Whenever available, it is mainly on only one water supply capacity aspect, without a holistic approach. No studies have been carried out on Gweru's water supply situation from an integrated approach that analyzes, at one goal, the state of all aspects that are critical to domestic water supply. The current state of water supply capacities were assessed for purposes of generating information that would assist authorities to develop sustainable water supply systems. This echoes Woodhill's Capacity Development Theory, where it is

acknowledged that capacity development is connected to local capacity and is therefore an endogenous process of change. The process is often referred to as "dynamic" because it requires constant adaptation to cope with rapidly changing environments (James, 1994; Morgan, 2005). In the process, people, society and organisations strengthen, create, adapt and maintain capacity over time (OECD, 2006). For the city of Gweru, population growth and urban expansion are the major drivers of change that ought to be considered at any given point in order to maintain adequate water supply capacities.

In light of the preceding discussion, this chapter assesses the water supply situation in the city of Gweru in terms of its ability to sustainably supply water to Gweru residents all year round. The case in question is not peculiar to Gweru; therefore the chapter has resonance that cuts across all cities in the country and internationally, particularly in third world countries. Problem solving suggestions raised for Gweru will be indispensable for other cities. The chapter informs policy in the dimension of water service delivery and its demand management in relation to existing capacities in any given locality. The assessment interrogated the status quo of the water supply chain capacities from the broad spectrum of the physical availability of water in dams to human capacities that would ensure water supply in the city amid the rise in demand. Water demand can only be met when people have knowledge of the stock of resources available which, in most cases when revealed, become an awakening call. In particular, the rationale behind this chapter is to establish the state and extent of changes in the available water supply capacities of Gweru over time and having a baseline of the potential subsequent implications of the current situation on availability of municipal water in the city.

2.3 Materials and methods

The chapter draws from qualitative and quantitative data. Data to unveil the water supply capacity situation were obtained from both primary and secondary data sources. The capacity aspects in question were infrastructural, financial, at source water availability and human resource capabilities to supply water. The capacity of the water sources (dams) that supply Gweru urban was examined through an assessment of the dam levels data of 10 years to track the changes that took place. This assessment was based on data from all the three supply dams from 2003 to 2012. The period 2003 was chosen as the baseline because that was the time ZINWA began to effectively monitor water sources through catchment councils. Data

for dam levels were obtained from ZINWA records with the assistance of the Sanyati Catchment Hydrologist as the key informant.

Key informants from Gweru City Council (GCC) were equally of importance as they provided data on the infrastructural, financial and human resources capacities of the city. The three key informants selected from Gweru City Council were from the engineering, human resources and finance departments. Using face to face interviews, with semi-structured questions the researcher solicited data on the state of finance, infrastructure and expertise availability.

2.3.1 Data analysis

A linear trend line was then fitted to the data and trend analysis was done to test for trends in water levels using the Mann-Kendall test. The Mann-Kendall test is used to test for whether Y values tend to increase or decrease with time (monotonic change) including accounting for seasonality (Hirsch et al., 1982). The R^2 value and the significance of the trend were used to test for trend. Interview responses were organised into sub-themes for results reporting and discussion using descriptive statistics.

2.4 Results and discussion

2.4.1 Water supply sources of Gweru

The city of Gweru draws its water from four different dams namely Amapongokwe, Gwenhoro, Whitewaters and Ngamo. Amapongokwe is the largest water supply dam for Gweru urban with a capacity of 37.58 ($x10^6$ m^3) whilst Gwenhoro is second largest with 31.36 ($x10^6$ m^3) capacity. However, because of the proximity to the works, water is normally pumped from Gwenhoro to municipal purification works that is approximately 2 km away from the dam. Whitewaters dam is the third largest of the four dams that supply water to Gweru. When hundred percent full, the expected capacity for Whitewaters dam is 4.90 ($x10^6$ m^3). Ngamo is the smallest with a capacity of 2.88 ($x10^6$ m^3) and supplies raw water for industrial purposes. The dam predominantly serviced Bata Shoe Company and Anchor Yeast. However, during the period of study, water from Ngamo dam service extended to urban greening largely because of lower production levels in industries as a result of downsizing (Dewa et al., 2013). The Ngamo water project was regarded vital as it reduced pressure on

the limited resources for water treatment. The dam once had a treatment plant which eventually failed. However, after a cost benefit analysis to resuscitate the Ngamo project, the city council found it prudent to use the water source to supply activities that thrive without treated water such as industries and urban greening in order to cut on treatment costs. However it is important to highlight that of major interest in the chapter were the three domestic water supply dams.

Unlike Ngamo dam, domestic water sources were closely monitored by ZINWA and the City Council, so that data on the levels of the other three dams were readily available and changes in volumes were assessed. In the selected 10 year period data, the key informants indicated that the dam levels had been fluctuating as a result of, inter alia, changes in rainfall amounts, evaporation rates and land use.

2.4.2 Percentage changes in dam levels

The annual average changes in the three dam levels exhibited the traditionally projected drought frequencies for Zimbabwe. After the 1982-83, 1992-93 and the 2002-2003 drought intervals (Department of Metrological Services, 1981), it was highly likely that Gweru would experince dwindling water sources in 2012 and 2013. With regards to the main water supply source, Gwenhoro was on average 45% full in 2003 and the level did not deviate much in 2012 as it was 42%. However, the water source was expected to be lower than 42% in 2013 owing to the effects of weather changes and increased water demand as a result of urban population growth. Changes in land uses within the catchments were further pointed out as affecting the water sources as siltation was evident due to economic activities that included farming and mining which degraded the water sources.

By virtue of its location and area serviced (which is comparatively smaller), Whitewaters dam was a relatively reliable source of water for Gweru since the source was above 90% full for the greater part of the period under review. However, for the years 2003 and 2012, the average levels for the dam were 74 and 89 respectively, further supporting the drought projection literature pegged at ten year intervals (Department of Metrological Services, 1981). Nonetheless, it has to be noted that the recent report from the meteorological department of Zimbabwe indicated an increase in the frequency of droughts from the generally agreed 10 year intervals to as short as five years (Department of Metrological Services (2014). This could explain why the year 2007 also experienced lower dam levels in

all the three dams. Supporting the changes, the dams recorded their highest levels with some seasons experiencing overflows during the period 2009-2010.

Despite annual differences, the levels also differed with seasons even for Gwenhoro and Amapongokwe despite the fact that the dams are in the same catchment (Runde catchment). However, rate of abstraction is another factor that explains the difference. The area serviced by Gwenhoro dam is much wider and it is the main source of water despite being the second largest. Gwenhoro dam directly connects to the treatment plant, making it a cheaper option in water supply. This explains the relatively lower volumes compared to Amapongokwe even during rain seasons because water is continuously pumped out.

Table 2.1: Different dam levels from an updated report as at the time of data collection (May 2013 monthly report)

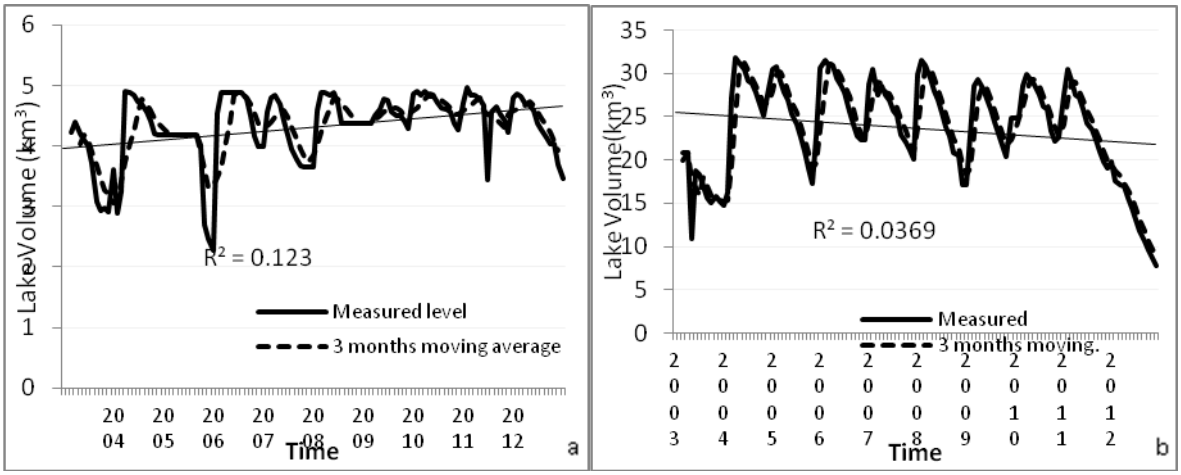
Dam	Dam level (m)	May 2013 Capacity (10^3*m^3)	May 2013 % full	April 2013 Capacity (10^3*m^3).	April 2013 % full	Total raw abstracted (m^3)
Amapongokwe	95.75	21 300	49	22,000	52	606 000
Gwenhoro	90.84	7000	9	7,750	15	591 570
Whitewaters	99.41	4 050	82	4,160	85	79 010
Ngamo	98.21	865	56	899	58	2 144
Total storage		**33, 215**	**49**	**35 009**	**49**	**1278 724**
Treated water pumped to the city		1242 169		1367,464		

Notably, with the exception of Gwenhoro the water sources were above 50% full during the period under study. This created room to further interrogate the water supply system to identify the root causes of the challenges to adequate water supply in Gweru. Although percentage changes in dam water levels were identified annually as well as seasonally, it was highly unlikely that this would affect the city's water situation to the magnitude it had manifested. In actual fact, any pressure on Gwenhoro was ordinarily supposed to translate into a change of source to Amapongokwe and not necessarily a shortage in supply. It was established that environmental flows were observed at the water sources; however, the only challenge was on the amount of water to be left since the authorities still used dam meters (an

average of 20 m) without taking into account the capacity and designs of dams. Mazvimavi (2003) also states that data for determining Zimbabwe Flow regimes to be maintained along rivers for environmental purpose was very limited.

2.4.3 Significance of differences in dam levels

After realising some percentage changes over years and in seasons, the trend analysis shows that there were no significant changes in water volumes in Whitewaters (R2=0.123, p>0.005), Gwenhoro (r2=0.0369, p>0.05) and Amapongokwe Dam (R2=0.2114, p>0.05) meaning that the combined available water volume for the dams did not change significantly over the years (r2=0.032, p>0.05). For Whitewaters (Figure 2a) and Amapongokwe (Figure 2c), the general trend shows an increase in dam volume from 2003 to 2012, which contributed to an increase in combined volume (Figure 2d). Only Gwenhoro dam had a decreasing trend in water volume. These results point to the fact that there were other factors contributing to the challenges of water scarcity in the city of Gweru other than a decline in water volume in the supply dams. These factors are directly linked to the capacity of GCC to draw, treat and distribute quality water to residents. The findings therefore support the information from key informants that human, financial and technical capacities to supply water in Gweru were limited. The water problem therefore becomes multi-faceted, requiring integrated water planning that combines supply and demand management in order to achieve sustainable water provision in the city.



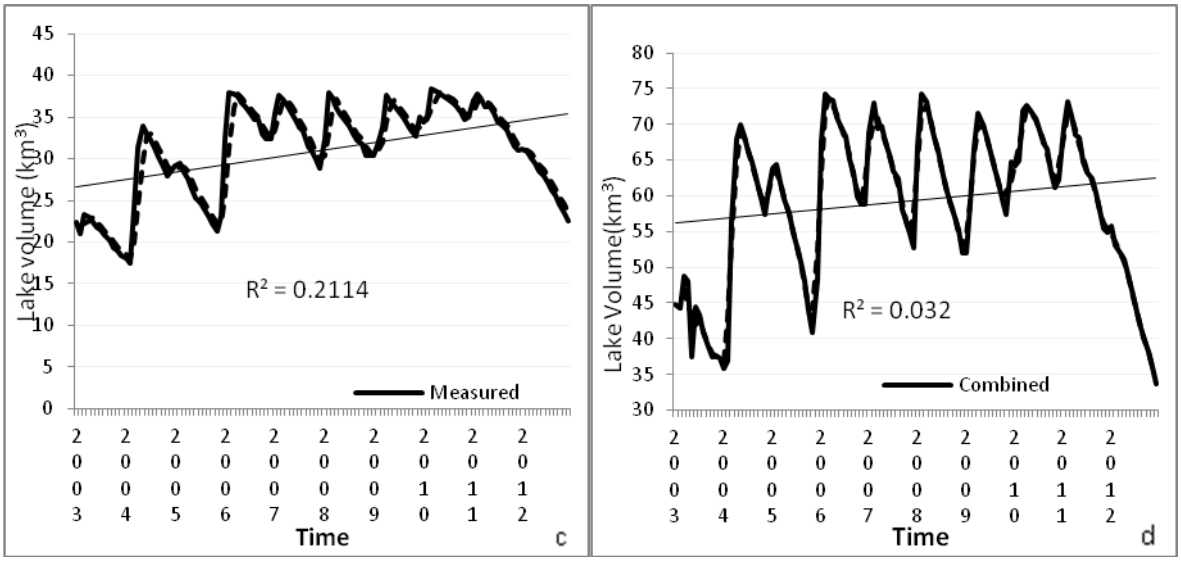


Figure 2.1 Trend of dam water levels from 2003 to 2012 in (a) Whitewaters dam (b) Gwenhoro dam (c) Amapongokwe (d) Combined volume of the three dams

The declining trend in Gwenhoro dam though slight and statistically insignificant, has serious implications on the city's water supply situation mainly because the particular dam is the one linked to the water treatment plant. Water from Amapongokwe would need to be pumped into Gwenhoro first for treatment. However, given the infrastructural and financial state of GCC, changing water source can only exacerbate the water supply problem.

It was further revealed that the city of Gweru was continually expanding, giving rise to new residential areas that were supposed to rely on the same strained water sources. Examples included the cropping up of Hertfordshire phase 1 and 2 suburbs, Mkoba14 extension, Woodlands Park and infills and extensions in almost every residential area to cope with housing challenges. Meanwhile, the same sources of water remained. To make matters worse, a number of urbanites now relied on municipal water to sustain their gardens to ensure household food security as a result of poor economic performance that had rendered a significant number of people unemployed. Whilst Whitewaters had been a reliable source, it was now faced with a challenge of supplying Hertfordshire area which was approximated to have 4000 housing units such that the slightest decline in water volume at source might lead to water shortages in the long run.

2.4.4 The condition of the water reticulation system in Gweru

Gweru has two treatment plants. These two, Whitewaters and Gwenhoro water treatment works are old and sometimes underperform. Residents in some areas, especially in the high density suburbs of Mkoba 19 and 20 went for close to two weeks or more without water for the greater part of the year 2013 because the city council did not have the funds to replace or fix the infrastructure. This phenomenon was not endemic to Gweru only as Harare, Masvingo and Bulawayo were experiencing similar problems (Mvura, 2012; Nhlahla, 2008). Although the city of Gweru is fourth largest in the country, the water reticulation infrastructure was still incongruous with the population levels. The pumps at Gwenhoro were not powerful enough to pump water to all areas of the city. The dilapidated state of pumps made it difficult for high altitude areas like Mkoba 19 to receive tap water. This challenge ushered an era of borehole sinking in Gweru, sometimes initiated by NGOs or the municipality itself to try and curb water problems. As a matter of fact, GCC faced infrastructural problems due to inadequate repairs, aging pipes and the incapacity of conveyance system to cope with the demand.

However, interview responses from the city engineer indicated a possible change in the state of infrastructure. GCC had acquired three pumps which were yet to be installed. The installation of the three pumps, one from the Germany Technical Corporation (GIZ) and the other two from the local authority were deemed a solution to water problems since water challenges had continued to trouble the city owing to inadequate pumping capacity. During the period under study, Gwenhoro water works had three functional water pumps which however took turns to breakdown causing persistent water paucity in Gweru even when raw water was available. The installation of additional three treated water pumps to augment the existing ones was expected to raise the pumping capacity to the extent where areas such as Mkoba 19 would receive tap water reliably. Meanwhile the water pumping capacity was very weak and slow such that the city reservoir rarely stored water even for near future use. Table 2 shows the condition of the water pumping equipment at the four sources (raw water pumpsets).

Table 2.2: Raw water pumping equipment at the four water sources

Gwenhoro pumpsets		
Pump No.	Condition	Remark
1	Good	Working well

2	Good	Working well
3	Good	Working well
4	Good	Working well
5	Fair	Unbalanced phases of the motor
Amapongokwe pumpsets		
1	Good	Pumpsets commissioned and working well
2	Good	Pumpsets commissioned but developed a problem on the shaft
3	Good	Working well
4	Down	Empty bay
Whitewaters pumpsets		
1	Good	Working well
2	Good	Working well
3	Good	Working well
Ngamo		
1	Good	Working well
2	Good	Working well

Source (Engineering Services Department Report, pg 6, May 2013)

Table 2.2 indicates that the pump stations in the water supply system were above average as more than 80% of the raw water pumpsets were in good working condition. However the research revealed that GCC was experiencing challenges in pumping treated water to the city. The pumped raw water was supposed to have highlift pumps with a capacity that corresponded with the pumped water in order to increase the pressure. Table 2.3 shows the condition of the treated water pumpsets which were situated at Gwenhoro and Whitewaters water works.

Table 2.3: Treated water pump sets

Highlift pumpsets		
Pump No.	Condition	Remarks
1	Good	Working well
2	Good	Working well
3	Down	Motor under repair

4	Down	Empty bay
5	Down	Empty bay
6	Down	Empty bay
7	Good	Working well
8	Down	Preparation underway for replacement
9	Good	Working well
Whitewaters treated water pumps		
1	Good	Working well
2	Down	Pump obsolete
3	Good	Working well

Source (Engineering Services Department Report, pg 5, May 2013).

Half of the treated water pumps were not in a good working condition. This implied that despite availability of raw water, Gweru experienced water shortages due to infrastructural incapacity. However the question which then arises is: in the event of adequate infrastructure, is Gweru capable of sustaining sufficient supply to satisfy the demand? Or the most prudent way would be to embark on serious water demand management measures as a supporting and permanent way of managing water supply and demand issues; including education and awareness in the process, in order to change the consumer's water use levels and mindset towards the resource that requires concerted efforts; if ever sustainability is to be achieved.

2.4.5 Human resources and water system knowledge availability

The July 2013 Chamber secretary's report indicates that the labour turnover as at July 2013 was at 0.17%. This implied that very few joined or left the organisation. However for the engineering services, the authorized strength or staff compliment was pegged at 390. Unfortunately this was authorized in 1980 and there had not been a review upwards to cushion the expansion in infrastructure and population. Moreover, the transfer of knowledge from the few old employees to the younger generation of workers has not been smooth. Sometimes critical information was personalised in order to avoid easy replacement. For instance GCC did not have an accurate and consolidated layout map of the pipe network. Such information remained in the hands of very few people who tended to monopolise it, as a strategy to manipulate the system and remain indispensable.

It was indicated that GCC lacked adequate staff, particularly for water use monitoring and this led to abuse of the resource by consumers, who sometimes diverted domestic water for other purposes such as farming. Another challenge troubling the city of Gweru as a result of limited monitoring capacity was Non-Revenue Water (NRW) due to vandalism by farmers, mostly those who lived along the treated water pipe line.

Water disconnections were the commonly used strategy to conserve water among different socio-economic groups in Gweru. Failure by residents, for any reason, to pay water bills would lead to immediate disconnections that attracted high reconnection fees (USD 23). The strategy seemingly produced mixed results among different groups. However there was general willingness among residents to settle water bills to avoid penalties. Nonetheless Madebwe and Madebwe (2011) pointed out lavish use of water in Gweru, especially amongst the high income households, coupled with a relief in the economic performance since 2009 that gave many residents a fair capacity to pay for services.

The municipality, however, lacked full capacity to constantly make check-ups on the efficiency of water use in residential areas. Despite specific bylaws that encouraged water conservation, the residents, mainly in southern low and medium density suburbs of Gweru, surreptitiously used hosepipe to water their gardens. This was done during weekends and after working hours when they least expected municipal patrols. Regrettably, water consumption and consumer habits were rarely monitored because of inadequate personnel as a result of the municipality's deficient budget.

2.4.6 Financial capacity

It was revealed that there was a wide gap between the existing water reticulation system, the demand for service and the available financial capacity to improve the state of affairs. The situation was exacerbated by changes in the demographic pressures and decline in the macro economic performance. The growing number of people in Gweru led to increased water usage. More so, the high unemployment rate in the city saw a number of people relying on municipal water for livelihood, through backyard farming. Pressure was overwhelming on the already burdened infrastructure that was rarely serviced due to inadequate funds.

In January 2013, when GCC budget for the year 2013 was presented, the economic environment had not changed much from 2012. The sources from which GCC generated

revenue were still struggling. Companies were to pay for water services and the same applied for the residents. Nationally, the fiscal policy review in 2012 saw the revision of the national budget downwards from $4 billion to $3.64 billion. The review had adverse impacts on the financial capacity of the municipality because it is a grant aided institution. The situation resulted in GCC failing to pay its suppliers, particularly the Zimbabwe Electricity Supply Authority (ZESA) resulting in challenges in the supply of power for water pumping.

