Understanding Water Payment Outcomes at Communal Water Kiosks in Malawi: A Causal Loop Approach

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A Thesis Submitted in Fulfilment of the Requirements for the Degree of *Doctor of Philosophy*

Declaration of Authenticity

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Date: 29/09/2024 **Signed**: Derek Mavesere

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Abstract

Decentralised water supply systems present a viable solution to the provision of improved water services in developing countries. However, their operational sustainability is hindered by inconsistent demand, representing an inconsistent willingness to pay. Using communal water kiosks, as a decentralised improved water provision model, this research explains why water payments are inconsistent at kiosks. The aim of the study is to develop a model that explains payment behaviours at communal water kiosks. Understanding payment behaviours is critical for investment decision making on decentralised water provision.

This study employs an Explanation Analytic Building Technique using a deductive -inductive approach. First, propositions are derived from causal loop diagrams (CLDs). These propositions are tested, amended and extended using data from 45 semi-structured interviews with users, NGOs and policymakers, and project documents from two comparative water projects in Malawi. The process resulted in other loops and resulting propositions inductively added to the final model. Confidence was built in the CLDs through four group sessions with selected members of NGOs and government. The final model is made up of various collective action-induced structures that drive outcomes. These structures are, trust in the community organisation with funds, trust amongst households that others will reciprocate payments, sense of ownership, conflicts between community organisation members and users on funds, interventions by funders and coping strategies that users employ when faced with a changing water service. This research makes several theoretical, methodological, and empirical contributions. From a theoretical perspective, the research contributes to the rural drinking water management field by extending the relationship between water payments and water service level, and development of a payment behaviour model that can help to explain payment behaviours at any decentralised shared improved water service provision model in rural Africa. Methodological contributions are made by combining the Explanation Building Analytic technique and CLDs for theory building and testing. Empirical contributions are made by employing cases in Malawi, where the involvement of policymakers in the confidence-building process facilitated learning and appreciation of systems thinking. The outputs from this model have wider theoretical and policy decision making implications in decentralised water provision in rural Africa.

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List of Abbreviations

CLDs	Causal Loop Diagrams
CLTS	Community-led Total Sanitation
CMWS	Community-Managed Water Systems
CONGOMA	Council for Non-Governmental Organisations in Malawi
CPR	Common Pool Resources
DC	District Council
DCT	District Coordination Team
DEC	District Executive Council
DFID	Department for International Development
DWDO	District Water Development Office
FCDO	Foreign, Commonwealth and Development Office
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoM	Government of Malawi
JMP	Joint Monitoring Programme
LCCA	Life Cycle Cost Approach
MoWS	Ministry of Water and Sanitation
MWC	Michesi Water Committee
NGOs	Non-Governmental Organisations
NWP	National Water Policy
O&M	Operation and Maintenance
OHCR	Office of the Higher Commission for Human Rights

OpEx	Operating and minor maintenance expenditure
SADC GMI	Southern African Development Community Groundwater Management Institute
SD	System Dynamics
SDG	Sustainable Development Goal
SES	Social-Ecological System
SESF	Social-Ecological System Framework
SSA	Sub-Saharan Africa
SSM	Soft Systems Methodology
SWC	Safe Water Committee
SWE	Small Water Enterprises
UN	United Nations
UNICEF	United Nations Children's Fund
VSLAs	Village Savings and Loan Associations
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WPC	Water Point Committee
WSP	Water and Supply Programme
WUAs.	Water User Associations
WUC	Water User Committee

Chapter 1: Background

1.1 Framing of the Research

The Sustainable Development Goal (SDG) target 6.1 aims "*by 2030 to achieve universal and equitable access to safe and affordable drinking water for all*" (World Health Organisation/ United Nations Children's Fund, 2017, p. 6). According to the World Health Organisation (WHO)/ United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) report in 2017, the indicator for SDG target 6.1 focuses on the proportion of the population using a safely managed drinking water service. Global figures in 2022 show that 2.2 billion people across the world do not have access to a safely managed drinking water service (WHO/UNICEF, 2023). Within this global crisis, 703 million lack at least a basic water service (WHO/UNICEF, 2023), where basic water service is provided by an "*improved source provided collection time is not more than 30 minutes for a roundtrip to collect water, including queuing*" (WHO/UNICEF, 2017, p.12). The situation is dire in Sub Saharan Africa (SSA) where more than half of those that lack basic water services reside (408 million) (WHO/UNICEF, 2023).

Water supply delivery models can be categorised as centralised, decentralised or self-supply (Bhatnagar, 2017). For communities, centralised and decentralised models are mostly employed. In centralised water supply delivery systems, water at the source is treated at a single facility and distributed to users (Wilderer and Schreff, 2000; Galada *et al.*, 2014) mainly in densely populated urban areas. The costs of planning, design and construction in centralised water systems are high and not feasible to provide water services to scattered areas in the developing world (Wilderer and Schreff, 2000; Galada *et al.*, 2014). In such areas, decentralised solutions are recommended (Galada *et al.*, 2014). In decentralised water delivery models, water is treated at network of smaller, individual facilities (Galada *et al.*, 2014). Technologies used in decentralised services include communally shared handpumps, gravity fed systems, protected springs, protected dug wells, communal water kiosks among others. Of those, shared handpumps are mostly used in rural areas and Small Water Enterprises (SWEs) are increasingly being used as an extension of services in market centres (can be a mix of urban and rural)

1.2 Characterisation of 'Rural' in Water Supply

The characterisation of what is deemed rural in terms of water supply has often been generalised. The difficulty comes from the binary characterisation by the JMP for water, sanitation and hygiene (WASH) in which location is mainly categorised as either rural or urban (Adank, 2013). In-between these two categories are emergent towns or market towns often referred to as small towns in the WASH sector (Adank, 2013). The World Bank Water and Supply Programme (WSP) define small towns as,

> "*Settlements that are sufficiently large and dense to benefit from the economies of scale offered by piped systems, but too small and dispersed to be efficiently managed by a conventional urban water utility. They require formal management arrangements, a legal basis for ownership and management, and the ability to expand to meet the growing demand for water. Small towns usually have populations between 5,000 and 50,000 but can be larger or smalle*r"(WSP, 2003, p. 3)

Small towns depict a mix between rural and urban characteristics. They are characterised by the core trading centres and relatively scattered settlements around the core (commercial zone) (Mugabi and Njiru, 2006). Usually, the core trading centre reflects urban characteristics, while the peripheral area tends to be rural (Mugabi and Njiru, 2006). In other countries such as Uganda, small towns are differentiated with those consisting of 5000 to 50 000 people referred to as urban and those with 1000 to 5000 people referred to as rural growth points (Wood, 2000). Even in countries such as Zimbabwe different thresholds are used to determine small towns with the term growth points and small towns often used interchangeably (Manyanhaire, Rwafa and Mutangadura, 2011), and in other studies they are referred to as rural markets. As such, within the rural water sector literature, there is much heterogeneity on what is referred to as rural (Moriarty *et al.*, 2013). The dilemma is made more complicated in studies that interchangeably use the terms rural and small towns within a similar study (see Whittington *et al.*, 1989).

1.3 Sustainability Challenges in Decentralised Rural Water Services

Multiple factors influence the sustainability of rural water services, and these include technical, social, institutional, environmental and financial factors (Walters and Javernick Will, 2015). Of those, financial factors have been found to be critical (Cater, Harvey and Casey, 2010), in particular, the community financing of operation and maintenance (O&M) costs has been found to be a precondition for sustainability (Cater, Harvey and Casey, 2010, Forster and Hope, 2017). The financing of O&M challenge is widely reported under handpumps. Research undertaken in SSA reveals poor revenue collection by Water Point Committees (WPC) and non-compliance with payments by users (Carter, Harvey and Casey, 2010; Foster, 2013; Foster and Hope, 2016).

The financial challenges experienced under communally managed shared handpumps highlight much of the debate in rural drinking water supply literature where two views on the appropriateness of charging tariffs to the poor dominate. One focuses on the morality of user fees and its health implications to the poor (Null *et al.*, 2012; Chowns, 2015). Such literature argues that tariff payments regardless of amount, results in users failing to access clean water (Null *et al.*, 2012). In addition to the above, tariffs are contrary to other sectors such as health and education which offer services for free (Chowns, 2015). Tariffs also are a leading cause of class struggles within the community, where the elite benefit from such arrangements (Chowns, 2015). Above all, rural incomes are low, and users are faced with stringent budget constraints that affect affordability. Payment of water services should not prevent users from accessing water services (UN, 2018; Truslove *et al.*, 2020).

The opposing view mainly led by practitioner driven literature sponsored by the World Bank and other neo-liberal centred institutions cautions against the assumption that rural users are too poor to make payments (even a small amount) (Maji, 2020). Providing a glimmer of the situation, Brown and Van Den Broek (2020) in Uganda found a situation where users would choose to buy beers rather than pay for access to clean and safe water. Evidence is mounting from studies showing that affordability might not be a major hindrance to payment (Nyarko, Oduro-Kwarteng and Adama, 2007; Kumasi and Agbemor, 2018). Even so, rural users are already paying high prices for substandard services (Hope *et al.*, 2020; Maji, 2020). In addition, communities have institutional arrangements of providing relief to the disadvantaged (Cleaver, 2012). Using this empirical evidence, supporters of the community financing policy have

argued that water user payments can be unlocked by creating value (Hope *et al.*, 2020; Hope and Ballon, 2021), that is, creating water services that rural users are willing and able to pay for (Hope and Ballon, 2019). As such in small rural towns, where users are expected to have some sort of income and demand improved water services, SWE are expected to be financially viable, thus providing better services and filling the water supply gap.

1.4 Problem Statement

SWEs (herein communal water kiosks) are critical in providing clean safe water in unserved and underserved areas (Opryszko *et al.*, 2009; Sima and Elimelech, 2013). Research has shown that they provide improved services (represented by water service attributes) (Opryszko *et al.*, 2009; Kapulu and Tembo, 2014; Cherunya, Janezic and Leuchner, 2015). Increasingly they are being used in rural areas (Huttinger *et al.*, 2017), including small rural towns (herein rural trading areas) (see Whittington *et al.*, 1989). However, demand is inconsistent (Contzen and Marks, 2018; Hope *et al.*, 2020; Hoque, 2023) which represents inconsistent willingness to pay for an improved water service (Maji, 2020). Inconsistent payments at water kiosks affects their financial and operational sustainability, risking the health and welfare of users (Hunter, Zmirou-Navier and Hartemann, 2009; Adams, 2018). Considering that water payments depend on the level of water services (Koehler, Thomson and Hope, 2015; Hope and Ballon, 2019; Hope *et al.*, 2020), this led to the overall research question, ***why are household user payments at communal water kiosks in rural trading areas inconsistent***?

Insights into the overall research question requires understanding of payment behaviours at an improved water service model. This study employs two separate strands of literature. The first strand identifies factors that influence payments (Hanatani and Fuse, 2012; Naiga and Penker, 2014; Foster and Hope, 2016) and the other identifies the attributes of drinking water services (Moriarty *et al.*, 2011; WHO/UNICEF, 2017). However, these strands remain fragmented. The interaction between the factors that influence payments and attributes of drinking water services have not been considered. Furthermore, insights into their dynamic interaction have also not been considered. Dynamic interaction of factors that influence payments and attributes of drinking water services produce feedback mechanisms that ultimately drive payment behaviours. As it stands, no theory explains and provides insights into this dynamic payment behaviour process. Capturing insights into the dynamic ways in which factors influence

payment for water and attributes of drinking water services is critical considering the finding in rural water supply literature that water issues are dynamic and systemic in nature (Walters and Javernick-Will, 2015; Valcourt *et al.*, 2020).

1.5 Research Aim and Questions

The aim of the study is to develop a model that explains and provides insights into dynamic payment behaviours at communal water kiosks in rural trading areas. This aim seeks to answer the overall research question, ***why are household user payments at communal water kiosks in rural trading areas inconsistent***?

The objective of the work is:

- To understand:
    - The factors that influence payment for water and
    - The attributes of drinking water services at water kiosks
- Develop a model that combines the above to explain dynamic payment behaviours at communal water kiosks in rural trading areas
- Use the model to help identify interventions to support consistent and sustainable payments for water

To commence the research, the researcher was initially guided by the following research questions:

1. What factors influence payment for water?
2. What are the attributes of drinking water services at water kiosks?

After using these questions to guide the literature review, further detailed research questions are presented in section 3.6.

1.6 Significance of the Study

The study is significant in that understanding payment behaviours help in getting insights into the lingering question in rural water supply on whether investing in improved shared water service models that provide reliable services will be able to elicit higher and more regular

payments (Hope and Ballon, 2019). This is critical because the lack of funds to cater for O&M costs in SSA poses a major threat to the achievement of SDG 6 (Foster, 2017). Furthermore, insights into payment behaviours can enable policy makers to make informed decisions for water infrastructure investment to meet 2030 targets. Such a decision is critical mainly because of evidence showing that rural users prefer and can afford safely managed drinking water services (Whittington *et al.*, 1989) and that urban users pay less than rural (Hope *et al.*, 2020). In addition to the above, understanding payment behaviours give water practitioners the chance to identify incentives for user payments (Hope and Ballon, 2019). The importance of identifying incentives for user payment is clearly illustrated by Hope and Ballon (2019, p. 2) who argue that,

"*Without improved understanding of what may incentivise user payments, public investments in infrastructure may provide limited financial returns and transient social impacts, which may partly explain the unsatisfactory progress achieved in rural water security in rural Africa to date*".

As such, research into payment behaviours can help in identifying viable approaches that unlocks user payments critical for the sustainability of water systems (Marshall *et al.*, 2023). Understanding payment behaviours also provides policy makers and water practitioners with a lens to determine what users value, thus informing their thinking and funding (Hope and Ballon, 2019).

1.7 Structure of the Study

The study consists of nine chapters. This introductory first chapter is followed by the following chapters.

Chapter 2 reviews SWE. The chapter identifies the challenge of inconsistent payments at communal water kiosks which affects their financial sustainability and ultimately their operations. The chapter continues by identifying the factors that influence payment for water drawing from theories and frameworks from collective action and common pool resource (CPR) literature and then identifies the attributes of drinking water service. Gaps in the literature are then highlighted.

Chapter 3 builds from the previous Chapter 2. In Chapter 2, key literature strands were found to be fragmented to capture the dynamic ways in which factors that influence collective water payments and attributes of drinking water service interact to drive payment behaviours. This chapter takes a systems thinking perspective and employs causal loop diagrams (CLDs), as an approach to bring these strands together and develop a conceptual model. The chapter is organised as follows; firstly, the chapter introduces the concept of systems thinking, then reviews its application in rural water supply. This is followed by the development of a conceptual model explaining payment behaviours at communal water kiosks from literature. This model is made up of feedback loops and resulting propositions that are deemed to be of theoretical relevance.

Chapter 4 provides the research methodology. This chapter begins by presenting a research philosophy to position the philosophical underpinning of the study. This is followed by a research design, methods of data collection and data analysis.

Chapter 5 introduces two case studies from Chiringa and Chimbiya schemes in Malawi. This chapter forms part of the empirical investigation. The chapter includes information on institutional arrangements from the two cases (schemes), including management arrangements and the financial performance of the schemes. Financial information provides insights to the amount of revenue collected, which is an indicator of the level of payment at a scheme.

Chapter 6 tests, amends, and extends the feedback loops and resulting propositions developed from the model in Chapter 3 based on the two case studies. The chapter begins with an introduction that provides context. Various feedback loops and resulting propositions representing existing themes that make up the propositions from the model in Chapter 3 are then tested, amended, and extended using empirical evidence from semi-structured interviews. The chapter also identifies other feedback loops and resulting propositions (emerging themes) inductively using textual data from the semi-structured interviews. The chapter ends with a model that explains and provide insights into dynamic payment behaviour at communal water kiosks in Malawi.

Chapter 7 builds on Chapter 6 and describes a group session that took place to build confidence in the feedback loops. The sessions involved discussing leverage points and possible

interventions. The chapter begins by providing general information on the confidence-building process. The chapter then discusses and amends propositions that result from the feedback loops as informed by data from the group sessions. Interventions suggested by group participants are also presented along with the impact they may have on the feedback loops.

Chapter 8 compares research findings with existing literature. This chapter also evaluates research findings in relation to the research questions.

Chapter 9 concludes the thesis. The chapter includes summary of the research and research contributions. The chapter also provides policy implications. This is followed by limitations of the study and the chapter ends with opportunities for future research.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews literature in areas of rural SWE, and the associated collective payment for water and drinking water services. This chapter is organised as follows; firstly, the chapter provides an overview on payment for water services in rural developing countries, focusing particularly on rural Africa. The chapter then introduces SWEs and reviews water kiosks in detail and highlights the challenge of inconsistent payments which affects their financial sustainability and ultimately their operations. To understand this challenge, the chapter identifies factors that influence payment for water drawing from theories and frameworks from collective action and CPR literature. The chapter also identifies literature on attributes of drinking water services. By evaluating these strands of literature, this chapter highlights gaps in literature.

2.2 Payment for Water in Rural Developing Countries

Non-compliance with water payments in rural developing countries is rampant (Mohanty and Rout, 2023). The challenge is widely reported in rural SSA (see Chowns, 2015; Forster and Hope, 2016). As mentioned, the issue is mainly reported under handpumps, with studies revealing rampant noncompliance under various payment models (Chowns, 2015; Forster and Hope, 2016). At one time a study in five SSA countries on 92 594 handpumps revealed extensive non collection of revenue by WPC (Carter, Harvey and Casey, 2010; Forster, 2013). Evidence from Malawi, shows that very little is saved from revenue collections (Chowns, 2015), in Uganda, regular water payments occur at fewer than 10 per cent of water points (Marshall, Guenther and Delaire, 2021) and in Ghana 87 per cent of people were not willing to pay for water (Kumasi and Agbemor, 2018), with one of the main reasons being the lack of capacity by community organizations to run these schemes (Chowns, 2015). However, even under professional management and maintenance, compliance with water payments under handpumps is low (Brown and Van Den Broek, 2020) and reduces with time (Smith *et al*., 2023). As mentioned, other studies call for a need to improve the level of service (see Hope and Ballon, 2019; Hope *et al*., 2020), with SWEs such as kiosks being found to have better services than handpumps. For instance, solar powered water kiosks eliminate the need to

manually pump water by providing water through taps. In doing so they save on queueing time (Wagner *et al*., 2025). Due to the attractiveness of these kiosks, literature on SWEs in particular water kiosks will be discussed in detail in this chapter.

2.3 Small Water Enterprises

SWEs are decentralised solutions that offer high-quality water through market-based approaches (Bhatnagar *et al.*, 2017). SWEs are often referred to by different names in the literature, but key terms used are decentralised membrane-based drinking water refill stations (Sima and Elimelech, 2013) or small-scale independent water providers (Albu and Njiru, 2002; Chidya, Mulwafu and Banda, 2016). According to Opryszko *et al*. (2009), there are different types of SWEs which are often differentiated based on the types of vendors employed. Three categories of vendors are mostly used by the World Bank studies which form a large portion of research in SWEs (Opryszko *et al.*, 2009). These categories are wholesale vendors, distributing vendors and direct vendors (Collignon and Vezina, 2000). Wholesale vendors are best described as vendors who might own a borehole or those that buy water in bulk from private borehole owners or from utilities and resell using trucks to other small-scale vendors (distributing vendors) (Albu and Njiru, 2002). Distributing vendors obtain water from the source or wholesale vendors and they sell directly to the customer usually using door-to-door services (Whittington *et al.*, 1989; Albu and Njiru, 2002). They can also use trucks and since they incur most costs and provide door-to-door services they usually charge more (Snell, 1998). Direct vendors are usually stationary and have customers come to them (Albu and Njiru, 2002). They can be individuals with piped systems that sell water either legally or illegally or in most cases they operate as water kiosks. In Asia and Africa, water kiosks are the most employed direct vendor type of SWEs. For instance, seminal work by Whittington et al. (1989) shows that in some areas, 64 per cent of the total water used in Ukunda village in Kenya was sold by kiosk operators in the rainy season and this figure could be higher in the dry season. Water kiosks are defined as "*stationary water points where water operators oversee container filling and collect payments*" (Huttinger *et al.*, 2017, p. 2). They can be divided into two categories, namely those that operate as extensions to public utilities and those that are connected to community-owned sources (herein communal water kiosks). This study focuses on communal water kiosks as they are the ones found mostly in rural Africa (see Huttinger *et al.*, 2017). In literature, they can also be referred to as safe water kiosks (see Contzen and Marks, 2018) or

safe water enterprise kiosks (Cherunya, Janezic and Leuchner, 2015), however, this study will use the term communal water kiosks. Some water kiosks come with water treatment devices ranging from simple sand filters to more advanced systems such as UV lights (see Opryszko *et al.*, 2013), while others are solitary standposts with no treatment of water (Opryszko *et al.*, 2009).

2.3.1 Water Kiosks

Water kiosks are viewed as an appropriate and cost-effective solution to the provision of water supply and sanitation in low-income areas where it is not economically sound to provide centralised systems or in areas where it can take longer to construct a water network (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2013). The cost-effectiveness of kiosks is due to them not requiring upfront connection costs compared to centralised systems (Opryszko *et al.*, 2009). Water kiosks incur lower costs per capita, low maintenance, short construction times and independence from utilities such as energy (GIZ, 2013). Furthermore, they are affordable and can be applied in both urban and rural areas (Opryszko *et al.*, 2009; Kapulu and Tembo, 2014). In addition to the above, they are adaptable to variable (seasonal) incomes in rural areas, as users are not tied to fixed monthly commitments (Whittington *et al.*, 1989). Above all, they are assumed to be financially sustainable (Sima and Elimelech, 2013). The presumed financial sustainability of kiosks is illustrated in projects such as Project Maji providing kiosks in rural Kenya and Ghana. Project Maji has the following mission statement,

"*We typically serve rural communities of less than a thousand people, as well as rural growth centres with a population ranging between 2,500 to 3,500 people. Our model is demand-driven, and we see villagers as consumers, willing and able to pay a fair price for water. The price is agreed on by the community through an inclusive consultation process. This modest charge is collected through an automated e-payment system that supports accountability and sustainability of operations. It covers operating expenses, technical support, and a reserve fund for long-term repairs. This makes each Maji cube self-sustaining after the capital investment is made*" (Maji, 2020)

The following are some of the practitioner-led studies supporting the financial sustainability of kiosks. These include studies by Whittington et al. (1989); Sima and Elimilech (2012) and Bhatnagar *et al*. (2017). These are explained below.

One of the seminal works in kiosks was sponsored by the World Bank and carried out by Whittington et al. (1989) in Kenya. In their study, one of the questions they investigated was whether vending was an appropriate system. To collect data, the study employed observations, interviews with vendors, and kiosk owners and mapping out vendor routes in Ukunda village. Ukunda village has an economy representative of many small provincial centres and heavily influenced by proximity to luxury tourist hotels. Their findings showed that both the vendor and kiosk owners were receiving adequate incomes without making exorbitant profits, thus demystifying the idea of a monopoly which would require government regulation. They argue that the vending system should be left to market forces. Another finding from the study was that the number of payments paid to kiosk owners and vendors shows that households can afford piped distributions which they are usually assumed not to afford. They went on to argue that the fact that piped systems to the household do not exist in this village is due to the government's lack of planning and not the unwillingness of the users to pay the cost of an improved service. Findings from this study are supported in a conceptual paper by Albu and Njiru (2002) where they illustrate the usefulness of SWEs operating under a conducive regulatory environment provided by utilities. They argue that the provision of water under this model is a win-win situation in that poor households can have access to a basic water service, which is affordable and has advantages for children and women who are the main users of water. On the other hand, the providers of water (vendors) can have incomes that secure their livelihoods and encourages them to be innovative and have a higher social status.

Sima and Elimech (2013) explored the potential for membrane-based drinking water treatment and refill stations (herein kiosks). One of the questions investigated by their study was whether kiosks can serve low-income areas while making a profit. Their study reviewed literature in developing countries and argued that kiosks can provide affordable water to consumers while still being profitable for operators. Their argument is based on the possibility of pricing kiosks at levels that can match daily labour wage. In doing so, consumers can have income to pay for water at the kiosks incrementally (such as daily). They used an example of the approach developed by Procter & Gamble and Unilever, where they designed one-time use micro packs of necessities which included soaps and shampoos. Even though the cost per volume was high,

the small incremental price (where soaps and shampoos are priced based on variable costs not the overall costs) was found to be affordable to the poor in countries such as India. In fact, the sale of shampoos in sachets in India is more profitable than in the United States of America market. In the same way the ability to pay for water incrementally could be more affordable to the poor who have no savings to improve the quality of their water or pay upfront costs for the provision of piped water directly to their households.

In another study, Bhatnagar *et al*. (2017) investigated 14 SWEs in Africa, Asia and Latin America to establish the scale of the market SWEs can realistically serve and recommendations on how to overcome challenges affecting their scale. Using the figure of 3.8 billion for those who lack access to safe and sustainable water services, the study found that SWEs have the potential to be part of the drinking water access solution on a global scale while at the same time being a cost-effective mechanism to serve the poor. The study estimated that an annual total cost of $65.9 billion is needed to serve 3.8 billion people who lack access to safe and sustainable water services at the time. This amount can cover both operating costs and fully amortised capital expenses. Furthermore, the study found the majority of this $65.9 billion can be covered by affordable user fees averaging three per cent of incomes as approved by the WHO/UNICEF. The study also found that of the 3.8 billion people, 2.16 billion are expected to have the ability to pay for safe water without subsidies, while an estimated 1.7 billion would need partial subsidies. These 1.7 billion people would need an estimated total annual amount of $14.4 billion which represents $8.50 of annual subsidy per person. These figures from the study show the potential that kiosks have in that, most of the costs can be covered by affordable tariffs.

Kiosks have many advantages as detailed above. In terms of operations, their main advantage is assumed to be the ability to be financially sustainable which is a critical component of water points and a precondition of overall sustainability (Carter, Harvey and Casey, 2010). The financial sustainability of kiosks stems from the idea that household users are assumed to demand and value improved water services (quality, quantity, accessibility, and reliability from the kiosks), for which they are willing to pay even higher prices (Cherunya, Janezic and Leuchner, 2015). As quoted by Whittington et al. (1989, p. 167) in reference to payment for water at kiosks, "*people in some rural villages are willing and able to pay substantial amounts of money for water, even when traditional sources are readily available*". Even so, the argument can be more relevant at trading centres (growth centres) which represent an increase in living

standards compared to traditional rural areas, where demand for improved water service is assumed to be higher (Moriarty *et al.*, 2013). Yet, such assertions are predominant in practitioner-led literature and articles from national and international organisations that are internally peer-reviewed (see some of the articles include Whittington *et al.*, 1989; Bhatnagar *et al.*, 2017; Maji, 2020). Evidence on the ground shows inconsistent demand (Contzen and Marks, 2018; Hoque, 2023), representing an inconsistent willingness to pay for improved water services. Figures 2.1 and 2.2 below present graphs from two selected case studies covered in a study by Wagner *et al*. (2025) in rural Mali. These figures show over time fluctuations in monthly payments at the water kiosks. These graphs demonstrate the problematic behaviour encountered with respect to financial sustainability at many water kiosks in Malawi. Considering that most of these communal kiosks are established after pilot studies and agreement with the community that they need the service and will comply with payment arrangements, and that water payments depend on the level of service (Koehler, Thomson and Hope, 2015; Hope *et al.*, 2020) this poses the question, ***why are household user payments at communal water kiosks in rural trading areas inconsistent***? Answering this question is critical to gain a better understanding of payment behaviours at improved water service provision models, especially considering the overwhelming evidence debunking the rival assumption of justifying non-payment mainly due to affordability (Kumasi and Agbemor, 2018; Hoque and Hope, 2020).

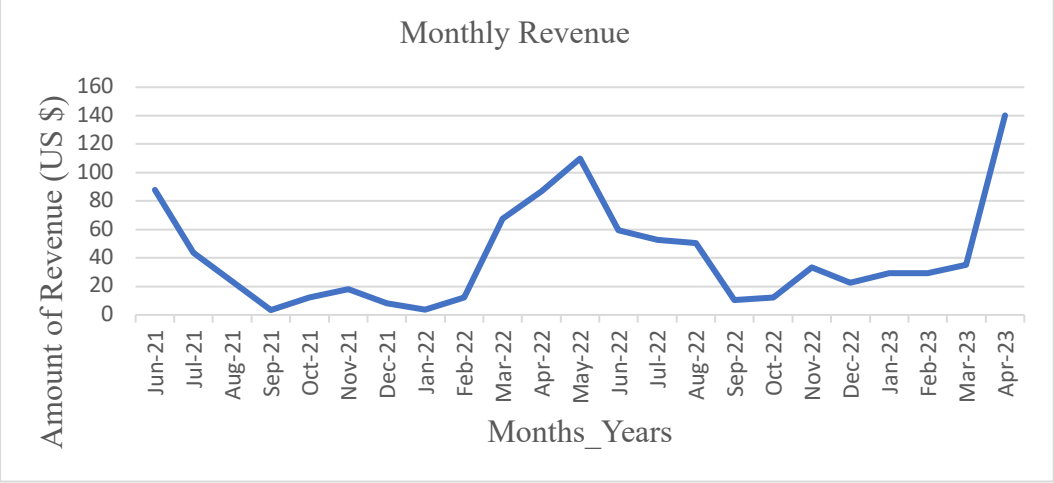


Figure 2. 1: Revenue collections over time in rural Mali (Wagner *et al*., 2025)

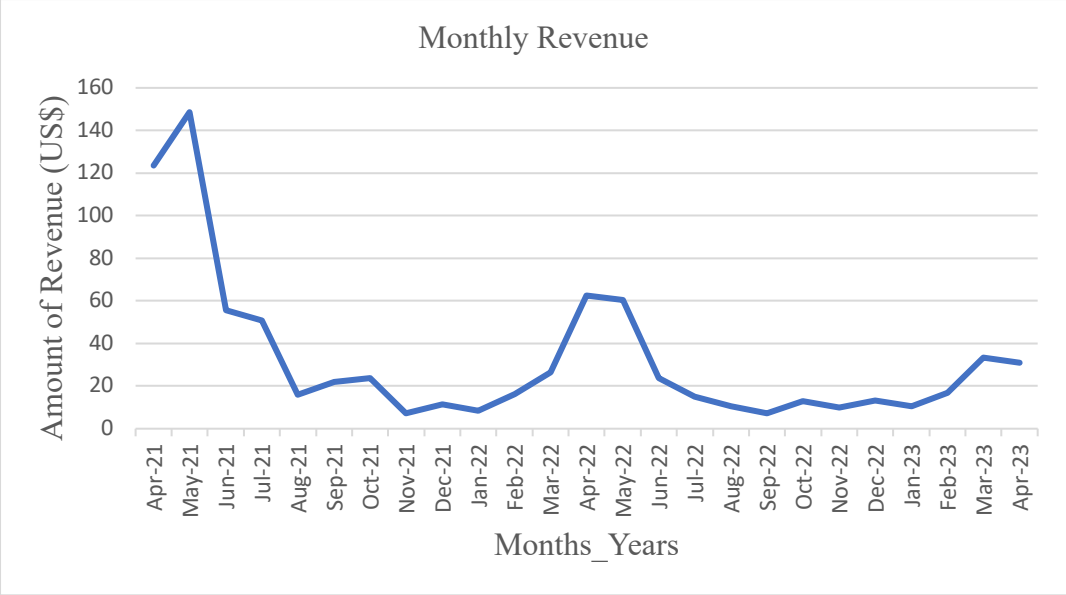


Figure 2. 2: Revenue collections over time in rural Mali (Wagner *et al*., 2025)

Two strands of literature can give initial insights into payment behaviours at an improved water service provision model such as water kiosks. The first strand of literature draws from frameworks and theories in collective action and CPR literature and identifies factors that influence payment for water. This strand answers the question, 1) *what factors influence payment for water?* The second strand identifies the attributes of water services at kiosks that are valued/demanded by households. This strand answers the question 2) *what are the attributes of drinking water services at kiosks*? An analysis of the contributions of both strands and their limitations is provided below.

2. 4 Payment for Water in Rural Water Supply Services

Literature on payment for water has argued that insights and analytical approaches from collective action and CPR literature have the potential to explain why some communities can pay for their water services while others fail (Foster and Hope, 2016; Foster, 2017). Although this literature is not specific to only communal water kiosks, it relates to groundwater which is a CPR (goods that are nonexcludable but there is rivalry (see Ostrom, 1990))and collective action (coming together of communities to manage and make decisions about a resource resulting in collective action situations) (Foster and Hope, 2017), all of which are characteristics of communal water kiosks. Literature on collective action and CPR was first explained by the work of Olson (1965) who argued that unless groups involved in collective

action are small or individuals are coerced, they will act in their self-interest rather than for the common good. Olson (1965) was supported by Hardin (1968) who argued that if communities are left to govern CPR such as groundwater, they go to waste as each actor looks at what is best for them, instead interventions such as privatisation and the state can help to solve social dilemmas (Hardin, 1968). Ostrom's work countered Hardin's (1965) work on the tragedy of the commons and argued that actors are not helpless, and they can come together and develop self-organised institutions (rules) to govern the commons without the need for privatising commons property or imposing state regulations (Ostrom *et al.*, 1994). Ever since, various CPR scholars have come up with variables that drive or hinder groups in the community to self-organise (collective action) and sustainably manage their resources (Agrawal, 2001). These factors have been put together in various frameworks/models in commons literature (see Agrawal, 2001). Literature within rural water supply also began to employ such frameworks to identify factors that influence water payments, where water payments are seen as a collective action process/problem (see Foster and Hope, 2016). These frameworks and theories are explained in detail below.

2.4.1 Frameworks and theories used in Rural Payment for Water Literature

This section provides frameworks and theories employed in rural water payment literature. These frameworks and theories are used to identify factors that influence collective payment for water. However, the frameworks and theories do not drive the study but are used as lenses by various authors to identify and explain payment behaviours in shared community water points.

2.4.1.1 Conceptual Framework for Causal Relationships among Collective Action Variables

A causal model was developed by Stern et al. (2002) to address the difficulty in depicting the possible associations and casual relationships among a plethora of variables identified in the literature to drive or hinder groups' ability to self-organise (collective action) and manage their resources sustainably. Such a framework is assumed to help researchers focus on propositions that are likely to have theoretical significance. Their framework identifies several typologies which are independent, dependent, moderator and intervening.

Independent Variables (interventions)

These are factors that are influenced by policy interventions over the short run. These factors include types of institutional arrangements and technology choice. Examples of such factors can be, use of sanctions to curb free riding and use of solar to power pumps rather than handpumps (technology) (Hanatani and Fuse, 2012).

Dependent Variables (Outcomes)

These are outcomes of collective action. They can include aspects such as resource use efficiency or in this study collective water payments. They are what the community wants to achieve.

Moderator Variables (Contingencies)

These are factors that cannot be altered by short-term policy interventions. They include attributes such characteristics of users. As shown in Figure 2.1 below, they influence how independent variables (interventions) influence intervening variables (mediators) and dependent variables (outcomes).

Intervening Variables (Mediators)

These are factors that directly affect dependent variables (outcomes). These include shared norms, ease/cost of monitoring resource uses and user behaviour, and cost/ease of enforcing rules and sanctions. As shown in Figure 2.3 below, they are influenced by independent variables (interventions) and moderator variables (contingencies).

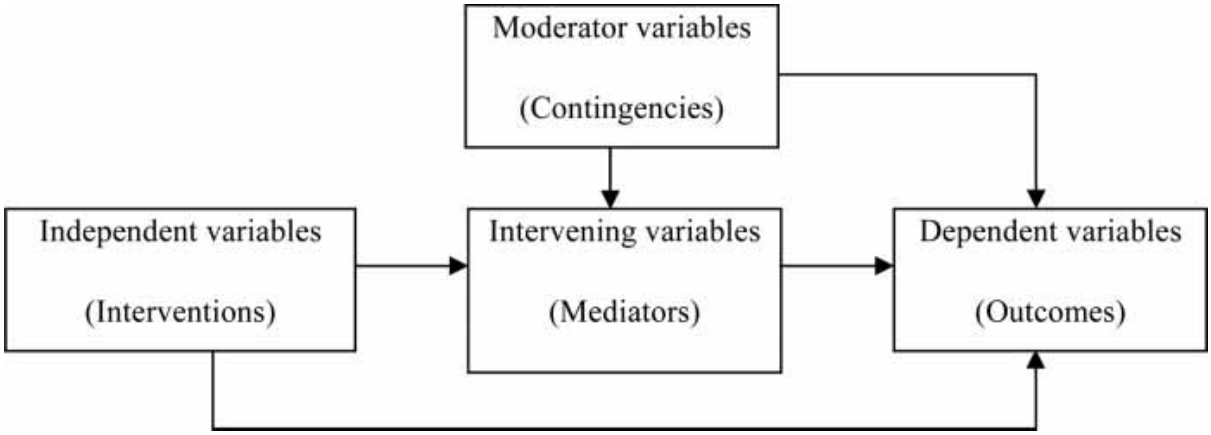


Figure 2. 3: Adapted schematic causal model from Stern et al. (2002) (see Hanatani and Fuse, 2012, p. 133).

To provide clarity on how the framework works, this study gives an example of a collective action problem of over-harvesting in CPR. In such a case the objective (outcome) of the community and/or policy is to ensure sustainable fishing. Such a policy can establish a local committee as an institutional arrangement (independent variable/ intervention variable). A local committee can affect the outcome directly but can also affect resource use behaviour by enforcing rules and sanctions. The cost/ease of enforcing such rules and sanctions (intervening variable/mediators) has a direct effect on fishing (dependent variable/outcome). For instance, if it is difficult and costly to enforce such sanctions, users are likely to overharvest fish. The relationship between the ability of the local committee to enforce rules and sanctions and the cost/ease involved and its impact on fishing is influenced by the characteristics of the resource users (moderator variables/contingencies) such as their behaviour.

2.4.1.1.1 Empirical Applications of the Causal Relationships among Collective Action Variables Framework to Rural Payment for Water

The only study that has applied the framework to rural water payments is Hanatani and Fuse (2012). Their study did not employ the framework in its entirety but focused mainly on intervening (mediators) variables and their influence on water tariff contribution. They argued that, unlike other variables in the framework, intervening (mediators) variables are subjective perceptions/judgements of a situation surrounding resource use and management. As such they fit with the aim of their study which is to investigate what motivates resource users to contribute financially to the management of water supply system infrastructure. Their reason for researching this question is based on the gap in literature where the true perceptions of users

and what motivates them to engage in collective action for CPR management remained under-researched. They also argue that much work has been done to investigate the effect independent and moderator variables have on resource management outcomes (collective action outcomes) but less has been done on intervening variables. As such, their study utilised water tariff contribution as the dependent variable along with three intervening variables; attitudes towards water (preference for borehole water and satisfaction with current water), cooperative benefits (long-term benefit and communal benefit), perceived sanctions and peer trust (on current and future payments). Other variables (moderator and independent variables) considered for the robustness of the model were households' expenditure per person, private water connection and management arrangements. All the variables (intervening, moderator and independent) were employed from commons literature. Their study analysed survey data from management committees and on households in 200 compounds (houses) at 10 sites in rural southern Senegal that use communally shared borehole water supplied by motorised pumps. The survey on management committees involved members of the management committees, while for households the survey was administered to heads of the house who were encouraged to be accompanied by a married female member since women are the main collectors of water in African households. First, descriptive statistics were used, followed by t-tests, chi-square tests and logistic regression analysis. The logistic regression examined the effect of explanatory variables (in this case the intervening variables) on water tariff contribution and the results showed that preference for borehole water use and satisfaction with the current water supply are strong predictors of water payments net of other factors. Furthermore, having trust in others to pay fees is also a determinant of water payments. Other factors were not related to water payments when controlled for other variables. These findings implied that, to motivate users to contribute tariffs there is a need to provide water services in a preferred and satisfactory way. Furthermore, there is a need for trust among peers that others are also paying for water.