Significantly, the council had been working flat out to source funds to improve the situation. The efforts bore the partnership with the Australian and Germany government that injected over USD 27 million for water services improvement. Of the fund, 1, 7 million was directed towards rehabilitation works in Gweru, particularly water and sanitation. GCC was also involved in a Public-Private Partnership with Unki Mine through the Democratic Councils Forum. Another notable achievement was that GCC got a loan in early 2013 from the Public Sector Investment Programme (PSIP) to the tune of $3 million for water and sewer rehabilitation. However, developments for the betterment of water service provision have been made but there still remained a mismatch between the financial water supply capacity of GCC and service demand. The expansion of residential areas and population growth posed increased demand that required an analogous infrastructural expansion. It is in actual fact difficult, if not impossible, to keep up with the pace, but efforts should always be in place to improve the water supply situation. Therefore, people ought to be educated on sparing water use and be encouraged to pay for water services as this makes sense from a Dublin principle point of view, where water is, and should be, treated as an economic good.

Consequences of the June 2013 water bills cancellation are still to be evaluated. Nonetheless, the general sentiment from respondents was that the move to write off debt was just a political gimmick to obtain votes (Zimeye, 2013). The money was supposed to develop and sustain water reticulation system and meet other municipal needs. It is therefore projected that if coffers are not immediately enhanced, service provision and financial capacity will be seriously compromised.

Information about water supply should always be available for resource optimisation and planning purposes, particularly to reveal the supply and demand gap. In this regard, the next chapter examines the gap between water supply and water demand in the city of Gweru. The chapter also examines the adequacy of public participation in water conservation, the effects

of the water supply situation and the coping strategies to water and water instigated food shortages given the observed limited water supply capacity bedevilling the city.

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CHAPTER THREE

AN ASSESSMENT OF THE WATER SUPPLY AND DEMAND BALANCE IN THE CITY OF GWERU, ZIMBABWE

3.1 Abstract

This chapter analyses water supply and demand situation in the city of Gweru. Data on Treated Raw Water (TRW), Treated Water Pumped to City (TWPC) and Consumption Estimate (CE) were obtained from Gweru City Council records. The data were used to measure the variations in water supply quantity from the source up to the consumer. Amount of water demanded by the city was established using annual population projection and World Health Organisation recommended water per capita per day guidelines. Interviews with the city of Gweru informants were carried out to reveal the causes of differences in amounts of water at different stages of conveyance and what was being done to reduce the losses. The findings revealed that there are apparent and real water losses in the distribution system and the causes are vandalism of pipes, bursts and leaks translating to 18% non revenue water. However, nothing much is being done to reduce the losses due to financial incapacity. Cost recovery operations are implemented through consumer water service payment mainly using estimate billing that is guided by water production cost. Findings further reveal that annual population growth is on the rise, yet the city maintained almost the same capacity of water supply. The study reveals that there is an imbalance between supplied water and what the city is demanding. Water supplies have been failing to meet the minimum Basic Water Requirement (BWR) by 30% and the difference between water supply and demand over the period under review was significant. It is therefore recommended that the city of Gweru embarks on serious public driven water conservation measures in order to optimise the available resources.

Keywords: water infrastructure, water stress, water demand forecasting, cost recovery, basic water requirement; urban areas

3.2 Introduction

Meticulously establishing the relationship between water supply and water demand is critical for achieving sustainable water service delivery (Herbetson and Tate, 2001). Water service providers ought to have knowledge about their supply capacities as well as the demand base in order to strike a balance between the two. Failure to create equilibrium between water supply and demand creates problems, socially, economically, ecologically and even politically **(**Uchtmann, 2011). Balancing water supply and demand is important for sustainable water resources management as well as the viability of water service provision in cities (Pereira, 2005).

The existence of water supply and demand imbalance is on the rise in both developed and developing nations (Alois, 2007). Rising population and economic growth around the world is driving higher water demands for households, farming, energy production, and manufacturing (Hejazi et al., 2013). To make the situation worse, urban populations are doubling every 20-30 years, exerting more pressure on available water resources (Macy, 1999). Unfortunately, most developing countries such as Zimbabwe still rely on ten year censuses and scattered interim data to project water demand for cities (ZimStats, 2012). Incomplete data on aspects such as population makes it very difficult to forecast and plan resource utilisation and conservation (Marambanyika, 2015).

For most developed nations, domestic water use increase has primarily been due to a combination of population and income growth (UNDP, 2006). However, for developing nations the increase in water use might not necessarily be as a result of income growth. In Sub-Saharan Africa a negative growth in income has led to increase in water use to support income generating activities and subsistence requirements (Hungwe, 2006; Marson and Savin, 2015). Developing countries cities tend to have rapidly growing populations that directly rely on natural resources for survival (Narain et al., 2005).

As a response to the disparity between water supply and demand, most countries unfortunately depend on traditional water management practices of investing in new sources of water in order to improve the supply situation (Gumbo and van der Zaag, 2002; Letsie and Allopi, 2008). However, the cost of developing such new water sources and supplies is continually increasing (Macy, 1999). There are different approaches that countries and cities take in response to water supply and demand imbalances. Some countries or cities focus on conservation as opposed to water resource development such as large dams and inter-basin

transfer systems (McKenzie, 2014; Williams, 2015). For developing countries with limited capacity to develop new water sources, water conservation could be the most reasonable way around the challenge. Conservation does not only yield viability from utilities but brings with it ecological benefits. In India, urban water shortages are still abated by the introduction of new water supply sources (Hejazi et al., 2013). This is regrettable because India is facing increasing population growth, declining surface water resources and deteriorating ground water quality (Biju et al., 2011). South Africa has tried to use an integrated approach of combining supply and demand methods with considerable success (Rademeyer et al., 1997; The Water Wheel, 2015).

Developing countries still place emphasis on the implementation of water projects through donor support while the operation and maintenance of the existing projects have often been neglected, with cost recovery comprising only about 30% (Cardone and Fonseca, 2003). However, cost recovery in developing countries must be carefully practised because there is a risk of denying citizens their right to water. Water pricing is done with little or no relation to the operation and maintenance costs of the water utility (UNDP, 2006). Such operations are likely to prejudice the service provider or the user. On the one hand, the service provider might not get full recovery of the cost of water production while, on the other, over-pricing might disadvantage the user. Nonetheless, maintenance work must be taken seriously in reticulation systems in order to reduce water loss, especially non-revenue water, for the benefit of all legitimate users (Bogardi et al., 2011). The American Water Works Association (2012) highlights that there are broad types of losses that take place in water utilities. These are real and apparent water losses. Real water losses are physical water loss in the distribution system that includes bursts and leaks which eventually translate into production costs. Apparent loss occurs due to inaccuracies in data handling and unauthorised consumption as well as consumed water for which no payment is made.

Africa is the fastest urbanising continent on the planet and the demand for water is outstripping supply in most cities (Vijayalaksm and Babu, 2015). However, there are several factors that lead to an imbalance in supply and demand. Some culprits could be lack of adequate maintenance of infrastructure and illegal connections, physical water losses as a result of leakage and burst pipes, and reckless garden irrigation, which results in high inefficient water use (McKenzie, 2014). Where water supply projects have been constructed, issues of equity, efficiency, cost recovery, sustainability as well as whether or not beneficiaries are willing and able to pay for service improvements have been raised (Bakker,

2001). As a result, some cities routinely provide water, causing areas of low priority to receive water for a few hours on alternate days. The factors raised above are mainly human in nature but natural factors such as shortage of water at source have also been pointed as a cause of water supply problems (Nhlanhla, 2009).

However, Mazvimavi (2010) and Mugandani et al. (2012) assessed rainfall patterns and rainfall availability in Zimbabwe and established that changes are not statistically significant. Their findings indicate that most places in Zimbabwe do not have at source water shortages though the conditions vary spatially. The situation then leaves the whole water supply and demand discourse within other parameters that include capacity of the city to produce water, capacity to convey it to users, cost recovery and conservation behaviours. Several efforts by the municipality, Non-governmental organisations and Public-private partnerships have been put forward to improve the water supply capacity of Gweru. Nonetheless, water shortages have been reported. Although sometimes generically reported, there is lack of scientific information on the actual gap between water supply and demand in Gweru. Therefore, this chapter seeks to analyse the amount of water pumped to the city of Gweru and consumed by residents in comparison with the basic water requirement standards. This chapter also examines the spatial disparities in supplies across residential areas. The study was conducted using only one city as a case study and the findings from this study do not claim universality to every city in Zimbabwe. However, they are of national value to guide policy in urban water demand forecasting.

3.3 Materials and methods

Secondary data on Raw Water Treated (RWT), Treated Water Pumped to City (TWPC) and Consumed Estimate (CE) were obtained from Gweru City Council engineering records. The records department availed data for 5 years only, that is, for period 2011 to 2015. The local authority indicated that the 5 year dataset was the only one available without missing data. The municipality had a challenge with record keeping although reasons were not listed. However, the 5 year dataset was used to establish trends in water supply and consumption. In order for the researcher to obtain annual water supply and demand gap, annual population data for the city was required. However, Zimbabwe carries out a population census after every 10 years, which makes it difficult to obtain annual population statistics. Therefore, using the last official results from the official population census carried out in 2012, a 5 year

annual population projection was established using the Annual Compounding Formula (Zimstats, 2015). For the year 2011, the same formula was used while applying negative power to the number of years:

The Annual Compounding formula:

$P(t) = P(0)(1+R)^t$

Where: R is the growth rate, t is the number of years and P is population

In order to establish the adequacy of water supplied to the city, World Health Organisation (WHO) guidelines on recommended per capita per day were used. On average 20 to 80 litres of water are required for a normal person's use per day (Peter and Gleick, 2016; Reeds 2015). Due to economic challenges experienced in Gweru, which is nevertheless endowed with sufficient water at source (Kusena and Beckedahl, 2016), the researcher used a Basic Water Requirement (BWR) of 30 litres per person per day, which is slightly above the lower end of the range.

Before carrying out field surveys, ethical clearance was sought and granted by the Research Ethics Committee, University of KwaZulu Natal (Reference:HSS/0450/015D). This was meant to ensure that there would be no violation of research ethics principles such as consent to participate, anonymity and confidentiality (also see appendix 3). Semi-structured interviews, guided by a prepared template, were carried out with the City engineer and Finance director. The City engineer was interviewed in order to obtain data on the amount of water pumped to the city, demand levels, possible causes of water loss and the measures available to reduce the losses in the supply chain. The Finance director provided information on the financial implications of the water supply capacity situation since the department was in charge of water billing in liaison with the engineering department. Responses from household survey were also a source of data on sufficiency of water across all residential suburbs (low, medium and high density represented). The sample for the survey was randomly selected using stratified sampling to arrive at a sample of 489 respondents out of 29 973 housing units. Sufficiency of water was assessed using per hour water availability in households per day.

3.4 Data analysis

The required water to maintain adequate human health is between 20 litres to 80 litres per day per person (Peter and Gleick, 2016). The lower end of the BWR range represents bare minimum for survival only, especially in arid areas whilst the upper end reflects an ideal situation in all water supply endeavours. Therefore, when determining BWR, worthy considerations are various circumstances that include capacity to pump water, climatic conditions, lifestyle and the wealth of the population. However, for the purposes of this study, the researcher used a BWR of 30 litres per day, which is slightly above the lower limit because of the economic situation of the city whilst bearing in mind that the city is not located in an arid area.

Quantitative data were coded and analysed using SPSS version 20 at 95% confidence interval. Normality testing was done using Kolmogrov-Smirnof test. Analysis of variances was used to assess the changes in volumes of RWT and TWPC over five years, that is, from 2011 to 2015. Kruskal-Wallis was used to determine differences in estimated consumed water between months in each year for the 5 year period. This was meant to understand if there were significant seasonal differences in domestic water consumption.

Kruskal-Wallis test was also used to determine whether there were differences in frequency of water supply. Responses were measured on an ordinal scale. Post-hoc analysis was later done using Mann-Witney U test to ascertain where differences were significant between different categories of residential suburbs. A parametric test (dependent t-test) was used to show statistical difference between RWT and TWPC. Wilcoxon Signed Rank test was used to determine the difference between RWT and CE as well as between TWPC and CE. Mann-Whitney U test was then used to assess whether there were significant differences between the annually consumed water and expected normal water supply in the city.

3.5 Results

3.5.1 Variations in Raw Water Treated, Treated Water Pumped to City and Consumed Estimate over time

ANOVA results show that there was no significant difference ($p = 0.577$) in the amount of RWT in Gweru over the 5 years under reviewed. ANOVA test results further show that there was again no significant difference in RWT between seasons ($p = 0.807$). Although slight fluctuations are recorded in the actual RWT data (Table 3.1), both annual and monthly RWT

do not show any significant differences over the years. ANOVA results indicate that there were no significant variations in TWPC between months (p = 0.242) and between the 5 years reviewed (p = 0.393). Kruskal-Wallis test results showed no significant changes in CE between months (p = 0.827) and over the 5 year period (p = 0.765).

Table 3.1: Mean variations in RWT, TWPC and CE (m^3) between 2011 and 2015

	RWT	TWPC	CE
2011	1347762.833	1296392.833	1137165.250
2012	1385774.167	1324128.417	1151712.917
2013	1317405.000	1247190.417	1129308.333
2014	1383988.333	1332153.250	1173662.917
2015	1328366.500	1303538.917	1134287.667

However, t-test results showed a significant difference (p = 0.000) between RWT and TWPC. The amount of water that was being pumped to the city was significantly less than the water treated over the 5 year period. Wilcoxon Signed Ranks test results further showed significant differences between RWT and CE (p = 0.00) as well as between TWPC and CE (p = 0.000)

3.5.2 Supplied water against city population over time

Mann-Whitney results show significant differences (p = 0.001) between the amount of water consumed per person and expected WHO amount per person over all the 5 years under review. In terms of average percentage coverage, using the 2015 produced water and WHO guidelines against the population, the city of Gweru still falls short by almost 30% to reach the expected WHO standard supply.

Table 3.2: Water Pumped to City against the estimated annual city population and demand

Year	Produced water	Consumed Estimate	Estimate Population	Expected consumption=Demand (WHO guidelines)
2011	1296392.833	1137165.250	**156 534**	**1690567.000**
2012	1324128.417	1151712.917	**158 233**	**1708916.000**

2013	1247190.417	1129308.333	**164 887**	**1780779.000**
2014	1332153.250	1173662.917	**168 514**	**1819951.000**
2015	1303538.917	1134287.667	**172 222**	**1859997.000**

Whilst there were no significant changes in supplied water, the population of Gweru (Table 3.2) has always been on a constant rise. The projected demand also shows the effect of population increase on water supplies, especially if there are no other measures used to conserve the available water.

3.5.3 Water supply situation in different residential suburbs

Kruskal-Wallis test shows that there is a significant difference ($p = 0.000$) in the frequency of water availability between low, medium and high density suburbs of Gweru. Post-hoc analysis results confirmed that the differences are clear between all different categories of suburbs in the city. Although there were differences in frequency of water supply as obtained from the household survey, there is however no significant difference ($p = 0.130$) in the sufficiency of the supplied water as it remains inadequate for all the areas. However, percentage insufficiency of water was higher in high and low density areas (Table 3.3).

Table 3.3: Water sufficiency in residential areas

Residential areas	Sufficient (Quantity)	Insufficient (Quantity)
Low Density	14 (22%)	49 (78%)
Medium Density	18 (69%)	8 (31%)
High Density	16 (5%)	306 (95%)

Using hourly water availability, the average hours that residents received water per day was 5 hours although they reported low pressure. The situation in low density suburbs was bad to the extent that some residents were no longer relying on municipal water for their day to day use. The medium density situation was relatively better and 69% of the respondents were almost content with the amount of water received per day. The situation was worse in high density areas as shown by only 5% of the respondents indicating sufficiency of water supply. A follow up interview with the City engineer indicated that the variations in supply of water to different residential areas were dependent on the condition of the infrastructure and the

topography in the residential areas. The medium density areas (Ivene and Southdowns) are found in the low lying areas of the city therefore pumping is relatively faster and easier.

3.5.4 Non revenue water and Cost recovery mechanism

RWT, TWPC and CE variations show that Gweru city council is running water production at a loss. TWPC has always been significantly less than RWT (Table 3.1).

Table 3.4: Percentage losses in distribution network

Year	Between RWT and TWPC	Between TWPC and CE
2011	4%	12%
2012	5%	13%
2013	5%	9%
2014	4%	12%
2015	2%	13%

Results show that there is less water loss between RWT and TWPC (Table 3.4), although they are statistically significant (p =0.000). However, the percentage losses show that Gweru water is mainly lost when already pumped to the city during transfer to the consumer. The maximum non-revenue water recorded for Gweru was 18% loss in 2012. An interview revealed that the utility then relies on consumed estimate for billing purposes in order to recover from the water production cost.

3.5.5 Causes of the variations in water supply (RWT and TWPC) and consumption estimate in Gweru

Interviews revealed several reasons that led to significant differences in RWT and CE. Low treated water pumping capacity was cited as a cause of the variations. Pumping capacity was an issue for both treated water to the city and the water pumped to consumers. Some areas of the city were given as examples of areas that suffered water shortages as a result of low pumping power. These areas included Mkoba 19, part of Ridgemont and Kopje area. The areas were established on high areas such that the law of gravity could not work to their advantage. There are also recorded high water losses as a result of illegal water abstraction that takes place along water distribution network.

Financial capacity to respond to leaks and bursts was also cited as another reason that led to water loss. Water loss (18%) increased the gap (30%) between supplied water and demand. In some instances municipal vehicles were hardly fuelled. Therefore, response time to leaks and bursts took longer. The city authority also lamented financial incapacity to repair and replace worn-out pipes and pumps. It was revealed that the engineering department was seriously understaffed to fully implement water distribution network maintenance exercises. At the time of the study the department had only one qualified engineer.

The local authority also cited population growth and slow updates on demographic characteristics as another factor that continued to widen the gap between water supply and demand. Gweru is fast growing both in terms of population and housing units that require water supply. However, such growth is not instantly factored in RWT. For the 5 years under review, TWPC showed no significant difference whilst the city population has been on the rise. This inevitably explains a gap between supply and demand, which is expected to widen further with time.

3.6 Discussion

The average means for RWT, TWPC and CE do not show any significant changes for the past 5 years in Gweru. This is an anomaly because population is continuously growing (Table 3.1) yet, in terms of RWT, the capacity has not really changed for the past 5 years. That is the same situation with the amount of TWPC. The fact that Gweru City Council is not changing the RWT and TWPC highlights that there are inherent shortages of water in Gweru because the population has not been stagnant yet the supplies were not changing. However, the supply capacity could be maintained, provided the city engages in serious and effective water conservation and demand management, a position supported by Hebertson and Tate (2001). On the other hand, demand forecasting is important for purposes of realising the urgency of resource optimisation.

Capacity to pump treated water to the city was cited as one major challenge contributing to significant difference between RWT and TWPC. This concurs with findings from a Gweru study that was done by Matsa (2012). The study revealed that Gweru city had low pumping capacity. The situation in Gweru shows a precarious condition, where the water that is being supplied to the city for the past five years has not been changing whilst at the same time the

difference between the amount of water produced and sent to the city continues to widen. This portrays a city that is losing water in the distribution system. Mckenzie (2014) reports that water losses are also experienced in South Africa but the municipalities are working frantically to reduce the loss; sometimes through replacement of worn out pipes. It is unfortunate that in Gweru nothing much is being done to reduce water loss.

Water loss along the distribution network is reported to be caused by farmers who vandalise pipes for domestic and irrigation purposes. This scenario of losses is common along the Gwenhoro work to city network. Overcoming non-revenue water is a process and great challenge that requires proper management investment (Williams, 2015). Heavy losses make it harder to keep water tariffs at a reasonable and affordable level (Frauendorfer, and Liemberger, 2010). This might explain why most respondents in Gweru were disgruntled and unwilling to pay for water services (Kusena et al., 2016).

The challenge presents itself through high water charges as local authorities try to recover the cost of water production. This becomes a liability to the consumer considering that funding from the central government is dwindling (Mutema, 2012). Although maximum water loss in Gweru accounts for only 18% of the produced water compared to 33% loss in South Africa (Bhagwan et al., 2013), failure to curb non-revenue water only exacerbates the situation of an imbalance between supply and demand in Gweru. Actually, the case of Gweru mirrors a case of water shortages that could be significantly reduced by curbing non-revenue water considering that the city fails to meet the WHO guidelines by 30%. An effort to eliminate or at least reduce the 18% water loss would go a long way in meeting the city water demand.

Water loss was also a problem even between the TWPC and CE. The significant variations still show a possibility of real losses through leaks and bursts. This finding simply implies that Gweru City Council is not maintaining the reticulation system. In actual fact, if the amount of water loss was to be reduced, improvement in service delivery could be made for the city. Nonetheless water shortages are being experienced and unfortunately the local authority focuses on recovering production costs through bill payment. However, sometimes billing can be done based on faulty meters (Fanner, 2009). Consequently, consumers lose out or the utility service provision viability is compromised. Cardone and Fonseca (2003) argued that developing countries put emphasis on the implementation of water projects while the operation and maintenance of the existing infrastructure has often been neglected. It is under such circumstances that the cost of losses is externalised to consumers.