2.4.1.2 The Social-Ecological System Framework

The Social-ecological system framework (SESF) (Ostrom, 2007; Ostrom and Cox, 2010; McGinnis and Ostrom, 2014) was developed to tackle two main challenges in CPR management. The first challenge is that CPR management involves the interaction of two different fields of study (social and ecological systems) that employ different languages and methods (Foster and Hope, 2016). The second challenge relates to the difficulty in handling

huge numbers of variables that influence the ability of communities to self-organise (collective action) and sustainably manage their resources (Agrawal, 2003). In addition, there is no agreement on which these variables are, thus making it difficult to develop a meta theory that can be applied across disciplines (Ostrom, 2007). As such, SESF was created to provide a list of variables that may be interacting and affecting outcomes in social-ecological systems (SES) (Partelow, 2018). The SESF can be broken down into multiple conceptual tiers and linkages among variables that constitute SES (Ostrom, 2007). The highest conceptual tier shown in Figure 2.4 consists of the focal point which provides variables of the resource system (RS), resource units (RU) generated by the system, actors (A), the governance system (GS) and an action situation. In action situations, individuals interact (I) with one another and thereby jointly affect outcomes (O) that are differently valued by those actors (McGinnis and Ostrom, 2014). Resource users (A) *extract* (I) resource units from the resource system (RU, RS), and in doing so they provide for *maintenance* (O) under a set of rules determined by a presiding governance system (GS) (MacGinnis and Ostrom, 2014). This process happens within a related ecosystem and broader social, political, and economic setting (McGinnis and Ostrom, 2014). To illustrate using an example in rural water service delivery, household users (A), extract/access (I) drinking water from a water point which is the infrastructure used to draw groundwater (RU, RS). In doing so they pay a tariff for maintenance (O) under the kiosk management model to a WPC member/ operator (GS). The tier I variables (RS, RU, GS, A) are relatively separable and they can affect the action situation, jointly or individually as shown in Figure 2.4. However, the action situation may produce consequences that may feedback/ spread to the variables. For instance, using our previous example in rural water service delivery, the process collection of drinking water from the water point and paying for maintenance to ensure the functionality of the water point (action situation), can lead to fewer people using the water (this represents feedback to the number of actors) or if too many actors participate in the process at a particular water point this can lead to over-abstraction of water (feedback to the resource system). Both outcomes have dire consequences such as conflicts (see Brown and Van Den Broek, 2020). The focal point of the SES can be viewed as a separable whole but can be influenced by exogenous factors from a related ecosystem and broader social, political, and economic setting which may affect a component of the SES (McGinnis and Ostrom, 2014). It is important to note that the concept of feedback in SES using the SESF has been elaborated, extended and improved by other studies (see Kopainsky, Huber and Pedercini, 2015).

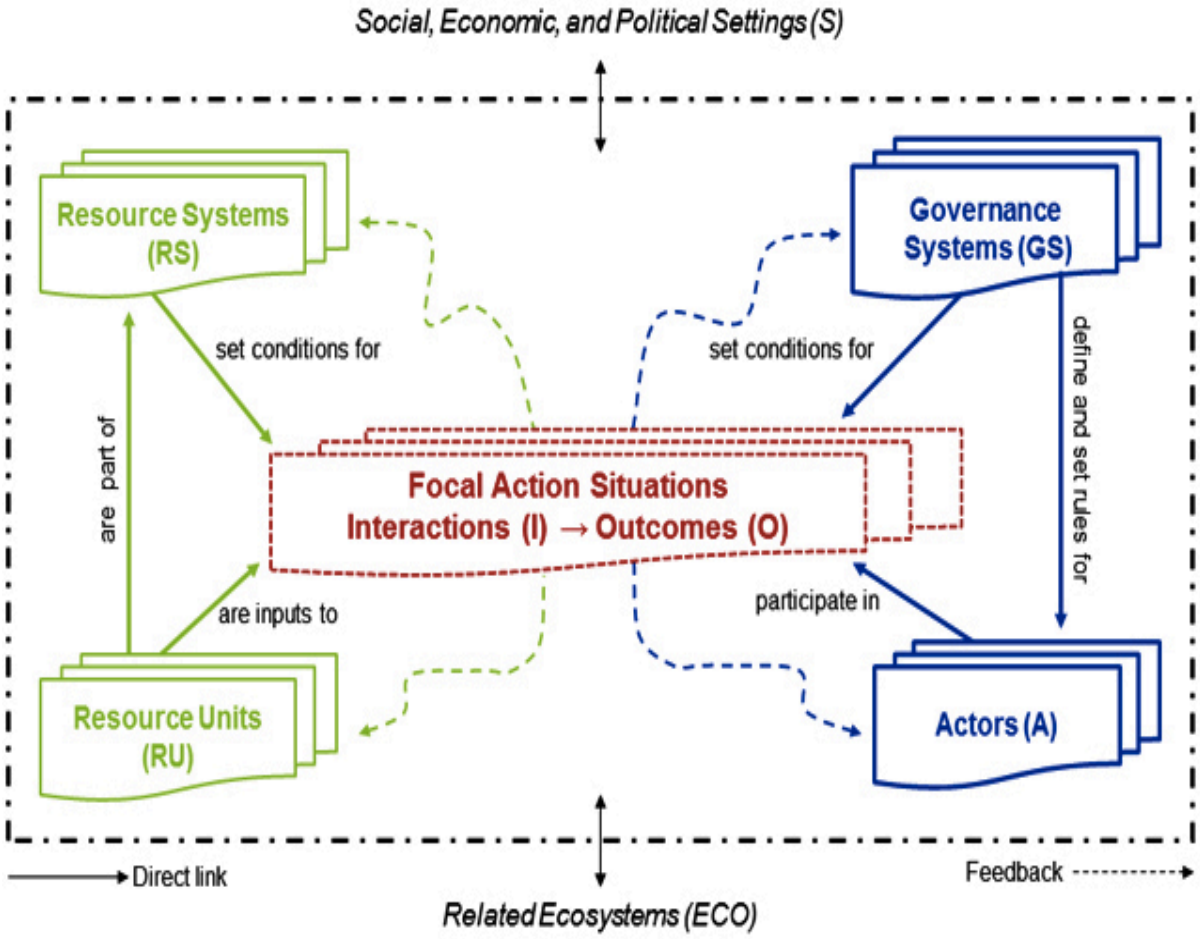


Figure 2. 4: Multiple first-tier components of the SESF (McGinnis & Ostrom 2014, p.4)

Each of the focal variables in tier 1 can be decomposed into multiple second-tier variables shown in Table 2.1. Second-tier variables are used to provide an extensive list of variables that influence action situations. For instance, the action situation (the process of accessing water and paying for maintenance to ensure that a water point functions well) can be influenced by the average distance between the water point and households (RS9) as the closer the distance the more the usage and payments (Naiga and Penker, 2014). Furthermore, the action situation can also be influenced by the socioeconomic attributes of the actors (A2) as females are expected to be more likely to pay for water than males (Naiga and Penker, 2014).

Table 2. 1: Second-tier variables of the SESF (McGinnis & Ostrom 2014, p. 5)

First-tier variable	Second-tier variables
Social, economic, and political settings (S)	S1 – Economic development
	S2 – Demographic trends
	S3 – Political stability
	S4 – Other governance systems
	S5 – Markets
	S6 – Media organizations
	S7 – Technology
Resource systems (RS)	RS1 – Sector (e.g., water, forests, pasture, fish)
	RS2 – Clarity of system boundaries
	RS3 – Size of resource system
	RS4 – Human-constructed facilities
	RS5 – Productivity of system
	RS6 – Equilibrium properties
	RS7 – Predictability of system dynamics
	RS8 – Storage characteristics
	RS9 – Location
Governance systems (GS)	GS1 – Government organizations
	GS2 – Nongovernment organizations
	GS3 – Network structure
	GS4 – Property-rights systems
	GS5 – Operational-choice rules
	GS6 – Collective-choice rules
	GS7 – Constitutional-choice rules
	GS8 – Monitoring and sanctioning rules
Resource units (RU)	RU1 – Resource unit mobility
	RU2 – Growth or replacement rate
	RU3 – Interaction among resource units
	RU4 – Economic value
	RU5 – Number of units
	RU6 – Distinctive characteristics
	RU7 – Spatial and temporal distribution
Actors (A)	A1 – Number of relevant actors
	A2 – Socioeconomic attributes
	A3 – History or past experiences
	A4 – Location
	A5 – Leadership/entrepreneurship
	A6 – Norms (trust-reciprocity)/social capital
	A7 – Knowledge of SES/mental models
	A8 – Importance of resource (dependence)
	A9 – Technologies available
Action situations: Interactions (I) → Outcomes (O)	I1 – Harvesting
	I2 – Information sharing
	I3 – Deliberation processes
	I4 – Conflicts
	I5 – Investment activities
	I6 – Lobbying activities
	I7 – Self-organizing activities
	I8 – Networking activities
	I9 – Monitoring activities
	I10 – Evaluative activities
	O1 – Social performance measures (e.g., efficiency, equity, accountability, sustainability)
	O2 – Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)
	O3 – Externalities to other SESs
Related ecosystems (ECO)	ECO1 – Climate patterns
	ECO2 – Pollution patterns
	ECO3 – Flows into and out of focal SES

2.4.1.2.1 Empirical Applications of the SESF in Relation to Payment for Water

The framework has been used to identify second-tier variables hypothesized to influence payment compliance as guided by rural water services literature. These are summarised and shown in Table 2.2 below. Only two studies applied the framework to identify and analyse the factors that influence water payments, and these are Naiga and Penker (2014) and Forster and Hope (2016). These studies are explained below.

Naiga and Penker (2014) is the first study to employ the SESF to explain water payment behaviours. Their study investigated the determinants of users' willingness to contribute to safe water provision in rural Uganda. First, before the structured interviews, the study carried out 19 exploratory interviews with representatives from all governance levels from the ministry, district and the local level, with three focus groups also carried out with male and female water users. This was done to ensure alignment with the context in rural Uganda. The study found that all the factors from this process were also part of the SESF list (see Table 2.2 below) and confirmed by commons literature, thus the SESF was used to identify factors influencing local water user contributions towards O&M and guide analysis. The factors found were characterised as institutional, biophysical, and demographic. Their study had two aims, which are (i) to establish if there is a link between actual contribution and willingness to contribute and (ii) to test if these factors increase or decrease the probability of users' willingness to contribute. Using a questionnaire and interviews, data was collected from 802 households and 50 water user committee (WUC) members in western Uganda. To answer the question on whether there is a link between actual contribution and willingness to contribute, their study used the Pearson Chi-square test to establish interdependence between categorical variables (willingness and actual contributions within a period of 6 months). The results of the test showed a highly significant relationship between the two variables. The likelihood to pay (actual payments) was found to be 19.6 times higher if the user is willing to contribute, compared to when they are not. To answer the second question, where the factors were identified by the SESF, a binary logit model was used to quantify the effects of these explanatory variables on the probability of users contributing towards O&M. On institutional variables, a lack of community participation in water-related activities such as decision-making reduces the probability to contribute by 0.213 times. Furthermore, both unawareness of WUC roles and responsibilities and mistrust of WUC by households with how they handle finances reduced the likelihood to contribute by 0.268 and 0.393 times respectively. The higher per centage drop in contribution of funds of 0.393 (39.3 per cent) highlights the importance of trust on water payments. The presence of women in WUC was found to increase the likelihood to contribute by 2.7 times. In the biophysical category, shorter distances between households and water points positively influenced willingness to contribute. Users close to water points are more likely to be willing to contribute towards O&M by 2.5 times. The last category included demographic factors. Their study found female users to be four times more willing to contribute than men. This is because women are the main users of the water. Furthermore, subsistence farmers (water users who farm produce for home consumption) were less likely to contribute

towards O&M by 0.304 times because they were mostly associated with less income. Their study concluded that the clear existence of a link between willingness to contribute and actual payments provides hope for water service delivery in Uganda which relies mostly on community financing through user fees. However, it is important to note that other studies in rural Uganda found the willingness to pay and actual payment to change with time and to be influenced by other social and institutional factors (see Brown and Van Den Broek, 2020) which the study by Naiga and Penker (2014) did not take into account in detail. The study by Naiga and Penker (2014) also concludes that the identification of factors that increase or decrease the likelihood of contributing provides points of intervention for policymakers.

The study by Naiga and Penker (2014) was followed by Forster and Hope (2016). Forster and Hope (2016) argue that insights and analytical approaches from collective action and CPR literature has the potential to give insights into payment behaviours. They went on to identify the SESF as a framework within these strands that has the potential to explain payment behaviours. Their selection of this framework was guided by the finding that community water points are part of the social and hydrological (ecological) systems. Therefore, they used the SESF to guide their research question, including, "*which factors pertaining to the resource system, resource units, government system, user (actors) and related system predicts collective payment rates*" (Foster and Hope, 2016) (see Table 2.1 above). The SESF was also used to guide the selection and classification of variables across subsystems. The study was carried out in Kwale County South coast of Kenya where 82 per cent of the people living in the County are poor rural dwellers. A household survey on 3233 households was carried out and water committee financial records were obtained from committees on 518 community water points fitted with Afridev Handpumps. Their study employed multivariate regression analyses to examine the effect of explanatory variables on the dependent variable (collective payment rate). The generalised estimating equation (GEE) technique was used to account for the correlation between recurring monthly observations for each water point to avoid undermining the multivariate regression. Since monthly contributions were the main revenue collection approach, the regression ended up covering only 44 water points and 309 surveyed households. The findings of the study confirmed using empirical evidence that non-payment and late payments were rampant. The factors that predicated/determined collective water payments were found across only three subsystems of the SESF which are the resource system, resource units and related ecosystem. These determinants were analysed with reference to willingness to pay. In terms of the resource system, the study found that aggressive groundwater can induce

corrosion from pipes affecting the potential hydrogen of water and other attributes such as taste, to have an impact on willingness to pay. Under the resource unit, the study found the distance between water points and households influenced willingness to pay. Households would not want to bear the burden to travel long distances to fetch water (McGinnis and Ostrom, 2014), as such the shorter the distance the more likely households will pay. Under resource units, the study found that water taste impacts willingness to pay. When water is not palatable, users are unlikely to pay (Forster, 2013). Furthermore, under the resource system, the study also found that productive water uses have an impact on willingness to pay. The study argues that their finding falls under the water pays for water hypothesis, where income from water-generating projects is assumed to increase the ability of users to pay. With regards to related ecosystems, the study found water users are less likely to pay during the wet season when they have access to alternative sources from rainfall abundance. During the wet season, the relative value of the water point diminishes. The identification of the factors relating to the resource system, resource units, government system, user (actors) and related system that predicts collective payment rates shows that payment behaviours reflect a socio-ecological process in rural SSA.

Table 2. 2: Second-tier hypothesised factors that influence water payments from Naiga and Penker (2014) and Forster and Hope (2016)

SES Component	Second-tier variables from SESF	Adapted variables used in the studies	Citation
Resource system	RS4: Human-constructed facilities	Ph	Forster and Hope (2016)
	RS9: Location	Average distance between water point and household	Naiga and Penker (2014) Forster and Hope (2016)
Resource units	RU4: Economic value	Productive water use	Naiga and Penker (2014)
	RU6: Distinctive characteristics	Taste	Forster and Hope (2016)
Actors	A2: Socioeconomic attributes	Gender/female Income	Naiga and Penker (2014) Naiga and Penker (2014)
	A5 Leadership	Unawareness of roles and responsibilities	Naiga and Penker (2014)
	A6: Norms, trust, social capital	Lack of trust in WUC Lack of community participation	Naiga and Penker (2014) Naiga and Penker (2014)
Related Ecosystem	ECO: Climatic patterns	Rainfall season	Forster and Hope (2016)

2.4.1.3 Public Goods Theory

The public goods theory was put forward by Samuelson (1954) to explain public expenditure. In his argument, the government (public sector) can provide public goods efficiently. Public goods are goods with one or two characteristics of non-excludability and joint consumption (nonrivalrous) (Holcombe, 1997). Non-excludability means that it is difficult or expensive to keep individuals from using the good once it is produced. Nonrivalrous means that once a good is produced for a consumer, additional consumers can consume the good at no additional cost (use by one person does not impute a cost on the other as the marginal cost of adding an additional consumer is zero). Two versions of public goods are mainly used for analysis at the community level; CPR (see Ostrom, 1990) and Club goods (see Buchanan, 1965).

Common Pool Resources

As mentioned previously, CPR are goods that are nonexcludable but there is rivalry (Ostrom, 1990). For instance, in rural water supply, community water points are non-excludable in that the measures to prevent free riding are weak or non-existent (Foster and Hope, 2017). They are rival in that the marginal cost of adding an additional consumer is greater than zero. This is because use by one consumer has effects on O&M costs (wear and tear), congestion and long queues or even the amount of water one can access (Foster and Hope, 2017). As mentioned, Hardin (1968) argued that management of these resources requires either privatisation or the state can help to solve social dilemmas. However, Ostrom and Ostrom (1977) used empirical evidence to show that there are instances where CPR have been managed by communities using institutions.

Club Goods

Buchanan (1965) expanded on the distinction between pure private goods and pure public goods brought forward by Samuelson (1954) to introduce club goods which are centred on principles of consumption, ownership, and membership. Samuelson (1954) had given a clear distinction between private goods which are individual goods with characteristics of being excludable and rival. On the other hand, public goods which are used by many people are non-excludable and nonrivalrous. Buchanan (1965) argued that these are polar extremes and there

is a missing middle where individuals can form groups (clubs) that enable them to achieve the highest possible utility from resources they are managing (club goods) through using exclusion devices to avoid congestion. Congestion in this case refers to the deterioration of a club good's quantity or quality due to increased use by users (Sandler and Tschirhart, 1997). Such devices used to prevent congestion can include use of higher tariffs or physical restrictions. It is by the above-mentioned mechanisms that club goods become excludable and nonrival.

2.4.1.3.1 Empirical Applications of the Public Goods Theory in relation to Payment for Water

Koehler, Thomson and Hope (2015) employed the public goods theory to determine the institutional arrangements at the community level that communities can undertake which have implications on payment behaviours. Koehler, Thomson and Hope (2015) proposed that community groups might have two institutional design preferences, i) some groups may prefer higher payments at the household level to limit the amount of water used by reducing the number of users (members) forming what are called handpump clubs ii) on the other hand, some groups may prefer lower payments to increase the number of users and income to cover maintenance costs, thus operating more as a CPR good. Using the theory of public goods, the study hypothesised that the institutional design of the user group affects willingness to pay levels. Their study was carried out in Kyuso District in rural Kenya on 66 Afridev handpumps filled with mobile-enabled transmitters that transmit user information via messages. Data were collected from household surveys, handpump monitoring data and focus groups with communities. These communities practised three types of exclusion which are based on physical excludability (lock, fence and pump attendant), financial excludability (membership joining fee, non-member fee, regular payment and fines) and social excludability (labour contributions, regular meetings and usage rules). First, the study counted the number of exclusion types at each pump to establish a value of exclusivity. The pumps were then divided into more exclusive groups (exclusivity levels six to ten) or less exclusive (levels up to five). Using the distinctions from the public goods theory, the more exclusive handpumps fall under club goods and the less exclusive ones fall under CPR goods. The other category was that of private pumps in households which fall under private goods. The study found that the average number of members in more exclusive groups (27 members) is 43 per cent smaller than that of less exclusive (inclusive) groups (47 members), where each member in both groups (exclusive and inclusive) has an average family of 5.3 people. The reason for excludability was to ensure

that each member has much utility (satisfaction from the water service) from the good or service (in this case water). That exclusion would prevent queueing, wear and tear on the pump, overuse of water and over-rationing of the water during dry seasons but with a higher membership fee. As mentioned by Koehler, Thomson and Hope (2015, p. 403),

"*Excludability is a response to water supply risks and trade-offs between sustainable abstraction, aquifer variability, handpump reliability and varying social demands. It is therefore an important feature of the institutional design of certain handpump groups. Too small or too large a membership limits group stability as demand can become insufficient or excessive. Through restricting membership, the good becomes less rivalrous. At the point of equilibrium between benefit and cost, an individual's preferences are best met, which contributes to the group's stability and the handpump's sustainability*".

However, their finding shows that more water (abstraction) was used at more exclusive water points. This was attributed to two factors, a higher willingness to pay in these groups (economic demand) and productive uses of water. The study did not show whether the payments from water (revenue) offset other trade-offs such as costs, or the impact of such a trade-off on other attributes of a service such as quality or waiting times.

On willingness to pay, the study found that more exclusive groups have a higher willingness to pay per member per month (USD 1.03) compared to inclusive groups (USD 0.72). Their finding implied that the institutional design that a group chooses determines the amount of water payments users are willing to pay. For instance, more exclusive groups tend to have tighter regulations that allow them to generate revenues to cover their costs. They do this not only through higher membership fees but can include other revenue-generating mechanisms such as non-membership fees (regulated access to non-members who pay a tariff to access water) and fines.

2.5. Summary of Literature on Payment for Water

The studies reviewed in sections 2.3.1.1 to 2.3.1.3.1 have utilised frameworks and theories within collective action and CPR literature to identify factors that influence payment for water as shown in Table 2.3 below. While these studies have made a significant contribution to rural water payment behaviours literature, the analysis and frameworks used neglect the dynamic

interaction of the factors that influence payment for water. For instance, as mentioned earlier, the decision to pay can be influenced by trust among peers that others will pay (Hanatani and Fuse, 2012) which is influenced by the level of community participation (Naiga and Penker, 2014). However, these relationships/factors can change based on how the collected payments are handled by the community organisation (trust in the community organisation) (Naiga and Penker, 2014). All the named factors can also independently affect payment for water, but they also interact and change with time or conditions (dynamic). While the study by Forster (2017) attempted to cover this gap, their study employed the critical mass theory to examine the dynamism and interdependence of payment behaviours by examining the interdependence of the decisions made by users. However, their study does not consider that this decision-making process from users arises from the interaction of various factors which change over time. This is critical considering the importance of dynamic interaction of factors that influence sustainability in rural water supply (see Walters and Javernick-Will, 2015).

Table 2. 3: Factors influencing payment for water

Variables from the reviewed studies	**Adapted Variables used in this study**	**Citation**
Satisfaction with the level of service	Community satisfaction with the level of service	Hanatani and Fuse (2012)
Trust that others will pay	Trust amongst households that others will reciprocate payment for water	Hanatani and Fuse (2012)
Ph and Taste (Groundwater quality)	Water quality	Forster and Hope (2016)
Average distance between water point and household	Average time taken collecting water	Naiga and Penker (2014) Forster and Hope (2016)
Productive water use	Productive water use	Naiga and Penker (2014) Forster and Hope (2016)
Gender/Female	Number of females on the committee	Naiga and Penker (2014)
Lack of trust in WUC	Trust in the community organisation	Naiga and Penker (2014
Lack of community participation	Community Participation	Naiga and Penker (2014)
Unawareness of roles and responsibilities	Competency of the local community organisation	Naiga and Penker (2014)
Rainfall season	Rainfall	Forster and Hope (2016)
Institutional design	Utility	Koehler, Thomson and Hope (2015)

2.6 Household Drinking Water Services

This section covers the other strand of literature on water services. Water service is all about the delivery of water to people (Moriarty *et al.*, 2011). The JMP defines improved water sources as "*those that are potentially capable of delivering safe water by nature of their design and construction*" (WHO/UNICEF, 2017, p. 13). The population using improved sources are subdivided into three groups. The highest level of service is a **safely managed** drinking water service. In order to meet the criteria for a safely managed drinking water service, households must use an improved source that is:

- Accessible on premises,
- Available when needed, and
- Free from contamination.

If the improved source does not meet any one of these criteria but a round trip to collect water takes 30 minutes or less including queuing, then it is classified as a **basic** drinking water service. This study focuses on a basic water service where communal water kiosks are shared by communities. If water collection from an improved source exceeds 30 minutes, it is categorised as a **limited** service. The JMP also differentiates populations using **unimproved** sources such as unprotected wells or springs, and populations drinking **surface water** collected directly from a river, dam, lake, stream or irrigation canal (WHO/UNICEF, 2017). The JMP service ladder for household drinking water is shown in Table 2. 4 below.

Table 2. 4: JMP service ladder for household drinking water (WHO/UNICEF (2017, p. 12)

Service Level	Definition
Safely managed	Drinking water from an improved water source which is located on-premises, available when needed and free from faecal and priority contamination.
Basic	Drinking water from an improved source provided collection time is not more than 30 minutes for a roundtrip to collect water, including queuing.
Limited	Drinking water from an improved source where collection time exceeds 30 minutes for a round trip to collect water, including queuing.
Unimproved	Drinking water from an unprotected dug well or unprotected spring.
No service	Drinking water collected directly from a river, dam, lake, pond, stream, canal, or irrigation channel.

Improved sources can be assessed based on water service indicators (herein attributes of drinking water service). These attributes are shown in Table 2.5 below,

Table 2. 5: Water service attributes (Adapted from Moriarty *et al*., 2011, p. 11)

Household Drinking Water Service Attribute	Definition
Quantity	Quantity refers to the amount of water that can be assessed by an individual and is often measured in litres per capita per day (lpcd).
Quality	Assessed based on microbial and chemical quality of water
Accessibility	Involves measuring the ease at which people can get water. Mainly measured in terms of time spend fetching for water including queueing. The standard time is usually not more than 30 minutes for a roundtrip to collect water, including queuing for shared water points.
Reliability	Refers performance of the water service in accordance with expectations. Reliability is usually measured in as the percentage of time the water point is not fully functional.

2.6.1 Empirical Applications on Attributes of Drinking Water Services in Kiosks Literature

Quantity of Water

As shown in Table 2.5, the quantity for water is measured in litres per capita per day (lpcd) (Moriarty *et al.*, 2011). The threshold of usually 20 lpcd is required to meet minimum requirements guidelines but this varies with specific country requirements (Moriarty *et al.*, 2011). In countries such as South Africa, the law advocates for higher lpcd as reported in the UN, Office of the Higher Commission for Human Rights (OHCR), UN- Habitat, and WHO (2010) report. In the report, after litigation, the constitutional court of South Africa set 25 lpcd as sufficient (UN/OHCR/UN-HABITAT/WHO, 2010).

Kapulu and Tembo (2014) investigated the sustainability and assessment of the impact of kiosks' water supply in Kanyama Compound in peri-urban Zambia. Their study employed a qualitative approach, and data was collected using publications, questionnaires, interviews, and discussions with 50 heads of households and management personnel. First, interviews were carried out to get preliminary data to be used for the questionnaire survey. After that, data from

the survey was coded using Excel and analysed using SPSS and results were shown using descriptive statistics. One of their findings was that users indicated instances when they did not have access to adequate quantities of water at the kiosks due to power outages and low pressure. In such instances, they coped with the use of alternative sources. Approximately 86 per cent of the respondents indicated that there are instances where there is no water throughout the day. The average figure for water availability was only eight hours, and some people would spend the entire day at the kiosks. The issue of intermittent supply of water at the kiosks was also found by Adams *et al*. (2022) at an informal settlement in urban Malawi. In their study, Adams *et al*. (2022) employed interviews, videos and risk coding to examine environmental risks associated with water fetching by women and girls at Ntopwa (informal settlement in urban Malawi). In their study, Adams *et al*. 2022 recruited 25 women at five different water points. These water points were borehole, water kiosks, public tap, small ponds and shallow wells. Their findings showed unpredictable water supply and long waiting times at water kiosks. Users coped with this household water insecurity by rescheduling (coming to the kiosks as early as 2 am in the morning) and use of alternative sources. The use of alternative sources as a coping strategy in informal settlements in Malawi were also found by other studies (see Price *et al*., 2021).

Quality of Water

The quality attribute anchors the concept of kiosks, as they are an innovative small-scale system for water treatment and safe water provision at the community level (Cherunya, Janezic and Leuchner, 2015). As such most studies on water kiosks emphasise the improved quality of water level from the kiosks (Opryszko *et al.*, 2009; Kapulu and Tembo, 2014). Opryszko *et al*. (2013) investigated the impact that water health centres (water treatment facilities/systems) and hygiene education have on the quality of drinking water supplied by water vending kiosks in rural Ghana. Their study builds on the work by Opryszko *et al*. (2009) which found significant gaps in the effectiveness of SWEs (kiosks) in delivering potable water. They argue that the increase in market demand for these kiosks justifies a need to investigate the public health impact of drinking water supplied by these kiosks in low-income rural populations. The study was carried out in six villages where first, formative research was done through interviews, focus group discussions and digital recording of water collection patterns on households. This formative process gave insights into household practices that may impact water quality. After the formative research process, baseline community surveys were carried out in each of the

chosen villages. A sample size of 100 households was selected in each village and a questionnaire incorporating 30 key indicators related to household water quality was administered. Concurrently, the researchers collected samples from stored drinking water at every 10th household. Testing for *E. coli* was done using the IDEXX Colilert Quanti-tray system as an indicator of faecal contamination (Opryszko *et al.*, 2009). The study found households using water from kiosks at water health centres had improved water quality compared to untreated surface sources. However, the study also found risks of contamination during transporting of water and storage. Concerning hygiene education, the study found that increasing hygiene education does not necessarily correspond with improved drinking water quality. For instance, an increase in hygiene education did not necessarily change behaviours on how users transport or store their water. The study implies that water at kiosks is of high quality, however, contamination can take place during collection, transportation, and storage. Their study was supported by Cherunya, Janezic and Leuchner (2015) who investigated the viability of safe water enterprises (kiosks) in Kenya. One of the questions the study attempted to answer was the differences in water quality perceptions and preferences between the rural (Ngoliba/Maguguni) and urban areas (Kangemi Gichagi) at SWEs. The study employed both quantitative and qualitative techniques. Data was collected using surveys and semi-structured interviews. In total, 50 households were interviewed in rural areas and 49 in urban. Quantitative data analysis used IBM SPSS statistics and Microsoft Office Excel which was used to produce descriptive statistics. Qualitative data analysis extracted keywords by hand (manually). From both study areas, 96 per cent of the participants were aware of SWEs. Of those, all of them perceived kiosk water to have superior aesthetic water quality compared to other alternatives. Furthermore, the main reason for purchasing water from SWEs was because the respondents value the water quality attribute of kiosks. Other studies on the quality of water in kiosks include a study mentioned earlier by Kapulu and Tembo (2014) at Kanyama Compound in Zambia. Water quality was assessed in two main attributes: low incidence of water-borne diseases and other water quality benefits such as taste. The study found that 86 per cent of respondents attribute the low incidence of diseases to good-quality water from the kiosks. In terms of taste, respondents were satisfied with the taste of the water from the kiosks.

Accessibility

The previously mentioned study by Kapulu and Tembo (2014) at Kanyama Compound in Zambia also assessed the sustainability and impact of kiosks' water supply in terms of

accessibility. Accessibility was determined by the distance to water points and time spent queueing for water at the kiosks. Their study found that 94 per cent of the households attributed the reduction in distances due to water kiosks which are within 500m walking distance. However, due to lower pressure, the time spent queueing to collect water at the kiosks was long, especially during peak hours when there is high demand. Another study that investigated the accessibility potential of communal water kiosks is by Kituku, Gihuchi and Nzengya (2020) which investigated the role of Lake Kenyatta WUA (LAKWA) water kiosks to women. The study was carried out in the rural and urban Mpeketoni division of Lamu County in Kenya. Data was collected using an open and closed questionnaire on 100 women from each case. Analysis was done using descriptive statistics and one of the findings of the study was that the closeness of the LAKWA water kiosks was beneficial to women in the area. However, within the same area of study by Kituku, Gihuchi and Nzengya (2020), Gedo and Morshed (2013) earlier study found contrary results. Their study investigated the impact of inadequate accessibility on the adequacy of water service. They measured accessibility using distance to the water kiosks (the same measure used by Kituku *et al*., 2020) against a threshold of one km to access at least 20 litres of water per person per day, with a collection time of 30 minutes a round trip (distance to and from the kiosks). To analyse the relationship between distance and adequacy the study employed geographic information system (GIS) maps to do spatial analysis. The GIS analysis showed that there were kiosks one km away from the households, as such the average time taken to collect water was approximately 45 minutes. The reasons for this outcome were population growth and the sparsely populated nature of rural areas. The 61 kiosks present in the area were not able to cover the whole population of approximately 30 452 people. At each kiosk, approximately 500 people were served. The 500 people served at each kiosk surpassed the 200 people threshold recommended per kiosk, thus this can have an impact on the capacity of the kiosk to provide a sustainable water service to each user. The study proposed 83 additional kiosks to be built which will reduce the number of people using kiosks to at least 300 at around 700 m – 1km. Distance to the water kiosks was not an issue in the previously mentioned study by Komakech, Kwezi and Ali (2020), however, 70 per cent of households complained about queueing at the kiosks. The study by Komakech, Kwezi and Ali (2020) claimed that water kiosks have not solved the issue of queueing which contributes to increased overall collection time.

Reliability

Adams (2018) in Malawi examined household insecurity at three peri-urban informal settlements of Lilongwe in Malawi. At these settlements, most people used communal water kiosks as an improved source of water provision. Using a mixed method, data were collected on 645 households using structured household surveys. Other sources of information included focus groups, policy documents and participant observations. Data were analysed using Stata 14 statistical software and Excel for descriptive statistics. One of the study findings was that some of the communal water kiosks were not functional and those that were functional were not reliable as they occasionally broke down. In this case, where water was not available, users used water from the river. Similar findings were found by Water Aid (2010) which found that about 63.4 per cent of water kiosks were not functional in low-income urban areas of Malawi. Issues to do with the functionality of kiosks were also found in the previously mentioned study by Komakech, Kwezi and Ali (2020) which found that approximately a third of the kiosks were not working because they were expensive to fix.

2.7 Summary of Literature on Attributes of Drinking Water Services

This strand of literature provides data and ways to measure attributes of drinking water services. Empirical studies on these attributes have merely assessed the perceptions of users on the attributes (Opryszko *et al.*, 2009; Kapulu and Tembo, 2014) or have measured one or more of the attributes to determine if they meet standards (Kituku, Gichuhi and Nzengya, 2020; Komakech, Kwezi and Ali, 2020). However, none of the studies has considered the interdependency of these attributes and how this influences household water use behaviour (demand for water at the kiosks) adequately. For instance, a water point that functions properly (reliable) might attract more people and lead to more pump use that increases collection time thus affecting the amount of water that households can have at any given time. Although, Moriarty *et al*. (2011) suggested that these attributes might be interdependent, there was no empirical application or further investigation into the issue and its implications for the water service level.

2.8 Defining the Research Gap

The first strand of literature has identified factors that influence payment for water by using various frameworks and theories (Hanatani and Fuse, 2012; Naiga and Penker, 2014; Foster and Hope, 2016). However, the studies in this strand have not considered the dynamic

interaction of these factors which influences payment for water outcomes. The other strand of literature has identified attributes of water service (Moriarty *et al.*, 2011; WHO/UNICEF, 2017). Similarly, none of the studies has considered the interdependency of these attributes and how this influences household water use behaviour (demand for water at the kiosks) as suggested by Moriarty *et al*. (2011). As it stands, these two strands have not been brought together and the interaction between their different components have not been considered. Furthermore, the dynamic interaction of factors has not been considered. Considering the importance of accounting for the dynamic interaction of factors in rural water supply where water issues are considered dynamic and systemic, there is a need to consider the dynamic interaction of factors that influence payment for water and attributes of drinking water services (Walters and Javernick-Will, 2015; Valcourt *et al.*, 2020). This led to question 3, *how can the dynamic interaction between factors that influence payment for water and attributes of drinking water services be captured and represented*?

While showing the dynamic interaction of factors that influence payment for water and attributes of drinking water services is critical, water practitioners can benefit by knowing the underlying theory that explains this outcome. Hope and Balllon (2019) attempted to cover this gap by coming up with a conceptual depiction of payment behaviour and drinking water services shown in Figure 2.5 below which is assumed to reflect the interactions between payment behaviours by users and water service attributes at a selected water provision model. However, their model is static (does not provide insights into how factors and their interaction change over time and is merely descriptive rather than applicable). It does not consider the dynamic interaction between factors that influence payment for water and attributes of drinking water services thus failing to adequately explain payment behaviours at an improved water service provision model. Failing to consider the dynamic interaction of factors limits understanding of payment behaviours which has both health and social consequences. The criticism of evaluating factors in a static way and its impact on sustainability is furthered by Walters and Javernick- Will (2015) who referenced other studies in the broader water sustainability literature (see Katz and Sara, 1997). As it stands, no theory or framework explains the dynamic nature of payment behaviours (provides insights into payment behaviours) in rural water supply literature.

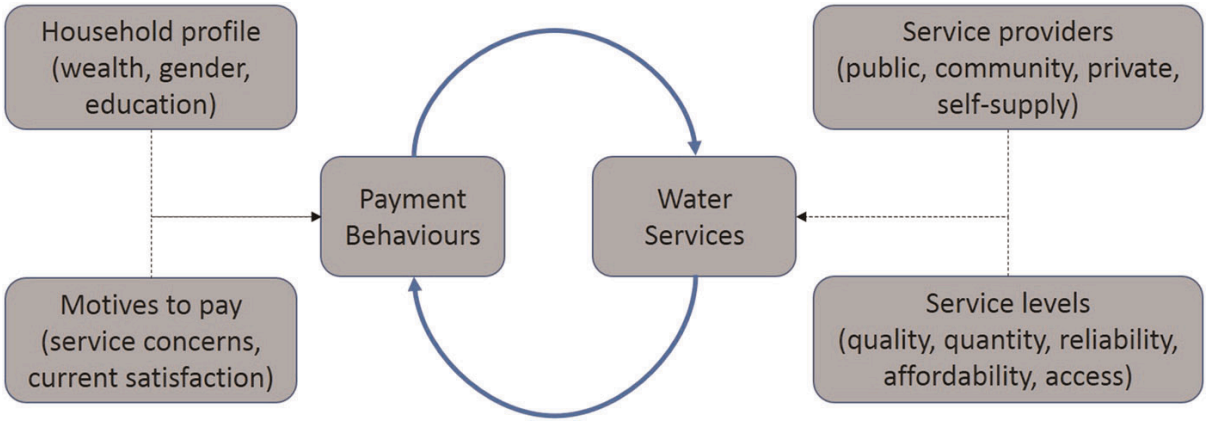


Figure 2. 5: Conceptual model of payment behaviours and drinking water services (Hope and Ballon, 2019, p.2)

To capture the dynamic interaction of factors that drive outcomes, literature from rural water supply has called for the need to use systems thinking approaches (Walters and Javernick-Will, 2015; Libey *et al.*, 2022). Since then, various system thinking methods have been employed which include Soft Systems Methodology (SSM) (Kayaga, 2008), Bayesian Networks (Ngai, 2011; Fisher *et al.*, 2015; Cronk and Bartram, 2017) and System Dynamics (SD) (Walters and Javernick-Will, 2015; Neely and Walters, 2016; Valcourt *et al.*, 2020; Daniel *et al.*, 2021; Cannon *et al.*, 2022; Chintalapati *et al.*, 2022; Libey *et al.*, 2022) to model the interaction of factors that influence rural water supply. Of these, SD has been largely employed mainly because of its ability to capture feedback mechanisms that arise from the dynamic interaction of factors within a closed system to drive problem behaviour (Walters and Javernick-Will, 2015; Neely and Walters, 2016). Capturing feedback is critical because feedback mechanisms are responsible for driving system behaviour. (Sterman, 2000; Walters and Javernick-Will, 2015). SD is also increasingly being used for theory testing and building in the management literature (Repenning and Sterman, 2002; Rahmandad and Repenning, 2016). As mentioned by De Gooyert (2019) other studies use SD for building theory, others for theory testing, while others combine the two in making theoretical contributions which are critical in understanding phenomena. In an overview by De Gooyert (2019) on the use of SD for theory building and testing in management literature, the study came up with four research strategies that can be employed to use SD for theoretical contributions. These strategies are mainly, grounded theory building, conceptual virtual laboratory, phenomenon replicating explanation and management flight simulator. Considering that this study aims to understand and explain inconsistency in payment behaviours at kiosks, the phenomenon replicating explanation is more appropriate. In

this approach, SD is used to show how a set of causal mechanisms is responsible for a phenomenon (De Gooyert, 2019). Studies that have employed this approach have two main starting points (gaps) which are (i) a lack of theories to explain a given phenomenon and (ii) a need to synthesise several existing theories or separate literature streams to understand the process behind a complex phenomenon. In all these studies, the goal is to have a theory that explains the phenomenon adequately. De Gooyert (2019), referencing the work of Rahmandad and Reppening (2016), showed how two separate streams of literature (learning curve literature and organisational failure literature) were combined (connected) to come up with a theory that explained firm heterogeneity and enhanced understanding of organisational demise. Their work was illustrated in the following quote,

"*By connecting the two disparate literatures, an explicit theory of capability erosion offers the possibility of new explanatory mechanisms to understand firm heterogeneity and an enhanced understanding of organizational demise*." (Rahmandad and Reppening, 2016, p. 652).