Population growth factor could have perhaps been countered by water conservation mechanisms. However, residents continue to report water shortages. Rademeyer et al. (1997) asserts that using a variety of WC/WDM techniques can lead to significant delays in the implementation and development of new water sources. The local authority at the moment is not self sustaining and can only change service delivery through financial interventions from the central government, Non-Governmental Organisations (NGOs) or through public and private partnerships. However, the economic situation in Zimbabwe was not at its best during the time of the study and local authorities ought to be innovative enough in order to improve financial capacity and meet the demand.

The fact that there is no significant difference in the amount of RWT for the past 5 years shows that the city is not experiencing shortages of raw water at source. This is contrary to reports which at one point in 2013 reported that the city of Gweru dams had run dry (The Chronicle 2013). In actual fact the city of Gweru observes ecological reserves (City of Gweru, 2015), but in as far as water for consumption at source is concerned, the city has been consistent in its supply.

An assessment of the water supply across residential areas shows that water supply is much better in medium density suburbs, the reason being better pumping capacity and the topography of the areas. However, a significant number (88%) of respondents across residential areas indicated that water was not enough. FAO (2008) points out that municipalities must always have information about existing and potential water uses at household level in order to devise strategies that best conserve water and improve supply.The next chapter, therefore, assesses the adequacy of public participation in water conservation and demand management process given the observed incapacitation of the municipality to balance supply and demand.

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CHAPTER FOUR

ASSESSING PUBLIC PARTICIPATION IN WATER CONSERVATION AND WATER DEMAND MANAGEMENT IN WATER STRESSED URBAN AREAS: INSIGHTS FROM THE CITY OF GWERU, ZIMBABWE

This chapter is in effect the paper:

Kusena, W, Desai, S. A, Beckedahl, H. R and Chemura, A (2016) Assessing Public Participation in Water Conservation and Water Demand Management in Water Stressed Urban Areas: Insights from the City of Gweru, Zimbabwe, *Review of Social Sciences*, 01(08), 30-43

4.1 Abstract

Third world municipalities are saddled by a plethora of challenges in service delivery. They also simultaneously have limited capacities at their disposal to solve the problems. However, public participation can reasonably enhance service delivery through conservation of the available limited resources. The chapter investigates the level of water user participation in water conservation in the city of Gweru. Data was collected from water users and key informants selected from the local authority and citizen representative groups. A survey of 489 households was carried out in the city. Several water conservation and demand management measures were identified. However, the majority of respondents (98%) was never consulted by the local authority and did not participate in water decisions. Only a few respondents (2%) participated in water conservation and demand management consultation meetings. This indicates that decision-making was a sole prerogative of the local authority. Conservation awareness across residential suburbs was incredibly low despite high literacy levels among the respondents recorded in the city. Respondents reported significantly low participation ($p = 0.078$) in water conservation trainings which may have translated into limited conservation literacy. The findings also revealed poor communication channels between the local authority and residents such that water users felt disrespected and disregarded. Unfortunately no initiatives were in place to encourage and enable water user participation in water management. Lack of water user participation will perpetuate water conservation and demand management problems in the city of Gweru. It is therefore recommended that active participation channels be opened for sustainable water utilization and service delivery to be realized in Gweru.

Keywords: Awareness; Compliance; Urban areas; User participation; User perception; Water conservation

4.2 Introduction

Water is a scarce resource in most third world cities as a result of its physical unavailability and/or financial incapacity of municipalities to supply water for the growing populations (United Nations, 2014; Watkins, 2006). However, Sub-Saharan Africa experiences more of economic rather than physical water scarcity (Kirono et al., 2013; Kusena and Beckedahl, 2016). The situation challenges cities to have a management approach that ensures water security in all its dimensions, such as availability, accessibility and quality (Ariyabandu, 2001; Beck and Walker, 2013; Kirono et al., 2013). Municipalities should always have contingency measures in place, that involve stakeholders in order to sustain water service delivery and avoid reactive responses in times of drought only. For effective urban water management, an integrated approach focusing on people's participation is essential (Vasquez, 2004) because water is a starting point for community development. Nonetheless, urban areas face supply imbalances as a result of population growth and city expansion (Sithole, 2012; Sorokovskyi and Olschewski, 2012). Principally, due to underperforming industrial sectors in developing countries' cities, residents survive on the available water whether rain or municipal for their income generating activities and food security (Chadyiwanebwa, 2012; Hungwe, 2006; Sithole, 2012). Water conservation discourse is therefore pertinent for financially struggling third world cities; especially where efforts to develop new water sources are becoming more expensive and overtaking municipalities' financial capacities (Macy, 1999).

The South African Department of Water Affairs and Forestry (DWAF) (2004) regards Water Conservation (WC) and Water Demand Management (WDM) as interrelated concepts. The former focuses on minimisation of loss or waste, care and protection of water resources whilst the latter is geared at reducing expected water usage through the adaptation and implementation of policies and initiatives by water institutions, in order to meet economic efficiency, social development, social equity and environmental protection, sustainability of water supply and services and political acceptability (DWAF, 2004). Slightly different concepts as they may sound, both WC and WDM can fit under the umbrella term 'conservation' because the ultimate goal is protection of available water resources. Macy (1999) uses water conservation and demand management interchangeably because both concepts refer to issues of water protection and management. Generically, WDM is a

component of WC. This article shall therefore refer to WC and WDM as slightly different but overlapping concepts.

When properly carried out in the framework of Integrated Water Resource Planning, WC/WDM can positively affect the supply capacities and ultimately improve water supply coverage in cities (Mckenzie, 2014). A big mistake that most third world cities still make is having a supply-oriented management of water (Gumbo and van der Zaag, 2002). They treat WC and WDM as separate campaigns yet conservation affects the supply capacity. Rademeyer et al. (1997) reported that using a variety of WC/WDM techniques leads to delays in the implementation and development of new water sources.

However, for WC/WDM to realise the intended goals, stakeholder participation is essential. Woodhill and Van Vugt (2008) encourages approaches that are tailor made to suit a particular situation and avoid the 'right answers' or 'one size fits all' approach which in most cases tend to sideline or discriminate players. Hudson (2001) and Keeley (2015) posit that answers to problems change with time and place of occurrence. Although general frameworks and typologies of participation (Cornwall, 2008) are available, approaches in developed and developing countries for water conservation are bound to differ because of differences in nature, extent of challenge and capacities to handle them. Aapaoja et al. (2013) state that the involvement of stakeholders contributes to conflict prevention and resolution. The idea of participation requires stakeholders working side by side rather than having a defined hierarchy whereby the organisations at the bottom of the hierarchy are disregarded in decision making (Nkondo, 2013). Arnstein, (1969) and Pretty, (1995) refer to the aforementioned typology of participation as therapy manipulation (non participation) or passive participation. In both typologies, there is a unilateral announcement of decision by authorities without listening to people's responses (Cornwall, 2008). To ensure incorporation of citizens, target 6b of Sustainable Development Goal number 6 aims to ensure availability and sustainable management of water for all and looks forward to support and strengthen the participation of local communities in water management (Griggs, 2013). Therefore, this chapter looks at the adequacy of citizen power and control participation typology as a form of 'good' participation in water management as explained by Arnstein (1969).

Observing the interests and priorities of all stakeholders, whether poor or rich, is vital for social justice (Rasul and Jahir, 2010). Policies and management styles that include

engagement of all stakeholders lead to improvements in water management and citizen representation (Ingram and Bradley, 2006). Mckenzie (2014) argues that the involvement of users is critical in the achievement of efficient water use because of perceived self-worthiness. For instance, Stenekes (2006) states that setting of water tariffs should be a participatory exercise whereby all stakeholders involved are actively participating. Consumer involvement should not be used as a stop-gap or drought-relief measure during times of serious water shortages only (Beck and Walker, 2013), but must always be included in the water service delivery system. The Dublin Principle on stakeholder participation also upholds the involvement of stakeholders at all levels (Solanes and Gonzalez-Villarreal, 1999). However, stakeholder participation is sometimes defeated by neoliberalism. Martinez and García (2000) state that neoliberalism embraces the concept of individuality that casts ordinary citizens aside and regard them as useless (Pretty, 1995). The individual focus means that ethos of public goods management is being discarded (Passas, 2000). Water is a political issue and decentralisation that involves devolution of power from the center to local units must be present in its management. Such management counters concentration of political power through transfer of responsibilities to sub-systems (Rondinelli et al., 1989). Devolution of power then makes water user participation a distinctive element in water resources management.

WC/WDM perspective requires that all consumers or users adopt conservation culture and ethics. Conservation is a long term goal whereby achievements are realised overtime (Bulawayo City Council, 2007). Resource users will always have a preconceived mindset about an existing management system, whether wrong or right. Such people require appropriate education and involvement in order to demystify and clarify issues to necessitate their incorporation (UNESCO, 1998). This implies that water conservation and demand management cannot be imposed on water users; it is something that comes over time, primarily as a result of awareness and participation. The World Bank Institute (2010) also makes reference to the importance of user participation and points to the results that were realised in Honduras as a result of changes in behaviour. User participation in Puerto Cortés municipality in Honduras resulted in significant accountability and transparency that brought about sound management of its own water sector. The term ‘own’ is strategic in conservation issues. When users possess ownership of processes and decisions, success in water conservation will be inevitable. An active involvement of the water users in the planning and provision of water services in Ghana contributed to water conservation and financial

viability. User involvement brought about subsequent change in perception and behaviour towards water conservation (Osumanu, 2010). This chapter incorporates the critical aspect of user perception that drives behaviour. According to Audi (1999), perception is a belief or opinion, often held by many people and based on how things seem. Although necessarily based on incomplete and unverified (or unreliable) information, perception is equated with reality for most practical purposes and guides human behaviour. Water conservation can only be successful when user behaviours and attitudes are transformed. Human behaviour is such that actions are guided by what people believe in or what they perceive or prefer to be wise at a given point (Gilbertson, 2011). Nonetheless, provision of incentives and appropriate education to save water is instrumental in making the poor water users more willing and conscious about water conservation (Adebayo, 2002; Narsiah, 2007).

The current body of literature in Zimbabwe is mainly on water shortages and service delivery limitations. The majority of research efforts to date focus on water supply challenges that bedevil municipalities and impressively articulate the effects of the discrepancies in terms of health and coverage (Gumbo and van de Zaag, 2002; Mangizvo and Kapungu, 2010, Matsa, 2012; Kusena and Beckedhal, 2016; Muranda, 2011). For Gweru, research findings also show supply challenges and shortages (Matsa, 2012; Madebwe and Madebwe, 2012) However, no research has attempted to assess the role of public participation as a potential panacea to the supply challenges. Literature outside Zimbabwe points to non-participation and lack of awareness as causes of deviant behaviours in resource management (Rondinelli et al., 1989; World Bank Institute 2010; Rosenberg-Kjelds, 2008; Ray, 2008). For example, as a result of non-participation in decision making processes, South Africans devised strategies that protected their space during apartheid. In places such as Soweto, users engaged professional plumbers who lived in the area to reconnect themselves to water supply illegally as counter-strategies to hegemonic systems (Narsiah, 2007).

Despite availability of evidence that public participation is indisputably indispensible in water conservation and service delivery, no research has been carried out to that effect in Gweru. There is dearth of information on the participation of citizens in the water service delivery system of Zimbabwe although potential benefits are known. Thus to address the reiterated gap in the current body of literature, this study used a household survey to unearth citizen perceptions regarding the space they occupied in water decisions. This was done through questionnaires to find out the forms and levels of participation in the water

challenges problem solving process. The thrust of this chapter is on the assessment of water user incorporation and participation in the WC/WDM strategies for better service delivery in the city of Gweru. The study findings suggest a knowledge base that informs urban water management policy through full incorporation of citizens at every stage for short and long term benefits. Recommendations have been proffered to enhance urban water security and for future studies in urban water management.

The chapter is organized as follows: Section 4.3 describes the conceptual framework that informs the study. Section 4.4 describes the study of the area and the methodology used to conduct the study. Section 4.5 presents the study results and their discussion. Finally, section 5 presents conclusions, implications for policy and suggestions for future research.

4.3 Conceptual framework

This discussion is embedded on political ecology theory, neoliberalism and Citizen Science. Political ecology theory emphasises power struggles and inequalities in environmental management (Adams, 2001; Wolf, 1972). Peet and Watts (1996) resuscitated the vibrancy and momentum of political ecology theory in the 1980s when they focused on the role of grassroots actors and social movements. The theory highlights the importance of social and political dimensions that are rarely considered, especially by natural scientists in environmental solutions. Environmental challenges are usually viewed with a scientific eye, but political ecology then places them in an integrated approach context across spatial scales that include the economic, political and ecological dimensions (Blaikie and Brookfield, I987; Bryant and Bailey, 1997). This theory gives visibility to marginalised socio-environmental actors, revealing often ignored connections and relations of power. In order to bring out all the latent causes of conflict, political ecology embraces an anthropological dimension that normally works through ethnographic methods in order to understand the decisions that communities make about the environment in the context of their political environment, economic pressure and societal regulations. Information from the general public, in this case water users, may even promote the questioning of existing public policies and the proposal of new forms of action and public control (Little, 2007).

Political ecology theory suggests that some stakeholders may be more powerful and more equal than others depending on their economic and political power (Blaikie, 1999; Carney and Watts 1991). Nonetheless, whether perceived or proven, political dimension of power struggle always exists. However, political ecology explains how marginalisation or non-participation of some stakeholders leads to degradation of resources as citizens will be disgruntled. The power of individuals or organisations echoes the systems of neoliberalism (Desai, 2003). Neoliberalism and individuality are actually an extension of colonialism. However, citizens always come up with counter-hegemony instruments (Narsiah, 2007) as they feel prejudiced, undermined and disrespected. Citizens then organise themselves strategically in ways that will help them survive in the midst of externalised challenges of public service to citizens. Citizens do that as they will be trying to protect their space. From analysis, the scenario created under political ecology and neoliberalism creates a lot of resistance from citizens. The problem could be redressed through a citizen science paradigm. Citizen Science according to Bonney et al., (2009) respects participation of all interested parties in the management of resources, both from the public and professional fraternities. Supporting the concept of citizen science, Adebayo (2002) adds that development should recognise the needs of entire populations regardless of their political affiliation or territorial locations. It is against the given conceptual framework that the chapter assesses the forms and level of user participation in WC/WDM discourse in a bid to achieve sustainable city water management. This chapter therefore attempts to take a simultaneous account of economic, political and environmental dialectics of Gweru water conservation system. Politically, is the user voice paid attention to? Economically, do the financial circumstances permit and does the environment still have the capacity to sustain demand and for how long can the *status quo* continue?

4.4 Methods and materials

The chapter used an emerging research approach of Citizen Science (Bonney et al., 2009). A combination of water user voice and official position from the municipality was used to obtain data for the study. Citizen science respects both public and professional participation in issues of service delivery and policy making (Bonney et al., 2009). Collaborations between scientists and volunteers have the potential to broaden the scope of research and enhance the ability to collect scientific data (Cohn, 2008). Therefore, the study deliberately paid attention to the officials' and citizens' voices through interviews and household surveys in order to establish the level of user participation in the city's water management system.

Household respondents for questionnaires were selected using a stratified sampling technique. Gweru has 49 residential suburbs with a total of 29 973 housing units, classified as high, medium and low density areas. Twenty percent of these residential suburbs were randomly selected as Primary Sampling Units (PSU). A sample of 489 housing units (representing 10% of the PSU population) was proportionally distributed across residential areas as shown on Table 4.1. Household questionnaires were administered using a drop and pick method in order to give consenting participants enough time to complete the questions. The questionnaire gathered data on existing water conservation measures and levels of water user awareness and participation in water issues. Compliance was measured using three aspects and indicators (Table 4.2). Questionnaires were used because they cover a large number of respondents within a reasonable time frame.

Table 4.1: Sample size determination

Classes of residential areas	Names and number of suburbs in each class	Number of housing units in each selected PSU.	Sample size of households (10% of total population in each suburb)
High density suburbs	**32** (Mkoba1,2,3,4.5,6,7,9,10,11,13,14, 15,16,17,18,19, 20; Senga; Mutasa/CliftonPark; Mambo; Ascot; Nehosho; Woodlands; Mutapa, Garikai, Shamrock; Montrose	**6** (Mkoba 1- 347 Mkoba 12- 405 Mkoba 19- 755 Senga- 1540 Shamrock-25 Mutapa 3 and 7- 489)= **3561**	6 (Mkoba 1- 35 Mkoba 12- 41 Mkoba 19- 76 Senga- 154 Shamrock- 3 Mutapa- 49)= **358**
Medium density suburbs	**3** (Ivene; Nashville; and Northlea)	**1** (Ivene- 370)=**370**	**1** (Ivene- 37)=**37**
Low density suburbs	**14** (Kopje; Athlone; Clonsilla; Harben Park; Dalysford; Windsor Park; Ridgemont; Riverside; Kingstone Park; Mimosa; City center; Lundi Park; Southdowns'/Extension; Christmas Gift	**3** **(**Harben Park- 79 Southdowns/Extension-737 Dalysford- 124 = **940**	**3** (Harben Park- 8 Southdowns/Extension- 74 Dalysford- 12)= **94**
Total	**49**	**4871**	**489**

The researcher also used a social media platform to collect data for the study by joining a Gweru Residents and Rates Association (GRRA) WhatsApp group. A WhatsApp Chat topic on water decisions and participation level was initiated in order to collect data on residents' (users) opinions. Participation was rated using meeting attendance and conservation training. Participation in any of the two or both implied active participation in city water issues. However, the use of social media presents challenges on the reliability of collected data. In most cases it is unknown whether those commenting represent the views of all water users because some of them might be of a different viewpoint but not commenting (Kolb, 2015). To counter this limitation, the data collected was validated through interviews with GRRA representative, ward councillors and officials from the municipality together with questionnaire surveys across suburbs.

Table 4.2: Aspects and indicators of compliance

WC/WDM Strategy	Indicator of Compliance
High monthly water charges	-Payment
	-Reduced usage
Fines in the event of abuse	-Payment
	-Following prescribed water use
Whistle blowing	-Citizen reports to the authorities

Compliance percentages were then calculated against the total sample rather than on users' awareness because some would be found complying by default without the requisite knowledge. Reasons for non-compliance were assessed based on residents' opinion. Though not scientific and hardly validated on their own, public opinion surveys are a potential valuable source of information, particularly in conservation efforts (Bennett and Dearden, 2014; Mahler et al., 2008).

4.5 Data analysis

Household survey data were coded and analysed in SPSS Statistics 20 at 95% confidence interval. The Kruskal Wallis test was used to determine whether sentiments towards 'municipal relations with residents' vary significantly across different categories of residential areas (high, medium and low density suburbs). The perceptions were measured on a 5 point Likert scale from very poor to very good (Very poor = 1, Poor = 2, Not sure = 3, Good = 4 and Very Good = 5); hence generating ordinal data. Chi-Square was used to test for

association between level of education and monthly income; bill payment and place of residence; consultation in water decisions and place of residence; and between area of residence and participation in WC training. ANOVA was also used to test for differences in income across residential areas. Interview responses and WhatsApp chat contributions were organised into sub-themes for results reporting and discussion using descriptive statistics.

4.6 Results and discussion

4.6.1 Socio-demographic characteristics of respondents

Four hundred and eleven respondents out of 489 completed and returned questionnaires. This response rate corresponds to more than half of the total questionnaires, a percentage that is acceptable for analysis and reporting (Babbie and Mouton, 2001). Fifty five percent females and 45% males completed and returned the questionnaires. Most respondents' (70%) income ranged from USD 101 to USD 500. These included teachers (26%), nurses (9%), security forces (7%), secretaries (4%), pensioners (5%) and the self-employed (19%). Only 3% of the respondents earned more than USD500 per month. The remaining 27% (111) were found to be unemployed. ANOVA results show that there were no significant differences ($p = 0.231$) in monthly incomes across residential suburbs. ZimStats (2015) states that the Poverty Datum Line for Midlands in July 2015 was USD510, 42 for an average family of 5. This shows that most residents of Gweru are living in poverty with the exception of 3% who earn a monthly income that is above USD500. This finding reveals a spatial and temporal change in incomes from the 2011 situation that had a notable number of high income households in low density suburbs (Madebwe and Madebwe, 2011). The current situation in Gweru also refutes the assumption of political ecology theory that disparities in income are based on affluence of an area (Robbins, 2004).

In terms of level of education, 81% of the respondents had acquired tertiary education. The sample had a relatively high literacy rate. Desai (2012) states that literacy reduces economic disparities and increases income. However, Gweru recorded a high literacy rate accompanied by low income that was below the Zimbabwe Poverty Datum Line, across the residential suburbs. Chi-Square test results confirmed that there was no association ($p = 0.084$) between level of education and monthly income across suburbs.

4.6.2 Water conservation and demand management strategies

Gweru municipality and residents pointed out several measures that were used in the city to save water, as shown on table 4.3 and 4.4. However, local authority officials revealed that the city did not have clearly communicated proactive water conservation and demand management policy. Gweru city resorted to *ad hoc* water conservation and demand measures that included fixing leaks or bursts and reducing water pressure only during drought periods. Gumbo and van der Zaag (2002) also lamented the reactive behaviour of municipalities in Zimbabwe, where water conservation and demand management is engaged as a last and desperate resort during water shortages. Water Demand Management strategies were obtained from the key informants through interviews because they were facilitated from the service provider whilst conservation strategies were identified from both interviews and household survey. Table 4.3 contains strategies that were randomly enforced and exercised in the city.

Table 4.3: Water conservation strategies revealed from the household survey

Water conservation strategies	Percentage Responses across residential areas
Morning or evening garden watering	24%
Water reuse	35%
Replace worn tap washers and leak fixing	49%
Not leaving the tap running while brushing teeth	8%
Keeping a bottle of water in the fridge to avoid running water till it gets cold for drinking in hot summer	13%
Use of buckets to wash cars instead of hosepipes	27%
Shower rather than filling bath tubs	31%
Low water pressure and water cuts by local authority	21%
Whistle blowing	12%

Respondents indicated multiple conservation measures from the provided options. However, 21% of them added water cuts and low pressure as conservation measures that were initiated from the local authority's side. Only 12% indicated whistle blowing as a conservation measure whilst the rest did not find the need to cooperate with the municipality because the service was poor and at the same time they were never consulted in decision making.

Table 4.4: Water demand management strategies by the municipality

Water demand management strategies
▪ Lower water pressure ▪ Water cuts particularly during the day

- Increasing monthly water charges
- Deterrent fines in the event of abuse
- Whistle blowing

Due to poor communication between the municipality and residents, respondents thought that water cuts and low water pressure were done in order to limit usage and conserve water. Although true to an extent, the city engineer revealed that in most cases water cuts were not as a result of demand management. The experienced water cuts and low pressure were actually a result of low pumping capacity and power outages. This concurs with the findings by Matsa (2012) that water supply was a problem as a result of low pumping capacity. Vijayalaksm and Babu (2015) also observed that it is hard to achieve supply of expected quantity of water to the consumer with adequate pressure head, particularly under circumstances like water loss and inadequate hydraulic capacity of the distribution system. In relation to that, other studies show that frequent water cuts attracted hostility from residents especially when coupled with a lack of communication (Ellen and Kellogg, 2013; Pereira, 2002; Roushdy et al., 2012).

However, the only challenge is that residents were not in a position to know whether low pressure was deliberate or as a result of low pumping capacity. The local authority indicated that efforts to notify residents about disruptions in service were done but were limited due to financial constraints. The municipality would sometimes use a loud speaker to notify residents. Nonetheless, failure to communicate with residents created misinformed citizens and that worked against water conservation efforts. In South Africa notices are given for maintenance schedules (Mangaung Metropolitan Municipality, 2016). Communication is critical because it gives users a sense of importance. It also gives them an opportunity to make necessary arrangements in preparation for the disruptions.

High and deterrent monthly water charges were sometimes used as a measure to reduce water usage in the city. These were meant to discourage residents from using much water for fear of high bills. However, 70% of the respondents indicated that the bills they receive on a monthly basis were not justifiable. The reason cited was that water was rarely available and residents wondered on what the local authority was basing the bills. Interestingly, an interview with the city authority revealed that Gweru City Council doubted the accuracy and functionality of their water meters. Therefore, using high monthly rates to deter wasteful use was incongruous with the situation considering the erroneous meters. In contrast, some communities in the

USA effectively conserve water as a result of rebates given as economic incentives for efficient water use (Borisova et al., 2009). Nonetheless, Gweru system was rather combative and punitive.

Whistle blowing was also confirmed as an existing measure by the local authority. Residents were expected to report cases of water abuse, for instance, when hosepipes were used during drought seasons. Whistle blowing was ineffective in Gweru mainly because there were no incentives for whistleblowers. A study that was carried out in South Africa (Ntshotsho, 2012) revealed that conservation efforts can be difficult and ineffective when users are only expected to comply with regulations without benefiting or having their full participation in the crafting of the same regulations they are expected to comply with. Therefore, all stakeholders, especially water users, who are the community entity, should be engaged and consulted at all times.

4.6.3 Residents' awareness and compliance with conservation measures

Table 4.5 shows that Gweru residents had limited knowledge about water conservation and demand management measures in place. Only one measure (high water charges) recorded an awareness level that is above half across the three categories of residential suburbs surveyed. UNESCO (1998) suggested that appropriate education and public awareness should be organised for sustainability in water conservation. Gweru has a high literacy rate with 81% of the population, across all residential suburbs, having acquired tertiary education. Ironically, these people possessed little knowledge about water conservation. The findings suggest that Gweru City council was lacking in the sensitisation of residents concerning efficient use of water. Braus (2013) argues that it is very important that local authorities increase environmental awareness and literacy in order to avoid unnecessary misunderstandings. High awareness pertaining to high water charges across residential areas was actually a result of negative reinforcement such as water disconnection due to non-payment. However, the Zambian government facilitated conservation awareness together with significantly subsidised water services to avoid disconnections and conflict (Plummer, 2003)

Unfortunately, in Gweru 78% of the household survey respondents had not gone through any form of water conservation training as a result of the municipality's initiative. Ninety one percent of the residents pointed out that they were not familiar with municipality by-laws relating to water use and conservation. Undesirably, only the key informants from

municipality were conversant with the by-law provisions. The authority confirmed that dissemination of that crucial information to residents was poor due to limited necessary human and financial resources. This implies that even where residents would have wanted to conserve water, limited conservation literacy militated against such efforts.

Table 4.5: WC/WDM awareness and compliance level in residential suburbs

WC/WDM strategies	User Awareness				User Compliance			
	HD (N=322)	MD (N=26)	LD (N=63)	City awareness level N=411	HD	MD	LD	City compliance Level N=411
Mornings or evenings garden watering	72 (22%)	7 (27%)	18 (29)	97 (23%)	14 (4%)	2 (8%)	8 (13)	24 (6%)
Water reuse	106 (33%)	8 (31%)	29 (46)	143 (35%)	210 (65)	6 (23)	38 (60)	254 (62%)
Replace worn tap washers	168 (52%)	9 (35%)	13 (21)	120 (29%)	12 (4%)	5 (19)	9 (14)	26 (6%)
Not to leave the tap running while brushing teeth	18 (6%)	5 (19%)	11 (17)	34 (8%)	4 (1%)	2 (8%)	4 (6%)	10 (2%)
Keeping a bottle of water in the fridge to avoid running water till it gets cold for drinking	21 (7%)	10 (38%)	21 (33)	52 (12%)	9 (3%)	6 (23)	18 (28)	33 (8%)
Use of buckets to wash cars instead of hosepipes	91 (28%)	7 (26%)	14 (22)	112 (27%)	40 (12)	6 (23)	13 (20)	59 (14%)
Shower rather than use bath tub	102 (32%)	11 (42%)	16 (25)	129 (31%)	76 (23)	5 (19)	19 (30)	100 (24%)
Increasing monthly water charges	210 (65%)	19 (73%)	37 (59)	266 (65%)	62 (19)	9 (34)	12 (19)	83 (20%)
Fines in the event of abuse	37 (11%)	9 (34%)	19 (30)	65 (16%)	8 (2%)	3 (12)	7 (11)	18 (4%)
Whistle blowing	17 (5%)	12 (46%)	21 (33)	50 (12%)	7 (2%)	4 (15%)	10 (16%)	21 (5%)

Key: HD = High Density; MD = Medium Density; LD = Low Density

Level of compliance rates across surveyed residential suburbs (Table 4.5). Cases that recorded more than half of the respondents' compliance, such as water reuse, were simply a result of water shortages; such that residents were forced to recycle water. Paradoxically,

52% of the high density respondents were aware that fixing tap washers was a conservation strategy, however only 4% complied. Lack of disposable income to replace the washers and fix taps was cited as a hindrance since most residents were living below the PDL. Therefore, WC/WDM awareness and financial capacity building is required to avoid water loss. In United States of America leaks account for 14 percent of indoor water use (Grace Communications Foundation 2016). Unfortunately, the city of Gweru is not taking the initiative to capacitate residents to fix pipes and taps. The situation also suggests the reason why there is non-revenue water in the water conveyance system in Gweru [Kusena et al., in review]. In South Africa, national leaders embarked on campaigns to fix leaks to save municipal water (Department of Water and Sanitation, 2015). The campaigns were done with the participation of water users in order to cultivate a culture of compliance with conservation strategies.

A number of reasons were suggested as to why compliance with WC/WDM measures in the city was poor. Firstly, the residents did not have conservation information. Secondly, some of them just did not want to conserve water because of lack of ownership of the system. Lastly, residents had lost trust in the municipality because of past experiences to be discussed. This suggests that whenever residents complied, it was mainly by accident. Fifty-two percent of the respondents from the survey emphasised that they did not conserve or observe WDM measures because the water was not owned by them. The public was not aware that water was not only the municipality's resource but everyone's responsibility. In the Samoa community in the Pacific Island, demand was controlled and conservation was achieved as a result of attitude change through community participation and empowerment (Grafton et al., 2010). In contrast, Gweru residents did not perceive water as a commodity that belonged to them but to the municipality. In this regard, residents did not view conservation as a civil duty. Interviews with the municipality officials to corroborate findings from residents shifted the blame to councillors. Respondents suggested that councillors were not playing their role of educating and orientating residents about water ownership.

Following interviews carried out with councillors, it was revealed that despite them being expected to educate the community, the councillors actually required water conservation and demand management training themselves. The councillors had no adequate information about water conservation. An interview with municipality informants to find out why there was no in-service training pointed out lack of financial capacity and time as challenges. The

authorities indicated that residents were supposed to look for information on their own because residents' ignorance would not be regarded as an excuse. In cases where there was no compliance prosecution of perpetrators for the benefit of the environment would apply. It was revealed during the interviews that the local authority would sometimes reprimand the guilty party, force the resident to pay a fine or just disconnect water supply. However, the decision was made solely by the authority and sadly not in consultation with the residents. This finding raises a question of discrimination echoed in political ecology and confirms that even in urban areas some people can face adverse impacts of a system simply because they are less powerful or do not have control over the system (Myers, 1999).

The majority (79%) of Gweru residents did not trust the local authority. Residents felt that they were not in a good relationship with the municipality and found it necessary to rally behind one another in solidarity. This is the reason why measures such as whistle blowing were hardly effective in Gweru. The Kruskal Wallis test revealed that residents shared the same sentiment across residential areas. There was no significant difference ($p = 0.182$) between high, medium and low density users' views with regards to relations between municipality and residents. The Water Services Regulatory Board (2012) revealed that involvement of users instils sense of ownership that translates into trust and behavioural change. Gweru municipality is perceived as a common enemy by the residents because they have a long history of imposing decisions on residents without consultation, and in the process, creating passive participation (Kusena and Beckedahl, 2016; Pretty, 1995). Therefore, according to the findings, cooperation with the municipality would be tantamount to betraying one another. As a result, water demand and conservation measures were rarely complied with by residents.

Sixty nine percent of the respondents cited cases that triggered lack of trust and non-compliance. These two cases were prominent. Firstly, residents' efforts to support the local authority through bill payment were previously not acknowledged. For example, a debt cancellation in 2013 did not benefit compliant water users. Water bills were cancelled and no incentive was given to the compliant residents. For that reason residents felt no need to co-operate. Secondly, in 2014 the local authority merged water services and owner's rates accounts without consulting residents. This applied to the low and medium density suburbs. The July 2014 water statement was written "*for easy administration, the local authority has merged the owner's and water services rates with immediate effect*". The statement served as

communication to the public. Unfortunately, this communication took place simultaneously with water disconnection for non-payment. This affected residents, particularly tenants who had no obligation to pay owner's rates. A study by Kalulu (2015) revealed that trust between and among stakeholders builds good relations, which is a good setting for resource conservation. In this case, the local authority used water as a tool to compel residents to pay other bills not directly related to the precious resource. Noteworthy is the fact that the exercise contravened section 77 of the Zimbabwe Constitution which states that access to water is a human right (Government of Zimbabwe (GoZ), 2013). Unfortunately, nothing was done to stop the exercise and residents were compelled to comply using payment plans. This created a disconcerted citizenry that was not willing to conserve water. This clearly manifests a picture portrayed by political ecology and neoliberalism hegemony (Narsiah, 2007), where power is centralised and a system takes advantage of the politically and economically weak (Bonney et al., 2009).

However, in terms of monthly bill payment, Chi-Square test results showed that the number of defaulters varied across residential areas ($p = 0.000$). This is confirmed by the fact that although most people were paying their monthly bills in high and low density suburbs, the number of defaulters and those who were complying was equal in medium density suburbs (Table 4.6).

Table 4.6: Monthly bill payment response

		Residential suburbs			Total
		Low	Medium	High	
Monthly bill payment	Yes	37	13	204	254
	No	26	13	118	157
Total		63	26	322	411

Bill payment enforcement through disconnections was common in high density suburbs. Respondents attributed this to residents' fear of prosecution. Despite the respondents' high general literacy rate, most of them were not aware of their constitutional rights in relation to water. As a result, high density residents normally responded faster. The results concur with the political ecology theory assumption which states that in societies there are power struggles which are visible and latent. The powerful elites in societies always find ways to externalise adverse effects in every situation (Bryant and Bailey, 1997). However, latent power of citizens manifests itself through non-compliance.

4.6.4 Form and level of user participation in water conservation and demand management

Findings revealed that at the meetings between the residents' association representatives and the municipality officials, the former felt overridden and disregarded. Most of their suggestions were never incorporated into decision-making. Initiating a meeting from the residents' side was reported to be difficult since the authorities only convened meetings as per their schedules. Residents from across all residential areas indicated that they were never consulted (98%) and had no control over water decisions. Only less than 1% indicated that they participated in meetings. This explains why 76% of the residents revealed that most water decisions came as a surprise as they only knew them through enforcements.

The users' representatives such as councillors and GRRA committee members were also not effectively executing their intermediary role. Residents' representatives failed to establish effective feedback channels between the local authority and residents. The findings revealed that 49% of the residents were not even aware of the existence of Gweru Residents and Rate payers Association. An interview with GRRA committee member revealed a lot of energy and zeal from the representative. Nonetheless, only those on WhatsApp had access to updates. Poor communication between residents and GRRA members may be attributed to the size and composition of the WhatsApp group as well as financial incapacity. In fact, there were 61 members as at 2 February 2016, including former and suspended mayors of the city. Other residents had no information about how to join the critical platform for information sharing and dissemination. This group was not a true representation of the residents' voice. The composition of the group qualified more as a political pressure group rather than a public platform for all residents. This was consistent with the political polarity of the city (Sithole 2013).

It was ironic that the majority (82%) of the residents across suburbs indicated that the only form of participation they were involved in was payment of water bills. Unfortunately, residents were not engaged in critical decisions such as water rates increase, water cuts, and administrative amendments despite the financial implications the changes posed on residents. Bonney et al. (2009) and Cohn (2008) emphasise the importance of public participation in resources management and conservation. Participation gives the public expressive space in the decision making process which is a pertinent ingredient for conservation and sustainable service delivery.

In terms of water conservation training across residential suburbs, the situation was almost the same. Results show that there were no differences ($p = 0.078$) between low, medium and high density suburbs in terms of water conservation training. Respondents indicated lack of training across all residential areas. Questionnaire survey results further showed that there was no meaningful consultation across all residential suburbs on water conservation and demand management issues, a situation confirmed statistically through Chi-Square test ($p = 0.741$). Findings show that there were no differences in terms of participation in water issues whether one was from low or high density suburb. Participation was almost absent across suburbs. The next chapter then analyses the effects of the water service delivery situation on household food streams.

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CHAPTER FIVE

ANALYSING THE EFFECTS OF URBAN WATER SERVICE DELIVERY SYSTEM ON HOUSEHOLD FOOD SECURITY

5.1 Abstract

The chapter assesses the implications of Gweru's domestic water service delivery situation on household food security. The objectives of the study were to identify household food sources, assess the effects of limited water supply capacity; billing and cost recovery; as well as examine the synergies of the political and legal landscape in service delivery on household food security. A household survey, interviews and observations were used for data collection. It was revealed that the main two streams of household food were purchasing and direct household food production. The city of Gweru experienced water supply challenges, mainly due to financial incapacities. However, in a bid to maintain service delivery, the municipality emphasised cost recovery through revenue collection. This process prejudiced residents of their livelihood by increasing the amount of household income channelled towards bill payment. Notwithstanding the fact that most of Gweru residents' income was below Poverty Datum Line, a significant portion (15%) of residents' income was channelled towards water bills. Water cuts and disconnections for non-payment had direct effects on household food security as the strategies led to plant wilting and death. The political environment in which the municipality was operating in also exacerbated the situation. The year 2013 debt cancellation by the central government further financially incapacitated the grant aided municipality. In turn, the financial burden is solely carried by residents. All the effects of inadequate capacities of the municipality to improve service are somehow externalised to residents.on the one hand it is recommended that the central government limits its interference with issues of local authorities, especially when decisions passed later on expose citizens to poverty. On the other hand, the municipality could introduce a participatory water conservation system that optimises the available water for the good of the utility and residents at large. In the long term, water harvesting and dual water system that supplies potable and partially treated water for farming purposes could also be introduced and reduce costs that mutate into high water bills and unnecessary disconnections that affect household food security. This will enhance in the simultaneous and sustainable availability of water and food for the city.

Keywords: supply capacity, high water bills, political interference, food policy, Gweru

5.2 Introduction

The 2011 Bonn conference emphasised the nexus between water and food, highlighting the importance of comprehending the links between the two aspects at any given point (United Nations, 2014). Although the relationship between water and food was more obvious in rural settings (Olschewski, 2013), urban environments in developing countries are increasingly relying more on available water for household food security through farming (Caritas International 2009; Hungwe, 2006 and Mbiba 2014). The emerging strong relationship between urban water and household food security has a potential of affecting urban water service resilience and sustainability. On the one hand, food security, according to the 1996 World Food Summit, exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). On the other hand, food insecurity can be transitory or chronic (FAO, 2015). Transitory food insecurity has turned into chronic food insecurity because of its duration and severity (FAO, 2008). Most financial donors were more inclined towards the rural poor whilst urban vulnerability was constantly growing (Sarelin, 2007).

In Zimbabwe, local authorities are key players in urban water supply and the general urban planning activities such as the distribution of land. However, they have often not considered the food system an important issue when designing, planning and managing cities (FAO, 2015). The tradition has been that food is always available in cities and can be easily accessed through purchasing from markets. However, the situation was altered for many from the beginning of the new millennium when the food prices soared (Hungwe, 2006). Incomes are becoming lower and they are reaching unprecedented levels of unreliability, with pay days changing every month, especially in all civil service departments. The economic crisis, which affected the country since 2000 to date resulted in unemployment (85%), which in turn created poverty through food shortages and, recently, a lack of buying power even when food is available in supermarkets (Dodo and Dodo, 2014; Mudzengerere 2012; Takavarasha, 2003 and Zimbabwe National Statistics Agency, 2015). Efforts to provide food for families have given momentum to the historically shunned urban farming activities (Rogerson, 1992; Takavarasha, 2003).

By definition, urban agriculture is an industry that relies on resources that are found within and around the city (Mougeot, 2005). Therefore, municipalities need to use human-rights

approaches that ensure both water and food availability within and around cities. The provision of alternative water sources can keep residents from exploiting expensive clean water for their backyard gardens (Cabannes, 2004).

However, Gweru City Council in its water service delivery system regularly embarks on serious water rationing during droughts and this is in line with the Urban Council Act of 1980 (CAP 29:15), which allows emergency water rationing. It is a fact that providing water for a growing urban population is a problem experienced by many water supply utilities in different parts of the world (WWAP, 2010). However, the effects are felt more in South cities where social security is limited (Tostensen, 2008). Nonetheless, no research has investigated the effect that city water service delivery system has on struggling cities' food systems. The Zimbabwean central government and local authorities admitted through the municipal development programme that there is a crisis in as far as urban food security is concerned (MDP, 2002). Unfortunately, urban farming has been institutionalised without establishing a proper national policy and legislative framework to formally operationalise the activity. Every city is governed by its own by-laws that are tailor-made to suit its area of jurisdiction and approved by the Minister. However, without revising their restrictive by-laws, local authorities have been reluctantly allowing urban agriculture.

This study analysed the dynamics around the City of Gweru water service delivery system and the implications on household food security. The researcher examined the impact of water supply capacity, billing system and the service delivery political environment on household food security. Particular attention was given to cost recovery and billing system of the city's water service and how it affected household food security in terms of buying power and direct food production at the household level.

5.3. Materials and methods

Household survey respondents were selected using stratified sampling technique. Gweru has 49 residential suburbs with a total of 29 973 housing units, classified as high, medium and low density areas. Twenty percent from each residential suburbs category was proportionately randomly selected as Primary Sampling Units (PSU). A sample of 489 housing units (representing 10% of the PSU population) was proportionally distributed across residential areas as shown on Table 4.1. Household questionnaires were administered using a

drop and pick method in order to give consenting participants enough time to complete the questions. The questionnaire gathered data on household food sources and how these are affected by the water service delivery dynamics in the city. Data on household income from plot produce and the general monthly income were also solicited. This was done for purposes of assessing household food security. Questionnaires were used because they cover a large number of respondents within a reasonable time frame.

Key informants from the City Council and Gweru Ratepayers and Residents Association were interviewed to reveal the effects of aspects such as the supply of water; billing system; city water and food policy; and the political environment in which the services were provided on household food security.