Systems thinking and SD will be explained in detail in the next chapter (Chapter 3) where the approach is used to develop a conceptual model.

2.9 Summary of the Chapter

The chapter identified two strands of literature that can give insights into payment behaviours at communal water kiosks. The main gaps are that key literature strands remain fragmented. The two strands have not been brought together and the interaction between their different components have not been considered. Furthermore, the dynamic interaction of factors has not been considered, thus failing to adequately explain payment behaviours at improved water service provision models. As it stands, there is no theory/framework that explains the dynamic nature of payment behaviours in rural water supply literature. The following chapter brings these two strands of literature together in a conceptual model.

Chapter 3: Conceptual Framework

In the previous chapter, key literature strands were found to be fragmented. The two strands have not been brought together and the interaction between their different components have not been considered. In addition, the dynamic interaction of factors has not been considered. As it stands no theory or framework explains dynamic payment behaviour. This chapter explores the concept of systems thinking, identifies the appropriate tool to bring together these different strands of knowledge and develop a conceptual model for rural water supply through kiosks. The chapter is organised as follows; firstly, the concept of systems thinking is introduced. After that, a review of its application in rural water supply is undertaken. This is followed by the development of a conceptual model using CLDs to explain payment behaviours at communal water kiosks from literature.

3.1 Systems Thinking in Rural Water Supply

Systems thinking is a "*school of thought that focuses on recognising the interconnections between the parts of a system and synthesising them into a unified view of the whole*" (Kim, 1999, p.19). The issue of focus should be viewed as whole, with much emphasis placed on the interactions amongst its components rather that the components themselves (Shaked *et al.*, 2017). Within the rural water supply, systems thinking was introduced after an increasing realisation that ensuring sustainable services requires understanding the factors that influence sustainability as part of an interconnected system (Libey *et al.*, 2022). Several water-related focused reports (Lockwood *et al.;*Battle, 2016) conference papers (Bhattarai and Neupane, 2002) and peer-reviewed journals (Walters and Javernick-Will, 2015; Liddle and Fenner, 2017) have called for a need for systems thinking to solve water sustainability challenges. As mentioned previously in Chapter 2, Section 2.7, SD has been the most utilised method in rural water supply mainly because of its ability to identify and capture feedback mechanisms (Walters and Javernick-Will, 2015; Neely and Walters, 2016; Valcourt *et al.*, 2020; Daniel *et al.*, 2021; Cannon *et al.*, 2022; Chintalapati *et al.*, 2022; Libey *et al.*, 2022).

3.2 System Dynamics

Wolstenholme (1990, p.3) defines SD as:

"*A rigorous method for qualitative description, exploration and analysis of complex systems in terms of their processes, information, organisational boundaries and strategies, which facilitates quantitative simulation modelling and analysis for the design of system structure and control*".

Sterman (2000, p. 12) argues that,

"*Much of the art of system dynamics modelling is discovering and representing the feedback processes, which, along with stock and flow structures, time delays, and nonlinearities, determine the dynamics of a system*".

The most complex behaviours of the system are not due to individual components within the system, but instead, it is the interactions (feedback) among components that result in complex behaviour (Sterman, 2000). SD models are used to improve understanding of how complex systems composed of interacting factors and feedback mechanisms behave under different policies or courses of action (Olaya, 2020). SD can either be qualitative or quantitative (Wolstenholme, 1990). The approaches are explained in detail below.

3.2.1 Qualitative System Dynamics

Qualitative approaches are mostly used at the initial stages of modelling before simulation (quantitative). These include, model boundary diagrams, subsystem diagrams, stock and flow maps, policy structure diagrams and CLDs (Maani, 2013). Of these CLDs are the ones mostly used in rural water supply literature (see Walters and Javernick-Will, 2015; Neely and Walters, 2016; Valcourt *et al.*, 2020). Before getting into detail on how CLDs were applied in these studies, first the study provides background information on CLDs.

3.2.1.1 Causal Loop Diagrams

CLDs are system thinking tools that seek, "*to highlight the feedback and complex interactions between variables, where root causes are often indiscernible*" (Goh *et al.*, 2012, p. 55). They can be used to represent the dynamic interaction between variables, communicate feedback

mechanisms (Sterman, 2000) and illustrate unintended consequences (Lane, Munro and Husemann, 2016). This allows them to be used as a tool to explain phenomena in complex systems such as rural water services, as previously reported by Walters and Javernick-Will (2015).

Variables and Causal Links

CLDs include variables of interest to a study that are connected by arrows that depict causal influences between the variables (Sterman, 2000). Every causal link in the diagram must represent what the modeller believes to be a causal relationship (Sterman, 2000). A positive polarity at an arrowhead means that "*if the cause increases, the effect increases above what it would otherwise have been, while if the cause decreases, the effect decreases below what it would have been"* (Sterman, 2000), therefore the cause and effect are moving in the same direction. On the other hand, a negative polarity means that "*if a cause increases, the effect decreases below what it would otherwise have been, and if the cause decreases, the effect increases above what it would otherwise have been"* (Sterman, 2000), therefore the cause and effect are moving in opposite directions. The other way involves counting the number of negative links in the loop. An even number of '-'links creates an overall positive or reinforcing loop, whereas an odd number of '-' links creates a negative or balancing loop. For example, for a loop that contained a total of 2 '-' links ., the overall effect would be '+' ie a reinforcing loop, whereas for a loop that contained only 1 '-' link., the overall effect would be '-' ie a balancing loop. The disadvantage of this approach is that it may not be easy to count the number of negative links in a loop when dealing with a complex diagram.

Feedback Loops

The most complex behaviours arise from feedback interactions between components of a system, not from the number of system elements (Sterman, 2000). A feedback loop arises in a closed chain of causal connections where the system's output impacts its input (circular causality). It is important to note that not all systems have feedback loops; some are just open-ended systems built on linear causal chains. The feedback loop is the unit of analysis in a CLD (Neely and Walters, 2016). Dynamic behaviour in a system is created by loops (Sterman, 2000). Complexity arises as a consequence of interacting feedback loops. Positive loops (self-reinforcing) amplify whatever is happening in the systems. Self-reinforcing loops can either be

vicious or virtuous. A vicious cycle is a reinforcing feedback loop with the current dynamic behaviour created by the loop operating in an undesirable direction (Sterman, 2000). On the other hand, a virtuous cycle represents a reinforcing feedback loop with the current dynamic behaviour created by the loop operating in a desirable direction. Negative loops (balancing loops) counteract change.

There are two ways of determining the loop polarity, namely counting the number of negative links, or tracing the effect of a change around the loop. The preferred way is to trace the effect of change around the loop. This tracing process will involve tracing the effect of a small change in one of the variables as it propagates around the loop (Sterman, 2000). If the feedback change reinforces the original loop, then it is a positive/reinforcing loop; if it is the opposite, then it is a negative/balancing loop (see an example in Figure 3.1 below). The other way involves counting the number of negative links in the loop. The disadvantage of this is that it may not be easy to count the number of negative links in a loop when dealing with a complex diagram.

Many feedback processes experience delays in the flow of influences, with the consequences of actions occurring gradually (Sterman, 2000). In human systems, delays between actions and consequences are everywhere, and, in most cases, they are either unrecognised or not well understood (Senge, 2006). Unrecognised delays in balancing loops can also lead to oscillatory behaviour in a system (Sterman, 2000). Delays are often shown in a CLD by two parallel lines perpendicularly crossing the appropriate causal link at which there is a delay (Sterman, 2000). Time delays are common in rural water supply systems. For instance, delays in waiting for external mechanics to fix water points when the task is beyond the local community technicians' expertise. Such delays often result in service disruptions leaving people to go for weeks or even months without a functioning water point (Chowns, 2015). This is likely to demotivate compliance with water payments.

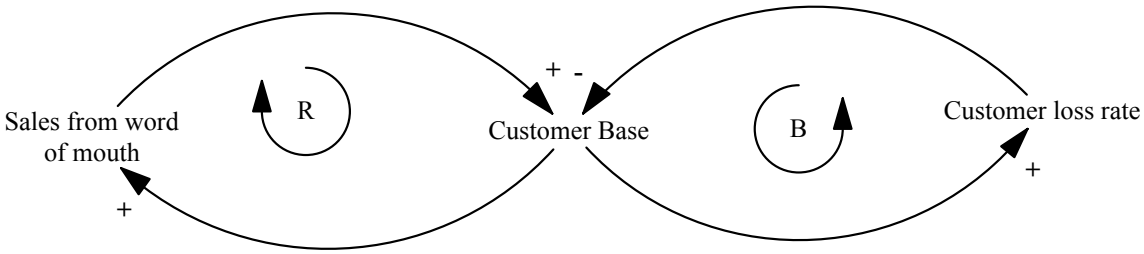


Figure 3. 1: shows examples of Reinforcing (R) and Balancing (B) Feedback loops (Sterman, 2000, p. 143)

3.2.1.2 Empirical Application of CLDs in Rural Water Supply Literature

The first study to employ CLDs was by Walters and Javernick-Will in the year 2015. Walters and Javernick-Will (2015) used CLDs to identify feedback mechanisms that drive the long-term functionality of rural water services (water system functionality) in developing countries. Their study argued that previous literature had focused on the interaction of sustainability factors in a static way, yet within rural water, there is a dynamic interaction of factors that produces feedback mechanisms hypothesised to drive sustainability outcomes. First, content analysis was used to find factors that influence long-term functionality from journals within the rural water supply literature. Second the study assembled water experts using the Delphi technique (see Linstone and Turoff, 1975) to do polarity analysis and Cross Impact Analysis (see Gordon, 1994) to obtain information regarding causal strength. After these steps, the study used Venism software[1] to identify feedback mechanisms that influence water system functionality (Walters and Javernick-Will, 2015). Findings from the study show that after modelling the relationships between factors, all feedback loops were reinforcing to influence water system functionaility. The dominant feedback included variables of water system functionality, community involvement, financing and management. This meant that in areas where water system functionality was high, community involvement, financing and management were also high. In areas where water system funcionality was low , community involvement, financing and management were low.

The study by Walters and Javernick-Will (2015) was followed by Neely and Walters (2016) who employed CLDs as a dynamic theory that explores drivers of rural water services in Timor Leste. Their study argued that the problem of sustainability of rural water projects is largely

[1] https://vensim.com/software/

due to two main drivers which are: i) Non-governmental organisation (NGO) -Funder dynamics and ii) the failure of communities to operate and manage their schemes under community-based management (community dynamics). Initially, a dynamic hypothesis was developed from literature which showed how NGOs' work is influenced by donors. A dynamic hypothesis was also developed that showed community dynamics. These dynamic hypotheses were then used for data collection and analysis. Data was collected using surveys and interviews with 94 participants in five villages in Timor Leste. Ethnographic observations and NGO strategic documents were also used. The study found that the amenity of the system (closeness to the house, portability and volume) had a direct influence on community satisfaction which influences the community's willingness to contribute (willingness to pay). Leverage points identified included the need to increase community satisfaction and increase training of NGOs.

In another study, Valcourt *et al*. (2020) employed a participatory SD method to produce CLDs of four geographical contexts in Ethiopia and Uganda. Their study argued that previous studies had generalised interactions undermining the uniqueness of complex systems as a response to their distinct local environment and historical development as argued by Byrne (1998), thus risking the blanket application of interventions within different context (Valcourt *et al.*, 2020). However, the argument by Valcourt *et al*. (2020) ignores the concept of learning (see Sterman, 2000). Group model building, a technique used in engaging stakeholders in the development of models was used (Vennix, 1996). The group model building process employed 62 local stakeholders, 51 regional government officials and civil servants and 11 NGOs. Their study followed a similar method to the study discussed before by Walters and Javernick-Will (2015). Their main finding was that although there was general agreement on the factors that influence service sustainability, their interactions vary across contexts.

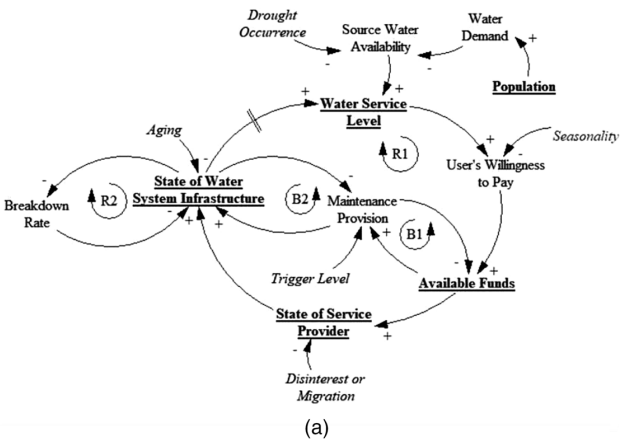
3.2.2 Quantitative System Dynamics

Quantitative SD (herein simulation) can be used in the later modelling stages of the modelling process often following the use of CLDs. However, it is important to note that some studies do not use CLDs before simulation (see Repenning and Sterman, 2002; Rahmandad and Repenning, 2016).

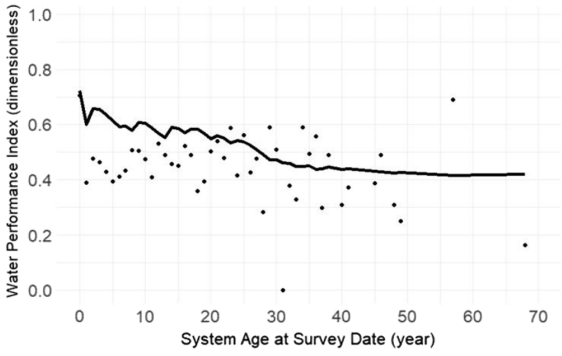
3.2.2.1 Empirical Application of Simulation in Rural Water Supply Literature

Within drinking water supply services in developing countries, simulation was first applied in a study by Daniel *et al*. (2021) in Indonesia where they investigated water taps service sustainability. Their study argued that previous studies have not considered all the factors that influence sustainability, thus undermining the core principle of systems thinking. They argue that, although institutional factors are mentioned in rural water sustainability studies, they are hardly included in models. Their study employed existing data to upgrade a CLD by using context-specific variables. The CLD was then translated into Stock Flow Diagram (SFD) and simulated for 120 months. Their study found the performance of the water board, response and support from the community to positively influence sustainability (Daniel *et al.*, 2021).

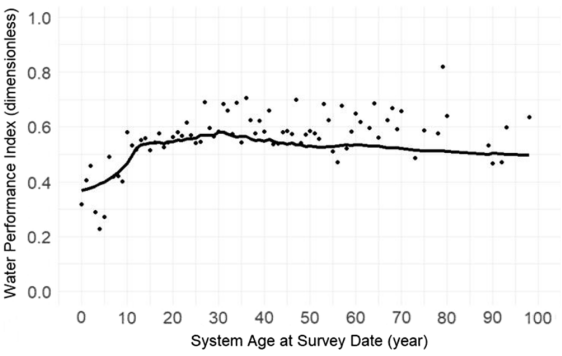
In another study, Cannon *et al*. (2022) developed an SD simulation model to simulate the perfomance of water infrastructure as it ages and to test strategies that can increase perfomance of community-managed water systems (CMWS) in Bolivia and Colombia using monitoring data. Before the simulation model, a CLD was developed from literature to gain insights into how the problem arose. The CLD developed by Cannon *et al*. (2022) and model perfomance simulation from both Bolivia and Colombia are shown in Figure 3.2 below



(a)



(b)



(c)

Figure 3 2: Conceptual model strucure and model performance simulaion in Bolivia (b) and Colombia (c) (Cannon *et al*, 2022, p. 4)

The reinforcing loop R2 in Figure 3.2 above depicted by letter (a) showed the reinforcing relationship between the breakdown rate and water system infrastructure. This reinforcing loop was balanced by maintenance to avoid exponential decay, where maintenance was subject to the availability of funds from users. The monitoring data in graphs b and c shows a general trend of decreasing performance of CMWS over time as the system ages. For instance, in Colombia, the performance will increase in the first 30 years during which maintenance is conducted but after that, there is a general decline in the performance of CMWS as the system ages and as service provider capacity decreases the quality of repairs. Three different strategies were tested which include external financial support, professionalisation of service providers and preventative maintenance. Of those preventative maintenance was found to be the most effective strategy to improve CMWS performance over time mainly because the strategy does not rely on reactive corrective maintenance which results in higher expenses in the long run to rehabilitate the system (Cannon *et al.*, 2022). The impact of employing preventative maintenance to the water system perfomance over time can be conceptually shown on the CLD in Figure 3.3 below. Figure 3.3 shows that preventative maintenance (represented by frequency and duration of maintenance) increases the state of the water system infrastructure (WSI) and the water service level. In order to motivate communities to adopt preventative maintenance, policy makers can target mental models (perceptions of preventative maintenance) (see Cannon *et al.*, 2022).

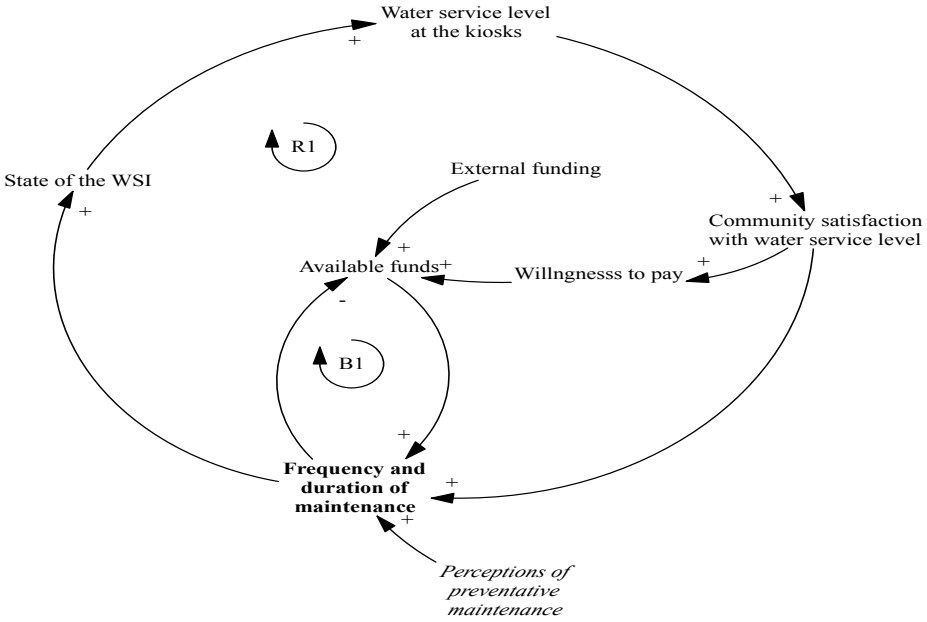


Figure 3. 3: CLD showing the impact of professionalised maintenance to the performance of the system (adapted from Cannon *et al*., 2022)

While the Cannon *et al*. (2022) study did not find professionalised maintenance to lead to improved water system performance in Bolivia and Colombia because of the current use of corrective maintenance, the study by Chintallapati *et al*. (2022) found the opposite. However the difference might be due to the inclusion of preventative maintenance on professionalised maintenance which is a key to the sustinability of the system. In their study, Chintallapati *et al*. (2022) simulated the financial and functionality effects of implementing professionalised maintenance using SD in rural Kenya. Their study argued that the professionalisation of maintenance has the potential to improve sustainability in a complex system. Data were collected from semi-structured interviews with relevant sector actors to collect information on the relevant factors and secondary sources. After that, a CLD was developed. The next step involved quantifying data on different factors and using SFD. The last step was to run simulations. The study found that over a 10-year simulation professionalised maintenance may reduce government spending by 60 per cent due to preventative maintenance that is guaranteed by the approach. However, there was still a need for subsidies, as income from community users only contributed 8 per cent of the total cost of providing a service. On functionality, the study found that professionalised maintenance may increase countrywide functionality rates

from 54 per cent to 83 per cent, leading to an increase in accessible water volume by 67 per cent (Chintalapati *et al.*, 2022). The effect of professionalised maintenance on financial spending and functionality can be described by the CLD adopted/taken from the supporting documents of Chintalapati *et al*. (2022) shown in Figure 3.4 below. The red links show the current status quo before the introduction of professionalised maintenance service and the green links show the introduction of professionalised maintenance.

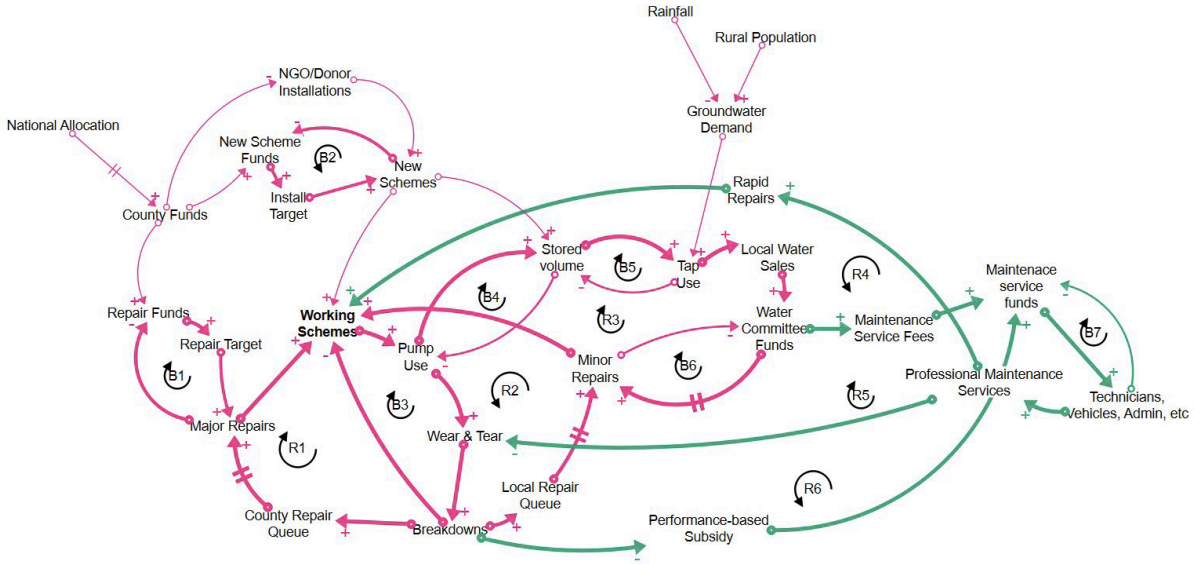


Figure 3. 4: CLD showing the intervention of professionalised maintenance on government spending and functionality (Chintallapati *et al*., 2022, p.4)

In another study, Libbey *et al*. (2022) used SD simulation to estimate the impact of financial allocation towards repair on mechanised borehole functionality in Kenya over time. Their study argued that a lack of resources for maintenance leads to delays that reduce the capacity for sustainable water services. Data was gathered by observing staff at the government's water department, semi-structured interviews which took place in 2019 and secondary sources. First, a CLD was developed, followed by SFD and then a simulation model. The study found that increasing maintenance and repair budgets from the current 30 per cent to 85 per cent of the available budget by governments for boreholes can result in an additional 83 working boreholes at 95 per cent working capacity by the year 2030.

3.3 CLDs v Simulation

In SD literature, there is debate on whether stand-alone CLDs (qualitative SD tools) are enough to infer and explore behavioural effects (Homer and Oliva, 2001; Schaffernicht, 2007; Lane,

2008). Those that make a case for stand-alone CLDs argue that there is a misconception that only simulation approaches provide value in dealing with dynamic behaviour (change and complexity over time of a dynamic system) (Wolstenholme and Coyle, 1983). Alexander (1997) supported the use of qualitative approaches by finding the use of qualitative tools in military strategy interventions in Brazil to be rigorous enough to stand on their own when describing the structure of the problem. Coyle (2000) highlighted the need to strike a balance in the literature that is often biased towards simulation. Coyle (2000) argued that in situations of high uncertainties, such as dealing with soft variables that are difficult to assign numerical data, qualitative mapping is more appropriate. However, Homer and Olivia (2001) refuted the justification of using stand-alone CLDs based on their appropriateness when dealing with soft variables. They argued that such soft variables can be quantified, and one can simulate incomplete data and soft variables (see Sterman, 2000). The flaws of CLDs have earlier been brought to bear with the work of Richardson (1986). CLDs have been critiqued because of the different definitions of polarity which can be misleading (Richardson, 1986). This critique is reinforced by Lane (2008) and Schaffernicht (2007) who argue that CLDs are prone to loop polarity errors. CLDs do not distinguish between stocks and flows, and between conserved flows and information links (Schaffernicht, 2007; Lane, 2008). They also do not provide a basis for behaviour deduction but rather are based on inference (Schaffernicht, 2007). Homer and Oliva (2001) therefore suggest that these shortfalls make CLDs inadequate to draw behavioural and policy inferences reliably (Homer and Oliva, 2001).

Therefore, the question that arises is whether there is any basis for using CLDs as stand-alone tools considering the contrasting views in the literature? According to Homer and Olivia (2001), several conditions determine the use of qualitative tools. These conditions include when the researcher is concerned mainly with the underlying structure responsible for the problem and not dynamic behaviour over time, when there are time and costs constraints, and when the audience (client) believes that simulation does not add value to understanding the dynamic problem at hand (Homer and Oliva, 2001). This study chose to employ CLDs mainly because the structural analysis is key in determining the inconsistent payment behaviour outcomes at kiosks. CLDs as a tool for system analysis can be used in structural analysis (see Bennich *et al.*, 2018). CLDs can also be used for discussions, capturing qualitative interconnections and allow identification of leverage points (see Bennich *et al.*, 2018). Although there is concern in their ability to identify leverage points (Schaffernicht, 2007), CLDs have been used to identify leverage points in the Healthcare (Cassidy *et al.*, 2022);

Forestry (Bennich *et al.*, 2018) and in rural water supply (Neely and Walters, 2016). While simulation has more added advantages in testing, and improving mental models and structure, they can be complex and difficult for policymakers to understand (see Goh *et al.*, 2012).

3.4 Developing a Conceptual Model explaining payment behaviours at Communal Water Kiosks

This study starts by developing initial CLDs from the literature on payments explained in Chapter 2 using the SD software Vensim[1] focusing on the sustainability problem of inconsistent water payments (Hope *et al.*, 2020; Maji, 2020). Information on whether users are making payments or not comes from the state/level of their financial balance. Literature has already shown that most community organisations in rural water supply services in SSA have limited to no money in their financial balances (Chowns, 2015; Foster and Hope, 2016). The level of financial balance represented by the variable 'financial balance of the community organisation' depends on the revenue and expenditure. In this case revenue of the community organisation comes from collective water payments (represented by the variable 'number of households who comply with payments at the kiosks'). Adding to the financial balance is also initial funding from NGOs and donors (represented by the variable 'initial funding from NGOs/donors' and contingency funding from NGOs and donors (represented by variable 'external funding'. Expenditure comes from meeting salaries and administrative costs, maintenance costs (represented by variables 'salaries and administrative costs' and 'repair costs'). The representation of the determinates of financial balance of the community organisation are shown in Figure 3.5 below.

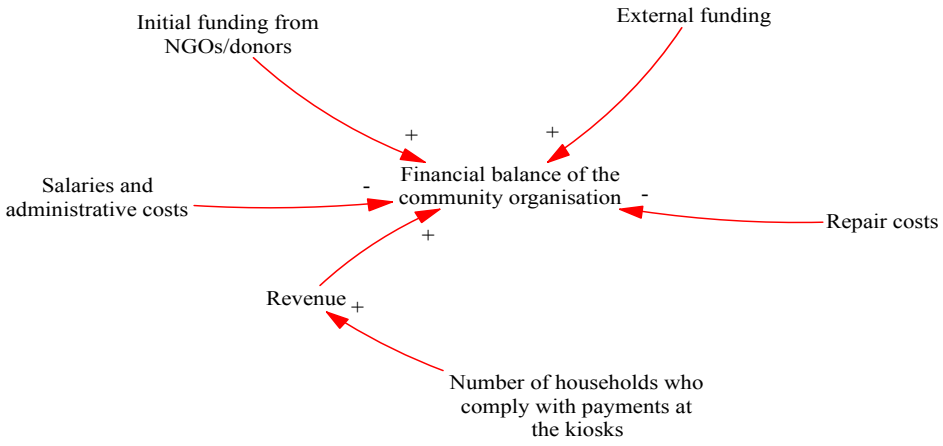


Figure 3. 5: Determinates of financial balance of the community organisation

Feedback loop R1 shown in Figure 3.6 could be either a vicious or virtuous loop. In a vicious loop, a lower financial balance reduces trust in the community organisation. When the community organisation cannot account for the money they collected, they lose trust with users (Chowns, 2015). Trust in the community organisation is subject to the level of the accountability (represented by the variable 'accountability of the community organisation with funds') and transparency (represented by the variable ‘transparency of the community organisation with funds') displayed by the community organisation. A reduction in trust reduces collective payments at a decentralised shared water point (represented by the variable 'number of households who comply with payments at the kiosks') (Naiga and Penker, 2014; Chowns, 2015). A reduction in the number of people who comply with payments reduces revenue and ultimately the financial balance of the community organisation. In a virtuous loop, an increase in the financial balance of the community organisation improves trust in the community organisation since they are the ones given the responsibility to look after the finances of the scheme (Chowns, 2015). Trust in the community organisation increases the number of households who comply with payments at the kiosks (Naiga and Penker, 2014). An increase in the number of households who comply with payments increases the financial balance of the community organisation.

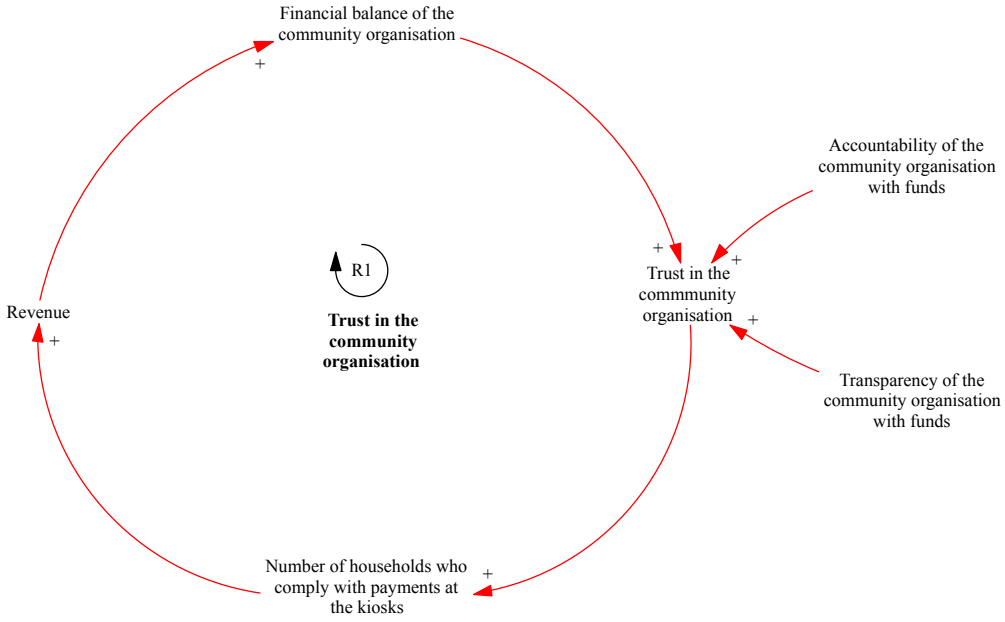


Figure 3. 6: Feedback loop showing impact of trust in the community organisation on water payments

Feedback loop R2 in Figure 3.7 could be either a vicious or virtuous loop and highlights how trust among households that others will reciprocate payments drives payment behaviours. In a vicious loop, a decline in the financial balance can reduce trust among households that others have made payments (reciprocate). A reduction in trust among households reduces the number of households who comply with payment at the kiosks (Hanatani and Fuse, 2012). A reduction in the number of households who comply with payments at the kiosks reduces revenue and ultimately the financial balance of the community organisation. In a virtuous loop, an increase in the financial balance creates trust among household users that others are making payments (reciprocate). An increase in trust that others have reciprocated will increase the number of households who comply with payments, representing norms of reciprocity within the community (Hanatani and Fuse, 2012). An increase in the number of households who comply with payments at the kiosks increase revenue and ultimately the financial balance of the community organisation.

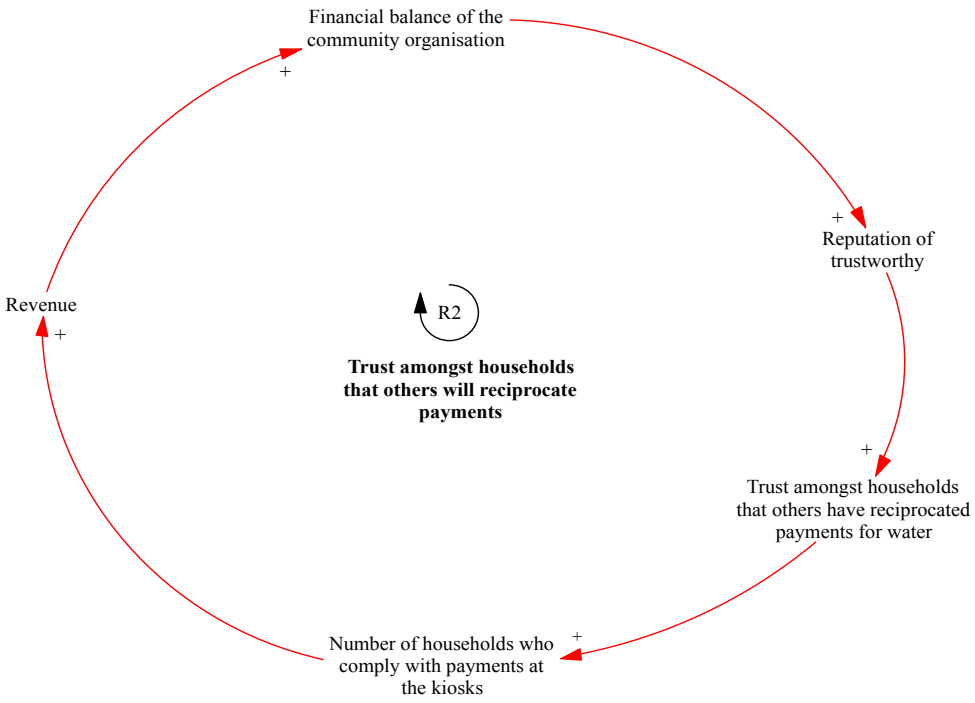


Figure 3. 7: Feedback loop showing the impact of trust amongst households that others will reciprocate payments

The variable number of households who make payments at the kiosks is also influenced by the variables number of females in the committee organisation (Naiga and Penker, 2014), level of community participation (Naiga and Penker, 2014) and demand for water at the kiosks (Huttinger *et al.*, 2017). Demand for water at the kiosks is influenced by community satisfaction with the water service level, number of users, income, price of water at the kiosks, demand for water at alternative sources. Demand for water at alternative sources is influenced by price of water at alternative sources (see Figure 3.14) (Huttinger *et al.*, 2017), water service level at alternative sources (Olaerts *et al.*, 2019), and seasonal variations (represented by variable 'rainfall') (Cook, Kimuyu and Whittington, 2016; Contzen and Marks, 2018; Ingram and Thomson, 2022). These variables are shown in Figure 3.8 along with the variables and feedback loops shown in in Figure 3.5, 3.6 and 3.7. This produces a CLD that summarises the key factors that influence payment for water.

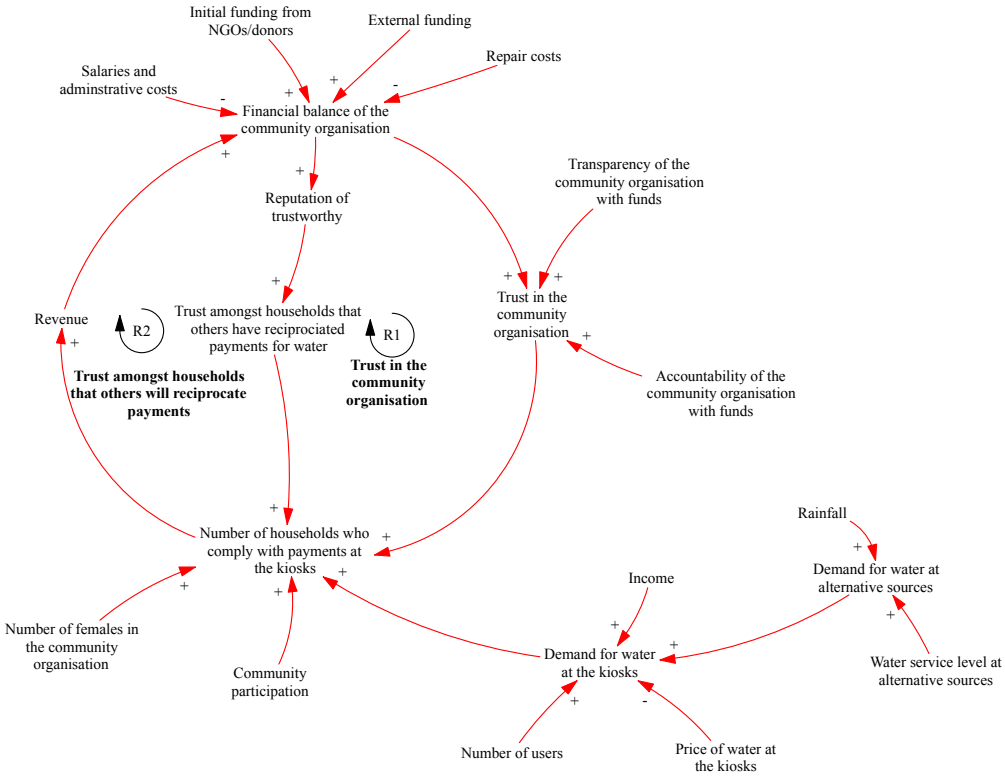


Figure 3. 8: Feedback loops showing relationships of the factors that influence payment for water

The second strand of literature included in chapter 2 covered attributes of drinking water services. Figure 3.9 below presents these attributes. In this study, the drinking water service level under consideration is the basic water service. The outcome of a sustainable shared water service system is to ensure that the system delivers at least a basic water service to everyone (WHO/UNICEF, 2017). Attributes of a water service include quantity, quality, accessibility, and reliability (Moriarty *et al.*, 2011). In this study, drinking water service (indicated by the variable ‘water service level at the kiosks’) is achieved when users have sufficient water, usually 20 lpcd (Moriarty *et al.*, 2011) (represented by the variable ‘quantity of water at the kiosks’), acceptable user quality perception (represented by variable ‘perceptions on quality of water at the kiosks'), accessible/collection time (represented by variable 'average time spent collecting water at the kiosks') and reliable water source (represented by variable 'functionality of the kiosks'). For a similar use of variables in the literature on various water points see Moriarty *et al*. (2011) and Hope and Balloon (2019).

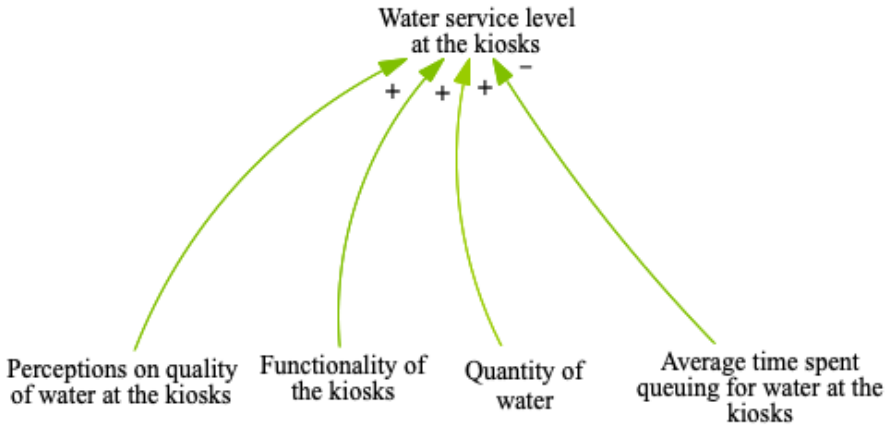


Figure 3. 9: Attributes of drinking water services

Next, Figure 3.10 below shows how Demand impacts quantity and collection time. To illustrate, when the water service level is high, this increases community satisfaction and enhances the attractiveness of the kiosks to the users (Neely and Walters, 2016). More people in the community start to talk about the service provided by the source. As such, as more people from closer villages can start to use the water source, word of mouth increases and the demand for water at the kiosks also increases. An increase in demand leads to more people using the kiosks. However, an increase in demand for water at the kiosks also increases pump use and increases the supply-demand gap (the supply-demand gap shows a reduction in the quantity of water at a given time). An increase in the supply-demand gap increases the average time spent collecting water at the kiosks (Kapulu and Tembo, 2014; Adams, 2018) and thus reduces the water service level, reflecting how demand impacts quantity and collection time (see B1).

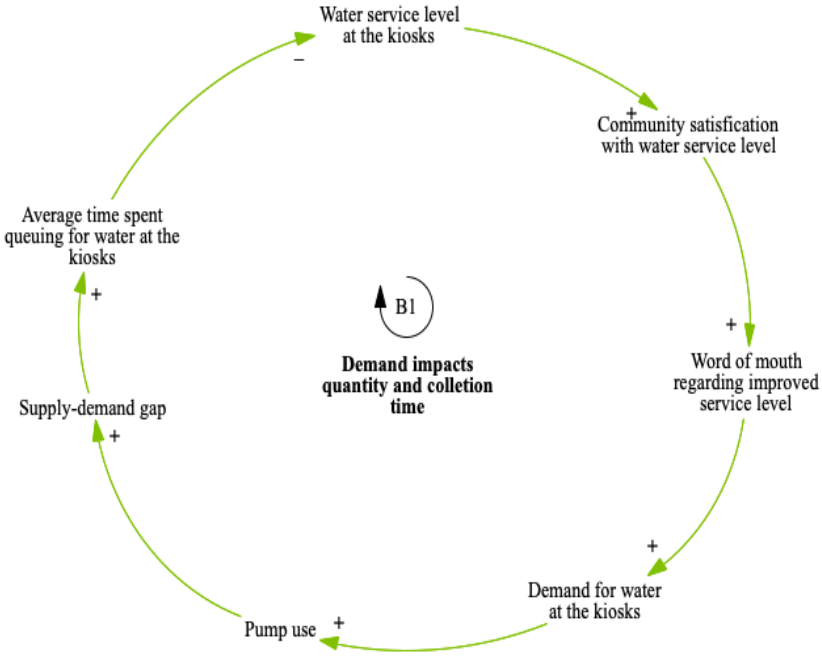


Figure 3. 10: Feedback loop showing the impact of demand on quantity of water and collection time

An increase in demand also results in an increase in pump use which results in significant wear and tear, which can increase incidences of breakdowns (Van Den Broek and Brown, 2015) see Chintallapati *et al*. (2022). Both wear and tear, and breakdowns take time (see Libey *et al.*, 2022). Breakdowns in water points reduce the water service level at the kiosks (see B2 in Figure 3.11).

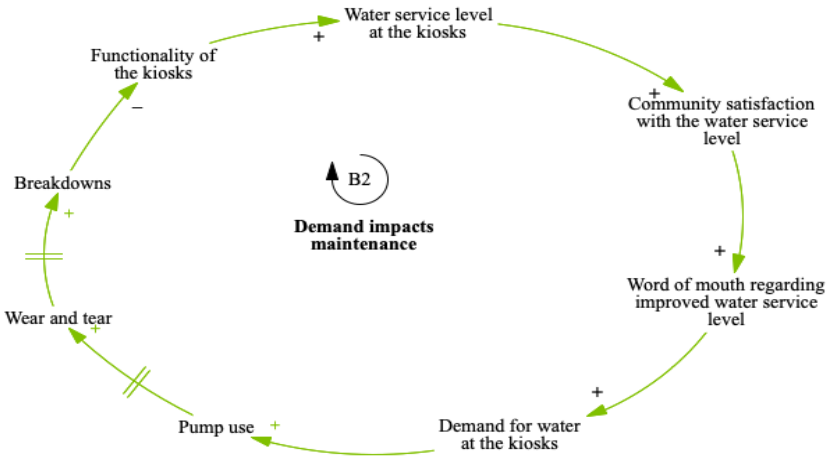


Figure 3. 11: Feedback loop showing the impact of demand on maintenance

Feedback loop B3 in Figure 3. 12 shows how an increase in demand for water at the kiosks can also lead to an increase in pump use, which leads to increase in water extraction and higher salinity (see Bouchet, Thoms and Parsons, 2022). Higher extraction of groundwater can also lead to release of toxicants which have health complications (Sarkar *et al.*, 2022; Pradhan *et al.*, 2023). Deterioration on water quality reduces previously held perceptions of the quality of water at the kiosks.

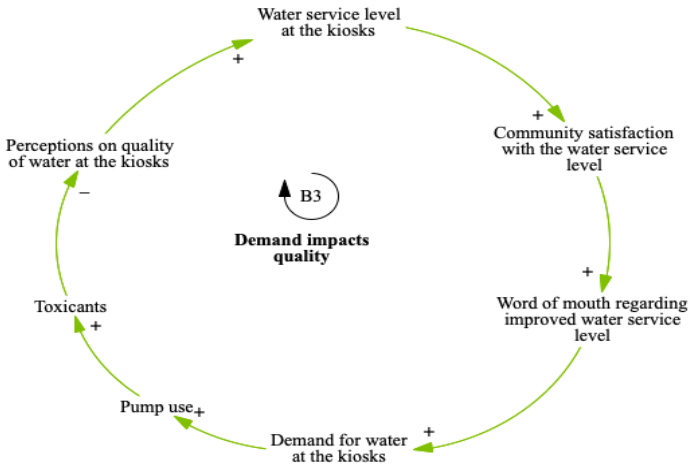


Figure 3. 12: Feedback loop showing how demand impacts quality of water

Figure 3.13 combines Figures 3.10, 3.11 and 3.12, thus bringing together loops B1, B2 and B3. Balancing loops B1and B3 above show that the system can only support a certain number of people as groundwater is a finite resource subject to trade-offs. While balancing loop B2 shows the influence of demand on infrastructure (water point) which is also subject to trade-offs. Therefore, the water service level at any given time changes in relation to the number of households that are using the water point (demand for water at the kiosks).

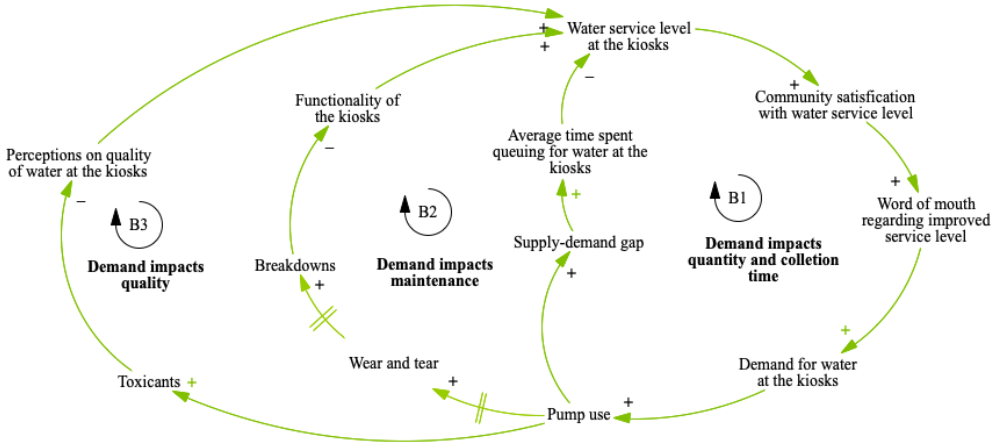


Figure 3. 13: Feedback loops showing relationships of attributes of drinking water services

As mentioned previously, the two strands of literature are currently fragmented. Bringing them together shows how they interact and the use of a CLD to do this enables this to be done in a visible and digestible manner. Figure 3.14 below provides an overview of the interaction between factors that influence payment for water and attributes of drinking water services. These interactions (relationships) provide insights into dynamic payment behaviours. Figure 3.14 combines Figures 3.8 and 3.13. Links shown in red come from Figure 3.8 (showing relationships obtained from the literature on factors that influence payment for water) and links shown in green come from Figure 3.13 (showing relationships obtained from the literature on attributes of drinking water services).

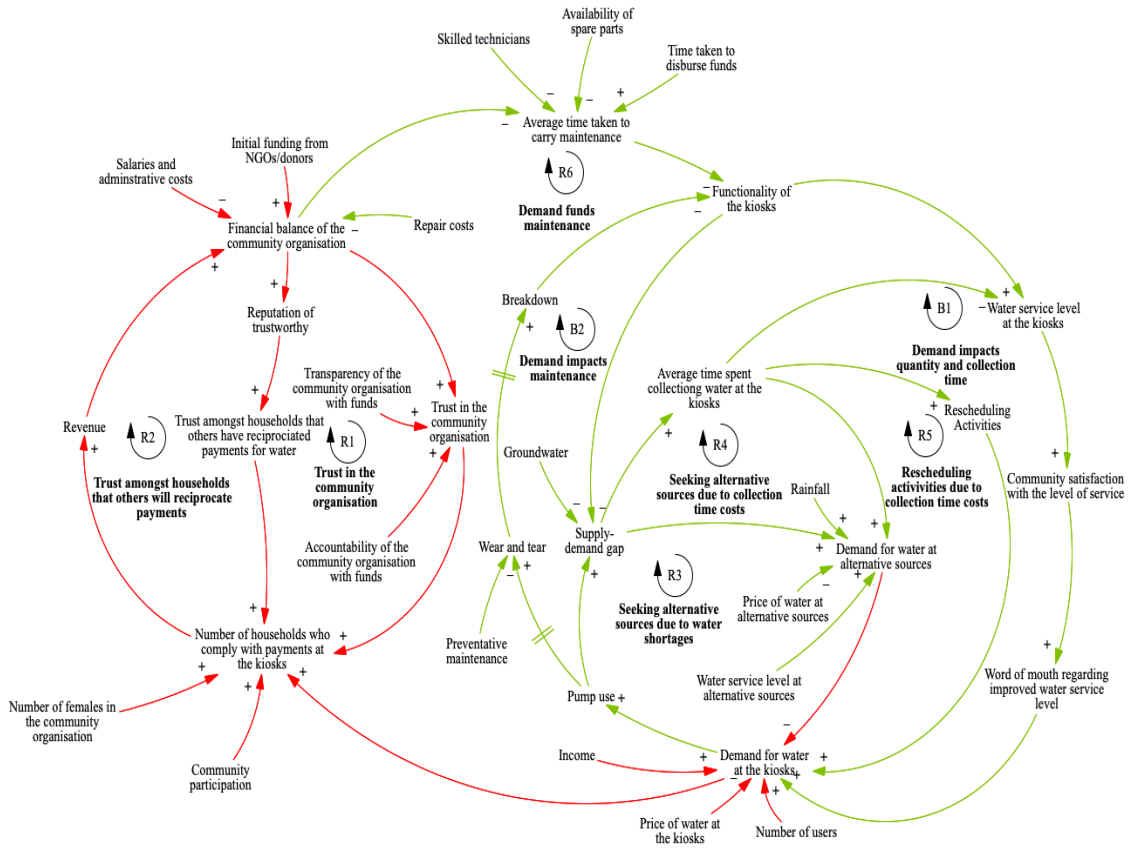


Figure 3. 14: CLD model explaining and providing insights into dynamic payment behaviours at communal water kiosks

After merging the feedback loops from the two strands of literature to show the dynamic interaction between factors that influence payment for water and attributes of a drinking water service some additional feedback loops are created by capturing different assertions from these strands of literature (see Figure 3.14 above). Feedback loops R3, R4, R5 and R6 have been created by combining the two strands of literature. These loops (R3, R4, R5 and R6) are explained next.

Additional Feedback Loops

As mentioned earlier, the attributes of water services changes with demand (see B1, B2, B3). When the level of service decreases, users employ coping strategies (Majuru, Suhrcke and

Hunter, 2016). Lower income households (mainly found in rural areas) are more likely to adopt two strategies which are the use of alternative sources (Chidya, Mulwafu and Banda, 2016; Majuru, Suhrcke and Hunter, 2016; Olaerts *et al.*, 2019) and rescheduling activities (Majuru, Suhrcke and Hunter, 2016). The coping strategies that users employ (use of alternative sources and rescheduling of activities in this study) form the basis of loops R3, R4 and R5.

Feedback loop R3 shown in Figure 3.15 below can be vicious or virtuous. In a vicious loop R3, a lower functionality increases the supply-demand gap (Adams, 2018). An increase in the supply-demand gap leads to an increase in demand for alternative sources (Chidya, Mulwafu and Banda, 2016; Adams, 2018; Olaerts *et al.*, 2019). As mentioned, use of alternative sources can also depend on other factors such as price of water at alternative sources (Huttinger *et al.*, 2017), water service level at alternative sources (Olaerts *et al.*, 2019) and seasonal variations (Cook, Kimuyu and Whittington, 2016; Contzen and Marks, 2018; Ingram and Thomson, 2022). Use of alternative sources reduces demand at the kiosks (Contzen and Marks, 2018). A reduction in demand reduces the number of people who make payments at the kiosks and revenue. A reduction in revenue reduces the financial balance and increases the average time taken to carry out maintenance (it should be noted that money from users is used mainly to cover recurrent costs and not capital costs). The average time taken to carry out maintenance is also influenced by availability of spare parts, skilled technicians and time taken to disburse funds (Neely and Walters, 2016). These additional variables (availability of spare parts, skilled technicians and time taken to disburse funds) are shown in Figure 3.14 above. An increase in the average time taken to carry out maintenance reduces functionality (Hope and Ballon, 2019). In a virtuous cycle, an increase in functionality lowers the supply-demand gap (Daniel *et al.*, 2021). This lowers the need to use alternative sources. A reduction in the use of alternative sources increases demand for water at the kiosks (Contzen and Marks, 2018). An increase in demand increases the number of people who make payments, increases revenue and the financial balance of the community organisation. An increase in the financial balance lowers the time taken to carry out maintenance and this increases functionality. The impact of fast repairs on functionality, are widely reported in literature (see Koehler, Thomson and Hope, 2015; Hope and Ballon, 2019).

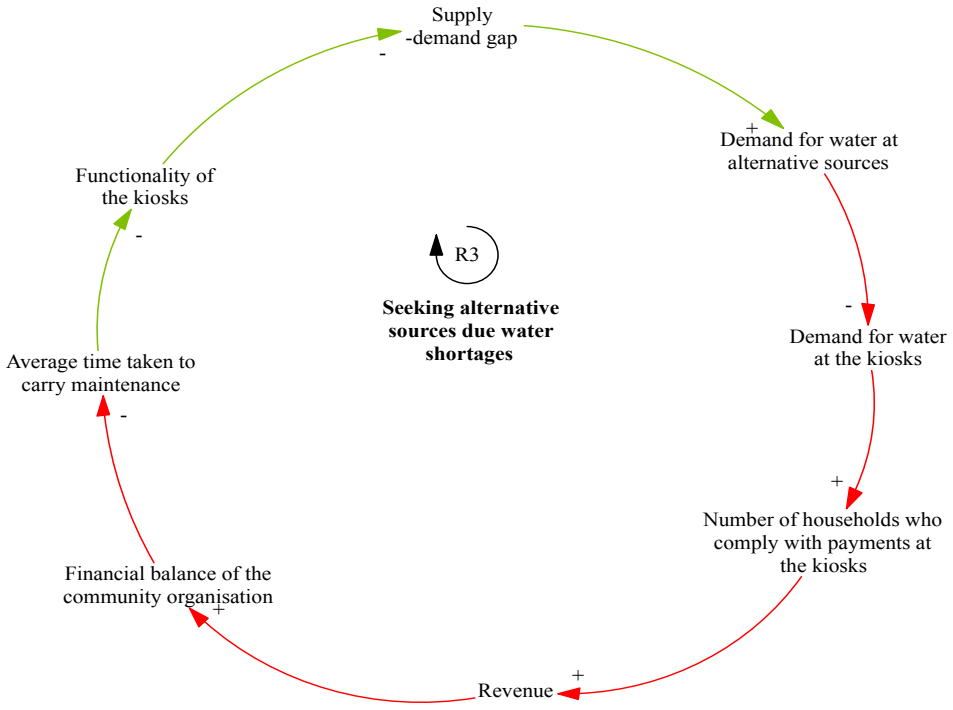


Figure 3. 15: Feedback loop showing households seeking alternative sources due to water shortages

Feedback Loop R4 shown in Figure 3.16 below also shows how users cope with an increase in collection time. A basic water service must not have a collection time exceeding 30 minutes for a roundtrip to collect water (WHO/UNICEF, 2017). This collection time includes time spent queuing for water (WHO/UNICEF, 2017). In a vicious loop R4, a decreasing functionality leads to water shortages (increase supply-demand gap) (see Chidya, Mulwafu and Banda, 2016) and this increases the collection time (see Cook, Kimuyu and Whittington, 2016; Smiley, 2016). An increase in collection time (average time spent queueing for water at the kiosks) increases the demand for alternative sources. An increase in demand for water at alternative sources reduces demand at the kiosks (Contzen and Marks, 2018). A reduction in demand at the kiosks reduces the number of people who make payments at the kiosks and revenue. A reduction in revenue reduces the financial balance and increases the average time taken to carry out maintenance. An increase in the average time taken to carry out maintenance reduces functionality. In contrast, a virtuous loop shows how an increase in functionality reduces the supply demand gap (Daniel *et al.*, 2021), reduces the average time spent queueing for water at the kiosks. This reduces the use of alternative sources. A reduction in use of alternative sources increases demand for water at the kiosks (Contzen and Marks, 2018). An increase in demand

increases the number of people who make payments, increases revenue and the financial balance of the community organisation. An increase in the financial balance lowers the time taken to carry out maintenance and this increases functionality.

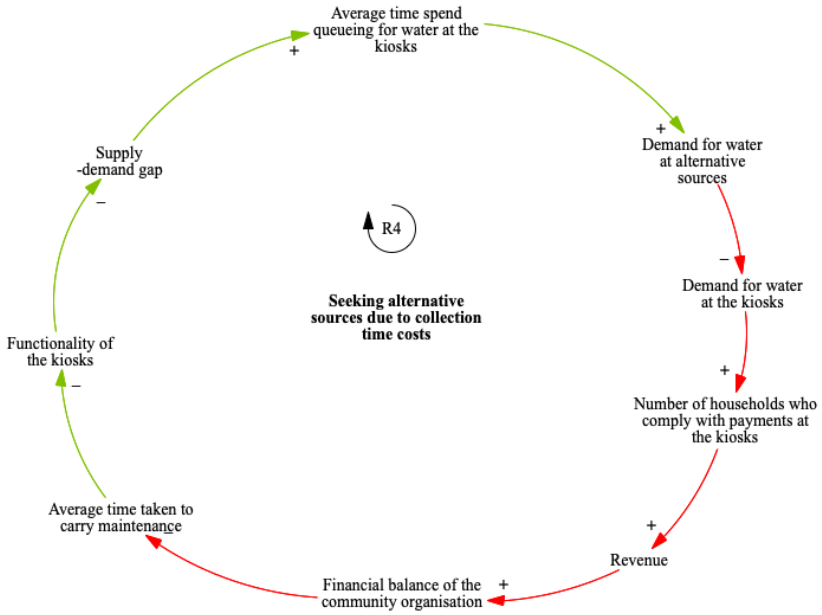


Figure 3. 16: Feedback loop showing households seeking alternative sources due to collection time costs

An increase in the average time spent queueing for water at the kiosks can either lead to use of alternative sources (Figure 3.16 above) or can result in users rescheduling their activities to times where there is less congestion (see Majuru, Suhrcke and Hunter, 2016). An increase in rescheduling of activities leads to less demand at the kiosks as users reduce the number of times they visit the kiosks. This leads to a decrease in the number of times users pay for water, reduces payments and revenue. A decline in revenue reduces the financial balance. When their financial balance is low, the average time taken to carry out maintenance is increased thus reducing functionality. This is shown in loop R5 in Figure 3.17 below.

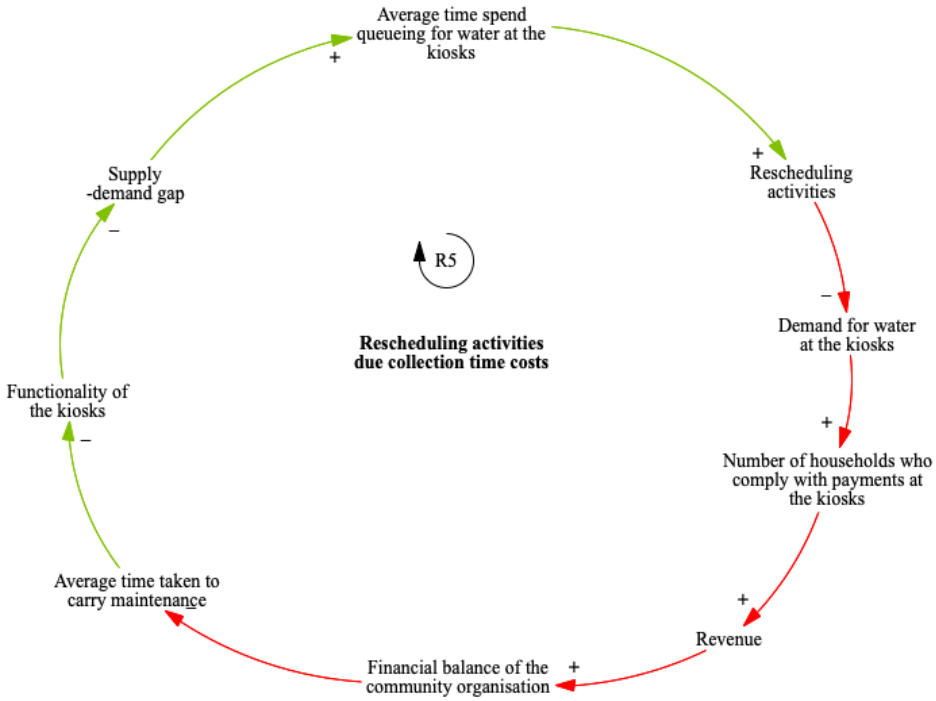


Figure 3. 17: Feedback loop showing Rescheduling activities due collection time costs

Feedback loop R6 in Figure 3.18 shows how demand is expected to fund maintenance at the kiosks (an improved water service provision model). In a virtuous cycle, an increase in the water service level increases community satisfaction with the water service level (see Neely and Walters, 2016). When users are satisfied, word of mouth regarding the water service level is likely to spread and this increases demand for water at the kiosks. An increase in demand leads to an increase in the number of households who comply with payments at the kiosks and revenue which can be used for maintenance. An increase in revenue increases the financial balance of the community organisation (Daniel *et al.*, 2021). The availability of funds means that maintenance is carried out quicker and this increases functionality (Hope and Ballon, 2019). In contrast, in a vicious cycle, the opposite process happens, and demand will not fund maintenance adequately.

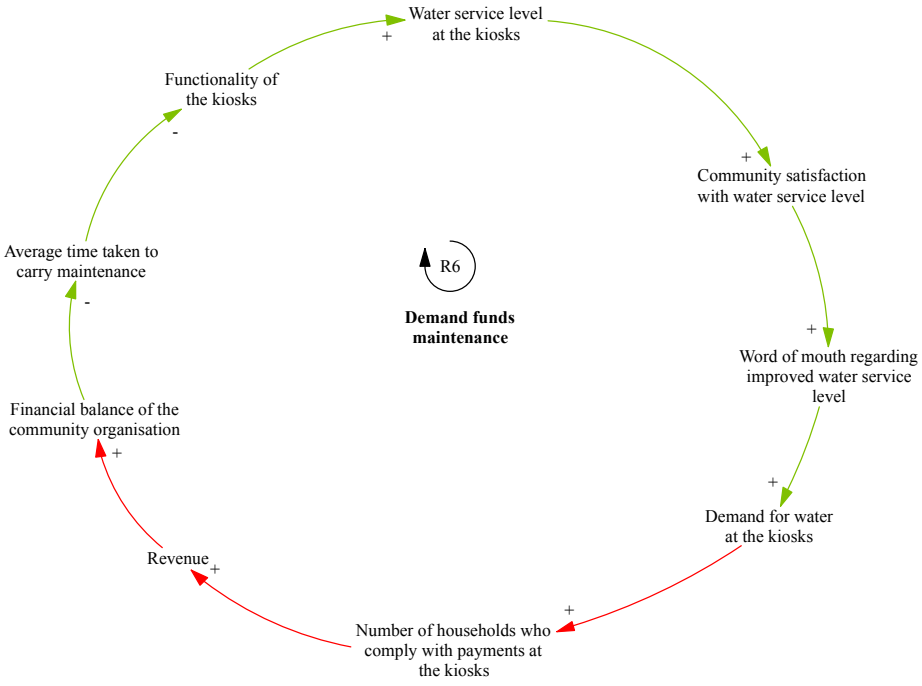


Figure 3. 18: Feedback loop showing how demand funds maintenance

3.5 Analysis of the Conceptual Model

The conceptual model (CLD in Figure 3.14) brings together several assertions in the two distinct strands of literature and present them in a visual and digestible manner. The loops in Figure 3.14 help in understanding/ giving insights into compensating feedback (structures) that drive payment behaviours. The recommended solution in literature to the problem of water payments has been to increase the level of water services (quantity, quality, accessibility and reliability) (see Koehler, Thomson and Hope, 2015; Hope *et al.*, 2020) and an increase in the level of water service would increase payments (this is depicted as a feedback loop in Figure 3.19 below). However, such a solution does not take account of the many feedback loops identified in this study and represented in Figure 3.14 above.

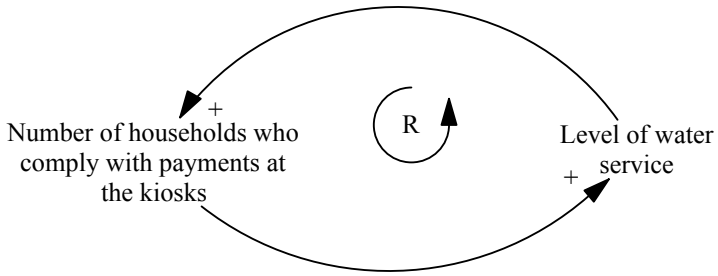


Figure 3. 19: Feedback loop depicting the recommended solution proposed in literature to the water payment problem

Besides the use of a CLD to provide insights into the dynamic interaction of factors and communicate feedback loops that drive problem behaviour (Sterman, 2000), they can also be used for theory development and testing (Goh *et al.*, 2012). SD techniques can be combined with case study research method to develop and test theories (see Kopainsky and Luna-Reyes, 2008). In such a case, propositions can be derived using feedback loops (Goh *et al.*, 2012). In this study, propositions are derived from the feedback loops from the CLD model in Figure 3.14. Such feedback loops are areas of theoretical relevance that explain payment behaviours at the improved water service provision model (communal water kiosks). This led to question 4, *which propositions can be derived from the dynamic interaction between factors that influence payment for water and attributes of drinking water service*? The following theoretical propositions are proposed,

i) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drives payment behaviours.
ii) Payment behaviours are driven by the coping strategies (R3, R4, R5) that household users employ when faced with a changing water service level (B1, B2, B3).
iii) Demand funds maintenance (R6).

3.6 Research Aim and Development of Research Questions

The study aims to develop a model that explains and provides insights into dynamic payment behaviours at communal water kiosks in rural trading areas. The literature review shows inconsistent demand (see Contzen and Marks, 2018; Hope *et al.*, 2020; Hoque, 2023) which represents an unwillingness to pay for an improved water service at kiosks. As such this led to the emergence of the overall research question, *why are household user payments at communal water kiosks in rural trading areas inconsistent?* The study employs two strands of literature, one which uses theory and frameworks from commons literature to identify the factors that influence payment for water. This led to question 1, *what factors influence payment for water*? Another strand identifies the attributes of a drinking water services. This led to question 2, *what are the attributes of drinking water services at water kiosks*? A key gap found in the literature was that the strands remain fragmented. The interaction between their different components have not been considered. In addition, the dynamic interaction of factors has not been considered. Furthermore, no theory or framework could explain payment behaviours in an improved water service model (kiosks) adequately. This led to question 3, *how can insights into the dynamic interaction between factors that influence payment for water and attributes of drinking water service be captured and represented*? To cover these gaps, the study took a systems perspective and employed CLDs to capture and provide insights into the dynamic interaction of factors that influence payment for water and attributes of drinking water services and represent a theory that explains and provides insights into dynamic payment behaviours at an improved water service provision model. To identify specific areas of theoretical relevance in the CLD, the study uses propositions to explain payment behaviours at the improved water service provision model (kiosks). This led to question 4, *which propositions can be derived from the dynamic interaction between factors that influence payment for water and attributes of drinking water services*? Although the information from the conceptual model gave insights into payment behaviours in an improved drinking water service model, it is critical to determine if the findings (propositions) occur in practice. Therefore, this led to question 5, *are the identified propositions on the dynamic interaction between factors that influence payment for water and attributes of drinking water services present in practice in selected case studies*? This requires the study to test, amend and extend the derived propositions using case studies (see Chapter 6). After testing, this led to question 6, *are there any other propositions (feedback loops) that emerge from the selected cases at rural trading centres that can provide more insights into the dynamic interaction between factors that influence payment for water and*

attributes of drinking water services? If there are any, the model in Figure 3.14 is extended and amended (see Chapter 6 and 7). This process results in the development of a model (theory) that explains and provides insights into dynamic payment behaviours at communal water kiosks. Such a model not only explains payment behaviours at water kiosks and broader decentralised shared water provision models but also allows for the identification of intervention points to ensure sustainable payment outcomes at kiosks. As such this led to question 7, *how can payment for water be sustained at water kiosks*? In summary, the questions that guide the study are listed below,

1) What factors influence payment for water?
2) What are the attributes of drinking water services at water kiosks?
3) How can the dynamic interaction between factors that influence payment for water and attributes of drinking water services be captured and represented*?*
4) Which propositions can be derived from the dynamic interaction between factors that influence payment for water and attributes of drinking water services?
5) Are the identified propositions on the dynamic interaction between factors that influence payment for water and attributes of drinking water services present in practice in selected case studies?
6) Are there any other propositions (feedback loops) that emerge from the selected cases at rural trading centres that can provide more insights into the dynamic interaction between factors that influence payment for water and attributes of drinking water services?
7) How can payment for water be sustained at water kiosks?

3.7 Summary of the Chapter

The chapter combines various strands of literature and develops a CLD conceptual model which explains and provides insights into the dynamic payment behaviours at water kiosks. This model will be tested using case studies to ensure that the relationships (loops) found in the literature are present in practice (see Chapter 6). This process allows for amendments and extensions of the model and identification of other emerging loops from data. The following chapter outlines the methodology followed by the study.

Chapter 4: Methodology

4.1 Introduction

The chapter begins by presenting a research philosophy to position the philosophical underpinning of the study. After that, the chapter introduces the research design and ends with a discussion on the ethical considerations taken before and during the study.

4.2 Research Philosophy

A paradigm is defined as "*patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which investigation is accomplished*" (Weaver and Olson, 2006, p. 460). The paradigmatic position of a researcher depends on their epistemological and ontological positions. Epistemology mainly involves a researcher's understanding of the nature of knowledge, whereas ontology involves the researcher's understanding of reality.

Research in rural water management has largely followed a positivism research paradigm (see Meisner, 2010). The ontological position of positivists assumes that there is a single, objective, and stable social and physical external reality that is governed by laws (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014) . Positivists argue that reality can be observed and is known (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014). This reality has order and regularity. Epistemologically, positivists researchers can investigate reality without being influenced by it. This is plausible because of the use of measurable, quantifiable data they collect (Saunders, 2019). They look for causal relations in the data to create law like generalisations. Such causal relationships can predict and control the natural world. They usually use an existing theory to develop hypothesis which can be tested and confirmed in whole, part or rejected. Their findings are considered objective and generalisable (Saunders, 2019). They heavily rely on experiments and quantitative research is usually employed. Knowledge is viewed to be because of empirical observation, thus creating a separation between science and non-science (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014). Criticisms of positivism has been its assumption that a cause has the same effect on all people, as such positivists do not consider the effect of the social, psychological, historical, and cultural context have on behaviour (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014).

Interpretivist position caters for the shortfalls of positivism. On ontology, interpretivists reject the idea of an objective and external reality which is experienced in the same way with everyone (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014). They argue that due to circumstances, culture, experiences, people may or may not experience reality the same way. Interpretivists believe that reality is a social construction and depends on the meaning that people ascribe to their own experiences and interactions with others (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014). Epistemologically, interpretivists view facts as fluid and immersed with meaning (Du Plooy-Cilliers, 2014). What is factual depends largely on context and people's interpretation of information. To gain understanding of these multiple realities, interpretivists employ qualitative data. Data is inductively used to formulate theory based on the information and analysis (Bezuidenhout, Davis and Du Plooy-Cilliers, 2014).

Both paradigms (positivism and interpretivism) offer important insights to water management. However, their difference in ontological assumptions makes them incommensurable. The difficulty in combining the two paradigms requires a position or a paradigm that addresses the contradiction and involves different methodological assumptions to understand research problems in water management which are complex (Valcourt *et al.*, 2020) and systemic (Walters and Javernick-Will, 2015).

The researcher adopted critical realism as the philosophical grounding of this research. Critical realism adopts the ontology of positivism and accepts reality as single and objective irrespective of the researcher's perspective and belief (Danermark, Ekstrom and Jakobsen, 2005). Critical realism differs with positivism on its epistemology as it accepts relativism of knowledge (Danermark, Ekstrom and Jakobsen, 2005), which is subjective. Epistemological relativism situates knowledge in history (historically situated) and recognises that social facts are socially constructed by people rather than independently (Bhaskar, 2013). Taking the ontology and epistemology of critical realism, there is a reality that exists, but it accounts for socially constructed situations. The ontology (what is reality) of critical realism is not reducible to epistemology (our knowledge of reality) (Fletcher, 2017). Human knowledge can only capture a small part of a larger and deeper reality (Bhaskar, 2013). The question that this study attempts to address is typical of the difficulty in understanding the social reality. Theory (including economic theory) suggest that water payments depend on the level of service (Hope and Ballon, 2019; Hope *et al.*, 2020). However, empirical data shows that demand is inconsistent (Contzen and Marks, 2018), representing an inconsistent willingness to pay. The

reason why users (assumed to afford) are not consistent with their payments on an improved water service is one of uncertainty. Alluding to the difficulty on the issue, Hope et *al*. (2020, p. 186) make the following quotes,

"*Whether the household consensually decides to under-invest in an improved water source and internalize potential health or immediate travel costs is a matter of uncertainty*."

"*Do people not pay because they have no service, cannot afford the service, or do not value the service?*"

Furthermore, the findings that a man would rather buy beer than pay for water and that jealousy and competition for social status affects commitment to making payments towards sustaining an improved water service (Brown and Van Den Broek, 2020) makes it difficult to understand the social reality in its entirety. Such a phenomenon would be difficult for a positivist to explain since they reduce reality to what can be empirically known.

Critical realism does not denounce attempts to understand the social world using philosophy and social science (Danermark, Ekstrom and Jakobsen, 2005). However, critical realist use theory as an avenue to gain knowledge, where some theories can be more or less true (see Danermark, Ekstrom and Jakobsen, 2005). These theories help critical realists to get closer to reality by identifying causal mechanisms driving a phenomenon (Fletcher, 2017). As argued by Fletcher (2017, p. 182)

"*The ability to engage in explanation and causal analysis (rather than engaging in thick empirical description of a given context) makes critical realism useful for analysing social problems and suggesting solutions for social change*".

In this study, the researcher seeks to come up with a theory that explains payment behaviours at improved decentralised water service models.

The researcher does not claim the theory (model) to be absolute. The researcher follows the assertions of critical realists that knowledge about reality is fallible but not equally fallible (Danermark, Ekstrom and Jakobsen, 2005). Theories are the best truth in the moment but can always be surpassed by new theories (Danermark, Ekstrom and Jakobsen, 2005).

4.3 Research Design

A research design is a plan of how one goes about answering the research questions (Saunders, 2019). It is generally concerned about the overall research plan (Saunders, 2019). Research designs are "*types of inquiry within qualitative, quantitative, and mixed methods approach that provide specific direction for procedures in a research study*" (Creswell and Creswell, 2018, p. 11). The research question of focus is, *why are household user payments at communal water kiosks in rural trading areas inconsistent*? The research design was developed to answer this main research question. The study adopts a multiple case study design methodology explained in detail below.

4.3.1 Research Design Process

A case study can be defined based on two-fold aspects in scope and features. Within the ***scope*** definition, a case study can be defined as an empirical method that, "*investigates a contemporary phenomenon (the "case") in depth and within its real-world context*" (Yin, 2018, p.15). The second definition encompasses the features of a case study. These include, how a case study copes with situations where there are many relevant variables of interest rather than just data points. A case study also employs the use of prior theoretical prepositions to guide design, data collection and analysis. Furthermore, a case study also uses multiple sources of evidence (Yin, 2018).

Yin (2018, p. 9) gave three conditions for choosing case study research. These conditions are (a) the form of the research question, (b) the control a researcher has over actual behavioural responses, and (c) the degree of focus on contemporary as opposed to entirely historical events. Yin (2018) argues that cases studies are more appropriate for the 'Why' and 'How' questions. This study seeks to address the 'Why' question and therefore meets the criteria for a case study.

4.3.2 Multiple Case Study Design

Multiple case study design should follow a replication logic (Yin, 2018). Each case study selected must either predict similar results (a literal replication) or predict contrasting results but for anticipatable reasons (a theoretical replication) (Yin, 2018). This study follows a

theoretical replication where cases expected to have contrasting results are chosen. This is because of the central argument of the study that there are structures that determine payment behaviours and therefore users in the same structure behave the same way (Senge, 2006). The logic that underpins the replication logic is a focus on issues of theoretical relevance (Yin, 2018). In this study, the researcher aims to determine a theory/model that explains payment behaviours at an improved water service.

The typical multiple case study design is shown in Figure 4.1 below. The initial step in designing a multiple case study design is the define and design stage. In this stage, the researcher needs to ensure that the study has theoretical relevance (involves developing and testing theories). This leads to development of new theory. After the theory is developed, case studies need to be chosen, and a data collection protocol must be in place considering methods of data collection. The define and design stage is followed by the prepare, collect, and analyse stage. In this stage, case studies are conducted at each case independently. Data is collected using data collection tools and analysed for each case study. The next stage is to analyse and conclude. In this stage, the case study researcher draws cross case conclusions. This leads to modification of theory and development of policy implications. The multiple case study research ends with a cross-case report (Yin, 2018).