Issues of citizen access to water and local authorities' autonomy are enshrined in the Constitution of Zimbabwe and the provisions serve as guidelines to city water supply by-laws (Government of Zimbabwe, 2013). Resultantly, this study consulted the Zimbabwe constitution as a secondary data source. This was done in order to understand the divergence between the existing legal provisions and practice in water service delivery, and how it impacts on household food security

5.4 Data analysis

Survey data were coded in SPSS Statistics 20 for analysis at 95% confidence interval. Analysis of variance was used across residential suburbs to test the differences in household income; incomes from food production; and differences in household monthly water bills. This is was done in order to understand how water service transactions impacted on household food security in different residential suburbs. A post-hoc analysis was done to ascertain where difference in income from food production was experienced across residential suburbs. The analysis was important in order to ascertain if the household food security challenges varied spatially as a result of incomes. Chi-square was also used to test for association between household level of education and food security through income thresholds. Interview and questionnaire responses were also organised into sub themes for results reporting and discussion using descriptive statistics.

5.5 Results

5.5.1 Socio-demographic characteristics

Chapter 5 presents findings for specific objectives of the thesis. However, the sample is the same as that of the preceding chapter 4. Therefore, socio-demographic characteristics are as explained in section 4.6.1

5.5.2 Sources of household food security

The two major sources of obtaining food identified in Gweru through respondents were direct food production (61%) and purchasing (84%). However, 45% of the rspondents indicated both options. With respect to food purchase, respondents' list of food stuffs had basic commodities such as mealie-meal, sugar, and flour. Forty eighty percent of respondents indicated that they purchase flour as they could not afford to buy bread every day. These respondents resorted to baking using homemade recipes that included a combination of mealie-meal and flour as ingredients to make a type of bread popularly known as *Chimodho or Chimupotahaya.* However, due to low household income, 14% of the respondents excluded flour from their lists and made use of mealie-meal only for a type of bread called *Chimiranebhodho/Amathebelengwane*. This survey revealed that the average number of meals per day in the city was two; the first meal is combined breakfast and lunch at midday and then supper.

However, the two city food streams were affected by the city water service delivery system. The implications of the existing water service delivery system on food security manifested themselves in two ways. Water shortages had direct impact on food production as plants wilted. Water Conservation/Demand Management strategies interfered with the amount of water that was at the disposal of residents for irrigation. Gweru residents indicated that they mainly relied on food purchasing for their day to day living. However, food purchasing was greatly compromised by water service bills which required an average of 15% of the average city household income. Sixty one percent of the residents indicated that they supplemented their food security through backyard farming that relied on municipal water. Five percent indicated that they actually supplemented both their income and food through farming. Types of crops grown included leafy vegetables, tomatoes, potatoes, green-mealies and legumes (Table 5.2). Maize cobs/green mealies were sold at an average of $1 for four depending on the season and respondents indicated that they were getting a reasonable amount of money from their sales (annual average of $41, 150 and 180 for high, medium and low density respectively). It was revealed that backyard gardening was now a lucrative option for household food security as it was practised by more than half of the population although it was mainly affected by inconsistent municipal water supply.

Table 5.1: Annual household farm produce income

Crop grown	**Annual Average income (USD)**		
	HD	MD	LD
Leafy vegetables	41	144	192
Green mealies	21	154	189
Potatoes	49	143	174
Tomatoes	53	157	165
Total	**41**	**150**	**80**

Thirty six percent of the respondents indicated that due to economic hardships they were compelled to produce more frequently all year round from their on-site plots (an average of three harvests of green mealies depending on the variety used). High density areas had the lowest income contribution from farming. The incomes from food production across residential suburbs were significantly different ($p = 0,011$). However, post-hoc analysis

showed that the significant difference was between high density and low density (p = 0.000) and high density and medium density (p = 0.013). The recorded differences could have been as a result of the size of residential stands (high density average of 200m^2). Low density and medium density stands (an average of 800m^2 to 1500m^2 respectively) are much bigger and provide more space for farming. However, it was observed that besides backyard gardens, most open spaces across all residential areas were being turned into farming plots. Spaces which were traditionally reserved for ornamental value such as parks and play centres, especially those adjacent to housing premises were equally affected.

5.5.3 City Water supply capacity and food security

Residents lamented water shortages through low pressure and cuts, especially in drought periods, as a hindrance to their food security. The municipality has limited financial resources to improve the city water pumping capacity and maintenance work. Various incapacities by the municipality to supply sufficient water for residents' multi water needs affects household's food security base. Respondents (59%) indicated that the amount of supplied water compromised household food security due to wilting and death of plants that were meant for household food. The most affected crops were leafy vegetables and mealies. However, it was revealed that maize was primarily rain-fed, but during dry seasons residents also resorted to municipal water for irrigation. An interview with a city authority acknowledged the reliance of urban agriculture on municipal water as backyard gardening was categorised under basic domestic use. Nevertheless, there was no municipal commitment to facilitate farming through provision of water. It was indicated that channelling available water towards farming was not a crime as long as it did not involve the use of hosepipes during times of serious water shortages. The authority revealed that the more water a household uses, the higher would be the revenue generated through billing. However, the sustainability of the use of clean water for farming was questionable. Regardless of the stated freedom to water, the supplied water was reported to be insufficient by 64% of the respondents with 59% specifically pointing to the shortage of water for agriculture. Thus, serving as a limitation against household food production process.

5.5.4 Water bills and food security

Residents identified high monthly water charges as a hindrance to their household food security. The results revealed that only 3% of Gweru residents across all suburbs had a formal

income that was above PDL. Therefore, majority (97%) of the residents were affected by high monthly water charges.

Table 5.2: Average monthly water bills according to suburbs

Residential area	Average household monthly water bill
High density	$51
Medium density	$65
Low density	$73

All residents were equally affected by monthly charges because despite differences in incomes from plot produce, the overall monthly average incomes were not significantly different ($p = 0.231$) across all surveyed areas in the city. The majority (70%) of residents indicated that their monthly water bills were too high. However, due to economic hardships affecting the country, grant allocation from the central government has not been reliable. Therefore, the local authority had become very thorough in revenue collection. The situation however increases burden of payment on residents. The average household monthly bill consumed an average of 15% of the average household monthly income.

Regrettably, an interview with the city authority revealed that the municipality, in most cases, relies on estimate meter readings due to limited personnel to carry out meter reading exercises in all residential areas. However, residents were free to record their own meter readings and forward them to the municipality. In the event of failure to do so, the municipality would use estimates. Respondents revealed that sometimes the water statements did not even show water consumption units. Nineteen percent of the respondents indicated that in cases where consumption was shown, it was too high and unrealistic for residential premises. GRRA respondent also reported that the bill statements are not being done at an interval of a full month. Sometimes respondents would receive water statements which show a three week interval.

The Engineering Department in the City of Gweru, ironically, doubted the accuracy and functionality of 70% of their own water meters. The issue of data mishandling by the city records department was also mentioned as a challenge. Paradoxically, although GCC was not sure about the functionality of water meters, billing continued to be done and residents received bills every month. Municipality officials insisted that they were not prejudicing residents financially although they could not validate their claim. However, respondents were

disgruntled. Sixty seven percent indicated that GCC water bills were always behind by two months. The reasons why the anomaly had not been corrected for the past years were not given. Therefore, the respondents felt short-changed by the system and the displeasure seems justified since the local authority conceded the existence of mal-functioning meters. For that reason, it might not suffice for the local authority to just make a claim that residents were not being prejudiced and fail to present corresponding evidence to transparently support the claim.

More than 98% of the respondents revealed that water rates were increased without their knowledge. The changes in water bills had a direct impact on household income and therefore required communication prior to implementation. It was revealed that even during the months where residents would have paid more than what reflected on their statements, subsequent water bill would still be very high. The situation infringed on household food security capacity as residents were expected to settle their bills or else disconnections would follow and affect food production

5.5.5 Legal provisions and practise dichotomy: The effect on household food security

In terms of Section 264 of the Constitution, local authorities must run their affairs independent of central government. Central government only plays an oversight role. Local authorities must ensure good governance, efficiency, transparency, accountability and institutional coherence, in terms of section 265 of the Constitution. In terms of Section 265(3) an Act of Parliament must be established to provide appropriate mechanisms and procedures to facilitate co-ordination between central government and local authorities.

Then in terms of Section 276 of the Constitution, local authority has the right to govern its own local affairs. This includes powers to levy rates and taxes to raise sufficient funds and revenue to carry out objectives and responsibilities of council. With regards to funds from treasury, these are channelled through the local government Minister to supplement the local government revenue in the form of grants. During the period of study, no money in the form of grants was received for the previous four years. Gweru municipality was struggling to pay workers' salaries and to institute major water projects because of lack of funding. In the case of the city of Gweru only, the central government through the ministry cancelled about 15 million (US dollars) debt. However, the municipality was owing ZESA over 7 million,

Zimbabwe Manpower Development Fund (ZIMDEF) 2 million and National Social Security Authority (NSSA) 3 million and these amounts are still being claimed.

Regardless of clearly spelt out provisions in the constitution, water service delivery is seldom run as expected. The study revealed that there was no full independence in the municipality's financial affairs. The central government's power to oversee through the Ministry would sometimes override municipality's local decisions. The 2013 debt cancellation was implemented from the top but left unprecedented financial incapacity. The 2013 debt cancellation was done for political and seemingly populist reasons, but soon after elections, the challenges went back to residents. This may explain the reason why the municipality charges high rates; in order to recover from the financial gap that was created. However, in the process residents are deprived of their livelihood.

Although the constitution grants local authorities autonomy to run their affairs and raise funds, whilst the central government aids through grants, instead of doing the expected, politics took center stage. The government had since ceased to aid the local authority financially. Instead, the political voice just descended to cancel debt, thus creating unparalleled financial incapacity, with absolutely no corresponding effort to avert the situation. After the debt was cancelled, the central government retreated and left the municipality and residents struggling. The municipality and residents are expected to meet their obligations, ironically, alongside a government that fails to meet its bare minimum duties. At the end of the day, citizens are the biggest losers.

5.5.6 Gweru city water and food policy

An interview with the city authority revealed that the city of Gweru did not have a clear policy on the nexus between city water and food production. The city was not really bothered by the use of clean and potable water for gardening. Nonetheless, the use of hosepipes was strictly prohibited during drought seasons. Unfortunately, monitoring of water use was lacking due to inadequate financial capacity to fuel vehicles and hire the necessary staff. However, the water supply issue was ignored and the assumption was that agriculture would be rain-fed. The municipality acknowledged the existence and importance of urban farming but had no clearly stated policy to facilitate sustainable water and food provision in the city. The municipality only had Ngamo dam supplying untreated water for urban greening in parks and road sides. However, there were no efforts to provide a similar option for urban

agriculture in order to protect the limited clean and expensive water whilst catering for household food security.

5.6 Discussion

Gweru residents' food security was dependent on direct purchasing and production of food. It was observed during the survey that some areas of the city that were known for their aesthetic and ornamental value were being turned into farming plots for household food security. Similar observation was made in Masvingo and Mutare by Tshuma and Mashoko (2010) and Chadyiwanebwa (2012) respectively, where urban people were forced to venture into urban farming in order to supplement their meagre incomes. Urban agriculture is mainly done as a result of poverty (Mapira, 2011). It is evident that in Gweru residents are no longer focusing on ornamental urban greening but they are now interested in what may be regarded *functional greening*, which is keeping spaces green with plants of edible value to citizens for food security. Traditional urban greening that included lawn, shrubs and palm tree were of no value to a starving population. No matter how noble an idea is, as long as it interferes with human needs and situations, it is seldom well received.

Results revealed that the two household food security sources in the city were affected by the water delivery circumstances. High monthly water charges deprived residents of their livelihoods as they attracted 15% of the average household income. According to Section 77 of the new Constitution of Zimbabwe, water is a basic human right and everyone should have a right to it regardless of their income (Government of Zimbabwe, 2013). In Gweru, despite the changes in the national constitution, the city council continued to disconnect water in the event of non-payment. The exercise was certainly *ultra vires* section 77 of the new constitutional law. Instead, most local authorities in Zimbabwe continue with the obsolete Section 8 on by-laws of 1913, unfairly subjecting citizens to water disconnections (Mbiba, 2014 and Nhapi, 2009). Therefore, high monthly water bills deprived residents of their rights to water for both agriculture and other uses that qualify under primary use. Primary use refers to the use of municipal water for activities that directly benefit a household. However, just 5% of the residents sold their produce but it was still at household scale to supplement subsistence.

According to the survey, the majority of respondents were below poverty datum line and deserved assistance from the central government. Sections 24 through 29 of the Bill of Rights in the South African Constitution recognise the socio-economic rights of citizens, including the right to social security. The South African government still offers assistance to vulnerable citizens (South African Social Security Agency (SASSA), 2014). Zimbabwe is still lagging behind in social security. Citizens struggle and assistance is limited particularly in urban areas (Wekwete, 1998). Kaseke (1988) noted that governments assume that employment will enable individuals to meet their basic needs and all contingencies. Unfortunately, Zimbabwean economy was underperforming and not generating enough jobs for urban the population. Many residents practiced urban farming because of poverty and limited available options to food security (Takavarasha, 2003)

The municipality was not confident about the accuracy of their meters and the utility relied too much on estimates. Such irregularities pose challenges especially to the public because they can consequently affect residents' capacity to ensure food security. At one point Bulawayo City Council collected more revenue than its water production cost (Mkwanazi, 2011). This shows that inaccuracies and estimates can seriously affect the financial capacity of residents to food security. Jaglin (2002) states that the market-oriented approach where all those served must pay full cost creates challenges, especially in cities that work with estimates. It must therefore be acknowledged that in such cases the drive for economic efficiency takes precedence over consumer protection (Michael and Smith, 1996). Cost is transferred from the water utility to low income households.

Municipal water that was channelled towards crop irrigation, though not quantified, was used by residents as a source of livelihood. Yet the municipality regarded the process as a revenue generating activity. Letting residents utilise clean expensive water for their gardens and in return charge them heavily is further exposing them. On the one hand, it was revealed that residents were already financially incapacitated and practised agriculture as a result of poverty (Chadyiwanembwa, 2012). On the other, opening potable water to agriculture is not sustainable ecologically and financially as the conveyance system is punctuated with low pumping capacity. Therefore, the situation in the city creates a challenge that is very difficult to solve. The fact that available water that is insufficient even for other basic uses (Kusena, et al., 2016 and Matsa (2012) other than crop production, is open for agriculture is rather short-sighted. However, a disturbing factor in Zimbabwe's water supply issues is the failure to have a clear cut definition between 'primary' and 'commercial water use' (Manzungu and

Machiridza, 2005). The use of municipal water to support food production at household level as residents seek to improve access or availability of food may well qualify under primary use and should be acceptable, as long as the methods used for irrigation are monitored.

Furthermore, although the Zimbabwean Constitution, section 77 states that water and food are basic human rights, the operations on the ground did not exhibit a holistic approach towards the cause (Government of Zimbabwe, 2013). The Municipal Development Programme (2002) in its acknowledgement of urban agriculture, turned a 'blind eye' on backyard gardening and left the matter of water supply in a quandary as no institution fully takes the responsibility. The situation in Gweru is difference from the Bulawayo City Council (BCC) which had Urban Agriculture by-laws which stated that urban agriculture was permissible within the municipal area for the purposes of providing household food security (RUAF, 2010). In order to expedite the farming process, BCC even provided a facility for wastewater reuse (Thebe and Mangore, 2010)

Shortages in the supplied water affected household food security since most residents were managing to have a second or third meal per day from home gardens. Literature shows that the produce from gardens enhances household food security, not only as result of quantity but through nutritional value as well (Mbiba, 2014). Billing and cost recovery issues are pertinent in household food security discourse. Respondents indicated that they were channelling a lot of money (15% of household income) towards water bills on a monthly basis and that affected their food buying power. Sometimes the local authority focused on cost recovery exercises without necessarily considering the effect on residents.

However, it has to be stated that what was happening in Gweru was a process of externalising liabilities. The municipality relied on a budget from the central government and residents. Conversely, when the financial assistance from the central government dried up the only reliable target for revenue collection were residents, besides donors. The central government expected local authorities to deliver, without financing the means, and the local authorities simply turned to the residents. Tenets of Political ecology theory (Adams, 2001; Wolf, 1972) resonate in this situation, whereby the distribution of power has left the general citizen exposed to poverty.

Although most residents celebrated debt cancellation, time brought to reality that the unplanned debt pardon later haunted the residents. Political ecology highlights that there is a lot of power struggles and ultimate social injustices that happen in water supply issues

(Narsiah, 2007). Residents now suffer high monthly bills because the local authority should fulfil its mandate, sadly at the expense of residents. Coupled with the effects of an underperforming economy (World Bank, 2016), citizens struggled to purchase food since a significant amount of their monthly income was channelled towards bill payment.

Political involvement in service delivery decisions has a history of affecting residents instantly or in the long run. In 2005, the central government moved water supply and waste disposal to ZINWA due to alleged mismanagement by municipalities (Mapira, 2011). However, after a period of four years, the responsibilities were handed back to municipalities after ZINWA proved to have dismally failed to run the services (Mabiza et al., 2008). Nonetheless, despite the changes, there was mismanagement of funds as evidenced by the removal and reinstatement of management in Gweru municipality. However, with all these challenges, residents are the most affected. A question that arises is: given the intellectual power Zimbabweans are endowed with, is it really a matter of not understanding water management and proper reforms or what is happening is a deliberately orchestrated confusion and chaos that creates a conducive environment for unknown agendas by politicians? Unfortunately, in all that confusion, during the conception and abortion of brilliant policies and programmes, it is mainly the innocent poor resident who suffers. The Gweru scenario depicts a true 'wicked problem', where solutions are difficult to arrive at (Ritchey, 2013).

According to the GCC finance report (2013), the municipality received a loan in early 2013 from the Public Sector Investment Programme (PSIP) to the tune of $3 million for water and sewer rehabilitation. During that same year residents' debts were cancelled. This implied that GCC could not pay back the loan. However, a political voice from the ruling party made the decision to cancel debt without looking at the likely impacts on service delivery. Kusena and Beckedahl (2016) revealed that the national, fiscal policy review in 2012 saw the revision of the national budget downwards from $4 billion to $3.64 billion. This had an impact on municipality financial capacity. However, due to debt cancellation the situation was worsened and yet service was still required. These developments resulted in high water rates in a bid to recover from the deficit. However, all this is affecting household food security. In as much as the central government, ministry and the municipality were struggling financially, the residents had a worse experience. Ncube (2009) states that in Harare over 1200 residents were cut-off from water supplies but surprisingly they still received high bills and were expected to pay.

In terms of food and water policies, the Municipal Development Programme (2002) contains everything that culminates to urban food security and development in theory but the reality seems different. Urban agriculture in Gweru is not fully supported especially through provision of water. Although the amount of income generated from the produce seems insignificant, it is of great importance to the residents, considering that only 3% Gweru residents were above PDL. Efforts by the municipality to provide water for agriculture could significantly improve household food security. The following chapter deliberates on this issue by assessing the strategies devised by residents and civil society to cope with water and food challenges in the city.

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CHAPTER SIX

CIVIL SOCIETY AND RESIDENTS' COPING STRATEGIES TO WATER SHORTAGES AND HOUSEHOLD FOOD INSECURITY IN GWERU

6.1 Abstract

Domestic water shortages are distressing many urban areas in developing countries and require well planned and sustainable coping strategies in order for citizens to lead decent lives. The objectives of this chapter were to identify water related civil society groups present in Gweru; reveal devised coping strategies to water shortages and to household food insecurity; and challenges faced by civil society and residents in coming up with sustainable coping strategies. A household survey was conducted to collect data on strategies used by residents. Interviews with civil society groups and observations were also used as data collection instruments. The findings show that residents relied on boreholes which were sunk in their respective areas by the municipality, Non Governmental Organisations (NGOs) and through individual initiatives. Although public boreholes were available, they were found at an average of only two in a given residential area. It was revealed that residents also collected water in containers during late hours of the night or early hours of the day, when water was still running. Residents also had strategies to cope with high water bills in order to reduce the impact on household food security. The strategies included coming up with payment plans, denying city personnel access into their premises for water disconnection and self reconnection in the event of disconnection. Community gardens and food imports from neighbouring countries were used as coping strategies for food insecurity. However, despite efforts by civil society and residents to cope with the challenges, the city requires financial aid to enhance service provision without necessarily solely relying on residents. Financial injection and investment in sustainable alternative water sources for the city's multiple uses will go a long way in solving the water shortages and food insecurity challenges without further exposing citizens.

Keywords: water shortages, food insecurity, coping strategies, water bills, community gardens, boreholes, urban areas

6.2 Introduction

Water has an essential role to play in day to day living. Unfortunately, several geographical locations do not have sufficient water to meet the growing demand for a range of uses (Swaminathan, 2001). Water is dwindling in quantities mainly due to rainfall variabilities and increasing population (IPPC, 2001). Since water supports all forms of life, its shortage poses a setback on every activity (Savedoff and Spiller, 1999). Approximately three quarters of the world's population represented in about 45 countries suffer from serious water shortages as a result of various reasons and the situation is projected to worsen by 2020 (Jobson,1999; Rekacewicz, 2005). For that reason, South cities must plan and prepare sound coping strategies for sustainable water service delivery. According to Pereira et al. (2009) coping with water scarcity means living in harmony with the environmental conditions specific to and dictated by limited available water resources. It involves employing diverse measures to meet the water needs of the people.