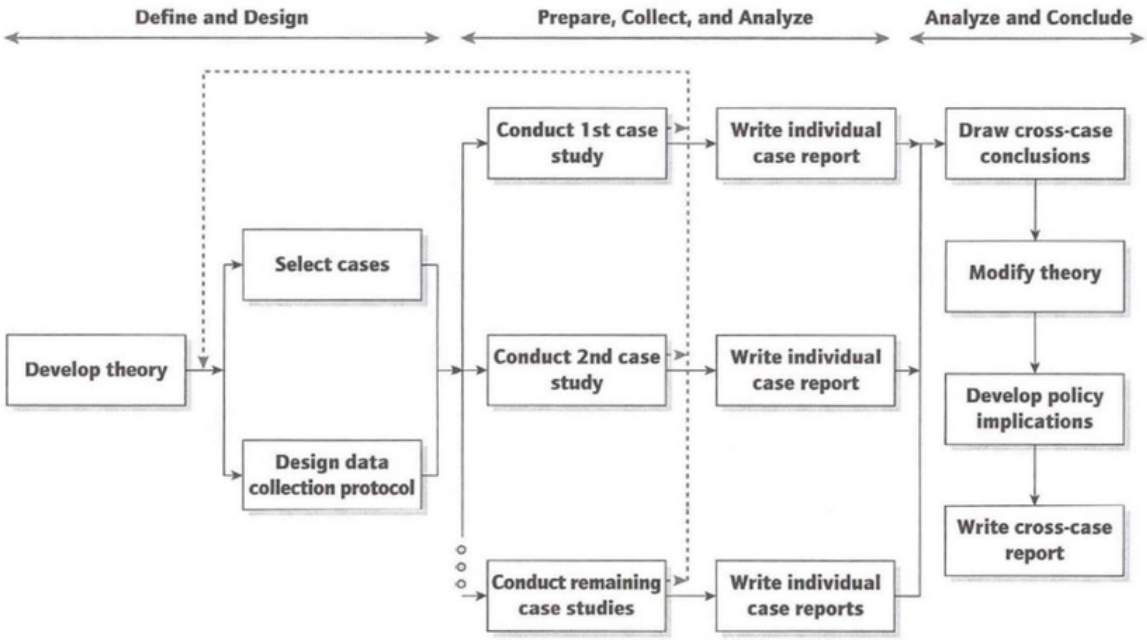


Figure 4. 1: Multiple -Case Study procedure (Yin, 2018, p 58)

In this study, the framework by Yin (2018) is adapted to meet the purpose of the study. Two case study are employed. Instead of writing individual reports on each case as recommended in the original framework in Figure 4.1 above, analysis in this study is done concurrently under propositions following the Explanation Building Analytic technique. As such cross-case conclusions were done. After cross case conclusions, the theory (feedback loops and resulting propositions) was modified. Further modifications were done through confidence building with selected participants in group sessions. The process also allowed for the identification of leverage points upon which payment outcomes can be improved.

4.3.3 Setting and Context of the Case study

Malawi

Malawi is a Southern African country with a population of 18.6 million people (Government of Malawi, 2018). Of the 18.6 million, 84 per cent live in rural areas, with more than 50 per cent below the poverty line (Government of Malawi, 2018). Malawi was selected for several reasons. As mentioned earlier, it is one of the countries that has been found to have issues in maintaining services due to non-payment compliance (see Chowns, 2015). In addition, the country has ties with the Scottish Government and the University of Strathclyde where several projects have been carried out in the country. Data from the MWater database (see www.mwater.co) provided by the Scottish Government through the work of the Climate Justice Fund (CJF) and the University of Strathclyde to the Government of Malawi (GoM) shows that the country relies mainly on groundwater (60 per cent), where water is provided by various water points shown in Figure 4.2 below.

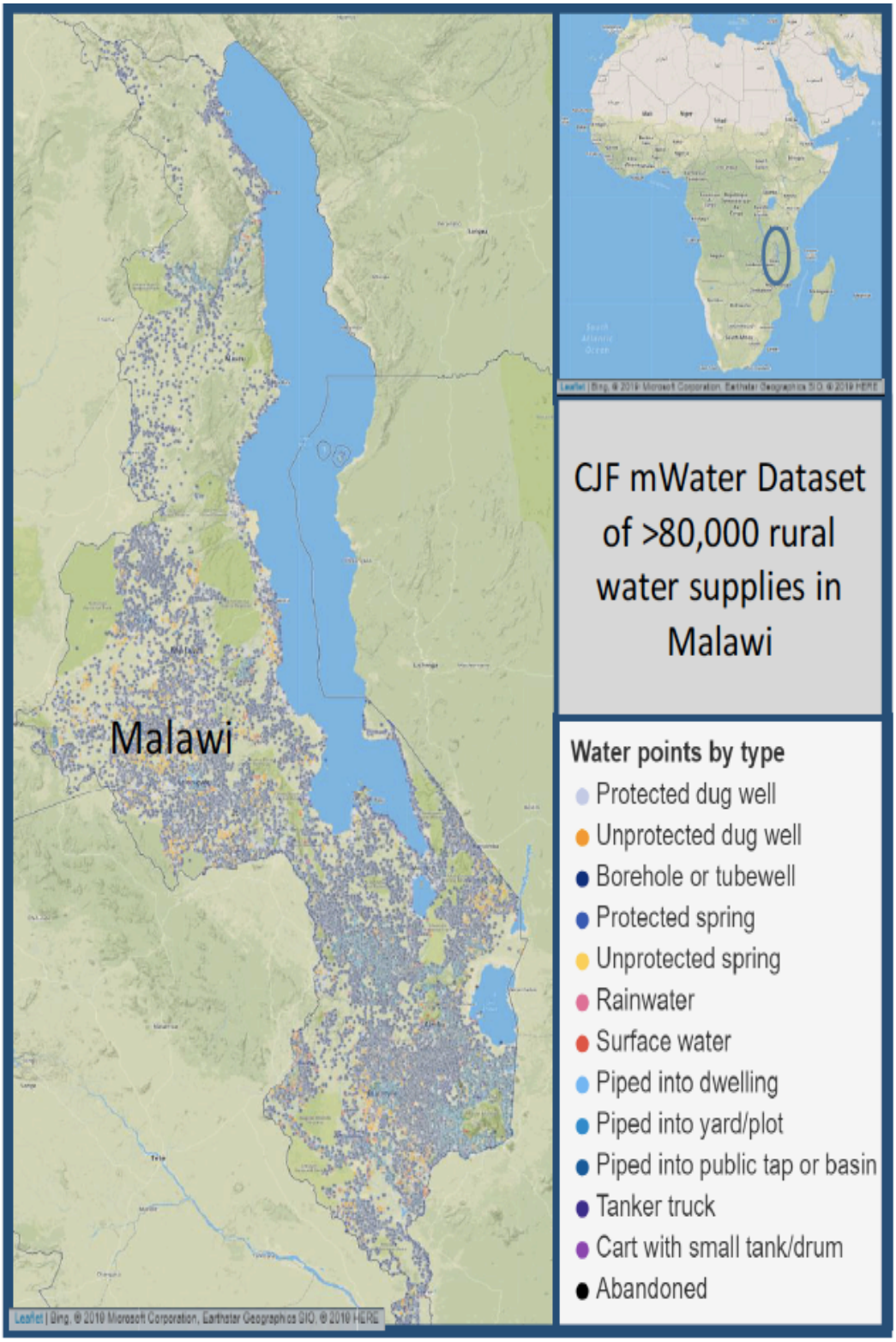


Figure 4. 2: Water point distribution in Malawi (Kalin *et al*., 2019, p. 3)

The aggregation of water services in Malawi is shown in Table 4.1 below

Table 4. 1: Water service levels in Malawi (WHO/UNICEF (2023)

Water Service Type	National (%)	Rural (%)	Urban (%)
Safely managed	18	10	52
Basic service	54	59	34
Limited service	21	23	10
Unimproved	5	6	4
No service	2	2	0

4.3.4 Water Supply Services in Malawi

Location of water supply in Malawi is mainly based on two categories. The first category is made up of the urban, peri-urban and market centres supply, and the second category is made up of rural water supply. The Revised National Water Policy (NWP) 2023 also aligns with the JMP guidelines where there are no clear guidelines on in-between categories. For instance, the category that trading centres fall into. Although the policy clearly categorises market centres to fall within the first category of urban, peri-urban and market centres supply, market/trading centres can also be found in rural areas. The policy defines a market centre as, "*a central place for exchange of goods and services by/among people from the surrounding area*" (Malawi National Water Policy, 2023, p. 8). Clearly, such places can either be under urban or rural.

4.3.5 Stakeholders in Water Supply Services in Malawi

There are many stakeholders in the water sector in Malawi shown in Figure 4.3. These stakeholders are expected to work together (shown by overlapping shapes in Figure 4.3) to ensure sustained provision of water services. The roles of each of the stakeholders are explained below.

Central Government

The Ministry of Water and Sanitation (MoWS) is responsible for water affairs in Malawi. The MoWS is made up of seven departments which are the Department of Water Supply Services, Sanitation and Hygiene, Water Resources, Planning, Administration, Human Resource and Finance (MoWS, 2023). The MoWS works together with other government departments such

as Ministry of Natural Resources and Environment and Ministry of Health through elected members (see Figure 4.3 below). The MoWS has regional and district offices, where coordination is done with water boards and various groups such as joint sector review groups.

District Government

A range of district-level stakeholders hold a variety of responsibilities in the planning and implementation process of rural water supply service delivery. These stakeholders include District Councils (DC) which are responsible for the overall development of the area (district). Executive decisions are carried out by the District Executive Council (DEC) which is supported by District Coordination Teams (DCT). The DCT helps in providing capacity to community actors such as training, however, their work is constrained by a lack of human capital and finances (Oates and Mwathunga, 2018). Another significant actor at the district level is the District Water Development Office (DWDO). They are the technical lead at the district level for the water sector and report to the DCT and DEC. They are responsible for extension services and provide support to communities.

Water Boards

Water boards are responsible for provision of water supply in urban, peri-urban and market centres (National Water Policy, 2023). They are namely Northern, Central, Lilongwe, Blantyre and Southern water boards in Malawi. For rural areas with kiosk and larger systems (than boreholes) regional water boards may also be involved, particularly in the case of trade centres and small towns. However, in most rural areas they are replaced by Water User Associations (WUAs). Water boards work with the government at both national and district level.

NGOs and Donors

There are many NGOs in Malawi focussed on the provision of safe drinking water which include Water Aid, World Vision, Water for People among others. These NGOs have influence in Malawi and are not formally regulated (Blackwood et *al*., 2016). Although, they are supposed to be registered under the Council for Non-Governmental Organisations in Malawi

(CONGOMA), some NGOs are not registered. As such there is limited control of their activities. However, there are some measures in place in Malawi to improve coordination. These include Joint Sector Review Groups, Water and Environmental Sanitation Network (WESNET) and Development Partner Groups. NGOs are often responsible for water point construction and rehabilitation and, in some cases, strengthening government capacity (Baumann and Danert, 2008). NGOs, rely on donor funding for their operations. These donors include Foreign, Commonwealth and Development Office (FCDO), UNICEF among others.

Private Sector

The private sector also plays a role in the rural water supply service delivery of Malawi. These include engineering consultants, construction contractors, radio stations and area mechanics. The private sector are sometimes contracted by NGOs for work on water projects. In rural areas, area mechanics are the dominant private sector stakeholder. Area mechanics can either be private companies or individuals. In most cases they are individuals who are selected from the community, trained by the government, and given basic equipment to do minor and major repairs (Truslove, 2020). Their roles include maintenance, monitoring functionality of water points and reporting issues to the DWDOs. They are not paid by the government but can have arrangements with communities for compensation for their work (Chowns, 2015).

Community

A variety of community-level institutions are critical in the provision of rural water services in Malawi. These include Village Development Committees, Traditional leadership, WPC and WUAs. Of particular importance is the role undertaken by WPCs and WUAs who are responsible for O&M at the community level and engage in activities such as collecting revenue and outsourcing maintenance to area mechanics and other private sector service providers. Traditional leaders are critical for the management of resources in Malawi, as they are usually the custodian of resources at the rural level (Oates and Mwathunga, 2018). Communities work together with district governments, water boards and NGOs.

Education and Research

Various institutions are responsible for education and research in Malawi. These institutions include Malawi universities, United Kingdom (UK) and other international universities. Projects undertaken by these universities are funded by various research funding bodies (Blackwood *et al*., 2016).

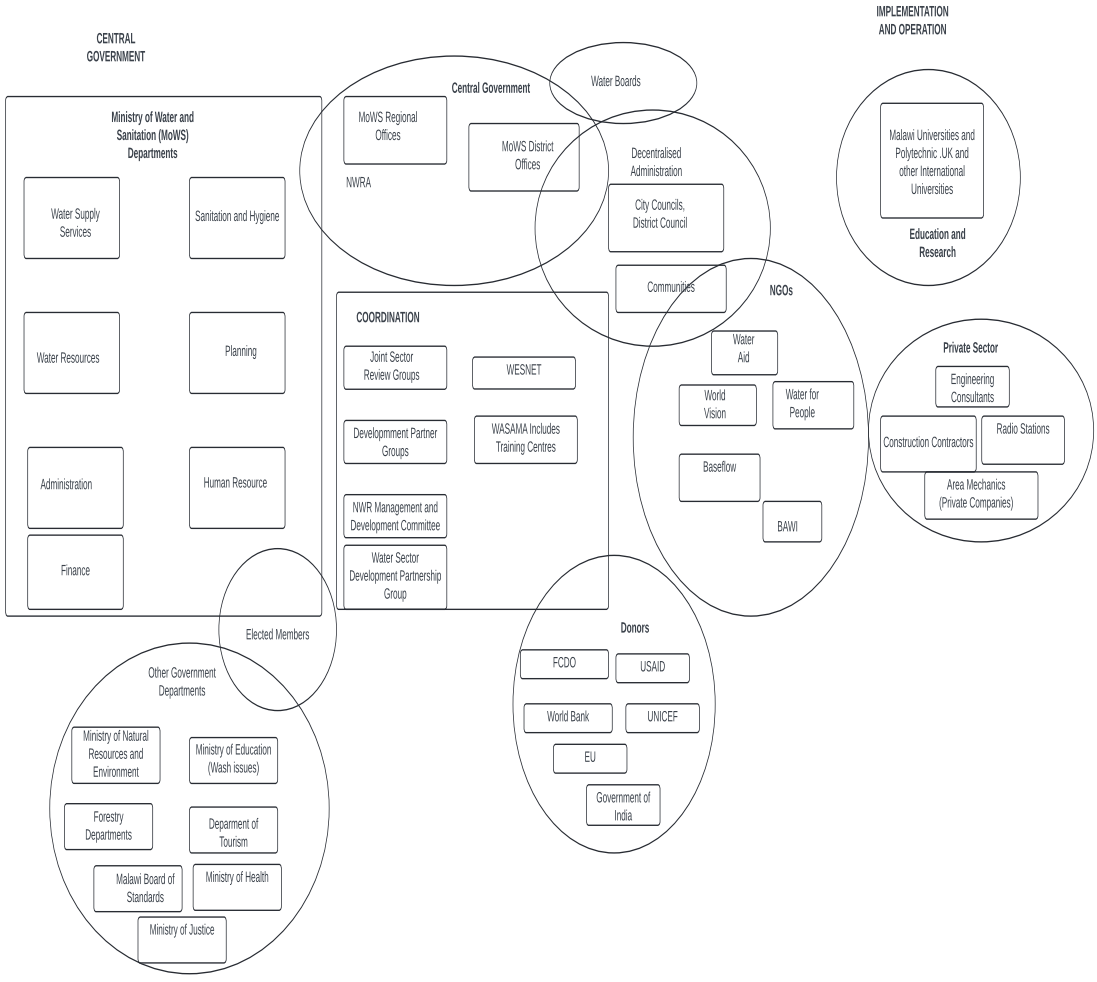


Figure 4. 3: Adapted water sector stakeholder map (Blackwood *et al*., 2016, p. 3)

4.4 Case Study Identification

The selected projects in the study are the Chiringa Borehole Project and Southern African Development Community Groundwater Management Institute (SADC GMI) Chimbiya Project. Introduction to these projects was facilitated by a senior researcher within the University of Strathclyde who has extensive experience with the rural water sector in Malawi. Upon their introduction, the projects offered significant comparative insights into how kiosks were managed and the associated payment behaviours.

4.4.1 Case Study 1: The Chiringa Village Borehole Project

Chiringa village is in Phalombe District in the southern region of Malawi. The district has approximately 429 450 people with an average household of 4.3 people (2018 Census Data). Chiringa has an estimated over 700 inhabitants as of 2018 (2018 Census Data). Chiringa is about five miles away from the Mozambique border. The village is usually dry but has aquifers that provide groundwater. Support for the Chiringa Village Water Borehole project was requested by the local NGO Care and Share from the Rotary Club Ayr (Scotland) to provide water services in the village. The Rotary Club Ayr partnered with the Rotary Club Maarssen of the Netherlands to fund the project. Hydrogeological services were provided by the University of Strathclyde's Civil and Environmental Engineering Department. The project was delivered to the community in mid-April 2019. The project comprises of a 70-metre borehole with an estimated yield of at least 20 000 litres per day of clean drinking water drilled from an aquifer. This borehole was fitted with a reticulated solar system (rating of 1000 watts) to pump water to four storage header tanks, each having a capacity of 5000 litres. These header tanks were then connected to pipework infrastructure supplying three kiosks stations within the village to serve over 700 inhabitants (Care and Share, 2021). Figure 4.4 below shows the location of kiosks in Chiringa.

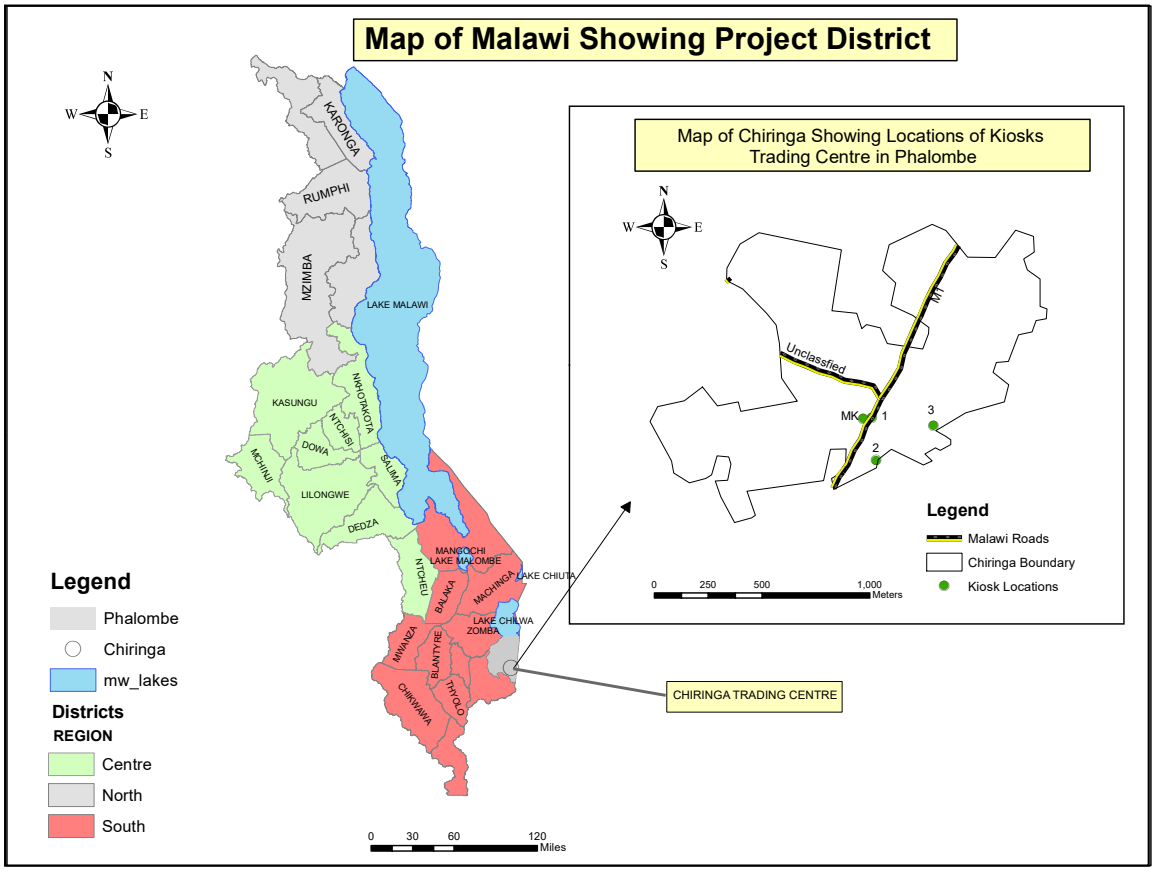


Figure 4. 4: Map showing the location of the water kiosks in Chiringa (Source: Author 2024)

Figure 4. 5: Water Kiosk in Chiringa (Source: Care and Share, 2021)

4.4.2 Case Study 2: SADC GMI Chimbiya Project

The project is located at Chimbiya Trading Centre in Dedza District of Malawi. The project provides water to over 15 300 people using groundwater. Boreholes are powered by solar and provide approximately 45 630 litres of water per day to people in Chimbiya. At the inception of the project 10 taps (kiosks) shown in Figure 4.6 below were installed (Water Mission Malawi, 2021). Figures 4.6, 4.7 and 4.8 shows some of the kiosks taps.

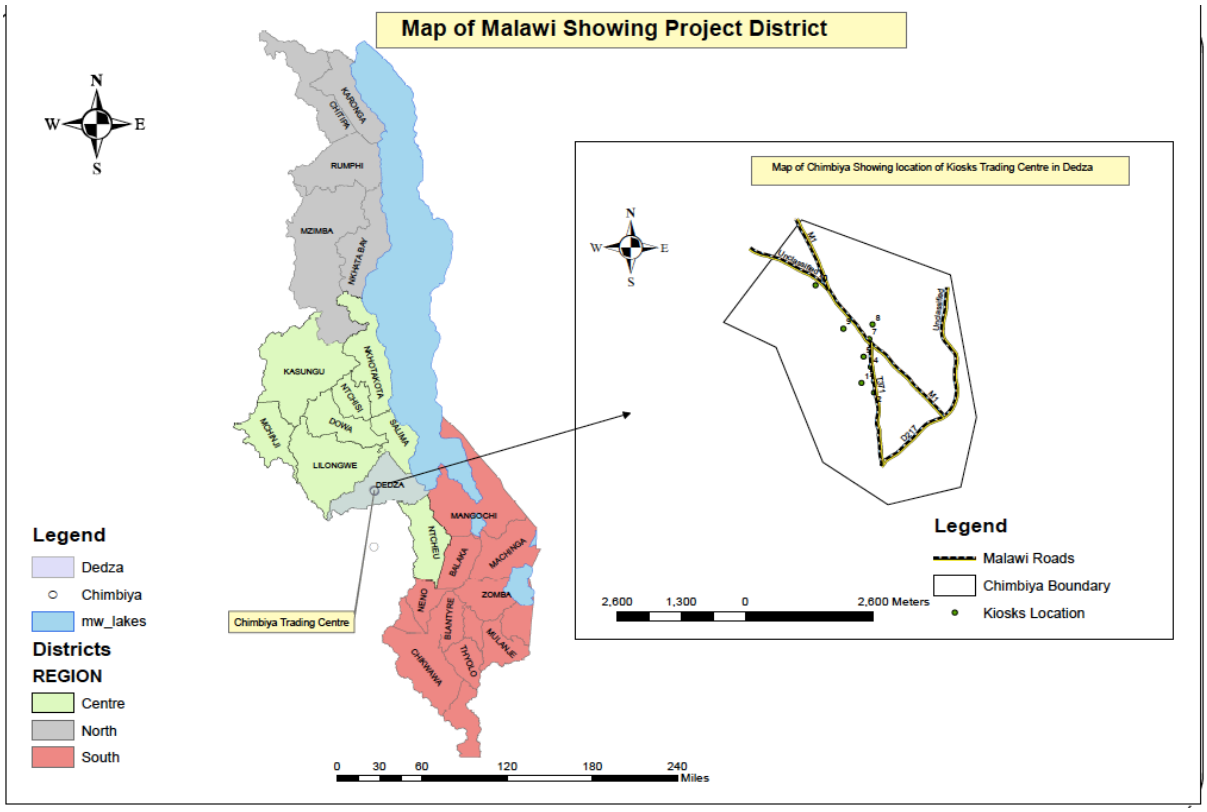


Figure 4. 6: Map location of the water kiosks in Chimbiya (Source: Author 2024)

Figure 4. 7: Water kiosks in Chimbiya (Source: Water Mission Malawi, 2020)

Figure 4. 8: Research Assistant at one of the taps in Chimbiya (Source: Fieldwork 2022)

4.5 Background Information as part of the Case Study

Contacts in both areas were made via the Climate Justice Fund Water Futures programme and through Dr Andrea Coulson who is a senior researcher with extensive knowledge of rural water services in Malawi. Before data collection, various meetings were held with people from the central and district government, NGOs and funders. In the Chiringa Borehole Project, further meetings took place with members of NGOs (Ayr Rotary Scotland) and Care and Share. With the SADC GMI Chimbiya Project, meetings were held with the government officials who were responsible for monitoring and implementing the project. This process allowed the researcher to identify significant comparative insights. Both projects are part of the introduction of water kiosks in trading centres in rural Malawi. However, the projects had different payment outcomes, where comparatively better outcomes were experienced in one case than the other. This argument falls under the *'polar types' of* recommendation by Eisenhardt (1989), where cases of success and failure are chosen (see Eisenhardt, 1989). The use of communal kiosks at trading centres in rural Malawi where population is increasing in both projects acts as a boundary of the study. The initial process of enquiry allowed the researcher to identify important stakeholders relevant to the research and get insights into details regarding payment behaviours and levels of water service in both projects.

4.6 Selection of participants

The recommended sampling technique to be used in case study research is purposive sampling (Schoch, 2020). Purposive sampling is mainly used to identify information rich cases in a resource efficient way (Patton, 2014). Yin (2018) recommends enquiring from knowledgeable people about potential case candidates or collecting information about potential candidates from documents. Purposeful sampling involves identifying and selecting individuals or groups of individuals with rich knowledge and experience about the phenomena under study (Cresswell and Plano Clark, 2011). As mentioned previously, the selected stakeholders were chosen based on initial contacts with a senior researcher at the university who knew stakeholders with experience and knowledge about the cases and phenomena under study. The selected stakeholders are outlined below:

- People in authority, either in a position of influence in policy formulation or implementation. They belong to three levels in the service delivery approach which are the national, intermediate (district/regional), and local levels.
- The users of the water service at the community level as represented by the community/local management committees/groups.

These categories are made up of the following groups,

- Ministry of Water and Sanitation
- District councils.
- Development partners either funding or implementing rural water supply development.
- Local management groups leaders.
- Selected households (these were selected based on availability and willingness to participate).

The above stakeholders are deemed to have extensive knowledge and lived experience of the system, with their expertise used as a basis for testing the propositions and resulting feedback loops derived from the CLD.

4.7 Data collection

4.7.1 Semi-Structured Interviews

The study employed semi-structured interviews. The interview questions are provided in the interview protocol/guide attached in Appendix 1. The advantages of semi-structured interviews are that they give the researcher structure while at the same time allowing the researcher to probe further in cases where more information is needed (Saunders, 2019). Semi-structured interviews are very insightful because they provide explanations and personal views (Yin, 2018).

If done well, semi-structured interviews are the most important method of collecting data (Gillham, 2000). Unlike unstructured interviews, semi-structured interviews allow another researcher to follow the same procedure and achieve the same result, thus can be used for a reliability test as instructed by Yin (2018).

The researcher had previous experience in conducting semi-structured interviews from his work with the Water Research Commission in South Africa, experience with research in clean water provision in rural areas of South Africa and personal experiences in Zimbabwe. One of the main challenges encountered by the researcher in conducting interviews was the pandemic. To mitigate the challenge posed by the pandemic, the researcher built in his design the use of online interviews, which is not new to social science research (Barratt and Maddox, 2016). However, there were difficulties in connection and language when conducting online zoom interviews with community leaders, members of the community organisation and households. In that case, the researcher, upon recommendation from other researchers in the same field in Malawi, employed an experienced research assistant to conduct the interviews in the local language (Chichewa). The research assistant holds a Bachelor of Science in Natural Resource Management at Lilongwe University of Agriculture and Natural Resources. He has nine years of experience in the water sector of Malawi where he worked on various projects as a research assistant. The researcher was in regular contact with the research assistant and held discussions on the requirements of the data collection process. Interviews were recorded and the research assistant provided translated transcripts for analysis. These interviews transcripts were double checked with another researcher who is proficient in Chichewa and has knowledge of water issues in Malawi.

In the study 45 interviews were completed. The first interviews began in October 2021 and were conducted via Zoom by the researcher. The first tranche of interviews included three NGO members in the Chiringa Borehole Project and three from Chimbiya, as well as two government officials from Chiringa and two from Chimbiya. The second tranche of interviews was carried out by the research assistant on behalf of the researcher between February and April 2022. A total of 35 semi-structured interviews were undertaken by the research assistant (20 in Chiringa and 15 in Chimbiya) with members of community organisations, community leaders and selected households in both projects. Information on the demographics of participants is shown in Tables 4.3 and 4.4 below. Each interview took between 30 to 60 minutes and was carried out in either English or Chichewa. During the interview process, the researcher took notes to capture thoughts and body language highlighted by the interviewees and to provide reference and backup to the recorded data in the event the recording equipment failed to function (Creswell and Creswell, 2018). As mentioned previously, the interview process was guided by an interview protocol in Appendix 1. This is important since interviews were carried out by two different people. The study followed the suggestions by Creswell and

Creswell (2018, p. 190-191) and aligned with the main research aims. Classification of the interviews on both projects are shown in Table 4.2 below.

Table 4. 2: Selected participants in Chiringa and Chimbiya

Stakeholder	**Number in Chiringa**	**Number in Chimbiya**
District government	2	3
NGO	5	3
Local community organisation	8	5
Households	10	9
Total	**25**	**20**

Table 4. 3: Demographics in Chiringa

Name of Participant	**Gender**	**Role**
CR_1	M	Senior leader in the Chiringa WUA
CR_2	M	Senior leader in the General Assembly
CR_3	F	Senior leader in both the MWC/ Chiringa WUA
CR_4	M	Mechanic and former member of the MWC
CR_5	M	Leader in the NGO Care and Share
CR_6	M	Former senior leader in the MWC
CR_7	M	Household beneficiary
CR_8	F	Household beneficiary
CR_9	F	Member of the Village Development Committee
CR_10	F	Household beneficiary

CR_11	F	Member of management at Care and Share Malawi
CR_12	M	Consultant
CR_13	F	Household beneficiary
CR_14	F	Household beneficiary
CR_15	M	Assistant community water supply and sanitation officer
CR_16	M	Household beneficiary
CR _17	M	Household beneficiary
CR_18	F	Assistant community water supply and sanitation officer
CR_19	M	Senior leader of the Rotary Club Ayr
CR_ 20	M	Retired academic and member of Rotary Club Ayr
CR_21	M	Member of the Chiringa WUA
CR_22	F	Household beneficiary
CR_23	F	Household beneficiary
CR_24	M	Household beneficiary
CR_25	M	Member of the WUA

Table 4. 4: Demographics in Chimbiya

Name of Participant	**Gender**	**Role**
CM_1	M	Community development team member at Water Mission
CM_2	M	Member of the Safe Water Committee
CM_3	M	Water Mission technical team
CM_4	M	Household beneficiary

CM_5	F	Senior leader in the SWC
CM_6	F	Household beneficiary
CM_7	M	Household beneficiary
CM_8		Household beneficiary
CM_9	F	Senior leader in the SWC
CM_10	M	Assistant community water supply and sanitation officer
CM_11	F	Senior government official
CM_12	F	Community development team member at Water Mission
CM_13	M	Senior leader in the SWC
CM_14	F	Senior leader in the SWC
CM_15	M	Household beneficiary
CM_16	M	Operator
CM_17	M	Household beneficiary
CM_18	M	Household beneficiary
CM_19	M	Hydrological research officer
CM_20	F	Household beneficiary

4.7.2 Interview Protocol

To develop an interview protocol, the suggestions posed by Creswell and Creswell were employed (2018, p. 190-191). The protocol contained the following categories,

Basic information about the interview

This section includes basic information about the interview so that the database can be organised, such as the time and date, location of the interview, and the interviewer and interviewee's names.

Introduction

This section provides instructions to the researcher so that useful information is not overlooked. The researcher started by introducing himself and the purpose of the study. This is also the time the researcher/research assistant enquired for consent from the participants and asked them to sign the consent forms. All the participants approached agreed to take part in the study.

Opening question

The opening question (Appendix 1) was an ice breaker. This question was meant to put the interviewee at ease and included general information. The researcher asked the interviewee to introduce themselves and talk about anything with regards to water provision in Malawi.

Content questions

This was the critical part of the interview, where questions that are relevant in understanding payment behaviours at kiosks in both projects were put to the participants. The researcher ensured that such questions were clear, understandable to participants.

Using probes

One of the advantages of using semi-structured interviews is that they allow the researcher to probe further on questions that require more clarity or seek more information when needed to help understand the problem and answer the research questions.

Closing instructions

This is an important stage of the interviewing process. At this stage the researcher thanked the participants for their time and information. Furthermore, most interviewees might want to know their outcomes from the study as such the researcher provided information on how the participants can have access to the final thesis and published material. Such material will be available on the university library.

Creswell and Creswell (2018, p. 191)

4.7.3 Analysis of Project Documentation

In order to augment and validate information provided in interviews, the researcher also undertook an analysis of relevant grey literature associated with rural water supply and the specific case studies. The advantage of using documentation is that information from documents can be reviewed repeatedly. Furthermore, the use of documents is specific in that documents contain exact names, references and details of an event or project. Documents also cover a longer period than personal recall from interviews (Yin, 2018). However, a researcher needs to be cautious and not take information from grey literature as exact facts, as they are written for a specific audience (Yin, 2018). In most cases, documentation is used to corroborate and augment evidence from other sources (see Yin, 2018). It is for this reason that documentation was mostly used in this study. The types of documents reviewed in this study include policy documents, administrative documents (proposals, project reports and other internal records), financial documents from local committee organisations and formal studies or evaluations related to the case.

4.8 Challenges in conducting Case Study Research

Case study research has several challenges attributed to its use. These challenges have been explained in detail by Yin (2018, p. 18-22). They are as follows:

Issues of Rigour

Lack of rigour is one of the most mentioned drawbacks by the opponents of case study research (Yin, 2018). Yin (2018, p. 18) highlights that "*too many times, a case study researcher has been sloppy, has not followed systemic procedures, or has allowed equivocal evidence to influence the direction of the findings and conclusions*". Yin (2018) urges researchers to desist from such practices. Therefore, a researcher followed a clear methodological path recommended by Yin (2018). The methodological path the researcher followed is explained in section 4.3.2.

Confusion with non-research Case studies

Yin (2018) gives an overview of what he calls non-research case studies that other researchers often confuse with research case studies. These non-research case studies include teaching practice case studies, popular case studies, and case records. Yin (2018) argues that these type of case studies do not follow any methodical procedure, as such, should not be used as a

yardstick of the rigour and robustness of a case study research. This study uses case studies as a research method, thus follows a clear methodical procedure and thus addresses issue of rigour previously mentioned.

Issues with Generalisability from Case studies

The most asked questions by critics of case study research are that "*How can you generalise from a single case study*" (Yin, 2018, p. 20). They miss that case studies are not generalisable to populations (statistical generalisations), but rather in doing case study research, the researcher's goal is to expand and generalise theories (analytic generalisations). Case studies are generalisable to theoretical prepositions. This study has already provided the theoretical prepositions upon which the case study is based on. The final model developed in this study is for the two case studies, however, it is useful to apply more widely across Malawi and other countries in SSA where community water points are used, and collective action structures are inherent.

Unmanageable level of Effort

There is a general argument among opponents of case study research that the method is time consuming as it employs time-consuming methods of data collection such as ethnography and participant observation (Yin, 2018). However, case studies are not only limited to such methods, other alternative multiple sources of data such as interviews and documentation are also suited for case study approach. Therefore, this study employs interviews, and documentation as methods of data collection within the case study to offset this argument.

Comparative Advantage

Case studies have often been compared with other methods such as Randomised Control Trials (RCTs). Often, RCTs have been preferred over case studies because they can address the effectiveness of interventions. However, Yin (2018) argues that case study research has a significant advantage over RCTs because they can address how and why questions with regards to why for instance a given policy intervention has worked or not, while RCTs are not equipped for that. This study addresses the why question and thus explains and captures the in-depth understanding of a phenomenon (in this case an inconsistency to what is believed (proposed) to work by rural water supply literature).

4.8.1 The validity of Case Study Research

Yin (2018, p. 42) gives an overview of four tests to validate case study research. These are as follows.

Construct Validity

Construct validity involves identifying correct operational measures for concepts being studied. For instance, Yin (2018) gives an example of a study in neighbourhood change and mentions that usually a critique in such case studies is failure to define what constitutes change. This can be overcome if a researcher for example chooses a specific concept in neighbourhood change, such as changes in neighbourhood crime, and uses specific operational measures such as FBI data. This concern has been addressed in this study, for example the study is specific in that it focuses on the financial sustainability of kiosks, in particular the inconsistent payment behaviours by users, and the specific operational measures are identified through financial data from the local community organisations (documentation) and semi structured interviews. Financial data from the local community organisation may be inaccurate or have been tampered with and so bank statements and information from NGOs who also have notes on financial records by the local community organisations were requested. Furthermore, construct validity was assured by use of multiple sources of data (interviews, documentation) and validation of findings with selected participants.

Internal Validity

Internal validity applies only to explanatory or causal studies and not to descriptive or exploratory studies. Therefore, since this study is an explanatory case study (causal) internal validity is very important. The reason for ensuring external validity is to avoid spurious relationships where incorrect relationships between variables are assumed. For instance, a researcher might assume that x caused y without considering that maybe z has caused y (see Yin, 2018). To take care of this, the researcher first considered relationships in the literature and then corroborated the relationships using empirical data and validation from participants. Furthermore, the use of CLDs also caters for instances of non-linear relationships. In addition, as suggested by Yin (2018) engaging in explanation building, which is an analytic technique that this study adopts, helps with ensuring internal validity. As quoted by Yin (2018, p. 179),

"*to explain a phenomenon is to stipulate a presumed set of causal sequences about it, or 'how' or 'why' some outcomes occur*".

External Validity

External validity involves defining the domain to which a study's findings can be generalised (Yin, 2018). One can use theory and the replication logic in multiple case studies to ensure external validity. This study uses multiple case study design and makes a theoretical preposition mentioned previously. Thus, the goal is to make analytic generalisation, where a theory (theoretical propositions) is proposed to explain payment behaviours at water kiosks from literature and is corroborated and extended using empirical evidence from the case studies.

Reliability

Testing for reliability involves proving that data collection procedures can be repeated with the same results. To ensure reliability, this study used a case study protocol (see Appendix 2) and maintained a chain of evidence. The main reason for doing this is to make all the procedures undertaken as explicit as possible, so that another researcher can repeat the case study if necessary (Yin, 2018).