Since independence, most urban centres in Zimbabwe have been facing water supply problems, with some of them going for long periods varying from hours, weeks or even months without water (Mangizvo and Kapungu, 2010; Chaminuka and Nyatsanza, 2013). Recently, water problems in Zimbabwe have been exacerbated by unclear policies, weak legislation and institutional management and, to some extent, political inference (Chenga, 2014; Dauramanzi, 2016; Mangizvo and Kapungu, 2012; Nhlanhla, 2008). The stated circumstances have instigated shortage of water even for basic domestic use. Zimbabwe is experiencing rapid urbanisation and population expansion (Chirisa, 2008). The situation has therefore outstripped available capacities to supply water and cope with demand.

Apart from the stated contexts, the economic meltdown of the country has exacerbated the challenges faced by citizens. Residents struggle to purchase food from supermarkets as a result of low incomes and therefore resort to actual production of food at household level (Hungwe, 2006 and Moyo, 2013) The shortage of water creates a bigger challenge of food insecurity, although the sustainability of farming, given the limited water supply capacities, is questionable. The shortage in supply directly translates into household food insecurity because water for irrigation is reduced (Kusena, et al. [in preparation]). Worth noting that Gweru municipality does not prohibit the use of municipal water for backyard and household food production activities as long as they do not use hosepipes (GCC Housing department report, 2016). However, there is need for further research on the sustainability of urban

agriculture that relies on municipal water, despite the fact that it is done for subsistence because the amount of water channelled towards the activity is unknown.

The average national household income is below the poverty datum line mainly because of the high rate of unemployment (Zimstats, 2015). However, while Gweru city suffers water shortages, unemployment and ultimate food insecurity; the municipality still prioritises cost recovery and revenue collection from the same citizens in order to sustain service provision. For that reason, civil society and residents' response to city water service delivery challenges warrant an interrogation.

The situation in Gweru exposes a 'wicked problem'. Ritchey (2013) defines a 'wicked problem' as a challenge that manifests itself in different ways and is difficult to solve. Horn (2001) calls these circumstances unstructured realities. A 'wicked problem' creates several other challenges, especially during the course of trying to solve the seemingly major ones. The mitigation is not an easy, quick, or solitary exercise but it demands interdisciplinary collaboration, and most importantly, the engagement and cooperation of all stakeholders. Participation of all stakeholders becomes pertinent because 'wicked problems' are exacerbated by mistrust and lack of accountability among stakeholders (Kalulu, 2015). Challenges in service delivery definitely receive responses from both the service provider and beneficiaries. However, poor communication can lead to parallel responses in the wake of defence of space. Unfortunately, the struggles for survival may be legal or even illegal (Narsiah, 2007). Citizens may devise strategies that are not in line with prescribed guidelines in order to counter oppression or hegemony from authorities (Dean, 2003).When citizens feel oppressed, protests may erupt as a result of frustration. Due to political power, authorities can use repressive apparatus to silence citizens but communities have a tendency of mobilising themselves into action that turns to counter the hegemony (Chaskalson et al., 1987)

It is in the face of such problems in service delivery that authorities sometimes take advantage of the poor and powerless, and externalise the negative effects of the system. The powers that be then try to even suppress the voice of civil society. Political Ecology theory (Adams, 2001; Wolf, 1972) observe that in the middle of challenges, citizens' disgruntled voices do not get attention. Adebayo (2002) also states that lack of attention to civil society is a common dimension of developing country city existence. Generally, in such cities there is aversion between authorities and citizens resulting in conflicts that are rarely resolved. In these cases, engagement is trivialised.

Several studies on Gweru focus on how the municipality and government have been dealing with water supply challenges. The responses have largely been infrastructure oriented (Mhlahlo, 2007). However, no research has focused on water user response to the challenges associated with the service delivery system. Annin (2008) alludes to the fact that in most cases policies are challenged and change is instigated from the domain of civil society. Civil society creates a platform for engagement and cooperation from all ends. However, failure to fully engage civil society has been a missing link in water service provision in most developing countries' cities. In the process, citizens feel overpowered.

Civil society is defined as the entirety of organisations that are formed by citizens outside the State, and remain independent in order to play a watchdog role (Cohen and Arator, 1992). For purposes of this study, civil society includes residents' associations, citizen elected committees, community action groups, social movements and/or any other established local or international NGOs.This chapter, therefore, focuses on how residents, either singularly or through the efforts of civil groups are responding to water challenges and household food insecurity.

6.3 Methods and materials

A household survey was carried out across the residential areas of Gweru. A stratified sampling technique was used to select respondents for the survey. Gweru has 49 residential suburbs with a total of 29 973 housing units, classified under high, medium and low density areas. The high density area constitutes 32 residential suburbs, 3 medium density suburbs and 14 low density suburbs. Of the total of 49 residential suburbs, 20% was randomly selected as primary sampling units (PSU) to make a sample of 10 proportionately distributed residential areas with a total of 489 respondents as shown on Table 4.1.

Questionnaires for the household survey were self-administered using a drop and pick method. The instrument was used to gather data on coping strategies for water shortages and household food insecurity put forward by civil society and residents as well as unearthing the challenges they faced in the process. Drop and pick was opted for in order to give consenting respondents enough time to fill out the questionnaires. Questionnaire respondents who required and requested for assistance in the filling out of the questionnaires were attended to by the researcher.

Interviews with councillors complimented data from the household survey in order to get views from all stakeholders concerning coping strategies to water shortages and food insecurity. Observations were equally instrumental in collecting data about alternative water and food sources in Gweru. The observation checklist focused on alternative water andfood sources. Observations were made concurrently with questionnaire administration.

6.4 Data analysis

Interview and questionnaire responses were organised into sub-themes for results reporting and discussion, using descriptive statistics. Borehole-User ratio was also established using the specific residential area population versus the number of boreholes available in the area against the expected international borehole-user ratio. The recommended international maximum population per borehole is 250 people and not households (DeGabriele, 2002). However, the only limitation is that it is not clear what the population should be if the boreholes are being provided as alternatives sources of water in urban areas rather than as the main source.

6.5 Results

6.5.1 Socio-demographic characteristics of the population

The socio-demographic characteristics explained in section 4.6.1 suffice for this chapter because of the homogeneity of the sample and statististical analyses done.

6.5.2 Identified civil associations in Gweru

The findings revealed that the city of Gweru had limited home grown civil society groups that focused on city water and food availability. The most active civil group in the city in terms of querying policy was the Gweru Residents and Ratepayers Association (GRRA). GRRA's mandate is generally on service delivery issues. These include, but are not limited to, issues of billing, water supply and allocation of farming plots. Churches were also part of the civil society that came up with coping strategies for the city. Cases in point were the Roman Catholic, the Latter Day Saints Churches and the Evangelical Lutheran Church that drilled boreholes in their premises which were used by the whole community during times of water restrictions.

The board of councillors elected from wards were also identified as a civil voice. However, it was revealed that as soon as the board members were voted into power, their service to citizens became questionable. There was poor feedback route such that 68% of respondents from the survey were not aware of the existence of ward councillors.

NGOs were also seasonally active in the city. These were: Care International, Red Cross, European Commission and the United Nations Development Programme. The organisations were mainly instrumental in the sinking of boreholes in residential areas, both for domestic use and community gardens for household food security.

6.5.3 Existing coping strategies to water shortages

The study revealed several coping strategies to water shortages as devised by civil society and sometimes through individual household efforts. However, the coping strategies varied spatially and temporally. The strategies included provision of boreholes, the use of large and small water storage containers, and wastewater reuse.

6.5.3.1 Borehole drilling

Besides tap water, Gweru residents get water from boreholes in the event of disconnections due to non payment, water rationing or during maintenance episodes. Gweru City Council indicated that most of the boreholes were initiated by donors but the local authority was noe responsible for maintenance. Low density areas such as Harben Park and Southdowns did not have public boreholes whilst only Daylesford had two public boreholes, as shown on Table 6.2.

Table 6.2: shows the number of boreholes and serviced population

Residential Area	Number of boreholes	Housing Units services (average of 5 members)	Provider/ donor
HD			
Mkoba 1	1	347 = 1735	Care International
Mkoba 12	0	405 = 2025	------
Mkoba 19	4	755 = 3775	European Union
Mtapa 3 and 7	2	489 = 2445	Caritas
Shamrock	0	25 = 125	------
Senga	2	1540 = 7700	Care International, Roman Catholic church
MD			
Ivene	0	370 = 1850	------
Southdowns	0	737 = 3685	------
LD			
Harben Park	0	79 = 395	------
Daylesford	2	124 = 620	Gweru city council

All selected residential areas with identified public boreholes had at most two boreholes except for Mkoba 19 which had 4. Mkoba 19 was a problem area in terms of water supply due to its terrain. The local authority did not have adequate pumping capacity for high topographical areas such as Mkoba 19.

Low density respondents indicated that they were not making use of the community boreholes. In any case, the findings revealed that low density areas only had two boreholes. Eighty one percent of the respondents revealed that they had their own boreholes as a result of household efforts and initiatives. However, half of the boreholes still qualified under wells because they did not have hydraulic pumping accessories and still used the manual rope and bucket method to draw water. ZINWA documented 54% boreholes for Daylesford and Harben Park combined. No wells or boreholes were recorded for medium density suburbs. This could be due to the fact that water supply in medium density areas of Gweru was relatively better as compared to low and high density areas of the city.

6.5.3.2 Water storage containers

Respondents indicated that they used from the smallest (2 litre containers) to the largest possible movable container (100 litres) to store water (Plate 1). However only 2% of the population surveyed had large water tankers mounted on stands at their premises. Respondents mainly from Senga, Mkoba 17 and 19, indicated that water was only available in the earliest hours of the day, or just before midnight. It was, however, revealed that in areas such as Southdowns, Ivene, and Mkoba 12 where tap water supply is relatively better, residents kept the same water in containers for a period that would sometimes exceed even a month till supplies were interrupted. Nonetheless, in areas such as Mkoba 19 and Mkoba 1, containers were used on a daily basis because tap water was rarely available. However, it was observed that most of the containers used, especially in high density suburbs, had no lids.

Plate 6.1: Small and large water containers

6.5.3.3 Wastewater reuse

Thirty five percent of the respondents indicated wastewater reuse as an option to counter water shortages. Containers with used water especially large dishes and buckets were observed during the survey. The water that was used for laundry and dishes was then reused to water gardens and flush toilets during times of water shortages.

6.5.4 Coping strategies to high water bills

Respondents revealed strategies that are used in the city in the event of high water bills in order to avoid disconnections and safeguard household income. These included self reconnection to supply, locking of gates, keeping vicious dogs and payment plans.

6.5.4.1 Payment plans

Twenty three percent of the respondents revealed that they always approached the municipal offices and arranged payment plans in order to avoid being disconnected from water supplies. It was indicated that the payment plan was spread over a period of three months after an initial upfront payment of a third of the total current bill. During the payment period agreed upon by the two parties, water supply disconnection was not allowed. Eighteen percent of the respondents were of the view that payments plans were effective in reducing the water bill burden. However, the remainder of the residents who relied on payment plans indicated that the arrangement was not effective because it would become a cycle.The municipality encouraged residents to pay according to payment plans whilst simultaneously honouring the current bill. This was urged in order to avoid accumulation of yet another debt that would lead to disconnection and an unaffordable bill.

6.5.4.2 Self reconnection to water supplies

Seven percent of the residents survived through self reconnection to supplies in the event of disconnections. However, most residents were not at liberty to divulge such information, despite confidentiality assurance which was evidenced by a consent form with an ethical clearance reference number. Chances are high that those who resorted to self reconnection could have been more than the 7% of the respondents. Residents expressed unwillingness to pay due to the fact that the bills were too high. However, some of the respondents indicated that self reconnection was their only option because they could not afford the water charges although they were more than willing to pay. One 34 year old respondent from Mtapa said '*ndakaona kuti chero ndikabhadhara shoma yandinayo, next week bill rinenge ratokwira futi. Saka better kuinvestor mubhobhojani, vakangovhara ndovhura kusvika ndazowanawo mari' meaning* 'even if I settle my bill now, in one week's time I will receive a new, exorbitant, bill again, so it is best that I invested in a spanner and reconnect myself whenever I am disconnected'.

6.5.4.3 Gate locking and keeping of vicious dogs

Some of the respondents indicated that they resort to tight security at their premises. Vicious dogs also served to scare away municipal personnel responsible for disconnections. Secured gates were in place in order to make access almost impossible, especially in high and low density areas. However, this strategy was only feasible in areas with water meters within the residential yards. In Southdowns and Ivene (medium density) it was not possible because

most of the meters were erected outside the premises so the municipality personnel had unrestricted access to the meter for both reading and disconnections.

6.5.5 Household Food insecurity coping strategies

The alternative sources of food besides purchasing and backyard gardens were community gardens, food purchasing and remittances from neighbouring countries.

6.5.5.1 Community Gardens

Non-governmental Organisations initiated the programme of community gardens in Gweru. This was done in order to increase the area of crop production and availability of borehole water for irrigation. The gardens were funded by CARE international and the European commission. The European commission project accommodated former sex workers and gave them an opportunity to decent food security source amid agriculture water shortages and low food purchasing capacity in the city.

6.5.5.2 Food stuffs from neighbouring countries

Gweru residents had low food buying power and limited household food production capacity. Findings revealed that some respondents still visited Botswana and South Africa for cheaper food stuffs. Sixty three percent of the respondents indicated that they were still conducting their shopping in neighbouring countries. Most of the households that were still buying food from South Africa and Botswana were those with family members who were into cross border trading. However, during the period of the study, the government of Zimbabwe banned all imports in order to promote local markets. This is likely to affect a significant number of residents' food security source if the economic situation does not change for the better.

6.5.5.3 Remittances

Respondents indicated that they were getting money to supplement food and assist in water bill payment from their family members who were employed in the neighbouring countries. Forty four percent of the 411 respondents were still benefiting from remittances for household food security. However, noteworthy is the fact that beneficiaries transcend all areas of residences without following any pattern. Both the employed and unemployed benefited from remittances.

Table 6.3: Remittances from neighbouring countries

Country	Average monthly remittances	Beneficiaries N=180 (44%)
South Africa	R870 (--USD)	120 = 67%
Botswana	P480 (--USD)	60 = 33%

*exchange rate was as at 18 July 18, 2016

It was, however, noted that the remittances were not consistent. Sometimes some of the households would go for months without receiving money. The findings showed heavy reliance on South Africa (67%) as compared to Botswana (33%). The money received lacked stability and certainty because exchange rates were always fluctuating on both formal and informal markets.

6.5.6 Challenges militating against sustainable coping strategies to household water and food insecurity

Inasmuch as residents and civil society were eager to come up with strategies that protected the interests of all citizens, several challenges worked against their concerted efforts.

6.5.6.1 Citizen apathy

There was general fatigue in citizens to cooperate with the civic groups for a change in the water supply circumstances due to historically poor engagement culture in the city. When invited to meetings that discussed city water issues, residents rarely attended in their numbers. Therefore, changes in the billing system were always passed without adequate input from the public. The scenario created parallel efforts whereby residents were struggling to clear debts whilst the municipality continued to hike charges and in the process affecting household water availability and food security.

6.5.6.2 Poor communication between the municipality and citizens

Respondents expressed their displeasure and indicated that engaging the municipality was not changing the city situation. The authorities made decisions that disregarded citizen views. For instance, concerning billing, it was revealed that tariffs were hiked despite the disapproval of the few citizens who would have participated. The GRRA representative further indicated that the municipality does not pay attention to their submissions. In some cases, even petitions that are signed by the participating residents were disregarded. The city was highly

top down in approach such that policies and decisions that affected household incomes and water availability were just implemented without full consultation with residents.

6.5.6. 3 Limited financial resources

GRRA lamented lack of resources to invest in sustainable coping strategies such as dual water systems and water harvesting. On the one hand, financial incapacity plunged GRRA more into social media activism with little tangible effects. On the other hand, the assistance offered by capable civil society groups such as NGOs is only seasonal and leaves residents with no means to continue with initiated projects. An example was the community gardens.

6.5.6.4 Use of controversial strategies

Some of the strategies devised by residents were just for momentary survival. They were short-lived and illegal. For example, self reconnection as a strategy showed the desperation of citizens. Due to the economic situation, Gweru residents were running out of options and resorted to drastic measures that created conflict with authority. Such strategies attracted punishment and could not be relied on.

6.6 Discussion

Due to challenges dictated by the water supply system of Gweru, residents and civil society came up with coping strategies to counter the discrepancies created by the status quo. Coping strategies from the side of the civil society were inevitable because the municipality operations were punctuated with a myriad of shortcomings that culminated in water shortages (Madebwe and Madebwe, 2011). Some of the municipality challenges included low water pumping capacity, leading to a wide supply and demand imbalance, poor water conservation and low citizen engagement culture, and relatively high monthly water bills (Kusena and Beckedahl, 2015; Madebwe and Madebwe, 2011; Matsa, 2012). All those challenges inevitably gave momentum to a rise in civil society movement. Annin (2008) argues that changes in the state of affairs do not just happen, they require citizens and groups that speak out and act against any weaknesses of a system, be it injustices or incapacities to offer the required service. Civil society voice is particularly important in cases where challenges are evident, but the State and authorities pretentiously cast a blind eye on service delivery issues, whilst expecting too much from the citizens in the form of service payment.

Unfortunately, some of the initiatives devised directly from the residents to cope with water shortages and food insecurity were in conflict with the municipality regulations. When citizens devise own survival mechanisms without engaging the authority, dispute is inevitable. For example in South Africa meter readers are chased away by disgruntled residents in Soweto. Narsiah (2007) describes the scenario as defence of space through use of counter discursive strategies. Residents reconnected water soon after disconnections were instituted by the municipality. This was done to ensure supply regardless of inability to pay for the service. The city of Gweru is characterised by high unemployment and low household income (average USD358). Therefore such actions are to be expected, especially considering that the government is not offering any form of assistance to the municipality and citizens. Although the strategies used, such as self reconnections, sound uncivilised and are illegal, citizens are left with no option but to devise even the most drastic methods for survival. It is unfortunate that sometimes due to circumstances, citizens cease to be 'civil' and act for survival. However, such actions and resistance mutate into serious conflict between citizens and authorities and are construed as irresponsible actions that attract punishment.

It was also revealed that GRRA effort to engage the municipality was always trivialised (Kusena et al., 2016). This could explain why it was now difficult to mobilise residents because they were already privy to the fact that the association would hardly yield any results to change their situation. Instead, residents trusted in their own ways around their challenges. This concurs with the coping strategies fashioned in Soweto, South Africa, where citizens mobilise themselves into social groups that reconnect themselves to supplies in the event of disconnections. Such actions usually occur when authorities are using power to oppress citizens who then develop counter strategies (Foucault, 1982).

In Gweru, self reconnection to water system is also an illegal act but, nevertheless, it is practised. This is mainly because the citizens feel unprotected and disrespected by authorities. Ironically, the municipality is always lamenting financial incapacity (GCC Finance Report, 2016) but expects residents to religiously pay for services yet they are in the same, if not worse, situation.

Coping strategies such as large container water storage, wastewater use, borehole drilling and borehole water use are very common in water scarce areas. However, measures such as borehole drilling at household level may not be feasible for ecological (Hlatywayo, 2013) and

financial reasons (Chuma et al., 2013). Regrettably, the available options were mainly at the disposal of average families who could afford to drill boreholes or even buy large containers. Otherwise the rest of the residents walked long distances to fetch water from boreholes provided in the city. The boreholes were oversubscribed and residents experienced long queues during water rationing periods. Round-trip water haulage time was likely to exceed 30 minutes due to the limited number of boreholes, and this infringed upon residents' productive time. WHO and UNICEF (2006) state that time spent fetching water must not exceed thirty minutes because it leads to loss of time for other productive activities. The time spent fetching water was not as a result of distance only but the borehole-user ratio. International guidelines recommend a maximum of 250 people per borehole (DeGabriele, 2002). The city of Gweru has very few boreholes that are overwhelmed by numbers during times of water cuts.

Literature reveals that since 2011 the central government has not been adequately funding local authorities (Mutema and Kanyane, 2015) and very little is done to make residents cope. Gweru municipality is relying on residents for funding (Kusena et al., 2016), thus making the already suffering residents more vulnerable. Non-govenmental organisations, only via the State, have been working towards provision of alternative water and food sources. The fact that the central government is not assisting municipalities is not peculiar to Gweru. Chinyama et al., (2012) reported that the Bulawayo City Council was complaining that very little of all estimated costs were realised by the government despite their promises. To make matters worse, the central government in its fiscal policy review of the last quarter of 2016 gave a directive to all government aided institutions to self fund all their operations, with no assistance from the government due to the economic situation (IMF, 2016). The central government was failing to meet its obligations to the local authority and unfortunately all the 'hiccups' in service delivery were felt by citizens.