4.9 Data Analysis

The study followed the Explanation Building Analytic Technique by Yin (2018). An Explanation Building Analytic technique is grounded in theoretical propositions. The approach starts by the researcher making initial explanatory propositions (can be causal mechanisms that explain or provide insights into a given policy) that explain a phenomenon (Yin, 2018). The propositions are then tested using case study data, where they can be amended and extended. Other propositions can also emerge from the data. The result is a theoretical explanation of how and why a phenomenon occurs. In this study, initially, propositions and resulting feedback loops derived from the literature were developed using CLDs. These propositions and feedback loops were then tested amended and extended using case studies in Malawi (deductive approach). Furthermore, other propositions and resulting feedback loops were inductively added to the model. Following Chalise (2015, p.43), "*the two approaches were applied simultaneously such that narratives that are related to feedback structures are coded in existing*

themes and new themes are generated for narratives that do not fit existing themes". The data analysis stage finished with confidence building (validation), where selected participants were involved in group sessions.

4.9.1 Coding process

All coding was done using the software Nvivo 12[2]. Two parent codes were created following the deductive- inductive approach. These two parent codes were, 'existing themes' and 'emerging themes'. The researcher then created child codes represented as feedback loops developed from literature. For instance, one of the feedback loops found was Trust in the local community organisation (R1), narratives from the textual data that supported the theme were coded under that theme (Chalise, 2015; Akcam, Guney and Cresswell, 2019). Narratives from the data that supported the loop increased confidence in the feedback structure (Chalise, 2015). An illustration of the decomposition of the initial child nodes is shown in Figure 4.9 below.

[2]https://help-nv.qsrinternational.com/12/win/v12.1.115-d3ea61/Content/welcome.htm

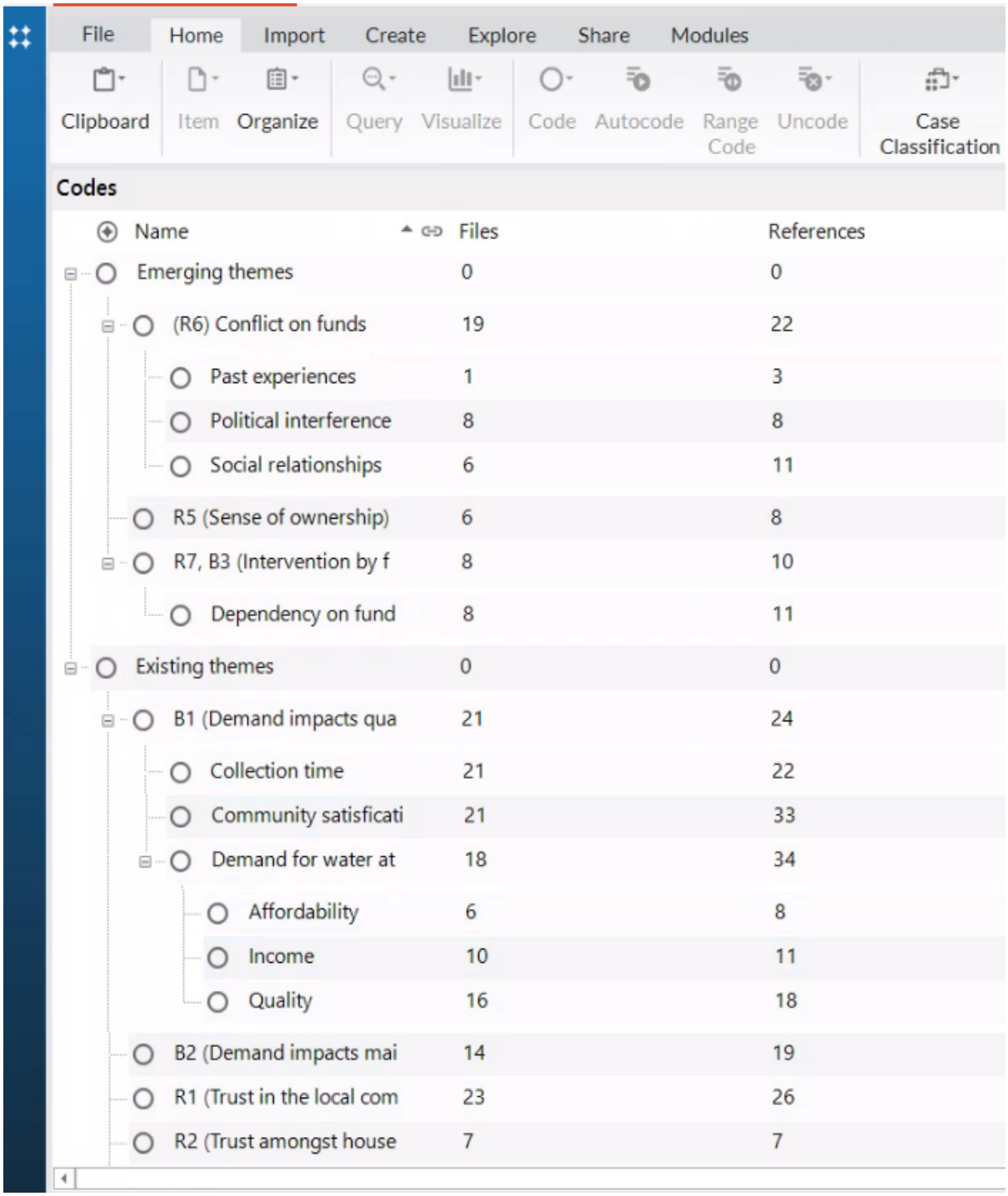


Figure 4. 9: Extract showing decomposition of nodes

For emerging themes, narratives from interviews were used to inductively create other emerging feedback loops. The study followed the inductive process by Eker and Zimmerman (2016) summarised in Table 4.5 below.

Table 4. 5: Summary of the coding approach (Eker and Zimmermann (2016, p. 5)

1.	Identifying concepts and discovering themes in the data	Open coding	Raw text data	A list of concepts and themes, and corresponding codes
2.	Categorising and aggregating themes into variables	Axial coding	The list of themes and corresponding codes	A coding tree
3.	Identifying causal relationships between aggregated variables	Axial coding, causal links	The coding tree	A list of relationships with references to the data (Coding dictionary)
4.	Transforming the coding dictionary into causal diagrams	Causal maps	The list of relationships	Final CLD

In *step 1*, the researcher open coded statements from the semi-structured interviews that hinted at a concept or theme. At this stage, the researcher (coder) developed an understanding of casual relationships expressed by the participants. In the *second step* the researcher created a coding hierarchy according to the aggregation of themes observed in the data. For instance, using interview data, participants' responses to the question gave insights into several factors relevant to the theme. In the *third step,* the researcher looked at words such as *because*, *if, and then* among others which are suggestive of causal relationships. Such relationships were linked to data sources in NVivo², in a way that maintains references and saves time. In the *final stage*, the researcher transformed relationships coded in NVivo² into CLDs.

4.10 Ethical Considerations

The researcher obtained ethical approval from the departmental ethics committee at University of Strathclyde. The study followed the guidelines of the University of Strathclyde Code of Practice. Ethical issues in the study included the need to respect cultural norms in Malawi. This concern was high especially in conducting interviews with local community groups' leaders. Such norms included ways of addressing elders that are a norm in African cultures. To mitigate this, the researcher conversed with contacts in the field before the investigation to gain information on issues such as acceptable greetings. Furthermore, the researcher converses well with the cultural protocols of Southern African communities considering his nationality. The

researcher also employed a research assistant from Malawi who is well conversed with such norms.

References to participants were pseudo- anonymised. All direct identifiers to participants such as names, addresses and contact details were removed in the investigation output. Data transcripts and videos/audios were pseudo- anonymised, coded and stored in the University of Strathclyde OneDrive where all files are protected with passwords.

4.11 Summary of the Chapter

The chapter presents the philosophical underpinning of the study where critical realism is employed. This has important implications on how the study was carried out and the results evaluated. The chapter also presents an innovative case study research design which combines use of Explanation Building Analytic Technique and CLDs. Furthermore, the chapter presents the methods of data collection and analysis. The following chapter provides insights into institutional arrangements (management and financial) at the chosen cases.

Chapter 5: Introduction to Case Studies

5.1 Introduction

The chapter forms part of the empirical investigation and presents findings from semi-structured interviews and scheme documents. The purpose of this chapter is to compare the two case studies. This chapter begins with basic institutional arrangements from the two cases (schemes). The Chapter then provides financial information from both schemes. Lastly, the chapter ends with a summary.

5.2 Institutional arrangements at the Schemes

5.2.1 Management Arrangements

5.2.1.1 Chiringa

The Chiringa water system was funded by the NGO Rotary Club of Ayr as the lead in partnership with the Rotary Club of Maarssen of the Netherlands and University of Strathclyde. Upon completion, the system was handed over to the local NGO (Care and Share) in mid-February 2019 (Care and Share, 2021). Care and Share Malawi Charity then handed the scheme to the community under the management of the Michesi Water Committee (MWC). MWC was responsible for ensuring the process of user fee collection, management and outsourcing of maintenance. However, during the period of 2019 to 2021, the MWC lost the trust of the households and the associated NGO. The failure of the MWC to perform its financial and maintenance duties led to the decision to disband the committee in December 2021. The NGO and the government intervened and gave the management of the scheme to the Chiringa WUA. Before taking over in December 2021, they managed access and maintenance of boreholes within the same vicinity. At Chiringa, the current WUA consists of 15 members: chairperson (shown in Figure 5.1), treasurer and vice treasurer, secretary, and vice secretary and 10 committee members. Upon their takeover, they incorporated two of the former MWC members (inclusive of the current 15 members) into their structures. These members are the former treasurer of MWC (female) and the secretary (male) The current set up of the WUA has seven males and eight females.

Figure 5.1: Research assistant (right) with the chairperson of the WUA (left) (Source: Fieldwork 2022)

5.2.1.2 Chimbiya

Chimbiya scheme was established with the community by a partnership of SADC GMI, the Government of Malawi and the NGO Water Mission. The project was commissioned on 13 February 2020. The local community committee known as the Safe Water Committee (SWC) was made responsible for managing the scheme since its inception. The members were selected through elections by the community members facilitated by the Community Development Assistant from Dedza District Council. The training was provided by the NGO and district government. The SWC is informal although known to the authorities and its function is guided by verbal and written expectations between the community and other stakeholders. The committee is responsible for collecting revenue, outsourcing maintenance, and facilitating the day-to-day operations of the scheme. They meet regularly to discuss issues with the community as shown in Figure 5.2 below. Minutes are recorded and shared with the NGO Water Mission which supports the committee. The committee is made up of 10 members (seven males and three females). They report to the NGO Water Mission and Dedza District Council (Water Mission Malawi, 2020).

Figure 5. 2: Meeting of the SWC with the community taking place in Chimbiya (Source: Water Mission Malawi, 2020)

5.2.2 Financial Performance

Cost recovery in Rural Water Supply

For rural water services to be sustainable, the full costs of providing a service must be matched to sufficient sources of finances (Jones, 2013). The life cycle cost approach (LCCA) has been a preferred approach/ framework to analyse costs, with the Department for International Development (DFID) (now FCDO) recommending it for development agencies (DFID, 2008). The LCCA classify cost in the following categories shown in Table 5.1 below.

Table 5 1: Cost components of water services (Fonseca *et al*., 2011, p. 8)

Capital expenditure – hardware and software (CapEx)	Expenditure on fixed assets such as physical infrastructure (for initial construction or system extension), and the accompanying 'software' such as capacity building.
Operating and minor maintenance expenditure (OpEx)	Expenditure on labour and materials needed for routine maintenance, which is needed to keep systems running, but does not include major repairs.
Capital maintenance expenditure (CapManEx)	Renewal, replacement, and rehabilitation costs which go beyond routine maintenance.
Expenditure on direct support (ExpDS)	Costs of ongoing support to users and local stakeholders, for example on local government or district support staff.
Expenditure on indirect support (ExpIDS)	Costs of higher-level support, such as government planning, policy- making and regulation.
Cost of capital (CoC)	Costs of servicing capital such as repayment of loans.

Currently most communities are not expected to cover all the costs of providing water services. However, the community are expected to have the capacity to cover recurrent O&M costs in (Harvey, 2007) which are part of the operating and minor maintenance expenditure (OpEx) under the LCCA framework.

Payment arrangements

At both Chiringa and Chimbiya, payment is collected under Pay as you Fetch (PAYF) arrangements. PAYF is based on the notion that users pay an agreed user fee to access an amount of water (Cord, 2018). The money is paid using cash or digital payment methods to a caretaker or an operator who monitors use and regulates access (Foster and Hope, 2017;

Morias, 2020). Part of the funds is then disbursed for O&M to ensure the sustainability of water points (Cord, 2018; Magara, 209). At these schemes (Chiringa and Chimbiya), household users are expected to pay one Malawian kwacha (MK) to access one litre of water (one MK = 0.0006 USD).

Financial Information

At Chiringa, in the 2020 financial year, MK 434,085 in water receipts were recorded. Due to improper budgeting and recording of transactions, there was no data on the expenses. For 2020-2021 financial year, financial data could not be accessed, however, the budget or that year was set around MK 1,262,000. Water usage from the kiosks could have been a good indicator of the expected amount of revenue to be collected, however, that information was not recorded. Information from one of the respondents showed that only one in every 10 litres was charged. A further probe into the issue from relevant participants showed that the taps leaked, and water was given to certain individuals (exempted families and connected individuals from the community) and school children for free (a norm in the community). There was no information on water meters which could have provided insights into the amount of water used. Information from the Rotary Club of Ayr highlighted an issue where access to the meters was hindered by a previous manager who did not return the key to the lock. During the year 2021 period, there were reports of rampant misuse of funds by the Chief who did not pass on the collected funds to the project coordinator, even though he is only meant to have an advisory role. This was supported by data from interview participants, with one member of the NGO Rotary Club mentioning,

"*We had a meeting which included the Care & Share management team. During this meeting we noted several problems. These include that water drawn was not charged and a lot of money was not being remitted by the committee members. Also, some money was being collected by Chief himself at the kiosk and was not remitted to the coordinator. In that month (November 2021), it was indicated that about 166,000 litres of water were drawn, instead of collecting about 166,000 Kwacha at the rate of 1 Kwacha per litre, only 24,000 Kwacha was collected*". Participant Chiringa (herein CR) _12)

In addition to the above, at kiosk 3, one of the landowners (the owner of the land on which the kiosk was located) was providing water for free and in other cases charging but not remitting the funds to the committee. This was highlighted by the WUA chairperson who said,

"*Some landowners offered land for free in view that they'll be exempted from paying user fees and get part payment from the water sales. This has caused a lot of disputes as the landowner now collect all user payments and does send the funds to the committee. I hope your coming will help us address this issue in future*". (Respondent CR_1)

The researcher managed to get financial information for the year 2022 from bank statements and reports from the WUA manager and NGO Care and Share (the WUA took over collection of funds from the MWC at the start of the year in January 2022). Information from water meters was requested by the researcher but not provided. Only copies of bank statements and records was provided. The revenues and expenditures were not separated per kiosk. As such the information was for all the kiosks (only two functional kiosks at the time of the study for the year 2022 from January to October). The financial performance for the two functional kiosks (Kiosks 1 and 2) at Chiringa are shown in Table 5.2 and 5.3 below.

Table 5. 2: Revenue and salary expenditures in Chiringa from January to October 2022 per month

Month	**Revenue**	**Salaries**
January	122,000	180,000
February	98,000	180,000
March	111,000	180,000
April	49,500	180,000
May	248,000	180,000
June	139,300	180,000
July	134,800	180,000
August	209,000	180,000
September	314,000	180,000
October	483,200	180,000
Total	**1,908,000**	**1,800,000**

The per centages of the cost components to the total expenditure and total revenue are shown below in Table 5.3

Table 5. 3: Components of operating cost in Chiringa in 2022

Expenditure components	**% of expenditure**	**% of revenue**
Salaries	63.78	94.30
Maintenance	28.99	42.85
Administrative	7.23	10.69

The total revenue covering period from January to October 2022 is MK 1,908,000. The distribution of revenue monthly is shown in Table 5.2 above and Figure 5.3 below. Revenues are usually higher than expected during the dry periods (winter periods) mainly in winter from the month of May to August (see Forster and Hope, 2016; Ingram and Thomson, 2022). This can be noticed by a sharp increase in revenue collected from the month of May. Revenues were much higher than expected in September and October of 2022 mainly due to delay in rains which usually offer alternative sources and the outbreak of cholera in Malawi as people opted for safer water sources. This finding reinforces the arguments in literature (see Kumasi and Agbemor, 2018; Hoque and Hope 2020) that affordability might not be the main reason for non-payment. The period September to October would normally be seen as a time of less disposable income in rural communities as they are preparing to plant and buy inputs, yet payments were higher during this period. Perhaps one can argue that the period also reflects opportunities for piece work and therefore more income. Either way, the findings from this study shows that when need arises users can pay to access clean water. The issue of cholera is captured by 90 per cent of the household participants at Chiringa. Some of the responses are provided below,

"*As you know there are cholera outbreaks, people now prefer using the kiosks than other sources*". Participant CR_13

"*These days I use the kiosk more regularly to ensure that I drink safe water. Cholera is spreading I do not want my children to get the disease*". Participant CR_7

The total expenditure was MK 2,822,000. This is made up of the total cost of paying salaries (MK 1,800,000), maintenance (MK 818,000) and administrative costs (MK 204,000) (note expenditure on maintenance and administrative costs is not provided per month). In the period January to October of 2022 salaries were the largest expenditure at Chiringa with a total of

MK1, 800, 000, that is 63.78 per cent of the total expenditure (see Table 5.3 above and Figure 5.3 below). In terms of per centage to revenue, salaries accounted for 94.30 per cent of the total revenue. The salaries include the revenue collector salary of MK 30,000 and coordinator salary of MK 150,000 per month. As mentioned previously, the scheme was given to the WUA which meant that, during times where maintenance was needed, plumbers from the WUAs who are paid MK50,000 monthly (paid from the WUA budget on their main scheme) were used but that cost was not attributed to the two kiosks. However, funds for spare parts came from the Chiringa budget. The finding of high salary expenditure is not new in Malawi. In a study by Coulson *et al*. (2021) it was found that much of the income from kiosks in peri urban Blantyre was used to cover operating costs, in particular salaries.

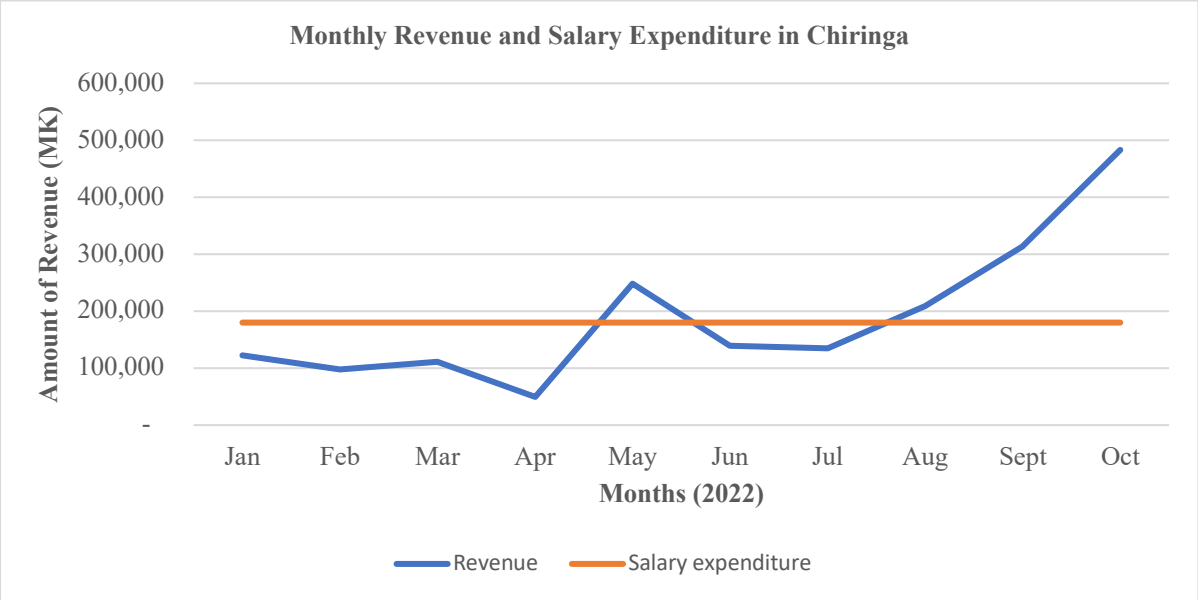


Figure 5.3: Revenue and salary expenditure in Chiringa

Compared to salary, expenditure on maintenance only cover 28.99 per cent (MK 818,000) of the overall expenditure. In terms of per centage of revenue, maintenance accounted for 42.85 per cent of the total revenue. Administrative costs accounted for 7.23 per cent of the total expenditure and 10.69 per cent of the total revenue. These costs covered transport for committee members to attend meetings and food allowances during meetings in addition to other costs such as stationery.

Whilst revenue increased in 2022 from previous years, following a change in the community organisation running the scheme (MWC to WUA), revenue in most months was lower than the

expenditure (see Figure 5.2 above). The shortfalls are usually covered by the NGOs/donors and sometimes by the government through the WUAs who receive funding.

In Chimbiya, of the ten water kiosks, three were non-functional since they needed major repairs and expertise beyond the community's savings and reach. Of the seven left, Kiosk 5 close to the church was reported as unreliable and the community around the kiosk have refused to make financial contributions. At the time of the study the researcher managed to obtain financial data from four kiosks (see Kiosks 1,2,3 and 4 in Figure 4.6). At the start of the year 2021 the committee had savings amounting to MK 1,700,000 in their account which represents the money left from an initial money provided by the SADC GMI and World Bank at the start of the project. This contrasts with Chiringa where no such amount was provided at the beginning. The researcher accessed financial data for the year 2021 and 2022 which is shown in Table 5.4.

Table 5. 4: Revenue and Expenditure in Chimbiya

	2021		**2022**	
Month	**Revenue**	**Salaries**	**Revenue**	**Salaries**
January	300,000	120,000	220,000	104,000
February	341,120	128,224	250,000	110,000
March	344,760	128,952	102,980	80,596
April	362,680	132,536	300,000	120,000
May	394,840	138,968	400,000	140,000
June	340,280	128,056	460,000	152,000
July	419,520	143,904	700,000	200,000
August	571,100	174,220	600,000	180,000
September	529,350	165,870	705,560	201,112
October	457,240	151,448	574,080	174,816
November	389,820	137,964	477,780	155,556
December	359,600	131,920	450,000	150,000
Total	**4,810,310**	**1,682,062**	**5,240,400**	**1,768,080**

The per centages of the cost components to total expenditure and total revenue are shown below in Table 5.5 below.

Table 5. 5: Components of operating cost in Chimbiya

	2021		2022	
Expenditure components	**% of Expenditure**	**% of Revenue**	**% of Expenditure**	**% of Revenue**
Salaries	34.20	34.97	45.63	33.74
Maintenance	62.75	64.15	50.50	37.35
Administrative	3.05……	.3.12	3.87	2.86

The total revenue from the year 2021 in Chimbiya was MK 4,810,310 and MK 5,240 400 in the year 2022. The monthly revenues are shown in Table 5.4 above and Figure 5.4 below.

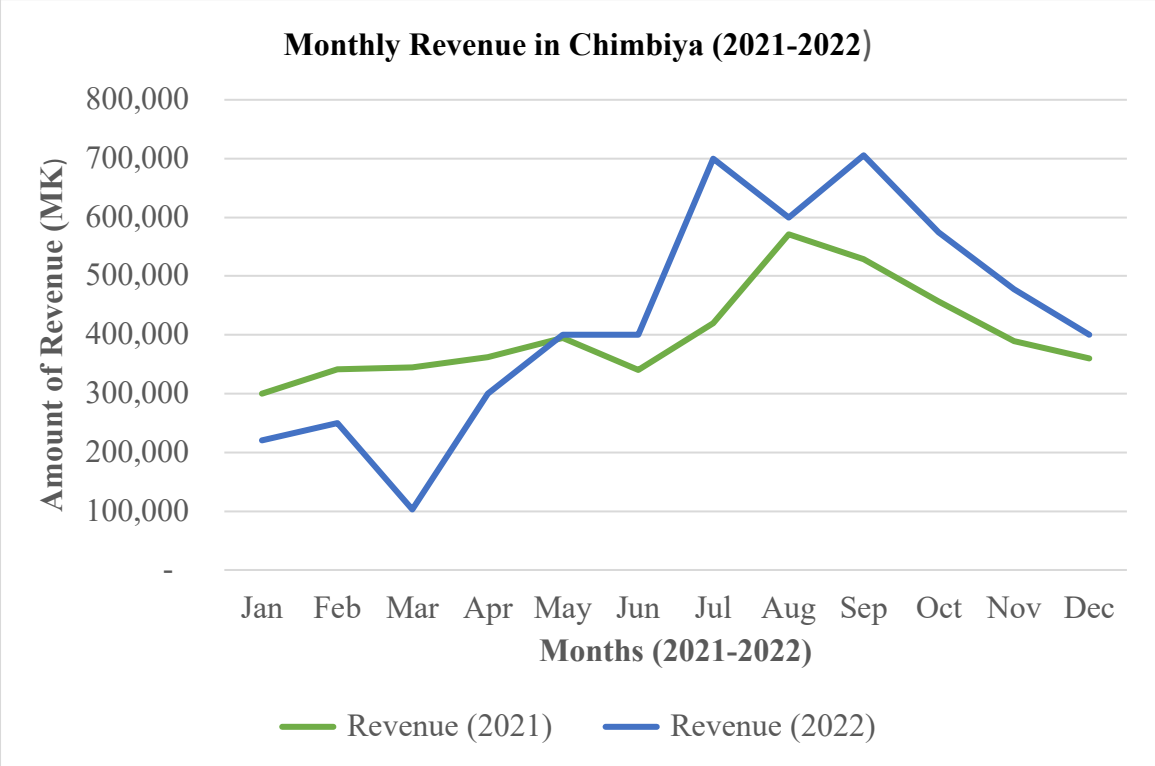


Figure 5. 4: Monthly revenue in Chimbiya (2021-2022)

In Figure 5.4 revenues are higher during the drier periods of the year (May to August) and lower during the wet seasons. This is mainly because of the seasonal switching that happens as rainfall gives access to alternative sources (see Ingram and Thomson, 2022).

The total expenditure for the year 2021was MK4,918,078. This was obtained from the total cost of paying salaries (MK 1,682,062), maintenance (MK 3,086,016) and administrative

expenditure (MK 150,000). For the year 2022, The total expenditure was MK 3,875,218. This was obtained by the total cost of paying salaries (MK 1,768,080), maintenance (MK 1,957,138) and estimated annual administration expenditure (MK 150,000). Contrary to Chiringa, in Chimbiya salaries are less than maintenance expenditure in both years (accounting for 34.97 per cent of the total revenue in 2021 and 33.74 per cent in 2022). In Chimbiya, the system operator was paid MK 20,000 per month, two guards were paid MK 20,000 per month each. The other tap operator who also collected revenue was paid 20 per cent of total revenue. This is contrary to Chiringa where payment is not linked to performance. The trends of revenue and salary are shown in Figure 5.5 and 5.6 below.

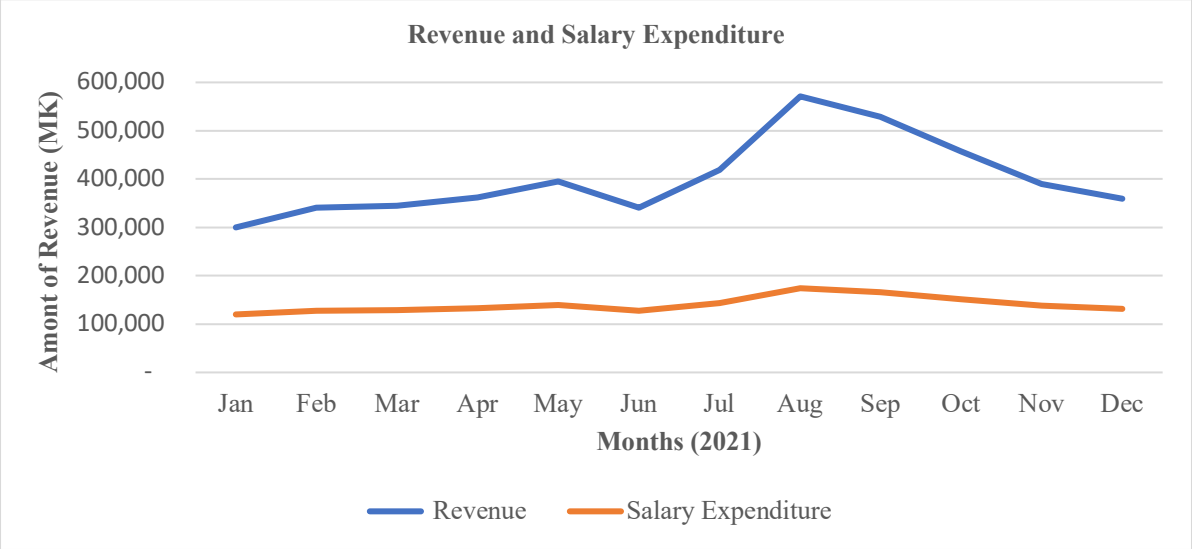


Figure 5. 5: Revenue and salary expenditure in Chimbiya in 2021

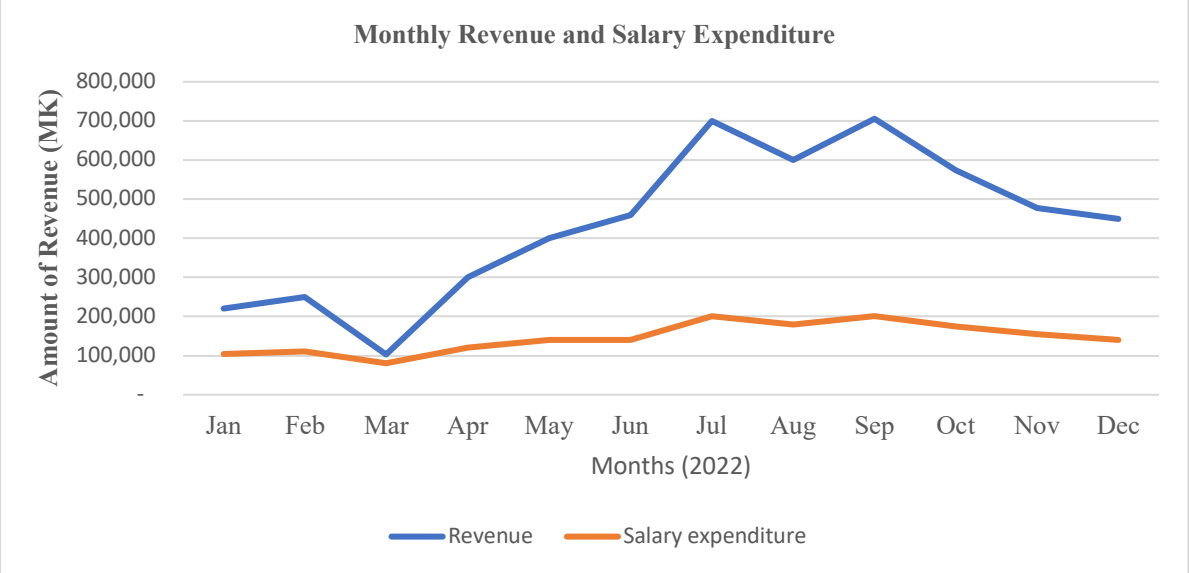


Figure 5. 6: Revenue and salary expenditure in Chimbiya in 2022

Maintenance is the main expenditure at Chimbiya, covering 62.75 per cent of the total expenditure in 2021 and 50.5 Per cent in 2022 (see Table 5.5 above). In terms of revenue, expenditure of maintenance accounted for 64.15 per cent of the revenue in 2021 and 37.35 per cent in 2022.

5.3 Summary of the Chapter

The Chapter provides background information on the institutional arrangements at both schemes. This included management and financial arrangements. The chapter shows how Chimbiya is preforming better than Chiringa which may be attributed to reasons to be discussed in the following chapter.

Chapter 6: Testing, Amending and Extending Feedback Loops

6.1 Introduction

The previous chapter (Chapter 5) provides background information on the institutional arrangements at both schemes and compared financial outcomes at Chiringa and Chimbiya. Chapter 5 shows better compliance with payments at Chimbiya compared to Chiringa. The possible explanations of this outcome are provided in Chapter 3 where feedback loops that drive payment behaviours are identified. This chapter (Chapter 6) tests if the feedback loops and resulting propositions developed using literature are present in practice. The purpose of this chapter is to test, amend and extend the propositions developed from the model in Chapter 3 with selected case studies in Malawi. The chapter starts with the stating of the propositions. Various feedback loops representing existing themes that make up the propositions from the model in Chapter 3 are then tested, amended, and extended using empirical evidence from the semi-structured interviews from both Chiringa and Chimbiya schemes. Other feedback loops (emerging themes) are also developed inductively using textual data from the semi-structured interviews in both schemes. The chapter ends with a revised model explaining and providing insights into dynamic payment behaviour at communal water kiosks in Malawi.

6.2 Propositions

The study identified propositions regarding the key dynamic interaction between a multitude of factors that influence payment for water and drinking water service attributes in Chapter 3. These propositions are made up of feedback loops driving problem behaviour (inconsistent payment compliance outcomes). These propositions are outlined below,

i) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
ii) Payment behaviours are driven by the coping strategies (R3, R4, R5) that household users employ when faced with a changing water service level (B1, B2, B3).
iii) Demand funds maintenance (R6).

This chapter answers question 5 and 6, where the study tests, amends and extends the identified propositions using case studies in Malawi at both Chiringa and Chimbiya (see question 5) and explain if there any other propositions that emerge from case studies at rural trading centres in Malawi that can provide more insights into the dynamic interaction between factors that influence payment for water and attributes of drinking water services (see question 6). As mentioned previously, the study employed the Explanation Building Analytic technique by Yin (2018) where propositions are used to analyse case studies. Data collected from the semi-structured interviews was coded using NVivo 12 software[2] . To code, the study employed the deductive-inductive approach by Chalise (2015) explained in Chapter 4. First, the existing feedback loops from the conceptual model were used as themes through a deductive process. Each feedback loop was used as a theme in NVivo[2]. In such instances, relationships within the loop were coded under the theme (Chalise, 2015; Akcam, Guney and Cresswell, 2019). Second, following the approach by Eker and Zimmerman (2016), NVivo[2] was used to code and develop themes. These themes were then represented as CLDs.

6.3 Testing, Amending and Extending Propositions using Case Studies in Malawi

This section tests, amends and extends existing propositions using empirical data from Malawi. Three colours are used to ensure clarity, first, informed from literature, the red coloured links represent the relationships obtained from the literature on factors that influence payment for water and the green coloured links represent relationships obtained from the literature on drinking water service attributes. The orange coloured links represent the relationships informed by the semi-structured interview data.

6.3.1 Existing Themes (Feedback loops)

Proposition i: Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.

The themes, interview transcripts and variables are shown in Table 6.1 below. Participants were asked questions concerning each loop (theme) in the original model in Chapter 3. To capture the theme **Trust in the community organisation** (R1), Participants were asked if they generally trust the community organisation with their finances at the kiosks and were asked to

explain their answer. As shown in Table 6.1, the theme (R1) was supported by the data from the interviews at both schemes.

Table 6. 1: Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments

Theme	**Chiringa**	**Chimbiya**	**Variables**
Level of trust in the community organisation (R1)	"*People did not trust us, as they thought we misused their money. This is not true; we did not collect much*". Participant CR_6 "*I would point the problem to the MWC, they allowed their friends and relatives to have free access to water, Even, now with the WUA in charge we hear allegations of these rumours*" . Participant CR_5	"*The committees make regular reports on the collected money and about any expenditures that they have undertaken. This results in transparency and accountability in terms of finances; At the end of the day I know how much is in the account, therefore, they are trusted*". Participant Chimbiya (herein CM)_17 "*I pay money knowing that I will have access to all transactions, this makes me very comfortable*". (Participant CM_13)	Financial balance of the community organisation Trust in the community organisation Number of households who make payments at the kiosks
Trust amongst households that others will reciprocate payments (R2)	"*The people would say to themselves, why should I pay, when others get water for free*". Participant CR_5 "*I have no confidence that others will pay. I used to pay but at the end of the day the total amount collected could not even buy grease". Participant*" CR_7	"*This is not the first project we have been successful at. As I mentioned the Pastor and the community have been involved in many projects such as women cooperatives*". Participant CM_6 "*In this community we have always trusted each other on various projects and we know that we have collective obligation to ensure water for our families*". Participant CM_9	Reputation of trustworthy Trust amongst households that others have reciprocated payments Financial balance of the community organisation

At Chiringa, the financial balance of the community organisation is very low due to some of the reasons provided in Table 6.1. As such, there is a general mistrust of the community organisation. This reduces the number of people who make payments and reduces revenue and the financial balance of the scheme. However, Chimbiya's financial balance is high compared to Chiringa. This is due to the high accountability and transparency of the community organisation enforced by the NGO. There is a general appreciation and trust in the work of the community organisation. An increase in trust in the community organisation increases the number of households who comply with payments at the kiosks and increases revenue and the financial balance of the community organisation. Figure 6.1 below shows the feedback loop that applies to both schemes with a vicious cycle at Chiringa and a virtuous cycle at Chimbiya.

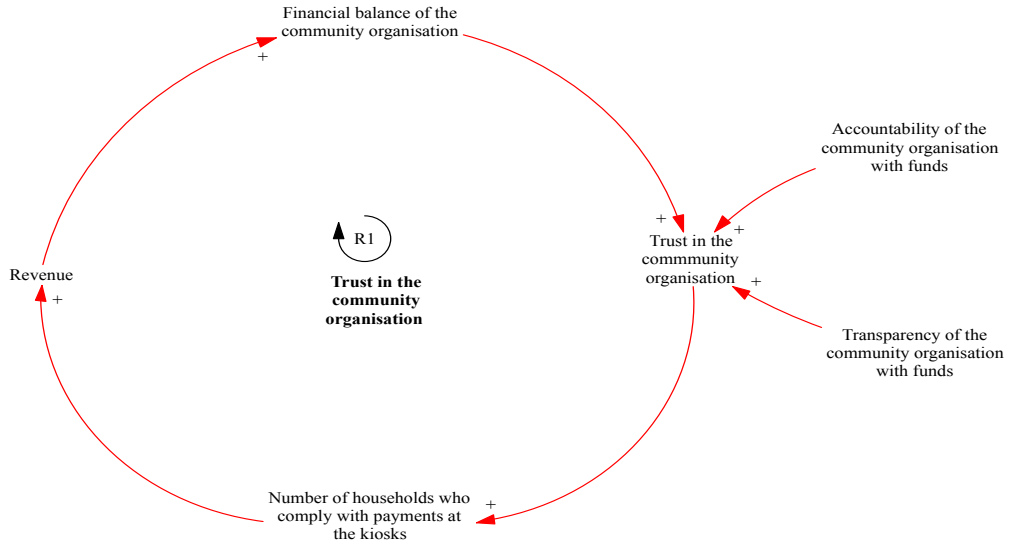


Figure 6. 1: Feedback loop showing the impact of trust in the community organisation on water payments

Issues of trust with the community organisation are found in the literature (see Chowns, 2015; Van Den Broek and Brown, 2015). Chowns (2015) investigated whether the community management (CBM) model has managed to improve the technical and financial performance schemes in Malawi. The mixed methods study employed surveys and interviews to collect data on 679 water points from 276 household users and 24 Village District Committees in four districts of Malawi. One of the findings of the study was that there was a general mistrust of the community organisation when it came to finances as funds had been misappropriated before

(Chowns, 2015). Similar findings were found by Van Den Broek and Brown (2015, p. 58), where one of the community members in that study was cited saying "*People feel their money will be eaten by the committee members. This feeling of being cheated is increased if the handpump is not breaking down for some period. Then, people start to wonder where their money is going*".

To capture the theme **Trust amongst households that others will reciprocate payments** (R2) shown in Table 6.1 above, participants were asked questions whether they trust that others will also pay and if their payments are influenced by the action (payment behaviours) of others. Information on the payment behaviours of others is represented by the level of the financial balance. This determines whether the collective activity of water payments has been a success or not. This creates a reputation amongst households that others have reciprocated the practice of water payments which is critical for O&M activities (also known as collective efficacy). These norms of reciprocity increase trust among households and increase the collective number of households who make payments at the kiosks, thus creating a virtuous cycle. However, a decrease in any of these variables will create a vicious cycle that leads to non-payment and has an overall effect on the operational sustainability of kiosks. The feedback loop (R2) representing trust amongst households that others have reciprocated payments is shown in Figure 6.2 below.

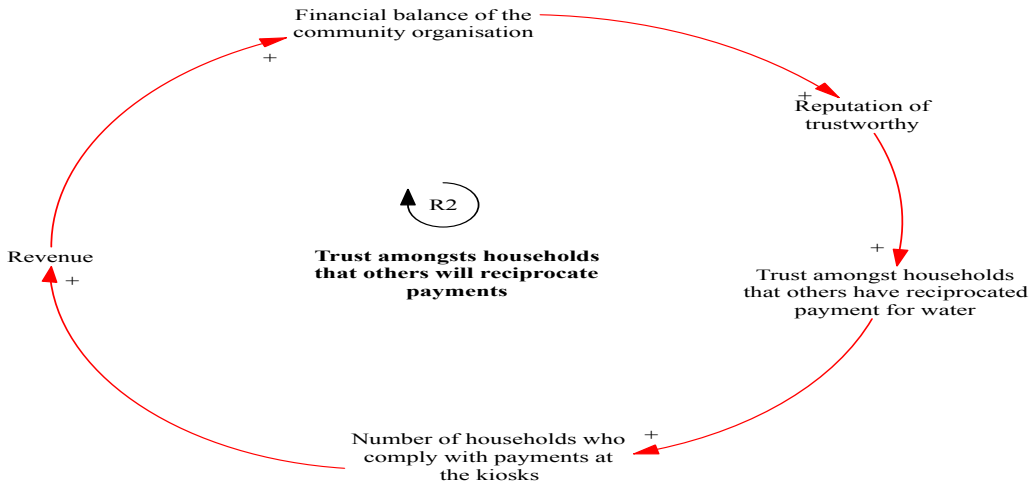


Figure 6. 2: Feedback loop showing the impact of trust amongst households that others will reciprocate payments

In Chiringa, there was an issue related to some people getting water for free because of their relationship with the MWC or WUAs. This non-revenue water use resulted in a low financial balance. This created a sense that others were not paying (reciprocity) and there was a general level of mistrust even among households, thus it ended up in households not paying. This outcome is generally shared amongst all the household beneficiaries interviewed in Chiringa as illustrated in the following selected interview transcripts.

"*We do not get information on the financial statements; all we are told is that there is no money. This reduces trust within the community. I would prefer someone to come and run this project, even a businessman, at least you know you can get a good service*". Participant CR_10

"*Everyone knows that if you are related to the committee somehow you do not pay, for me this discourages payment*". Participant CR_8

On the other hand, in Chimbiya, there was a general expectation that most users will pay (reciprocity). This results in a higher financial balance. A higher financial balance created a reputation of reciprocity, which increased trust amongst households and increased collective payments (the number of households who comply with payments at the kiosks) (see interview transcripts in Table 6.1).

The implication of the proposition

The proposition that payments at the communal water kiosks are influenced by trust in the community organisation (see Chowns, 2015) or trust amongst households that others will reciprocate payments (see Hanatani and Fuse, 2012) all indicate to the centrality of trust within collective action (Ostrom, 2009).

Proposition ii: Payment behaviours are driven by the coping strategies (R3, R4, R5) that household users employ when faced with a changing water service level (B1, B2, B3)

To provide clarity, first, the study tested how the water service level (attributes) changes with the demand for water at the kiosks (B1, B2, B3). The study then enquired about the coping

strategies employed in both schemes by household users facing a changing water service (R3, R4, R5).

a) The water service level changes with the demand for water at the communal water kiosks (B1, B2, B3)

To test this proposition, participants were asked questions concerning each loop (theme). To capture the supply-demand gap (B1 **Demand impacts quantity and collection time**), participants were asked if there were any instances when they do not have enough water and, if there was, then which coping strategy they used. They were also asked if there are instances when they spend more time queueing for water at the kiosks, and, if there was, then which coping strategy they used. In addition, they were asked what they believed cause long queues. Participants were also asked in which periods they encounter the most breakdowns and how long it normally takes to repair the breakdowns (B2 **Demand impacts maintenance**). To test the impact of demand on the quality of water, participants were asked if they had experienced any water quality issues such as taste, colour or odour since the start of the project (B3 **Demand impacts quality**) Table 6.2 shows the themes under study and supporting selected interview extracts from both Chiringa and Chimbiya schemes. It also shows the variables that will be used in the CLD.

Table 6. 2: The water service level changes with the demand

Theme	**Chiringa**	**Chimbiya**	**Variables**
Demand impacts quantity and collection time (B1)	"*Frankly speaking, the water supply at the scheme is under threat from the rising population in the area. Chiringa being a commercial and border area with Mozambique experiences immigration of people within a short period due to business opportunities in the area as a lot of people are migrating to Chiringa*". Participant CR_1	"*During winter the weather is mostly very cloudy every day as you may observe that Dedza is mountainous. We, therefore, experience low water supply as the solar cannot pump the required volume of water to meet the demand for the entire community. To cope with shortages, some people come and pump water with their generators. In this case, they get free water to compensate for their fuel*". Participant CM _2	Supply-demand gap Average time spent queueing for water at the kiosks.

	"*Queuing time depends on whether it is during school days or not. Students congest the taps as they get water for free. Also, during holidays many of our young people come back with their families and a lot of people pass by on their way to Mozambique*". Participant CR_1	"*During winter where there is the low water pressure at the kiosks, congestion is experienced as it takes longer for one to fill the buckets*". Participant CM_18 "*The issue of cholera has resulted in more demand at the kiosks, such that even those that sometimes used wells, had to use the kiosks. In those instances, you can even wait for an hour to collect water*". Participant CM_17	
Demand impact maintenance (B2)	"*The water demand is high during this period of cholera as I have mentioned before. As such there are many breakdowns but usually minor. The only major repair I can think of is the issue with the water meter. Even now that issue has not been solved. I am sure you know that one of the kiosk is not working as well*". Respondent CR_4	"*I would say during dry seasons, and holidays, there is high demand. Therefore, you do notice an increasing need to carry out minor maintenance*". Participant CM_14 "*We encourage our operators to constantly apply grease and tighten bolts to prevent too much friction*". Participant CM_17	Pump use Wear and tear Breakdown Preventative maintenance

The theme **Demand impact quality** (B3) was not supported by the empirical data as the two cases are known to have fluoride issues, therefore there was no evidence that poor water quality was due to changing demand levels, rather the water is already salty but not bad enough to affect consumption. Water quality issues in the two cases are captured in the following quotes by the Assistant community water and supply and sanitation officers in Chiringa and a senior government official in Chimbiya respectively,

"*Although tests were made by government officials, there are some concerns with the taste of the water. It is a bit bitter. This is not something new in this area. I know some people who use ash to improve its taste"*. Participant CR_ 18

"*There is an issue with the taste. I think it is the problem of fluoride. But people drink the water, it is not too bitter to taste it, but you know sometimes it can irritate you. You can taste that this water is a little bitter. People have no choice; the alternative is worse*". Participant CM_11

The issue of taste was confirmed by the household beneficiaries, local community organisation members and assistant community water supply and sanitation officers interviewed in Chiringa. Therefore, this loop will not be included in the final model in Figure 6.11 as it is not supported by our findings from the case studies. It is also important however to note that water quality had no significant impact on water payments by households. This is captured by approximately 84 per cent of the households in both schemes and all the government officials as represented in the following interview transcripts.

"*For us it's not about the taste, all we care for is to have clean water*". Participant CR_ 13

"*As you know the issue of fluoride is a problem in this area. I do not think this affects payments in anyway. People here have not had clean water for years, so as long the water is clean that is okay*". (Participant CR_ 15)

This finding is supported by literature that found households to have a preference on water attributes they value most and are willing to pay for. For instance, in their study in Kenya, Safe Water Network (2012) found the main determinant for paying user fees to be access to water at the kiosks rather than its quality. Informed by evidence that treating water is expensive, Safe Water Network (2012) treated only 20 per cent of the water which consumers can use for drinking and cooking and leaving the 80 per cent untreated for general uses. Their expectation was that users will buy more of treated water than untreated since the price is generally lower than what users used to pay before the project. However, their findings showed that 94 per cent of purchases was for untreated water at the kiosks (Safe Water Network, 2012). Supporting this argument are calls by Hope and Balloon (2019) for academics and water practitioners to focus on attributes that households prefer and are willing to pay for. Although they mention that this

recommendation is controversial but evidence from their study showed that some people in Kenya traded potable water and proximity for lower payments. Their finding and this study's finding support the notion that sometimes the taste of water is often ignored for access to a sufficient amount of water (see Participants CR_18, _13 and CM _11, _20).

The theme **Demand impacts quantity and collection times** (B1) shown in Figure 6.3 was confirmed by interview data from both cases. An increase in demand due to; word of mouth regarding an improved water service level, cholera outbreaks, an increase in population, income from activities at the trading centres, lower prices compared to alternative sources, and weather conditions increase the supply-demand gap. This gap represents the difference in the quantity of water that users desire and the actual amount of water that can be collected at any given time. When this happens, long queues are experienced at the water kiosks in both Chiringa and Chimbiya schemes, reducing the level of services, and forming a feedback loop shown in Figure 6.3 below.

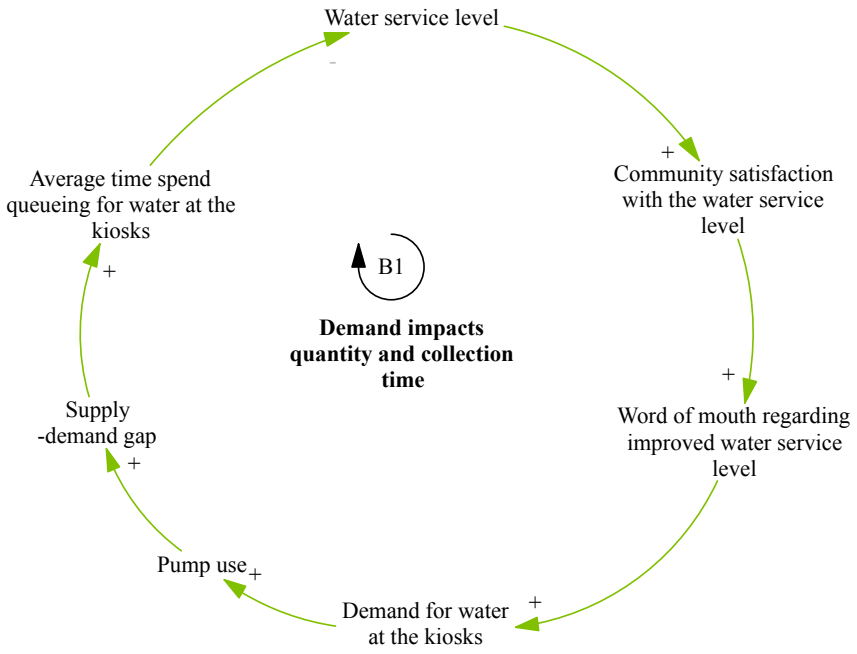


Figure 6. 3: Feedback loop showing how demand impacts water quantity and collection time

Previous studies have shown the impact of demand on water quantity and waiting times. In his study, Adams (2018) investigated household water insecurity in informal settlements in

Malawi. Their study found that waiting times are due to irregular water supply (also see similar finding by Mowfe, Kapulu and Tembo (2014) in Zambia), population density (demand) and non-functionality. Furthermore, those with bigger containers may fill the whole container, creating large queues. Their study found that at each kiosk, an average waiting time of 38 minutes was experienced. These waiting times were more than the waiting times at alternative sources which averaged 3.89 and 4.55 minutes. This shows that feedback loop (B1) is supported by the literature.

As shown in Table 6.2 above, unfavourable weather conditions are cited as a reason for water shortages. This finding questions the use of solar systems throughout the year as an effective strategy in mountainous places such as Dedza district where Chimbiya is located which are mountainous and cloudy at most times throughout the year. The deficiencies of the solar system through the year are reflected in the interview transcripts below with approximately 95 per cent household participants agreeing to the issue.

"*Dedza is a mountainous area and sometimes due to the weather, water pressure is low*". Participant CM_18

The deficiencies of solar systems are not reflected only in Chimbiya but also in Chiringa. This is summarised by the quote below.

"*We have problems with solar system not supplying enough water since the weather affects heat energy that powers the solar unlike when we have much sunlight*". Participant CR_8

The inefficiencies of the solar system in some parts of the month were widely shared by all the interviewed participants of household beneficiaries, local community organisations and household beneficiaries. However, participant CR_19 believes that this is not a significant factor arguing that there are batteries that can store energy to support during times of less sunlight. The use of solar systems due to the benefits experienced in another context can be part of the tendency of water practitioners and development partners to apply institutional arrangements that have worked in a different complex ecological system in another area and expect the same results (see Meinzen-Dick, 2007). The result is the failure of panaceas to achieve sustainable outcomes (Meinzen-Dick, 2007; Ostrom, 2009).

In terms of the theme **Demand impacts maintenance** (B2), the same process is experienced in both schemes. An increase in demand for water at the kiosks leads to an increase in pump use, which leads to wear and tear. An increase in wear and tear leads to an increase in breakdowns, reducing the functionality of the kiosks and ultimately the water service level. This can be shown in Figure 6.4 below. This is supported by a study by Libbey *et al*. (2022) in East Africa. In their model development, one of their findings was the impact of demand on pump use led to more breakdowns and affected the use of water.

The difference between the two schemes was that at Chimbiya, they had the financial balance to carry out some preventative maintenance and quicker corrective maintenance which reduces wear and tear and increases functionality. Such an impact of maintenance on water service attributes was investigated by Chintallapati *et al*. (2022) who simulated the financial and functionality effects of implementing professionalised maintenance (preventative maintenance) using SD in Kenya. Their study found that professionalised maintenance may increase countrywide functionality rates from 54 per cent to 83 per cent, leading to an increase in water volume by 67 per cent (Chintalapati *et al.*, 2022).

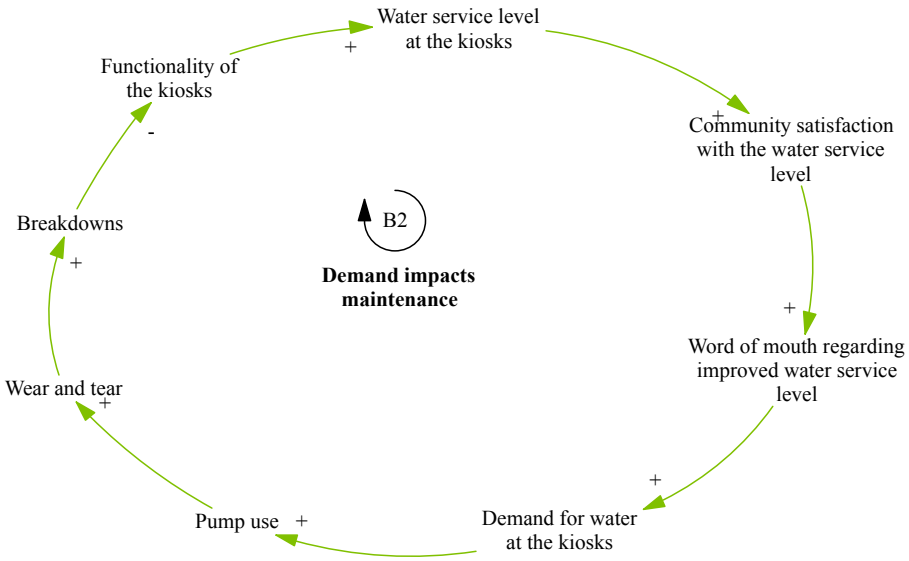


Figure 6. 4: Feedback loop showing how demand impacts maintenance

b) Payments at communal water kiosks are driven by the coping strategies that users employ when faced with a changing water service level (R2, R4, R5).

To test this proposition in both schemes, participants were asked which coping strategies they employ when the water service level provided at their main source does not meet their needs. Table 6.3 shows the coping strategies that household users employ when faced with a changing water service level.

Table 6. 3: Coping strategies

Theme	**Chiringa**	**Chimbiya**	**Variables**
Seeking alternative sources (R3,R4)	"*There are paid boreholes in the area. These boreholes have been installed in most places where kiosks are placed but they usually dry up during the dry season, so their yield is low, but sometimes they are functional. I would say, if the boreholes are working, then more people would use them. I mean who would not want cheaper water? Also, during the time, the pump was not working and when the kiosk is not working, boreholes are the only better source available to people*". Participant CR_1 "*Sometimes when the pump is not working well in the dry seasons, we use boreholes that are functioning or home-dug wells if there is water*". Participant CR_8	"*Alternative sources are mainly boreholes which are very far and wells. These boreholes are always broken, and the wells have dirty water. You cannot use their water for drinking. Since the project came, I have not used them at all*". Participant CM_18	Demand for water at alternative sources

Rescheduling activities (R5)		"*During winter the weather is mostly very cloudy every day. We, therefore, experience low water supply as the solar cannot pump the required volume of water to meet the demand for the entire community. To cope with shortages, The SWC outsource a generator from individuals to come and pump water and the individual is compensated by free water*". Participant CM_2 "*When there are long queues at the kiosks, sometimes I wake up very early to meet the opening time of 6 am*". Participant CM_16	Rescheduling activities

The theme **Seeking alternative sources** (R3, R4) was supported by interview data from both cases as shown in Table 4.3. At Chiringa the most used coping strategy is to use alternative sources. Figure 6.5 and 6.6 respectively below shows that each time the water kiosks are not functioning properly, the supply-demand gap increases. An increase in the supply-demand gap leads to either an increase in demand for alternative sources or an increase in long queues at the kiosks (average time spend queueing for water at the kiosks). Although these alternative sources are not reliable, some of them function well. This reduces demand for water at the kiosks, reducing the number of people who make payments and revenue. A reduction in revenue reduces the financial balance and again leads to a decrease in functionality, creating a vicious loop shown in both Figure 6.5 and 6.6 below. The practice of household users coping with alternative sources each time there is a reduction in quantity (see Chidya, Mulwafu and Banda, 2016; Olaerts *et al.*, 2019) or long waiting times (see Cook, Kimuyu and Whittington, 2016; Smiley, 2016) is a common coping strategy in water literature.

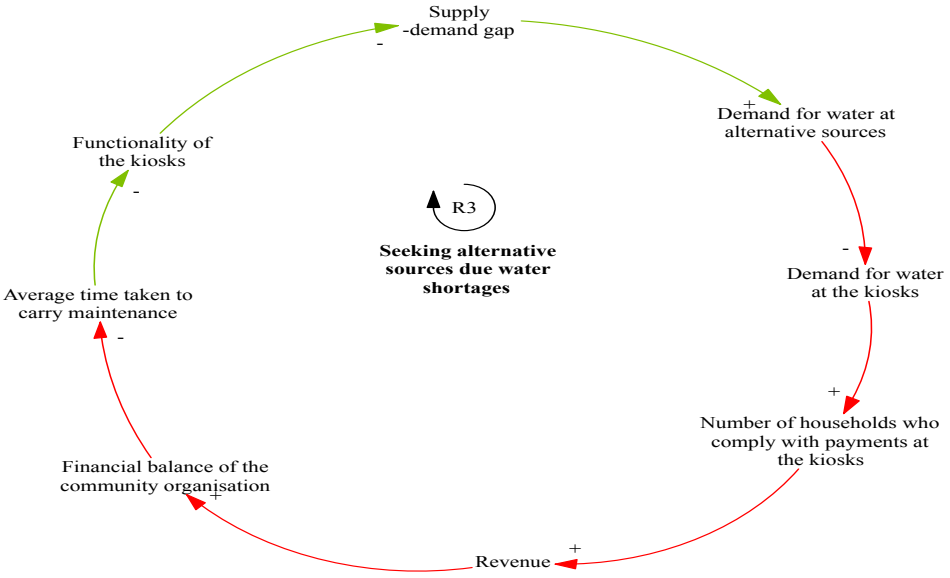


Figure 6. 5: Feedback loop showing households seeking alternative sources due to water shortages

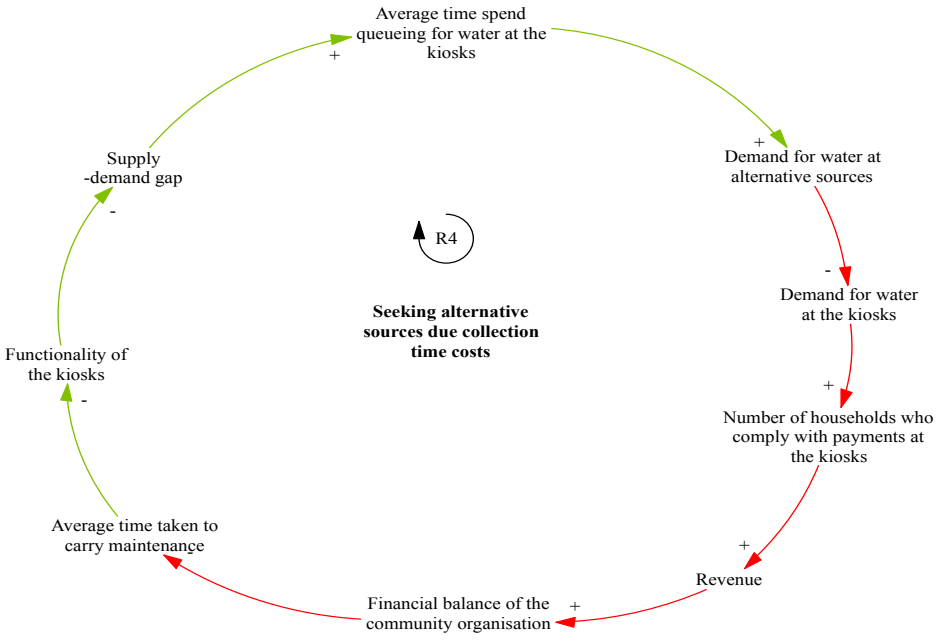


Figure 6. 6: Feedback loop showing households seeking alternative sources due collection time costs

Compared to Chiringa, Chimbiya does not have functioning alternatives except some home-dug wells which are generally less preferred, even more so at the time of study when there was a cholera outbreak. Therefore, in this case, households coped with rescheduling their collection

times (theme **Rescheduling activities**). There was no evidence that this rescheduling of water collection activities had a significant impact on payments at the communal water kiosks, as the participants responded that this did not limit the amount of water they would have collected even if there were delays. It is however reasonable to think that some might be discouraged by this practice and reduce their water usage. However, the amount of revenue collected indicated that demand remained stable. While this finding can be supported by Olaerts *et al*. (2019), who found previous exposure to breakdown and absence of alternative sources that are working or closer as a condition that results in increased payment compliance, other studies such as Huttinger *et al*. (2017) found opposing results. In their study, Huttinger *et al*. (2017), found that consumer demand was low where there were fewer improved sources (alternative sources) and where prices were double that of the piped sources. This compares to consumer demand in areas where there are other improved sources within the area and where the price was competitive with other sources. It could be argued that in the study by Huttinger *et al*. (2017), the competitive price was the reason for the high consumer demand in areas where there are already functioning improved sources compared to lower demand where there was less competition from improved sources. The other reason could be the presence of a culture of payment that exists where there were many paid improved sources compared to where people use only a few improved sources and rely on unimproved sources.

The implication of the proposition

The implication of this proposition shows that the water service level (quantity and collection times, functionality) is not static but changes with demand. In literature there is a tendency to believe that an increase in any of the water service level attributes will increase payments and lead to the sustainability of services, however, these attributes change with demand. This speaks to the question by Forster and Hope (2016) which questions whether an increase in payment rates (reflects demand) can end up outweighing the benefits by increasing maintenance expenditure (affecting functionality). Because the amount of tariff paid is very for political reasons (Fonseca and Njiru, 2003), the impact of increase in payment rate might result in more maintenance expenditure (demand impacts maintenance). It is therefore important for water practitioners to consider how these attributes change with demand and to investigate the coping strategies that users use in such a situation which determine payments at the kiosks. For instance, in Chiringa, they have alternatives which sometimes function, this is critical because they do not have to use unprotected wells. On the contrary, the alternatives available at

Chimbiya are unprotected wells which have severe health implications and so they have no option but to wait at the kiosks and get water for drinking. Although this is important for revenue at the kiosks, it happens at the expense of time costs which mainly affects women and girls, who sometimes miss school (Hope and Ballon, 2019).

Study proposition iii: Demand funds maintenance (R8)

To test, amend and extend feedback loops used in this proposition with the case studies at both Chiringa and Chimbiya schemes, participants were asked if they value an improved water service provided by the kiosks and if they are willing to pay for it. Household users demonstrate their demand for improved water service by showing a willingness to pay. Table 6.4 presents the theme under study, supporting interview extracts from both schemes and variables used. To capture the number of households who comply with user fee payments, the study drew from secondary data provided by the schemes on water revenues (see Chapter 5) and asked participants to comment on the data. To capture the average time taken to carry out maintenance, participants were asked the time it takes to repair a water point after it breaks down. All 45 participants in the study mentioned that they/users value water service and are satisfied with the level of service. This sentiment is shared in the interview transcripts in Table 6.4 below.

Table 6. 4: Demand funds maintenance

Theme	**Chiringa**	**Chimbiya**	**Variable**
Demand funds maintenance (R6)	"*Yes, we are satisfied and do value this improved water source. More people are realising the benefits, especially now with this cholera outbreak. On payment, if you want to protect yourself and your children from cholera you must pay*". Participant CR_7	"*Yes, they value improved water service at the kiosks. When we went there, the women were saying, even our families were almost breaking because sometimes you go to fetch water at the kiosks and spend a lot of time waiting and then the husbands will be wondering, where is this one (Laughing). Yes, they are talking about so many things, girls being late to school. They were mentioning so many things. So, you can see the value they are putting into the water. It's the*	Community satisfaction with the water service level

		value that matters, the value that people put into the water. You see even for that market centre to thrive they need water. They know they must pay for it". Participant CM_11	
	"*I am sure everyone wants good water. Whether they are willing to pay for it, that's another issue. I would say some of our people are used to free things. It is because of this issue that these kiosks are in a state of disarray. For the initial three, only one functions properly* now". Participant CR_2	"*Communities value improved water at the scheme. Compared to broken handpumps and open wells which we used before; this project has improved our lives. In terms of payment, that's the rule, to access water you need to pay*". Participant CM_2 "*People here have waited for such a project as this one for a long time. They always said to us that we need good water, and you can see that this is a large area with many people. They said help us with good water, we are willing to pay for it*". Participant CM_11	Demand for water at the kiosks
	"*When we started this programme people had shown an increased demand and willingness to pay, however, when it comes to actual payments, we are not collecting enough. Water is used but little money is collected We use the little we have, to do what we can*". Participant CR _1	"*I would say so far so good, the numbers are okay, you can see we collect enough to at least do minor maintenance. I am sure you also know we have reserve funds that we were given at the start. Our agreement was those funds are only touched when there is a need for major repairs. Otherwise, minor maintenance like buying grease and tightening bolts is paid from our collections*". Participant CM_3	Number of households who make payments at the kiosks
	"*During the time of MWC, it would take months to get a simple problem fixed. But recently with*	"A*s soon as there is a breakdown it does not take that long to repair since as you might be aware, we have*	

	the WUA, at least you know that after a period you can notice some maintenance done. I would also like to mention that there are periods we go months with a non-functioning kiosk, in these instances, no payments are collected". Participant CR_ 4	*trained Tap Operators who regularly check for the need for tap maintenance and repairs. Instances, where tap has not been functioning for more than 12 days, are when there are delays in signatures needed to release money*". Participant CM_ 14	The average time taken to carry maintenance

With regards to the theme **Demand funds maintenance** (R6), in both schemes, the money for O&M is generated from the demand for improved water service at the communal water kiosks. What differs is the amount collected, with fewer revenues collected at Chiringa as compared to Chimbiya as shown in Chapter 5. It must be mentioned however that although revenues collected from Chimbiya is more than that of Chiringa, in both schemes money from household users was not enough to meet major repairs. This could be attributed to the fact that the tariffs set do not reflect the economic value of water and its diverse use. This is largely common in rural water supply where tariffs are set very low for political and social reasons (Fonseca and Njiru, 2003; Komakech, Kwezi and Ali, 2020). The major difference in their financial balance was that at Chimbiya, they already have money in their reserves which are only used when they do not have enough for major repairs (Participant CM_3). But even so not all major repairs can be covered by this fund. This finding supports the general finding that kiosks are not financially sustainable in rural areas (Bhatnagar *et al.*, 2017; Komakech, Kwezi and Ali, 2020), but if at least revenues are collected they ensure that reserves are not depleted and contribute substantially to the financial balance which can be used for maintenance. This could be the reason why the kiosks taps investigated in the study at Chimbiya were working while at Chiringa only one kiosk was fully functional, thus cementing the empirical findings by Forster and Hope (2017) that revenue collection is critical for operational sustainability. As such in this study, payment outcomes have either led to the deterioration of the water service level provided (in Chiringa) or maintained the water service level at an acceptable rate (in Chimbiya). At the time of the study, in Chiringa, a vicious cycle was in action. In the case of Chiringa, the poor water service level reduced the community's satisfaction with the water service level thus reducing the demand for water at the kiosks. This results in a reduced number of households who comply with payments at the kiosks, less revenue and less financial balance at a point in

time, where financial balance refers to the total amount of money available for O&M. This money comes from either NGOs/donors or payments collected from water sales (revenue). A reduction in the financial balance of the community organisation led to delays in maintenance and limited functionality, which reduces the water service level at the kiosks. On the contrary, a virtuous cycle was present in Chimbiya. In the case of Chimbiya, an improved water service level at the kiosks increased the community's satisfaction with the water service level, which increases the demand for water at the kiosks. Demand increased the number of households who comply with payments at the kiosks, this increases revenue and the financial balance of the community organisation. An increase in the financial balance of the community organisation reduces the average time taken to carry out maintenance and increases the functionality of the kiosks and ultimately the water service level at the kiosks as shown in Figure 6.7 below.

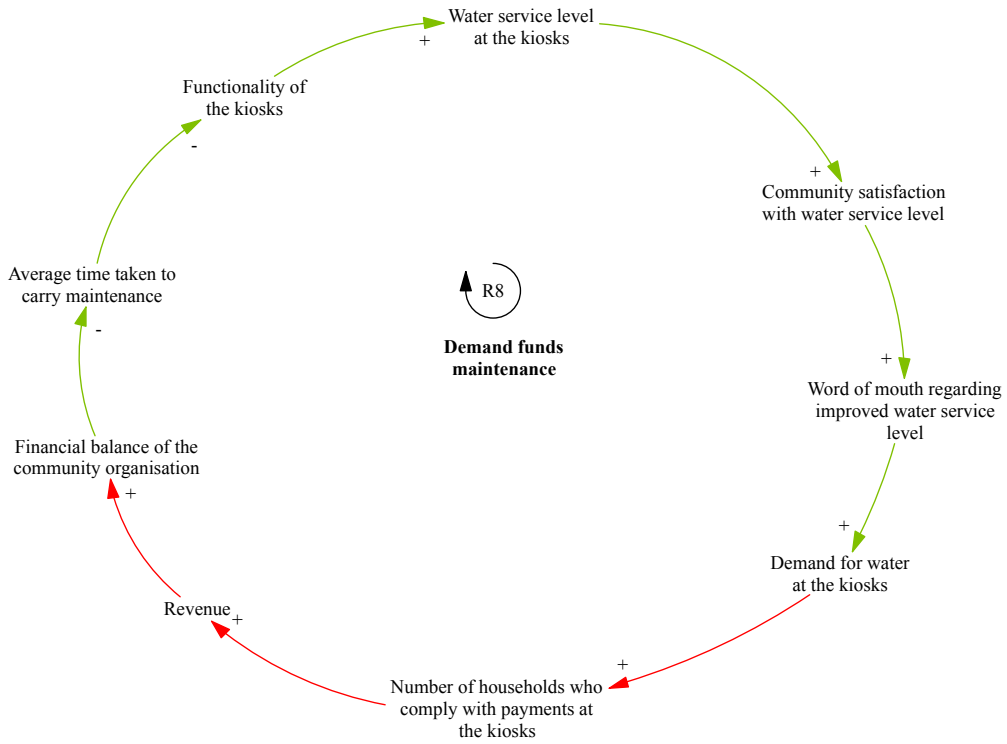


Figure 6. 7: Feedback loop showing how demand funds maintenance

Various factors are responsible for the vicious cycle in Chiringa and a virtuous cycle in Chimbiya. The first reason could be attributed to the difference in population between these two cases. In Chiringa, it is estimated there is over 700 inhabitants compared to an estimated 15300 people in Chimbiya. However, it is important to note that boundaries in rural water

supply are artificial (see Cleaver, 2012; Van Den Broek and Brown, 2015). Users can move across villages to collect water. In areas such as Chiringa which are closer to the boarder of Mozambique, there are times when there are a lot of people in the area. Also important to note is that the 15 300 number is an estimation of the population around the area in Chimbiya and does not exclude those with self-supply. Furthermore, the study did not cover all the other taps. Regardless, population size is a determinant of demand. As argued by Bhanagar *et al*. (2017) one of the requirements for a kiosk to be financially sustainable is for the target market to be around 1000 people. This is important to achieve economies of scale and reduce the price, where achieving economies of scale in rural water has been recommended (see Hope *et al*., 2020). However, insights from the interviews show that the failure to meet the theoretical threshold does not justify the high usage of water without payment by users at Chiringa (non-revenue water) and there is no evidence that even if they were more than 1000 people, the situation was going to improve. Participants were asked if they thought the expansion of the project to other villages will increase revenue, the general sentiment by 80 per cent of the household beneficiaries interviewed in Chiringa is illustrated by the quote below.

"*I do not think that the idea of increasing the number of users would have stopped misuse of funds or corruption by the traditional leader as you have heard. For me, we should sort out this issue now, so that expansion into other areas can be a success*". Participant CR_17

The second reason why there was a vicious cycle in Chiringa and a virtuous cycle in Chimbiya has to do with the costs of providing a service involved (expenditure comes from meeting salaries and administrative costs, maintenance costs (involving repairs) shown in Figure 6.11 below). For instance, there was a huge difference in the amount operators were paid at Chiringa as compared to Chimbiya. Paid members received a salary regardless of their performance as opposed to Chimbiya, where operators were paid based on performance such as 20 per cent of the total amount collected. As mentioned earlier, the issue of money being spent on committee-related tasks, salaries and their actions attributing a cost to the sustainability of water kiosks is not new in literature. A study done by Coulson *et al*. (2021) that estimated the costs of a sustainable water supply at network kiosks in peri-urban Blantyre in Malawi found that the operating costs of WUAs (local committees running kiosks) substantially offset the profits made from sales. Furthermore, the payment of honoraria which was paid to traditional leaders also resulted in more costs (Coulson *et al.*, 2021). In Chiringa, the Chief also has access to this payment although it was not recorded on their costs. On the contrary, such practices were not

present at Chimbiya. The other reason for the vicious cycle in Chiringa and a virtuous cycle in Chimbiya is that, at Chiringa, there were a substantial number of people who had access to free water (non-revenue/unaccounted for water) (represented by variable 'number of free water users' in Figure 6.11 below). When the participants at Chiringa, were asked why the amount of water collected from the meters did not align with the revenue collected (at one time only one in 10 litres was collected) the following reasons by the assistant community water supply and sanitation officer, a senior leader in the Chiringa WUA and a household beneficiary were given,

"*A lot of school children get water for free at the kiosk, this issue needs to be addressed*". Respondent CR_15

"*Some landowners offered land for free in view that they'll be exempted from paying user fees and get part payment from the water sales. This has caused a lot of disputes as the landowner now collects all user payments and does send the funds to the committee. I hope your coming will help us address this issue in future*". Respondent CR_1

"*All the members of the committee (10 members) have access to approximately 100 litres per family each day*". Participant CR_20

Furthermore, 32 families were exempted from paying based on their affordability status. These families were offered access to 60 litres of free water per day per family. All these people (free riders) accounted for water that was not paid for. In addition, leakages were observed from kiosk 2. This leakage took a long time to be repaired, and intervention only came after assistance from the donor Ayr Rotary from Scotland. From the interviews, different time frames were given on how long it took for the leakages to be repaired but 6 months were mostly cited by 80 per cent of the household beneficiaries and 75 per cent of local community organisations. As mentioned by participants:

"*To be honest, there were always leakages, I would say it took about 6 months to be fixed*". Respondent CR_4

When probed as to why it took so long, the mechanic said,

"*There was no money to buy the valves and also they paid me late, there was nothing I could do*". Respondent CR_4

This period of leakages meant that there was not enough money for maintenance, which reinforced a lower level of service and non-payment (see the impact of leakages on revenue in Figure 6.11 below). The issue of non-revenue water caused by leakages at water points is not new in Malawi as non-revenue water at kiosks is responsible for intermittent water supply (see Harawa *et al.*, 2016). Non-revenue water affects the financial viability and operational performance of utilities (Smiley, 2016). As mentioned by Winnipeny (1994) many systems have unaccounted for water which affects the financial viability of schemes.

The implication of the proposition

The proposition, Demand funds maintenance (R8) shows a mismatch between theory and practice (see Brown and Van Den Broek, 2020). As explained in Chapter 2, theoretically water kiosks are expected to elicit payments from rural water users who are willing and able to pay for it (Sima and Elimelech, 2013). Even the poor in developing countries are believed to value a reliable supply much more than they value an unreliable water supply which is mostly provided in developing countries (World Bank Research Demand Team, 1993). While a case of affordability can be made, it is not always a satisfactory argument to why users do not comply with payments (Hoque and Hope, 2020) and communities in rural areas are expected to cover at least the O&M costs of providing a service (Harvey, 2007). Even so, communities have mechanisms to identify and exempt those who cannot afford to pay (Cleaver, 2012). However as shown, the fact that people demand an improved service does not mean that they are willing to pay for it (Moriarty *et al.*, 2013). Even when willingness to pay surveys have taken place and the donors were assured by the local NGOs that users are willing and able to pay an agreed affordable tariff as in Chiringa (Participant CR_1), there is a divergence between willingness to pay and actual payments over time (Foster and Hope, 2016) and that payments cease with time (Brown and Van Den Broek, 2020). The proposal that an improved service leads to an increase in payments to cover the O&M costs does not consider other drivers which will be discussed later in the Chapter.

6.3.2 Emerging Themes (Feedback Loops)

As mentioned, and previously explained in Chapter 4, the study also followed an inductive approach recommended by Eker and Zimmerman (2016) from which new themes (feedback loops) emerged from textual data. These themes are Sense of ownership **(R5)**, Conflict on funds **(R6)** and NGO/donors intervention on payment behaviours **(R7)**.