High monthly charges to generate revenue for the municipality affected household income. On average, residents' household income is $358 and paying an average of $55 is consuming almost 15% of the average households' income. This is more than 5% that was recorded in Nigeria (Ahile, et al., 2015). However, residents devised some drastic measures to cope with the situation of high monthly bills. Taming vicious dogs for tight security could be a sign of hostility against the system. The municipality is regarded by residents as a common enemy. However, good measures such as payment plans should always be encouraged and facilitated

as a coping strategy. Bill payment plans are not endemic to the city of Gweru. The City of Raleigh Report (2016) also encouraged residents to make necessary arrangements for payment prior to service disconnections. However, the challenge with the municipality was communication, where in most cases utility bills delivery were done simultaneously with disconnections.

Concerning household food security, literature shows that community gardens are seriously deteriorating in output mainly because of poor management (Matsa and Dzawanda, 2014). Remittances from nearby countries especially South Africa are reported to be dwindling. Business is no longer lucrative for those who rely on cross border trade with South Africa and those working there. To further cripple the situation the June statutory instrument 64 of 2016 that declared an import ban on some commodities in order to avoid cash shortages and promote Zimbabwe's local industry seems to cause more harm than it intends to solve given that the basic goods imported was a source of livelihood for many.

Results from this study show that sustainability of water service delivery requires engagement and capacity development andparticipation of citizens in order prevent illegal coping strategies to challenges. Where options were available, residents were eager to do good as evidenced by payment plans, waste water reuse and adoption of community gardens.

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CHAPTER SEVEN

THE DYNAMICS OF URBAN WATER SERVICE DELIVERY CAPACITY AND THE IMPLICATIONS FOR HOUSEHOLD FOOD SECURITY: A SYNTHESIS

Water has a direct relationship with every activity for economic development and human livelihood (Botkosal, 2009 and Giordano, et al., 2012). Several studies in cities have investigated water supply issues and reported that shortages are being experienced (Gumbo, 2012; Kumar, 2013; Makwara and Tavuyanago, 2012). Still in cities, researchers have also discretely focused on the emerging wave of urban agriculture. However, there has been little effort to understand the impact of urban water supply dynamics on household food security. At a national level, water and food rapport is mainly associated with the rural setting where food production used to be dominant (International Fund for Agricultural Development (IFAD, 2013; ZimVAC, 2013). However, due to economic hardships bedevilling the country (Zimstats, 2013) many urbanites are resorting to farming that relies on municipal water, yet the capacity of the utilities to support the multiple uses are not fully examined. There is also a lack of understanding about why municipalities acknowledge the importance of urban agriculture but do not fully facilitate its proper implementation in cities, including Gweru. No study has attempted to simultaneously look at water supply and food security aspects from both the municipalities' and users' perspectives. The current study has shown that there is a direct link between urban water and household food security. The situation is exacerbated by the national economic situation that is affecting both the utility capacity to supply water and the user capacity to pay for the water service.

The study revealed that lack of an integrated monitoring of city water and food issues continue to pose challenges in water management, planning and conservation. In a bid to minimise water and food challenges in cities, an integrated urban water and food management strategy is required, involving an assessment of available water supply capacity, the gap between supply and demand, conservation and demand management, that incorporates water users and the effects of water service delivery system on food sources. Therefore, in an attempt to remedy the stated gaps, this study interrogated the city water service delivery dynamics; how these affect food streams and how people then respond to water and food challenges. In this chapter, the study findings are summarised using the following key topics deduced from the study objectives:

7.1 An overview of Gweru's water supply chain capacities

An inventory of available capacities in water service delivery is an important starting point for effective resource conservation and sustainable service delivery. The City of Gweru water

supply chain capacity was assessed to understand the prevailing situation. The analysed capacity related aspects were infrastructure, human resources, finances and physical availability of raw water at source. Purposively selected informants from the Zimbabwe National Water Authority (ZINWA) and Gweru City Council (GCC) provided data on the infrastructural, financial and human resources situation of GCC. Dam levels data for Gweru's three domestic supply dams were obtained from Zimbabwe National Water Authority records. A ten year period data set from 2003 to 2012 was used for water availability trend analysis using Mann-Kendall test. The study revealed that the City of Gweru lacks adequate pumping capacity to supply water and the city experienced water shortages that vary with residential areas. Notably, GCC is not experiencing high staff turnover, but it is seriously under-staffed and failing to effectively monitor water use in the city.

However, what is incongruous and least expected from the findings, given the reports of water shortages, is the fact that the city has sufficient raw water at source. The trend analysis shows that there were no significant changes in water volumes in Whitewaters (r^2 = 0.123, p>0.005), Gwenhoro (r^2 = 0.0369, p>0.05) and Amapongokwe Dam (r^2 = 0.2114, p>0.05) meaning that the combined available water volume for the dams in Gweru did not change significantly over the years (r^2=0.032, p>0.05). However, due to incapacity of the municipality to pump water to the city, residents experienced water challenges particularly in areas such as Mkoba 19 and Senga.

7.2 Water supply and demand gap

For purposes of planning, it is not adequate to just report shortages in supply and failure to meet demand without demonstrating the extent. Although shortages were evident in city residential areas (Matsa, 2012), the extent of the gap between supplied water and demand in Gweru was unknown. An assessment of the difference between Raw Water Treated (RWT), Treated Water Pumped to City (TWPC) and Consumed Estimate (CE) were assessed using five year data from the municipality records department. The results demonstrated that there is a significant difference between supply and demand. T-test results showed a significant difference (p = 0.000) between RWT and TWPC. The amount of water that was pumped to the city was significantly less than raw water treated over the 5 year period. Wilcoxon Signed Ranks test results further showed significant differences between RWT and CE (P = 0.00) as well as between TWPC and CE (p = 0.000). The use of annual projected population estimate

has also shown that the gap between supply and demand continues to widen with time. Mann-Whitney results show significant difference ($p = 0.001$) between the amount of water consumed per person per day and the expected WHO water amount per capita. The City of Gweru still falls short by 36% to reach the expected WHO standard supply by the year 2015. Kruskal-Wallis test showed a significant difference ($p = 0.000$) in the frequency of water availability between low, medium and high density suburbs of Gweru. However, there is no significant difference ($p = 0.130$) in the sufficiency of the supplied water as it remains inadequate in all the areas. The study also revealed that the city recorded a maximum of 16% non-revenue water between the year 2011 and 2014 and relies more on estimates for billing in order to recover from water production costs.

The results of this study further revealed that the causes of variations in water supply and demand in Gweru were low treated water pumping capacity, financial capacity to respond to leaks and bursts, and population growth. The findings demonstrated a scenario of a water utility that is struggling in the capacity to meet its obligation but operates in a way that externalises costs on water users. The results clearly suggested a need for water user participation towards optimal use of the available resource in order to evade citizen vulnerabilities.

7.3 Public participation in water conservation and demand management in water stressed areas

Public participation is vital for effective resource management (Woodhill and Van Vugt, 2008). Apart from general claims of the importance of public participation in resource management, information about public participation in water service delivery in Gweru was seriously lacking prior to the present study.

The study assessed the level of user participation using Citizen Science (Bonney et al., 2009), an approach that pays attention to both official and citizens voice through interviews and household surveys in order to have a balanced perspective of the situation. Results showed that public participation in water conservation and demand management was inadequate. In an effort to deal with water shortages, the municipality has used several conservation and demand management strategies that users were expected to comply with. However, in Gweru 78% of the household survey respondents had not gone through any form of water

conservation training. Due to lack of awareness and consultation, residents did not comply with the strategies to save water. Results showed that there were no differences ($p = 0.078$) between low, medium and high density suburbs in terms of water conservation training. Results further showed that there was no consultation across all residential suburbs on water conservation and demand management issues, a situation confirmed statistically through Chi-Square test ($p = 0.741$). There were no differences in terms of participation in water issues whether one was from low or high density suburbs as respondents (98%) reported that they were never consulted.

The majority (79%) of Gweru residents did not trust the local authority. There was no significant difference ($p = 0.182$) between high, medium and low density users' views with regards to relations between municipality and residents. Sixty nine percent of the respondents cited being disregarded as a reason that triggered lack of trust and non-compliance. The views of water users were not incorporated into decision making. Water charges were reviewed without sufficient consultation. The majority (82%) of the residents across suburbs indicated that the only form of participation they were involved in was payment of water bills. Unfortunately, residents were not engaged in critical decisions such as water rates increase, water cuts, and administrative amendments despite the financial implications the changes posed on residents.

7.4 Water service delivery situation and impacts on household food security

Literature is lacking in interrogating the link that exists between city water and food systems in struggling economies. City water and food issues if not carefully managed can create 'wicked problems' (Blaikie and Brookfield 1987), where focus on one creates a challenge on the other.

Household survey results have demonstrated that more than half (61%) of Gweru citizens relied on direct food production that was supported by municipal water whilst, 84% indicated food purchasing as another source of food. The average number of meals per day was two; respondents had one late morning meal and the last meal in the evening. Of the 61% that resorted to farming, 5% of them sold their agricultural produce to supplement household income. Types of crops grown include leafy vegetables, tomatoes, potatoes, maize and legumes. Maize cobs were sold at an average of $1 for four getting annual average of $41, $150 and $180 for high, medium and low density respectively. The incomes from food production across residential suburbs were significantly different ($p = 0.011$).

Nonetheless, respondents (59%) indicated that the amount of supplied water compromised household food security due to wilting and death of plants that were meant for household food. The water supplied was reported to be insufficient by 64% with 59% of the respondents specifically pointing to a shortage for agriculture and that worked against household food production process. Moreover, the majority (70%) of the residents indicated that their monthly water bills were too high. The average household monthly bill consumed an average of 15% of the average household monthly income. Changes in water bills had a direct impact on household income and translated into low food buying power that caused food insecurity.

The municipality was financially incapacitated and embarked on serious revenue collection. In revenue collection the municipality used water disconnections to force water users to pay for water services. The situation was exacerbated by the 2013 debt cancellation and withdrawal of funding from the central government. The government made a decision on behalf of municipality to cancel debt, an act that is legal according to the Urban Councils Act (CAP 29:15) Section 283 and 303, but then failed to continue aiding the utility and left residents more vulnerable than before. Above all, the city also lacks a consolidated food and water policy, such that the municipality focuses on water service provision in a way that compromises household food security through water cuts and high monthly charges. The situation concurs with the tenets of political ecology (Adams, 2001) and 'wicked problems' (Ritchey, 2013), where in the wake of meeting the obligation of supplying water, the municipality turns to externalise all costs on citizens and tends to forget human rights and social justice issues.

7.5 Civil society and residents coping strategies to water and food shortages

Literature shows that there is aversion between authorities and citizens resulting from the cities service delivery. This causes conflicts that are rarely resolved and engagement is trivialised (Adebayo, 2002). However, full engagement with civil society has been a missing link in service delivery in most developing countries' cities. Despite just acknowledging the importance of public participation in coping with challenges, the actual response of citizens and civil society to water and food shortages was lacking prior to the current study.

The civil society groups identified in Gweru were GRRA and the Roman Catholic and Latter Day Saints churches. The churches were instrumental in drilling boreholes at their premises

for community utilisation. NGOs (Care International, Red Cross and United Nations Environmental Protection and European Commission) also assisted through borehole drilling, water reticulation maintenance and community gardens for household food security.

Findings revealed that coping strategies to water shortages for both food production and other domestic uses were boreholes, small to large container water storage and wastewater reuse. For purposes of reducing the impacts of high monthly water bills, residents resorted to payment plans (23%). However, 18% of these respondents were of the view that payment plans were not effective in reducing the water bill burden due to continuously high monthly service charges that overtook their efforts. Seven percent of the residents survived through self-reconnection to supplies in the event of disconnections. Respondents also indicated that they resorted to tight security at their premises and keeping of vicious dogs which served to scare away municipality personnel responsible for disconnections in order to save money for food.

In order to cope with food shortages, civil society came up with community gardens. The European commission project actually accommodated former sex workers and gave them an opportunity to decent food security source in the midst of water shortages and low food purchasing capacity in the city. Sixty three percent of the respondents were still conducting their shopping in neighbouring countries for cheaper food stuffs. However, during the period of the study, the government of Zimbabwe banned imports in order to promote local markets. This is likely to affect a significant number of residents' food security source if the economic situation does not change for the better. Forty four percent of the 411 respondents were still benefiting from remittances for household food security. The beneficiaries transcend geographical differences. Both the employed and unemployed benefited from remittances. There is heavy reliance on South Africa (67%), compared to Botswana (33%). However, the money received was subject to the fluctuating exchange rates on the formal and informal 'black' market. However, citizen apathy, poor communication between citizens and authority, limited civil society financial resources and use of controversial strategies militated against sustainable coping strategies for water and food shortages in the city.

7.6 Conclusion

The overall intention of the study was to assess the dynamics of water service delivery and implications on household food security in the City of Gweru, Zimbabwe. The findings projected that water service delivery in poverty stricken areas require engagement and participation of all interested stakeholders. The central government should play its role of aiding utilities financially lest vulnerabilities are created as all costs are externalised on the already struggling citizens.

The findings revealed that the immediate handicap for Gweru municipality in terms of capacities was not unavailability of water at source. Instead, financial, infrastructural and limited human resources were identified as major drawbacks in the supply of sufficient water to the residents of Gweru. Topping the incapacities was the lack of financial muscle of the utility. Water pumpsets were not functioning at full capacity due to breakdowns. The water supply chain capacity was limited and water shortages were to be expected.

Results of the study further showed that the City of Gweru has maintained production of almost the same amount of water for five years across all months. In as far as the supply of raw water for treatment was concerned, the city has been stable. However, due to population increase and multiple uses, water that is supplied to the city is not sufficient. Causes of the gap between supply and demand for water were revealed to be non-revenue water, low pumping capacity, and vandalism of pipes, financial incapacity, crop irrigation and population increase. In terms of non-revenue water, GCC is losing already treated and expensive water, particularly between TWPC and CE phase. It was, however, revealed that part of the lost water is also rationalised among users in order for the municipality to recover cost of production though estimate billing. Efforts to recover cost whilst ignoring water loss is not sustainable. There is no significant difference in sufficiency of water that is supplied to all suburbs. All residential areas indicated a shortage of water. Furthermore, annual population growth has always been on the rise, whilst the amount of water supplied is not positively responding to this development. The city water supply still lags behind the recommended WHO per capita by 30%, a percentage that can be greatly reduced by curbing the 18% water loss that is being experienced in the distribution system.

Despite the revealed city incapacities to supply water, the findings further revealed that there was lack of dialogue and engagement between municipality and residents. The situation

created a fertile ground for strife, disgruntlement and non-compliance with water conservation and demand management strategies. Awareness and participation are essential attributes for water conservation and sustainable water service delivery system in every city. However, Gweru users exhibited non-compliance with conservation measures because they lack knowledge of those crucial prerequisites. Non-participation in water decisions rendered all water conservation and demand management efforts ineffective no matter how effectual they sounded in theory. Whilst residents are expected to be participating in water conservation, most decisions were merely imposed on them. Gweru residents, across all suburbs, were not in control. Furthermore, the only stakeholder who had a say in the whole process was the service provider (Gweru City Council) and this concurs with the neoliberalism tenet of individuality. However, the municipality cited limited time and financial incapacity as major hindrances to user engagement. The attitude of the municipality towards awareness and participation also demonstrate lack of determination and hegemony. For instance, pointing lack of time as a hindrance to engagement and consultation of citizens is not justifiable because it reduces citizens to passive participants. Most of the residents were below the Poverty Datum line. In relation to the findings, only 3% of the residents were not in poverty. Therefore, the majority of the residents were not interested in water conservation issues; instead they were preoccupied with utilising the available water for their livelihood. In the process, this created two stakeholders with parallel agendas.

Findings have further revealed that the circumstances around Gweru water service delivery system are compromising household food security. The municipality has a mandate to provide water but interference from the central government adversely impacted the service provider production cost recovery system. As a result of 'meddling' of the central government through debt cancellation, the municipality became incapacitated to sufficiently supply water for the city's multiple water uses. Due to that reason gardens also suffer water shortages. It was revealed that Gweru water service system burdens residents through high bill payment, water disconnections for non-payment of the bills and water rationing. All the strategies used compromised the residents' food security system. The municipality is relying on residents' money for the day to day running of the utility. Water is no longer provided as a human right (social) good but as an economic good for revenue generation, while ignoring the urban poor in terms of their food security needs. The measures that are being employed to achieve service delivery inversely affect the intended service beneficiaries. Water cuts are leading to wilting and loss of potential household food security. Emphasis is on the economic

value of water and in the process a significant percentage of household income is taken up by water bills. Ironically, government is very active in making decisions that attract favour from the residents, yet in the long run the decisions seriously affect service provision capacity and ultimate household food security.

Results of this study in all the water service provision dynamics revealed that the main strategies used to counter water and food challenges were provision of boreholes and community gardens. Residents were also active in devising their own ways of survival. Some of the strategies implemented by residents were illegal and uncivil, but were still executed as a result of lack of alternative. Taming vicious dogs and self reconnection were some of the identified drastic coping strategies due to lack of bill payment capacity. Such measures show poor engagement between authorities and citizens. The municipality prioritised revenue collection from citizens who are well known to be incapacitated financially, just as the local authority is equally weak financially. The act of expecting payment from suffering residents is just transferring a problem downstream without solving it. Noteworthy is the fact that most residents were more than willing to do what is right and legal, but the surrounding circumstances left them with no options. Strategies such as payment plans and wastewater use show that residents were self driven to do good. However, there is need to understand the plight of residents and eliminate possibility and existence of deliberate deviant behaviours.

Residents have no food purchasing power. They resort to farming and assistance from neighbouring countries for food security. However, farming has proven to be difficult due to water shortages and food purchasing is compromised by high water service bills; food imports are banned and community gardens are underperforming. The residents of Gweru are caught between ‘a rock and a hard surface’, considering that the coping strategies revealed are not sustainable and the municipality still expects service payments from the same unemployed and hungry populace. The findings of the entire thesis showcase a precarious situation in Gweru which requires an integrated and people-centred service provision.

7.7 Recommendations and the need for the further research

The research has explained the importance of understanding the dynamics of urban water service delivery capacities and their implications on household food security. It provides insights to water resources researchers and managers, environmentalists and policy makers,

to shift towards an integrated approach to urban water management as a result of the demonstrated relationship that it has with household food security. This study can facilitate effective, sparing and conscious utilisation of urban domestic water with the aspect of household food security in mind in Zimbabwe, a situation that is currently lacking. Therefore, the findings of this study provide baseline information that can be considered in the formulation of integrated city water and food policies based on an understanding of the socio-economic situation of both citizens and municipalities.

In order to build and develop capacities to achieve sustainable water and food service delivery in cities, it is recommended that local authorities be given full autonomy of city affairs in order to sustain service delivery. The findings suggest that there be less politically driven government intervention in the water service delivery, for instance the 2013 debt cancellation that was implemented ahead of presidential elections, as this interferes with the financial capacity of municipalities to supply water. Although water is a basic human right, the findings suggest that Gweru City Council could work on introducing prepaid meters as a water conservation and cost recovery measure, of course with the urban poor in mind. This might go a long way in the sparing use of the resource.

The Government of Zimbabwe should strive to improve national social security in order to cater for the urban poor and protect available water resources. The adamant prioritisation of bill payment from citizens whose income is below the poverty datum line is a sign of negligence and failure of the central government. However, it is also suggested that municipalities consult with water users in order to optimise the available water resources for the multiple uses through public driven conservation and demand management. In the long term, the city may consider investing in a dual water system that reaches the consumer and provide them with an option to water their gardens, without necessarily using treated expensive water. For instance, water from Ngamo Dam, could be availed for residents' food security activities and not just for urban greening as is the current situation.

The following recommendations for future research emanate from this study:

- Further research should be conducted on the amount of municipal water that is channelled towards food production for planning purposes, and understanding the feasibility of urban agriculture that is based on potable water
- Further studies must be carried out on the suitability of alternative water sources for intended uses during shortages, in order to deal with potential health hazards

- The reliance of residents on municipal water for household food production calls for a research on alternative long term water supply sources and suitable crop varieties to sustain urban agriculture without jeopardising other water uses in the city.
- Further research should be carried out to assess the condition of the containers that are used to collect and store water since these have a bearing on the health of the residents.
- Similar interrogations should be done in several other cities of Zimbabwe to establish how different municipalities' capacities in water service delivery affect household food security.
- Further study should be carried out on the effect of the Statutory Instrument 64 of 2016 Control of Goods/Import Ban on city water conservation and household food security.
- The current study focused on the effects of water service delivery system on household food security interms of food availability and access. Further research should be carried out on the nutritional value of the identified alternative food sources since quality is a critical food security dimension.

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APPENDIXES

APPENDIX 1: QUESTIONNAIRE

I am a student at University of KwaZulu Natal in South Africa and a Zimbabwean. I am kindly asking you to complete the questions below. The tool is soliciting data about; "***Gweru urban water supply capacity; demand management and conservation capacity; and implications for household food security"***. Please be advised that the information collected will be strictly for academic purposes and the data will be destroyed after the final thesis writing. Do not fill out your name for anonymity reasons.

Have you signed the Consent form, If not, Please do so ☐

SECTION A

SOCIO-ECONOMIC DATA

Sex: Female ☐ Male ☐

Age: ☐

Household size ☐

Marital status: Single ☐ Married ☐ Widowed ☐

Divorcee/Separated ☐

Highest Level of education: Tertiary ☐ Secondary Level ☐ Primary Level ☐

None ☐

Occupation: ……....

Period stayed in the area: ……

SECTION B

WATER SUPPLY SITUATION

1. Are you connected to municipal water system? Yes ☐ No ☐
2. If Yes, How often do you receive municipal water? Daily ☐

   Weekly ☐ Fortnight ☐ Monthly ☐ Rare ☐
3. What do you think influences provision of municipal water in your area?
   Payment ☐ relations with GCC workers ☐ availability at source ☐

   Affluence of area ☐ other, specify……
4. Would you say the supplied water is adequate for your needs? Yes ☐ No ☐
5. If not, which activities are affected the most by the shortage?
   Washing ☐ gardening ☐ cooking and bathing ☐

   Other, specify……..
6. How has been the water supply situation in Gweru in the previous years? Excellent ☐
   Good ☐ Poor ☐ Average ☐
7. Do you think the 2013 water debt cancellation was a good idea? Yes ☐ No ☐
8. How do you rate the water service charges? Reasonable and justified ☐ Too high ☐
   Too low ☐
9. Do you normally honor your monthly water bills? Yes ☐ No ☐
10. In your opinion, do you think the water supply situation in Gweru will improve any time soon? Yes ☐ No ☐

11. If not, why? Financial constraints ☐ shortage of raw water ☐ corruption ☐

Poor infrastructure ☐ politics ☐ other, specify……

SECTION C

WATER DEMAND MANAGEMENT AND HOUSEHOLD FOOD SECURITY

12. What mechanisms are in place to limit water usage in your area? High monthly charges ☐ Low tap water pressure ☐ Water cuts during the day ☐

Disconnections for nonpayment ☐ other, specify……

13. How do the above (*number 12*) demand management strategies affect your household food security?

Shortage of water for farming ☐

Lack of money to buy food as too much is channeled towards bill payment ☐

Loss of chances to farm for the market ☐

14. What type of farming do you practice? Poultry ☐ backyard gardening ☐

Other, specify……..

15. What is the source of water for your farming? municipal water ☐ Rain-fed ☐ Borehole ☐ other, specify……

16. For what reasons do you farm? Hobby ☐ Food ☐ Income supplement ☐

17. How many meals do you have per day? **1** ☐ **2** ☐ **3** ☐ or more ☐

18. Would you say the produce from your farming improves your household food security? **Yes** ☐ **No** ☐

SECTION D

SUPPLY CHALLENGES AND COPING STRATEGIES

19. Are there any alternative sources of water for your needs in your area? **Yes** ☐ ☐

20. If Yes, Which alternatives do you have? Borehole ☐ protected well ☐ unprotected well ☐ bottled water ☐ am ☐

21. How far is the alternative source from your house? (distance *in m/km)*……

22. For what purposes do you use the alternative source of water? Cooking ☐ gardening ☐ washing ☐ bathing ☐ other, specify……..

23. Were these alternative water sources tested for suitability in terms of quality for intended use? Yes ☐ No ☐

24. Do the alternative sources of water ensure adequacy in terms of quantity required for all household needs? Yes ☐ No ☐

SECTION E

WATER CONSERVATION AND CONSUMER INVOLVEMENT

25. Are there any water conservation measures you use? **Yes** ☐ **No** ☐

26. If yes, how do you conserve water? Wastewater use ☐ Report pipe leakages ☐

and bursts ☐ Avoid using hosepipes ☐ Repair taps ☐

……

27. If **Not**, Explain why you do not conserve water? Municipality does not involve us in water issues ☐ I pay for it ☐ It is abundant ☐

……

28. To whom do you think tap water belongs? I do not know ☐ It's ours ☐

Gweru city Council ☐

29. Do you feel you have any control over decisions made concerning water issues? **Yes** ☐ **No** ☐

30. If Yes, how have you been involved in water issues in the city? We are always consulted ☐ I attend water meetings ☐ Other, specify…….

31. **If Not** (*on 30*), what makes you feel that you have no control over water issues in Gweru?

Water service charges are imposed on us. ☐

There is no established communication channel between residents and GCC ☐

32. Have you ever gone through water conservation training? **Yes** ☐ **No** ☐

33. How frequent does municipality monitor water use in your area?

I have never seen them ☐ Only when they want to collect revenue ☐ Every month ☐

34. What measures are taken by the authorities in the event of 'water abuse' (*to be explained to the respondent)?*Fines ☐ Negotiation and bribery ☐

Reprimanded ☐ other, specify……..

35. Do you think the measures **(***on 34***)** are justified and fair? **Yes** ☐ **o** ☐

36. Do you think it's possible to practice urban agriculture that is based on municipal water? Yes ☐ No ☐

37. What do you think should be done to improve both water supply and food security in Gweru?
Employment creation ☐ Education and awareness ☐ ublic involvement ☐

38. How best do you think water could be conserved in Gweru?
Employment creation ☐ Education and awareness ☐ ublic involvement ☐

Other, specify……

THANK YOU VERY MUCH FOR YOUR PARTICIPATION

APPENDIX 2: INTERVIEW SCHEDULLES

Each respondent will be requested to complete an informed consent form.

Gweru City Council Human Resources Manager

1. How much workforce do you have in the City Council?
2. What expertise is required for the supply water in Gweru and is it adequately available? If it is not available how do you deal with the challenge? If you out source where do you get the expertise from?
3. How is the staff turnover, especially in water supply and demand management experts
4. Do you think the personnel involved in water supply and demand management should be increased? If yes, explain why
5. Do you think there is enough staff to implement WDM in Gweru? If not state why and if yes explain your answer
6. Does the City Council have a clearly defined/structured process of transferring skills from old to new personnel in order to maintain the same or improved stock of knowledge about the supply and management of water in the city? If yes, explain how it is done. If not, explain the challenges you have
7. What is being done to increase consumer's knowledge on water conservation?
8. In your opinion, do you think GCC has the capacity to effectively monitor water use? If yes, explain your answer. If not, what are constraints and how are you dealing with them?
9. Do residents always participate in water decisions, If Yes, in what way and to what is extent is their involvement? If not, explain your answer.

The City Engineer

1. Does the available water supply infrastructure have the capacity to adequately service the city (the supply dams, reservoirs and pipes)?
2. Is the current water supply meeting the demand in selected residential areas? If not what is the challenge and how are you dealing with it.
3. What is the life span of the city's water supply pipes and how old are they now?

4. Is everyone in your department conversant with the city's water reticulation system layout?
5. How frequent do you service/repair the available infrastructure and is the expertise for the repairs available? If not, how do you deal with repairs
6. What is normally your response rate to leakages and pipe bursts whenever they are identified or reported? Do you fix problems within the stipulated/expected response time, if not, explain why?
7. Are roles and responsibilities clearly defined in your department, If not, explain your answer.
8. Given the residential expansion in the City, is the available water supply source able to cover the new and proposed areas without experiencing water shortages in the city? If not, what are the City's plans to matchup with the expansion?
9. What is your comment on the quality of material that is used for water reticulation in the city today? Is it likely to increase the supply capacity or not, explain your answer

Gweru Housing Department Head

1. How many housing units are there in the city?
2. Are there any plans to expand the residential areas in the near future, if not explain why. If yes, is the growth going to tally with the water supply and if not, how are you planning to cover up for the gap?
3. How big are the residential stands in Gweru and what activities are carried out on the stands?
4. How much water is used per household on average and are there in changes in water use. If yes, explain why?
5. In the event of water cuts due to any cause, are there any alternative sources of water, if yes, state them?
6. How safe are these alternative sources of water and how do you ensure continuous safety?
7. Are there any income generating activities going on in housing units? If yes, state where they get water from?

Gweru Ratepayers and Residents Association (GRRA) representative

1. How is the water supply situation in the City?
2. In your opinion, do you think that you are part of the water management or decision making in the city? If not, explain why you say so?
3. How does the municipality deal with water shortages, are you happy with the response rate in the event of water shortages, leakages and or pipe bursts?
4. In the event of water shortages, do you have alternative sources of water? If yes, state them and indicate how far they are from housing units?
5. Are there any water conservation measures that you implement, if yes, state them and explain how you got to know about them and why you use them. If not, explain why there are no water conservation efforts?
6. What is your feeling about backyard urban farming?
7. Where do the small famers get water for their gardens? Do you support urban farming and explain why?
8. Do you think Gweru residents have a platform to air out their views or grievances on water supply and demand management?
9. Do you think there are water conservation or demand management mechanisms that are affecting household food security of Gweru residents? If yes explain why?

Zimbabwe National Water Authority (ZINWA) hydrologist

1. How many water sources are available to service the city of Gweru?
2. Does the city have enough raw water to service the current population? If not explain your answer.
3. Do you think the available raw water can adequately service the city in the next ten years? If yes, explain why, if not, how are you planning to cover up for the gap,
4. Are there any future plans to investment in more water infrastructure? If not explain your answer.

Ward Councillors

1. Are you happy with the water supply situation in Gweru, if not, what do you think could be done to help the situation?

2. Are there any water conservation measures that you know?
3. Are there any efforts by residents in your ward to conserve the available water, if yes how do they do it and if not, can you explain why?
4. Do you feel you are part of the city's water management programme, if yes, how are you involved? If not, explain your answer.
5. Are there any people in your ward that are into farming activities, if yes, where do they get water from?
6. What is your feeling towards urban farming?

APPENDIX 3: INFORMED CONSENT FORM

Discipline of Geography, School of Agricultural, Earth & Environmental Sciences

University of KwaZulu-Natal (Pietermaritzburg Campus)

Informed Consent Document:

To whom it may concern,

My name is Kusena Winmore, a PhD student at University of KwaZulu Natal, (Pietermaritzburg Campus) South Africa and Lecturer at Midlands State University, Zimbabwe. I am conducting a research on *"Water supply, demand management and implications for household food security in Gweru"*. The research is focused on selected residential areas in the city. The research output will contribute information towards sustainable water management and will (hopefully) contribute positively to food and water policy development to benefit the whole city and the country at large. I am seeking your consent and agreement to participate in this project by sharing your experiences and views anonymously, so that I will be able to successfully complete the research programme. Please note that this investigation is being conducted in my personal capacity. I can be conducted on winniekusena@yahoo.com or 213572836@stu.ukzn.ac.za or 00263773632815. My supervisor is Professor H. Beckedahl and can be communicated with at hbeck@ukzn.ac.za or 0027332605345.

I assure you that all the information gathered will remain anonymous, kept confidential and used for academic purposes only; at no stage in the research will it be possible to trace results or views expressed in the research direct to a particular respondent/group of respondents. It is also emphasized that your participation is voluntary (for both individual questions and the questionnaire as a whole), and you reserve the right to withdraw if you feel and deem it necessary, without any negative consequences for you as a person. I appreciate the time you are devoting to complete the questions. Should you have any difficulties in terms of the language, please raise these with me (researcher) and I will happily translate and/or explain any questions or concepts to you.

If you accept the aforementioned conditions, **please complete the section below**:

I, _____

(Full name of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Signature of Participant: _____

___

Date: _____

APPENDIX 4: ORIGINAL DAM DATA

GWENORO DAM			AMAPONGOKWE DAM			WHITEWATERS DAM		
CAPACITY	SEASON	MONTH	CAPACITY	SEASON	MONTH	CAPACITY	SEASON	MONTH
19.045	1/2003	1	22.415	1/2003	1	3.287	1/2003	1
20.909	3/2003	3	23.384	3/2003	3	4.226	3/2003	3
20.784	4/2003	4	23.044	4/2003	4	4.393	4/2003	4
19.908	5/2003	5	22.403	5/2003	5	4.21	5/2003	5
18.787	6/2003	6	21.714	6/2003	6	4.103	6/2003	6
18.263	7/2003	7	21.483	7/2003	7	4.022	7/2003	7
16.952	8/2003	8	20.817	8/2003	8	3.718	8/2003	8
15.712	9/2003	9	20.161	9/2003	9	3.078	9/2003	9
15.053	10/2003	10	19.365	10/2003	10	2.949	10/2003	10
15.744	11/2003	11	19.061	11/2003	11	2.971	11/2003	11
15.193	12/2003	12	18.458	12/2003	12	2.914	12/2003	12
14.763	1/2004	1	18.117	1/2004	1	2.883	1/2004	1
16.19	2/2004	2	17.498	2/2004	2	3.264	2/2004	2
27.212	3/2004	3	24.104	3/2004	3	4.912	3/2004	3
31.908	4/2004	4	31.257	4/2004	4	4.895	4/2004	4
31.241	5/2004	5	33.895	5/2004	5	4.837	5/2004	5
30.484	6/2004	6	33.075	6/2004	6	4.739	6/2004	6
29.7	7/2004	7	32.248	7/2004	7	4.708	7/2004	7
28.798	8/2004	8	31.345	8/2004	8	4.574	8/2004	8
27.871	9/2004	9	30.292	9/2004	9	4.425	9/2004	9
26.426	10/2004	10	29.062	10/2004	10	4.204	10/2004	10
25.178	11/2004	11	27.964	11/2004	11	4.181	11/2004	11
28.199	12/2004	12	28.523	12/2004	12	4.181	12/2004	12
30.473	1/2005	1	29.145	1/2005	1	4.181	1/2005	1
30.856	2/2005	2	29.429	2/2005	2	4.181	2/2005	2
29.185	3/2005	3	28.428	3/2005	3	4.181	3/2005	3
27.836	4/2005	4	27.594	4/2005	4	4.181	4/2005	4
26.932	5/2005	5	26.421	5/2005	5	4.181	5/2005	5
25.329	6/2005	6	25.357	6/2005	6	4.181	6/2005	6
24.093	7/2005	7	24.673	7/2005	7	4.181	7/2005	7
22.55	8/2005	8	23.956	8/2005	8	4.181	8/2005	8
20.96	9/2005	9	23.11	9/2005	9	4.026	9/2005	9
19.069	10/2005	10	22.205	10/2005	10	2.707	10/2005	10
17.219	11/2005	11	21.267	11/2005	11	2.465	11/2005	11
22.782	12/2005	12	23.109	12/2005	12	2.286	12/2005	12
30.709	1/2006	1	32.421	1/2006	1	4.544	1/2006	1
31.532	2/2006	2	37.912	2/2006	2	4.895	2/2006	2
30.878	3/2006	3	37.821	3/2006	3	4.89	3/2006	3
30.969	4/2006	4	37.476	4/2006	4	4.895	4/2006	4
29.502	5/2006	5	36.655	5/2006	5	4.895	5/2006	5
28.654	6/2006	6	36.187	6/2006	6	4.895	6/2006	6
27.847	7/2006	7	35.689	7/2006	7	4.895	7/2006	7
25.559	8/2006	8	34.706	8/2006	8	4.785	8/2006	8
24.185	9/2006	9	34.643	9/2006	9	4.494	9/2006	9
22.724	10/2006	10	32.937	10/2006	10	4.163	10/2006	10
22.392	11/2006	11	32.43	11/2006	11	3.996	11/2006	11
22.392	12/2006	12	32.43	12/2006	12	3.996	12/2006	12
28.775	1/2007	1	36.509	1/2007	1	4.576	1/2007	1

30.524	2/2007	2	37.693	2/2007	2	4.805	2/2007	2
27.537	3/2007	3	37.101	3/2007	3	4.859	3/2007	3
28.598	4/2007	4	36.532	4/2007	4	4.7	4/2007	4
27.512	5/2007	5	35.484	5/2007	5	4.421	5/2007	5
26.938	6/2007	6	34.677	6/2007	6	4.183	6/2007	6
25.817	7/2007	7	33.793	7/2007	7	3.945	7/2007	7
25.183	8/2007	8	33.357	8/2007	8	3.79	8/2007	8
22.912	9/2007	9	31.5	9/2007	9	3.688	9/2007	9
22.014	10/2007	10	30.838	10/2007	10	3.668	10/2007	10
21.091	11/2007	11	29.952	11/2007	11	3.668	11/2007	11
20.086	12/2007	12	28.91	12/2007	12	3.668	12/2007	12
29.971	1/2008	1	32.363	1/2008	1	4.588	1/2008	1
31.497	2/2008	2	37.947	2/2008	2	4.895	2/2008	2
30.979	3/2008	3	37.337	3/2008	3	4.895	3/2008	3
29.494	4/2008	4	36.137	4/2008	4	4.831	4/2008	4
27.961	5/2008	5	35.313	5/2008	5	4.895	5/2008	5
26.974	6/2008	6	34.587	6/2008	6	4.722	6/2008	6
25.377	7/2008	7	33.883	7/2008	7	4.386	7/2008	7
23.748	8/2008	8	32.965	8/2008	8	4.386	8/2008	8
22.847	9/2008	9	32.193	9/2008	9	4.386	9/2008	9
20.777	10/2008	10	31.797	10/2008	10	4.386	10/2008	10
20.512	11/2008	11	30.384	11/2008	11	4.386	11/2008	11
17.189	12/2008	12	30.384	12/2008	12	4.386	12/2008	12
17.196	1/2009	1	30.384	1/2009	1	4.386	1/2009	1
22.853	2/2009	2	31.697	2/2009	2	4.386	2/2009	2
28.574	3/2009	3	33.727	3/2009	3	4.499	3/2009	3
29.329	4/2009	4	37.629	4/2009	4	4.612	4/2009	4
28.269	5/2009	5	36.868	5/2009	5	4.77	5/2009	5
27.138	6/2009	6	36.32	6/2009	6	4.76	6/2009	6
25.907	7/2009	7	35.6	7/2009	7	4.572	7/2009	7
24.346	8/2009	8	34.994	8/2009	8	4.517	8/2009	8
23.102	9/2009	9	34.317	9/2009	9	4.513	9/2009	9
21.75	10/2009	10	33.467	10/2009	10	4.419	10/2009	10
20.409	11/2009	11	32.651	11/2009	11	4.295	11/2009	11
24.896	12/2009	12	35.064	12/2009	12	4.879	12/2009	12
24.846	1/2010	1	34.395	1/2010	1	4.905	1/2010	1
24.967	2/2010	2	35.102	2/2010	2	4.859	2/2010	2
28.601	3/2010	3	38.356	3/2010	3	4.834	3/2010	3
29.871	4/2010	4	38.025	4/2010	4	4.902	4/2010	4
29.342	5/2010	5	37.705	5/2010	5	4.824	5/2010	5
28.665	6/2010	6	37.547	6/2010	6	4.716	6/2010	6
27.513	7/2010	7	37.13	7/2010	7	4.638	7/2010	7
26.177	8/2010	8	36.72	8/2010	8	4.61	8/2010	8
25.857	9/2010	9	36.214	9/2010	9	4.567	9/2010	9
23.399	10/2010	10	35.565	10/2010	10	4.388	10/2010	10
22.151	11/2010	11	34.655	11/2010	11	4.262	11/2010	11
22.598	12/2010	12	34.979	12/2010	12	4.723	12/2010	12
27.543	1/2011	1	37.086	1/2011	1	4.969	1/2011	1
30.498	2/2011	2	37.854	2/2011	2	4.856	2/2011	2
29.175	3/2011	3	37.178	3/2011	3	4.853	3/2011	3
27.503	4/2011	4	36.181	4/2011	4	4.77	4/2011	4
27.288	5/2011	5	36.176	5/2011	5	4.67	5/2011	5
25.875	6/2011	6	35.419	6/2011	6	3.454	6/2011	6
24.279	7/2011	7	34.439	7/2011	7	4.576	7/2011	7

23.575	8/2011	8	34.142	8/2011	8	4.643	8/2011	8
22.337	9/2011	9	33.511	9/2011	9	4.535	9/2011	9
21.047	10/2011	10	32.383	10/2011	10	4.437	10/2011	10
19.795	11/2011	11	31.463	11/2011	11	4.22	11/2011	11
19.062	12/2011	12	31.022	12/2011	12	4.794	12/2011	12
19.864	1/2012	1	31.33	1/2012	1	4.864	1/2012	1
17.562	2/2012	2	30.786	2/2012	2	4.817	2/2012	2
17.174	3/2012	3	30.1	3/2012	3	4.726	3/2012	3
16.953	4/2012	4	29.446	4/2012	4	4.676	4/2012	4
15.707	5/2012	5	28.617	5/2012	5	4.581	5/2012	5
14.426	6/2012	6	27.949	6/2012	6	4.371	6/2012	6
13.05	7/2012	7	27.12	7/2012	7	4.268	7/2012	7
11.759	8/2012	8	26.236	8/2012	8	4.136	8/2012	8
10.632	9/2012	9	25.614	9/2012	9	4.035	9/2012	9
9.598	10/2012	10	24.55	10/2012	10	4.035	10/2012	10
8.714	11/2012	11	23.522	11/2012	11	3.704	11/2012	11
7.751	12/2012	12	22.512	12/2012	12	3.473	12/2012	12
7.599	1/2013	1	22.577	1/2013	1	4.517	1/2013	1
7.886	2/2013	2	22.29	2/2013	2	4.697	2/2013	2
7.397	3/2013	3	21.315	3/2013	3	4.617	3/2013	3
6.717	4/2013	4	20.571	4/2013	4	4.507	4/2013	4