Sense of ownership (R5)

To illustrate the process described in Chapter 4 by Eker and Zimmerman (2016), the study uses the emerging theme of Sense of ownership. The steps are explained below,

Step 1: Identifying concepts and discovering themes in the data

In step 1, the researcher open coded statements from the semi-structured interviews that hint at a concept or theme. In this case, one recurring concept that emerged from the interviews was a sense of ownership of the project. Participants were asked how the project started and if any other factors affect water payments at the kiosks. A recurring theme of Sense of ownership was captured. This is revealed by participants in both schemes where sense of ownership is revealed in Chimbiya and the lack of sense of ownership in Chiringa who felt that the kiosks belong to either landowners or the NGOs. This is revealed in the following quotes,

"*The Pastor told us that he has done the work, now it is in our hands, we believed it, now it is ours. The project relies on our commitment and payments. So yes, I feel involved and an owner of the project. I owe it to my wife and children to make sure that I pay for water and attend meetings, so they continue to have sustained access to clean water*." Participant CM_18

"*I would say people are not united. For some people, it seems as if they have been forced to agree to the terms of payment. They want water from the kiosks, yet they complain about payments. Also, there is a need to avoid landowners from collecting money*." Participant CR_2

As argued by Eker and Zimmerman (2016), during this stage, the coder gets an understanding of causal relationships expressed by the participants. Such understanding is critical for aggregating causal relationships in Step 3 (Eker and Zimmermann, 2016). In this study, a possible relationship between a sense of ownership of the project and water payments (the number of households who comply with payments at the kiosks) emerged.

Step 2: categorising and aggregating themes into variables

In this stage, the researcher formed a coding hierarchy according to the aggregation of themes observed in the data as shown in Table 6.5 below. For instance, using Chimbiya data, participants' responses to the question gave insights into several factors relevant to the theme. These factors (sub-themes) are trust in local leaders, community participation and user fee payments.

Table 6. 5: Coding tree for theme Sense of ownership

Coded Theme	**Textual Data**
Sense of ownership	
Financial balance of the community organisation	"*Because the communities always have the information on the amount of money in the bank and expenses incurred, they trust the word the Pastor has told them, that under his watch money will be used transparently. As a member of the committee, I have respect for the pastor and would not want anything to go wrong with money issues*". Participant CM_14
Trust in the local leadership	"*The Pastor indeed played a big role in the success of this project. People trust him. He is the one who partnered with Water Mission and proposed that they support us with this water project since before the project, the pastor was supporting other community projects such as managing orphanages and training women on vocational skills that I talked about earlier. We would not have this project if not for this pastor, as several attempts to have tap water in Chimbiya have failed as the ground below is known to be very rocky but Water Mission managed to drill the rocks*

	and install a system that is running until now". Participant CM_6
Community participation	"*I would say the level of participation in the community here is high. This is because of the Pastor who works with NGOs. To us this is our project, and we are responsible for its success".* Participant CM_13
Sense of ownership of the project	"*The project is for the people, it is for us, it is our responsibility to ensure its success*". Participant CM_17
User Payments	"*Yes, a Pastor from the Baptist Church. He helped much in sourcing funds for the project through his international partners.* *People trust him and this then helps with payments because people know that with him involved no one will misuse the funds*". Participant CM_5

Step 3: Identifying causal relationships.

Using data from Chimbiya, the storyline formed by the interviewee's statements is that the presence of leaders that are trusted encourages community participation. This participation invokes a sense of ownership of the kiosks and encourages the households to make payments. As recommended by Eker and Zimmerman (2016) words such as *because*, *if, and then* among others are suggestive of a causal relationship. Such relationships can be linked to data sources in NVivo², maintaining references in a less time-consuming way.

Step 4: Transforming the coding dictionary into causal diagrams.

In the last step, the relationships coded in NVivo² were used to develop a CLD. This is shown in Figure 6.8 below. As mentioned previously in Step 3, Trust in community leadership increased community participation. Community participation increases a sense of ownership. This sense of ownership led to more households paying for water at the kiosks. This improved the financial balance of the scheme and reinforced trust in the community leadership.

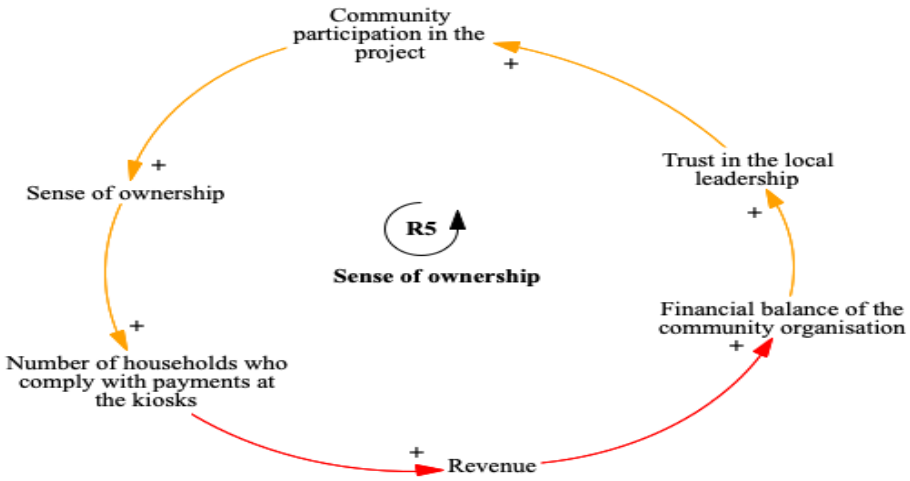


Figure 6. 8: Feedback loop showing the impact of sense of ownership on payments at communal water kiosks

This CLD applies to both schemes, the only difference is that the loop is on a downward spiral creating undesirable behaviour, and thus vicious in Chiringa, and on an upward spiral creating desirable behaviour, and thus virtuous, in Chimbiya. At Chiringa, from the onset, the project was requested by the local NGO Care and Share to support an already existing government-provided borehole in the area. One can argue that since there is no evidence that it is the community who requested or led the call for the project, their sense of ownership might be low (see Respondent CR_2). Even during the start of the research when the researcher gathered background information on the case (Chiringa Village borehole project), the donors acknowledged that no exercise was taken to assess the perceptions of the users on water kiosks and their institutional arrangements including payment to access volumetric water.

At Chimbiya, unlike Chiringa, it is the community through the Pastor that requested the project. From the start, the community at Chimbiya were consulted by the Pastor on whether they are willing to agree to the terms and conditions of the provision of water which are rooted in paying for water. As such, the Pastor went to other partners with a mandate from the people on decisions including location of the potential kiosks and other institutional arrangements. Even now, the people continue to be involved in decision-making as they are consulted during monthly meetings when reports on finances are being made and on decisions related to maintenance (see Participants CM_ 17; CM_7). It is clear from the interviews that the community perceive the scheme as their own and continues to participate in the running of the

scheme. As mentioned by Participant CM_17 in Table 6.5 above, there is a general sense of ownership in the community. This sense of ownership is driven by community participation from the start of the project until the present. Their involvement in the setting up of the project and its rules was highlighted a senior government official whose response is summed up in the quote below,

"*What I want to say is that paying is something that has been established from the start of the project. It is like they know for them to have access to this water; they must pay. So, it is something that is already there, it is a norm. So, they know we asked for this system and one of the requirements is you must pay*". Participant CM_11

Community participation in decision making increases a sense of ownership of the project. For instance, in their study in Tanzania on water kiosks GIZ (2013) assert that the involvement of the customers (community) in decisions such as location increases a sense of ownership. The influence of a sense of ownership on water payments found in this study is contrary to the arguments by Harvey and Reed (2007). In their study, Harvey and Reed (2007) cast doubt on the notion that a sense of ownership increases willingness to pay. In their study they reference work done in Zambia, where out of the 60 communities studied in Zambia, 82 per cent expressed a sense of ownership, however, the operational performance of the system (including payment for water) was poor compared to those who did not express a sense of ownership. However, it is important to note that they acknowledge that a sense of ownership can lead to a willingness to pay in some cases (which are not mentioned or supported with empirical data). This study (researcher's findings) will serve as one of those cases where there is a link between sense of ownership and water payments as supported by empirical data.

Conflict on funds (R6)

For the theme of **Conflict on funds** (R6), the following feedback loop in Figure 6.9 is shown. In Chiringa, conflicts between the community organisation and households reduced the number of households who comply with payments, reducing the financial balance and leading to more conflicts. The result is a reinforcing feedback loop, which is currently working as a vicious cycle, which affects the sustainability of water services. On the contrary, for Chimbiya, a higher financial balance reduced conflicts between the community organisation running the kiosks and the household users. This increased the number of households who comply with payments

at the kiosks, increased revenue and again the financial balance, creating a virtuous cycle. Of the interviewed participants in Chiringa, 64 per cent of them mentioned the presence of conflicts on money-related issues as one of the reasons why they are discouraged to continue with payments. The general sentiment is captured in the quotes below.

"*We had disagreements and conflicts with the committee on payments which led to a resolution for the MWC to be disbanded*". Respondent CR_9

"*The conflicts on money became too much, there was tension, and this discouraged payments. The committee, together with the chief and landowners took us for granted*". Respondent CR_14

"*People did not trust the MWC with their money and rightly so. There is a general belief that the MWC misused people's payments. Even more, the committee did not have customer care which led people to use other sources*". Respondent CR_5

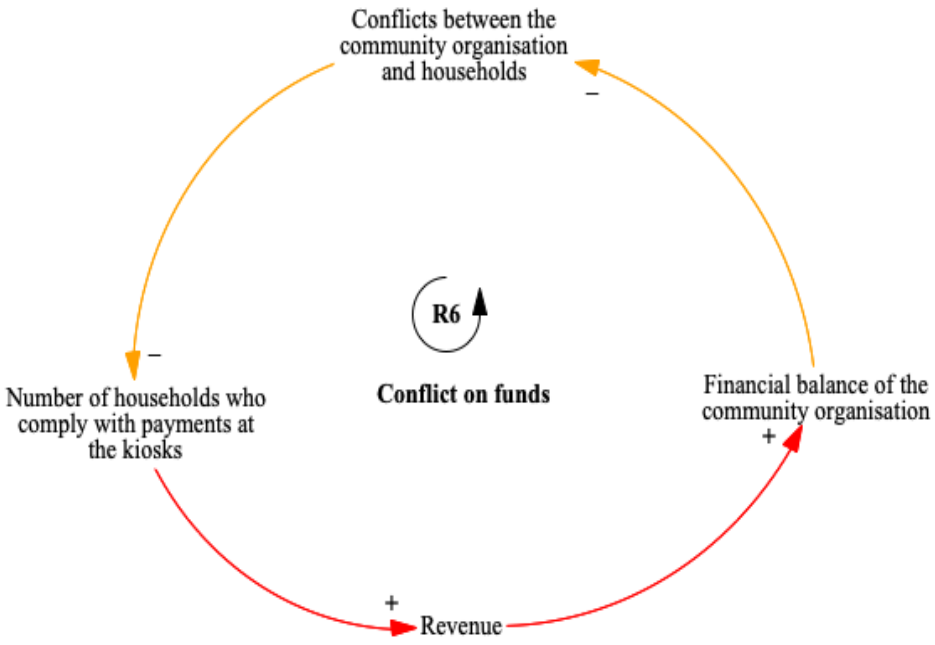


Figure 6.9: Feedback loop showing the impact of conflict on funds on payments at the communal water kiosks

This study's findings are contrary to the study by Olaerts *et al*. (2019) on their study on factors that influence revenue collection for preventative maintenance under a public-private partnership programme which found intra-conflicts between WUC members to influence water payments rather than conflicts between WUC members and the household users.

NGO/donors intervention on payment behaviours (R9)

Table 6. 6: Response of NGOs/donors to functionality challenges at the kiosks

Theme	Chiringa	Chimbiya	Variables
Actions of NGOs/ donors (R7)	"*Sometimes we have to step in and help with salaries and maintenance*". Participant CR_20 "*One can argue that we might create dependency, but you must understand the overall goal is to support the local people and ensure that they have access to clean safe water*". Participant CR_20	"*The only financial support we provided was when there were no kiosks at all. We partnered with SADC GMI to provide the infrastructure to the people. Now we ensure that money is collected and accounted for*". Participant CM_10	Functionality of kiosks NGOs/donors funding Dependency on NGOs/donors for maintenance

The theme NGO/donors intervention on payment behaviours (R7) is shown in Table 6.6 above. NGOs and donors had a role in both Chiringa and Chimbiya schemes. At Chiringa the two donors from Scotland and Netherlands are the main funders of the project. It is worth noting that donors step in to cover some of the salaries of the employees at the scheme and provide funds for maintenance when there are shortfalls in the scheme. They also subsidise the local NGO, Care and Share and pay for some costs related to the project. Information from the interviews shows that interventions by the NGO on providing funding for maintenance were triggered when there was no water at the kiosks (non-functional kiosks). For instance, this occurred on one occasion when the pump was not working and in other instances, there were issues with the valves. In these instances, the NGO got funding from donors in Scotland and Netherlands to pay for these repairs on behalf of the community organisation. While this helped in ensuring that the kiosks functioned, it also created dependency as shown by interview

transcripts in Table 6.6. This was supported by several of the participants, with one participant responding,

"*We knew that the NGO would help us in time of need. Thanks to them, they assisted us*".
Respondent CR_9

Dependency on NGOs/donors to pay for maintenance reduced the number of people who pay and ultimately reduced the funds for maintenance. This issue, which Mulenga (2022) in his RWSN report called baby-sitting communities, is rampant in Malawi. This affects functionality, creating a vicious cycle shown in Figure 6.10. The issue of donor dependence is in part aligned with the project mentality that is inherent with most NGOs. During the period assigned to the project (in most cases a few years), NGOs do whatever is possible for the project to be determined a success. In the previously mentioned study by Neely and Walters (2016) in Chapter 3, the NGOs targets are mainly influenced by short term donor funding models that reward coverage (more projects) rather than ensuring sustainability of the already implemented projects. Since NGOs are implementors that rely on donor money, their focus is mainly on ensuring that they finish as many projects as needed to meet donor targets and retain funding. Neely and Walters (2016) gave an example of how donors usually do not require a report on the longevity of a project after implementation. The focus by NGOs is on how many projects have we achieved so far, thus affecting long-term thinking and sustainable outcomes. In different circumstances, some NGOs including religious organisations always intervene to help communities with good intentions but with long term consequences on sustainability (see Mulenga, 2022). For instance, these interventions bypass government policies and sustainable models put in place by making communities depend on them (see Mulenga, 2022) instead of supporting the community financing policy which is stipulated in Malawi National Water Policy of 2005.

On the contrary, in Chimbiya, the NGO Water Mission working with SADC GMI assisted with management of one-time lump sum fund from the donor, in which they play an active role to monitor. This is highlighted in our findings. They regularly check the kiosks and authorise the withdrawal of funds for maintenance by the community organisation and encourage preventative maintenance. This has improved accountability in the scheme. Communities trust the community organisation because they know that whatever they present to them has gone

through the NGO Water Mission. This is a general sentiment shared in Chimbiya (all the household participants) as captured by participants.

"*Previously when we used the boreholes, no one trusted the community organization at that time, that is why noone paid. There are cases where money was misused for personal benefit. But now with these new kiosks, the committee is accountable to the NGO, which for me has improved my level of trust in the information we get from the committee. As you can see, we pay our money, and the kiosks are working*". Participant CM_15

However, one of the kiosks in Chimbiya is subject to the actions by religious organisations. In this case, the kiosk is placed very close to the church which has a borehole that offers water for free and was functioning. As such, the kiosk did not collect any revenue and ended up being closed.

"*We have the kiosk at the church which has given us a lot of problems. People there do not want to pay, and maintenance is rarely done. Most of them use water at nearby borehole which fortunately functions well*". Respondent CM_16

Before the kiosk at the church was closed, As the operator I used a string to tie it since the rubber stopper in the tap was loose. Even more, they were no collection points for water that overflows from filled buckets which created swamps around the tap. This compromised quality due to flies and bad smell. There was no income from this kiosk because demand was low. Ultimately, we had to close the kiosk". Respondent CM_16

It is worth noting that this kiosk does not form part of the kiosks in which revenue information was collected but gives insights that wherever there is a free, or cheap, alternative close by, functioning water source, users will switch to use it, thus affecting the operational sustainability of the kiosk. In this case, the borehole was provided by the church, showing how issues to do with beliefs that water should be for free can affect decision-making and the provision of rural water services. The impact of the actions of stakeholders in influencing payments is not new in Malawi. For instance, in their study in Malawi, churches were providing water for a free or lower amount, compromising revenue collection (see Truslove *et al.*, 2019).

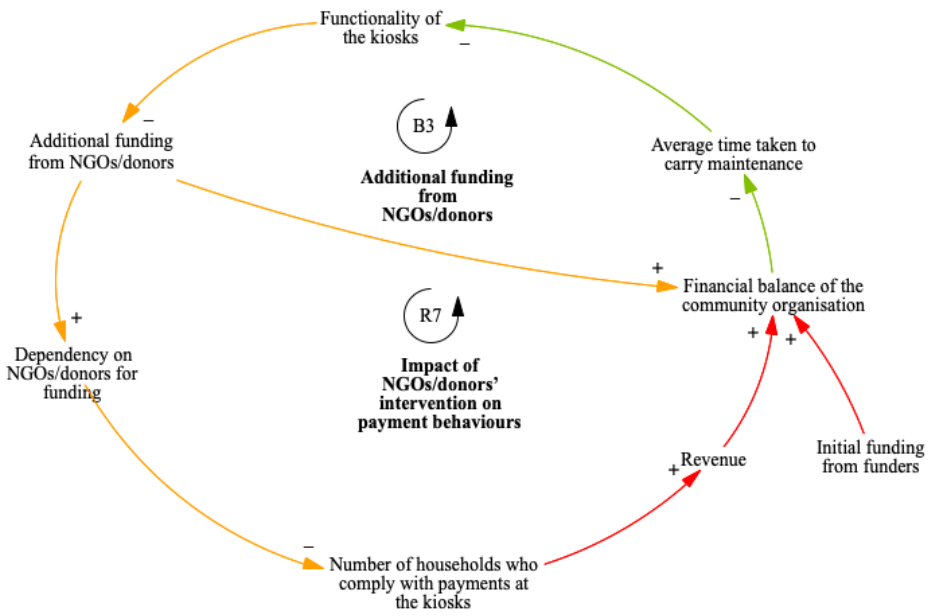


Figure 6.10: Feedback loop showing the impact of NGOs/donors on payments at communal water kiosks

Implication from Emerging Themes

The feedback loops under this proposition, Sense of ownership (R5), Conflict on funds (R6), Additional funding from NGOs/donors (B3) and Impact of NGOs/donors' intervention on payment behaviours (R7) all speak to the social and cultural embeddedness of community contexts. When an institutional arrangement (water payments and rules of payment) is introduced in such a context, people consciously and unconsciously draw on existing social and cultural arrangements to shape institutions in response to changing situations (Cleaver, 2001). Outcomes from this process can be favourable or unfavourable depending on the nature of the structures present (vicious or virtuous).

6.4 Model explaining and providing insights into dynamic water payment behaviours at communal water kiosks

Figure 6.11 below shows the full model representing and providing insights into payment dynamics at communal water kiosks in Malawi. Such a model shows the key dynamic relationships between payment compliance outcomes and improved drinking water services at communal water kiosks. The model was first developed from literature in Chapter 3 and tested,

amended, and extended using data from semi-structured interviews in this Chapter. The testing, amending and extension of the CLDs also resulted in a new list of propositions which are outlined below,

i) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
ii) Level of sense of ownership drive payment behaviours (R5).
iii) Conflicts on funds between community organisation members and households drive payment behaviours (R6).
iv) Interventions by NGOs/donors drive payment behaviours (R7, B3).
v) Payment behaviours are driven by the coping strategies that users employ (R3, R4) when faced with a changing water service level (B1, B2).
vi) Demand funds maintenance (R8).

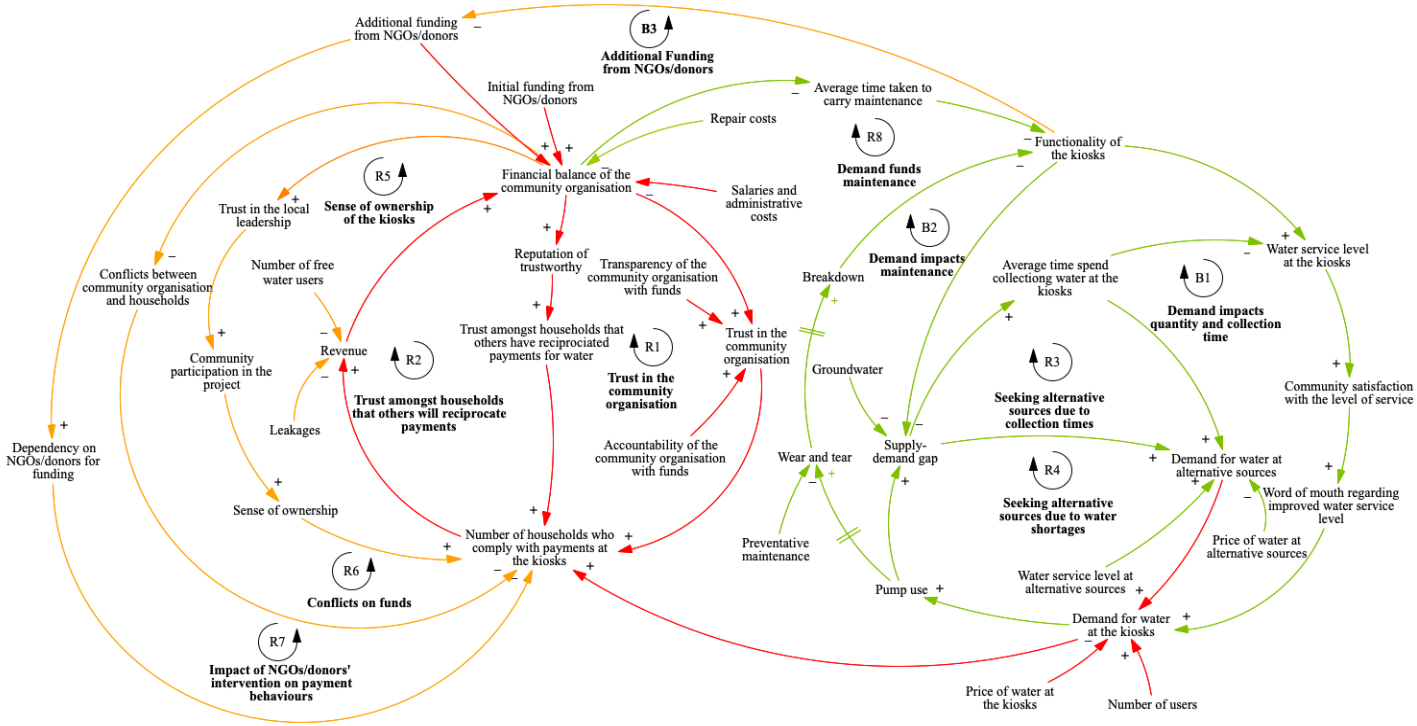


Figure 6.11: CLD Model explaining and providing insights into dynamic payment behaviours at communal water kiosks in Malawi

6.5 Summary of the Chapter

The chapter tested, amended and extended the propositions using interview data from both schemes. Other feedback loops were developed inductively from qualitative data. The chapter ends with a final model in Figure 6.11 explaining and providing insights into key dynamic relationships between payment compliance outcomes and improved drinking water services at communal water kiosks. This model will be validated by selected stakeholders in Chapter 7.

Chapter 7: Confidence Building and Leverage Points

7.1 Introduction

The previous chapter tested, amended and extended the feedback loops and propositions. In this chapter, these loops were presented to selected participants in a group session for confidence building, discussion on leverage points and possible interventions with participants. The chapter begins by providing general information on the confidence building process. After that, various structures that are represented in the form of propositions are discussed and amended following the group session with selected participants. In addition, suggested interventions from the selected participants are also presented.

7.2 Validation Process

The participants selected for the validation process were part of the initial interviews upon which the loops and resulting propositions were tested, amended and extended in the previous chapter. Ideally, the researcher would have included the local community members including members of the local committee but due to practical challenges, the researcher chose participants who can be accessed using Zoom and had a deep understanding of the problem. The selected participants belonged to both groups in Chiringa and Chimbiya and were composed of either NGOs/donors or government officials. To illustrate, participants from the group of NGOs/donors in Chiringa were referred to as CRN while for Chimbiya CMN. For government officials, in Chiringa participants were referred to as CRG while for Chimbiya CMG. In Chiringa, all the participants responded to the invite for the validation process except an invited member of the local NGO Care and Share operating at Chiringa who was unavailable at the time. As such the main donor and funder Ayr Rotary based in Scotland which works together with the local NGO Care and Share and has direct links to the committee organisation and local government officials was invited. In Chimbiya all the participants invited from the government and the NGO operating locally (Water Mission Malawi) responded and participated in the validation process. Information on participant's gender and positions is attached in the Tables 7.1 and 7.2 below. After the selection of the participants, an interview guide (Appendix 3) was employed focusing primarily on asking participants to comment on the feedback loops by either agreeing or making changes to the name of the variables, contents

of the loops and resulting proposition. Furthermore, the participants were given the opportunity to recommend leverage points based on the structure of the loops.

Data was collected through interviews on the Zoom platform with each group. Two interview sessions were carried out with members for each group (group of NGOs/donors and group of government officials) at each scheme (in total four group sessions). Each of the four sessions were carried out in June 2023 and lasted approximately 90 minutes. The data was transcribed using the software NVivo[2].

Table 7. 1: Participants involved in the validation process from Chiringa

Name of Participant	Group	Gender	Position
CRN1	NGO/donor	M	Chairperson
CRN2	NGO/donor	M	Retired academic and member of staff.
CRN3	NGO/donor	F	Member of staff
CRG1	Government	M	Assistant community water supply and sanitation officers
CRG2	Government	F	

Table 7. 2: Participants involved in the validation process from Chimbiya

Name of Participant	Group	Gender	Position
CMN1	NGO/donor	M	Member of staff
CMN2	NGO/donor	M	Member of staff
CMG1	Government	F	Chief groundwater development officer
CMG2	Government	M	Hydrological research officer

7.3 Leverage Points

Leverage points are "*places in the system where a small change could lead to a larger shift in behaviour*" (Meadows, 2008, p. 145).

After representing various structures that influence water payments, leverage points provide ways in which water payments could be sustained at water kiosks. In the list provided by Meadows (2008) there are various places to intervene in the system. These include making changes to balancing and reinforcing loops.

7.3.1 Balancing and Reinforcing Feedback Loops as Places of Intervention

The dynamic interaction between factors that influence payment for water and attributes of drinking water services produces feedback loops which drive payment behaviours at communal water kiosks. In this study, the feedback loops were categorised into propositions to specify the feedback loops under consideration and their theoretical relevance similar to Goh *et al*. (2012). The propositions are listed below,

i) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
ii) Level of sense of ownership drive payment behaviours (R5).
iii) Conflicts on funds between community organisation members and households drive payment behaviours (R6).
iv) Interventions by NGOs/donors drive payment behaviours (R7, B3).
v) Payment behaviours are driven by the coping strategies that users employ (R3, R4) when faced with a changing water service level (B1, B2).
vi) Demand funds maintenance (R8).

Propositions i, ii, iii, iv and v represent structures that drive payment behaviours at both schemes. The last proposition (vi) highlights the impact of the outcomes of payments from both schemes.

7.4 Propositions

Proposition i: Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours

Trust in the community organisation (R1)

Feedback loop R1 in Figure 7.1 below represents the impact of trust in the community organisation on payments.

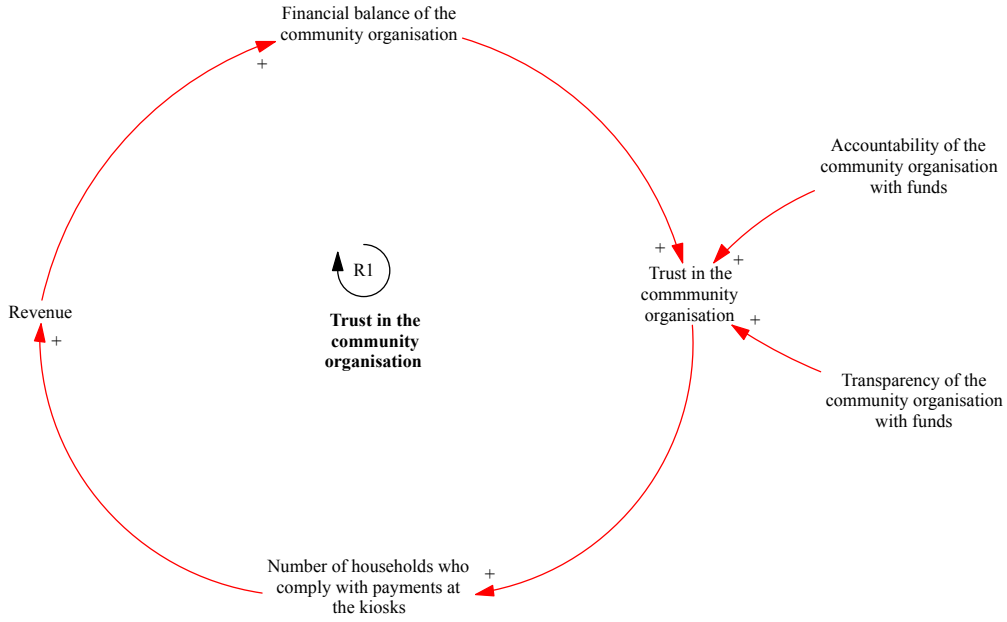


Figure 7. 1: Feedback loop showing the impact of trust in the community organisation on water payments

After the presentation of the loop in Figure 7.1, one of the participants suggested the name of the loop be changed from Trust in the community organisation to *Trust in the community organisation with funds*. This is shown in the quote below.

"*For clarity, I would change the name of the variable to Trust in the community organisation with funds. This makes it clear that the issue of trust under consideration has to do with funds, which is a big issue in Chiringa*". Participant CRN2

This change was agreed to by all other participants in both schemes, who also agreed to existing variable names, contents of the loop and resulting propositions. The iteration is shown in Table 7.3 and Figure 7.2 below.

Table 7. 3: Showing a change of variable name to trust in the community organisation with funds

Loop	Type of Issue	Observation
R1	Change in labelling loop	Participants from both schemes agreed to change the name of the feedback loop from Trust in the community organisation to *Trust in the community organisation with funds* for clarity reasons.

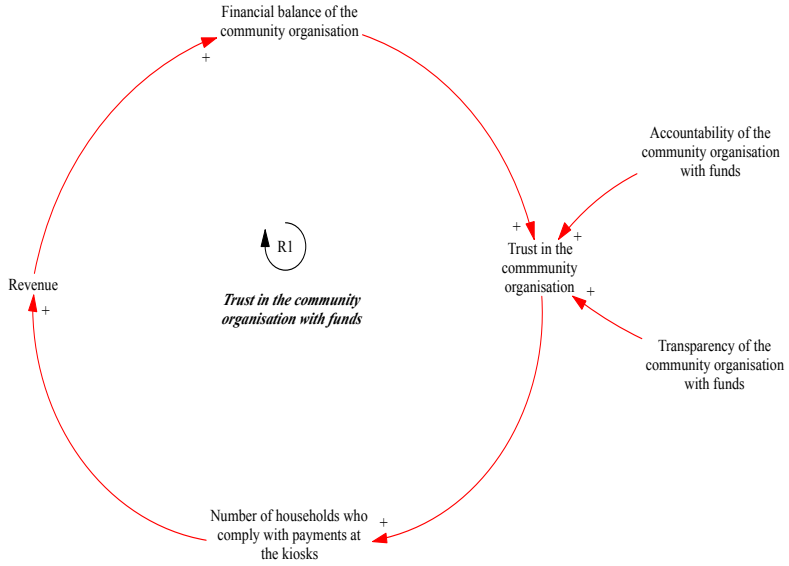


Figure 7. 2: Feedback loop showing the impact of trust in the community organisation with funds on water payments

In Chiringa, all participants from both groups agreed that people have lost trust in how the MWC and recently the Chiringa WUA have been managing collected funds. One of the participants commented,

"I never understood this committee arrangement, it's not like it's a cooperative like those well run by people who understand the business. This for me is a case of the government delegating their responsibility to someone else. Look at Glasgow for example, I just pay for my water, and I trust the local council (utility) that they will deliver satisfactory service".

Participant CRN2

"*These committees are very inefficient and are prone to corruption. There is no accountability for the money collected at all. Furthermore, sometimes you realise that a lot of water has been used but nothing has been collected, and this affects trust*" Participant CRG1

These comments fit into a plethora of literature that criticises the local community committees' model (Chowns, 2015; Van Den Broek and Brown, 2015). Such literature argues that the community management model was a transfer of responsibility from skilled and trained individuals to unskilled individuals who end up being blamed for poor performance. After the statements by Participant CRN2 and CRG1, which were unanimously agreed upon by the participants in both groups in Chiringa, the researcher asked the participants from Chiringa to suggest points of intervention. One of the participants replied,

"*I would have suggested returning the system to government management, but, of course, I know the government will not take over, but let's professionalise this scheme and look for external or other service providers to run the kiosks. The local community committee must be as far away from money as possible*". Participant CRN2

In this response, comments by Participant CRN2 reflect the current trend in rural water supply literature calling for the professionalisation of rural water service (see Moriarty *et al.*, 2013; Lockwood, 2019). In this approach, the registered local community organisations instead of being a service provider can employ paid professionals/ personnel to carry out their maintenance and repairs (Lockwood and Smits, 2011; Lockwood, 2021). The professionals will be working under clear legal, contractual and accountability frameworks whose performance can be monitored against agreed indicators (Lockwood and Smits, 2011; Lockwood, 2021). While this recommendation was unanimously agreed upon, one of the participants who works with the Malawi Scottish Partnership and a member of the NGO Ayr Rotary Club and founding member of the Chiringa project said,

"*While I agree with your point, remember when we started, we appointed a manager and other members who were professionals within the area, however, we later fired them because they misused money and gave water to friends for free*". Participant CRN1

The statement made by Participant CRN1 referred to the appointment of a local professional who already had ties with the community in Chiringa. While this has been found to cause divisions, jealousy and difficulties in enforcement in other studies (see Brown and Van Den Broek, 2020), there is no evidence that employing someone from another area as suggested by Brown and Van Den Broek (2020) with no ties to the local community will work either. This is because people (and the institutions they represent) assimilate into communities and end up becoming part of the social milieu (Cleaver, 2012). This line of argument is explained in detail by a strand of academics who follow the critical institutionalist lens, where they argue that institutions (local committees either voluntary or professionally run) do not work as designed but can either be reshaped, reinterpreted, or rejected through the process of bricolage (Cleaver, 2012; Whaley *et al.*, 2019). Institutional Bricolage acknowledges the messy interface between bureaucratic institutions (local committees and rules) and socially embedded institutions (culture, social relationships, norms, knowledge, technologies, practices and conditions (De Koning, 2011). In this process actors (bricoleurs), consciously and unconsciously patch together institutional arrangements from social and cultural resources available to them, with results being either favourable or unfavourable (Whaley, 2018). For instance, in this case, trying a different management arrangement has led to undesirable outcomes. These committees including some professional individuals end up being embedded or are already embedded in social networks that affect their decision-making. For instance, it might be contrary to their culture to deny water to women, children, and the elderly. Furthermore, in most African communities' people are related, making it difficult to enforce compliance. After the statement by participant CRN1 on the failure of an attempt to use professionals in the committee, another participant suggested,

> "*I think maybe it is time we find one or two people that are influential and have integrity in the community to work with these local committees and run the kiosks*". Participant CRN3

Indeed, this proposed recommendation has worked in Chimbiya where payments were comparatively high compared to Chiringa. When the explanation of loop of R1 working as a virtuous loop was presented to the participants in Chimbiya, they all agreed that the Pastor was the pillar of the project, as mentioned by one of the participants who was also supported by the other colleagues,

"*I am not surprised that the story you mentioned happened here at Chimbiya, the pastor carries respect and works well with local committees, and he has shown this not only in this project but on other projects as well*". Participant CMG1

The recommendation to work with influential local leaders suggested by Participant CRN3 was agreed upon by most of the participants (see the impact of this leverage point to the feedback loop in Figure 7.4). The concept of working with influential local leaders (herein working with the grain) stems from work in development literature (Booth, 2012). Such work has been further applied in rural water where local leaders of authority can be used as change agents that address water-related challenges by working together with institutions and individuals in politically smart ways (Whaley, Cleaver and Mwathunga, 2021). Even so, Whaley, Cleaver and Mwathunga (2021) agree the complexity of facilitating this process and there has been little evidence on how these leaders can be identified and trained in drinking rural water supply. However, related literature in sanitation through their work with the approach of Community-led Total Sanitation (CLTS) have provided more clarity and steps on how these leaders often referred to as natural leaders in sanitation can be identified and trained (Kar and Chambers, 2008; Crocker *et al.*, 2016). In Ghana, natural leaders were selected by first introducing the CLTS (a process known as triggering) and allowing leaders to emerge through demonstrating motivation by building latrines and influencing others. These leaders are then trained to be central to the functioning of CLTS (see Crocker *et al*., 2016). Such a criteria enabled the implementers to avoid a situation where trainees are only after personal and financial gain. Using diffusion theory (see Rogers, 2003) the study by Crocker *et al*. (2016) shows how natural leaders are the early adopters and opinion leaders in that they adopt latrine use quicker and influence their community peers. A key point to make is that these natural leaders are not necessarily people in positions, rather they are people that are motivated or influential. This is key because sometimes you have people that are in positions but are not necessarily motivated or influential (Crocker *et al*., 2016). Crocker *et al*. (2016) found that in areas where natural leaders were added to CLTS and trained, there was a 19.9 per cent drop in open defecation. Sanitation and hygiene activities were much higher in areas where trained natural leaders were in place. A small number of trained natural leaders influenced collective behaviour (latrine use) without money, or materials provided to them, but in part through social interactions. This finding is in line with Diffusion theory which states that after triggering an innovation (CLTS) and early adaptors emerge, success depends on social networks and peer communication (see

Rogers, 2003). It is important to note that critical to the success of the natural leaders in CLTS approach is the level of social cohesiveness within the community (see Crocker *et al*., 2016) and sometimes gender, with women found to be more effective natural leaders in countries such as Uganda and Kenya (see Tiwari, 2011). The impact of natural leaders (herein working with the grain) on trust is shown in Figure 7.4 below. As found in Chimbiya, the presence of an influential pastor who led by example made users trust the community organisation, which in part had his support.

Other solutions in the water literature attempt to eliminate the role of community organisations to reduce incidences of misuse of funds. These solutions include the use of delegated management models (Nzengya, 2015). Delegated management models are partnerships between utilities and the SWE, where utilities delegate management of infrastructure to residents (Nzengya, 2015). In this case, the delegation is not to community groups but to individuals who can be entrepreneurs or private cooperatives who have experience in running market-oriented projects. In such instances, the utility delivers water to master operators (metered individuals or groups from the community) who pay the utility and deliver water either to individuals directly at households or to kiosks to serve the poor who cannot afford household connections. In other instances, water is provided through boreholes which are given to master operators to sell water. Implementation challenges of the approach include resistance from private operators and landlords and poor attendance at meetings (see Nzengya, 2015). However, the approach has been found to provide opportunities for residents in slums to earn an income from selling water, reduce costs and improve utility revenue collection. Critical to its success is the working together of utilities, master operators, kiosks and households, avoiding voluntary local committees which are vulnerable to social networks. Other studies have called for the need to return to state control/centralisation, arguing that there are better public service delivery outcomes achieved under this institutional arrangement in countries such as Malawi (Booth, 2012). However, it is highly likely that voluntary community organisations will persist, in such cases, other interventions from literature include the need to strengthen collective efficacy within community organisations. Collective efficacy is defined as "*a group's shared belief in its conjoint capability to organize and execute the courses of action required to produce given levels of attainment*" (Bandura, 1997, p. 477). It is based on the notion that groups that believe in their capabilities to execute tasks are likely to achieve their intended outcomes (Bandura, 1997). The concept has been empirically tested in various

settings including crime prevention (Sampson, Morenoff and Earls, 1999) and water conservation (Thaker *et al.*, 2019). In all these settings, groups that believed in their capability to organise and execute actions achieved positive collective outcomes. If such a strategy is implemented and a community organisation with high collective efficacy is in place, it is likely going to ensure transparency and accountability (in R1) within the community organisation itself (can be through rules) thus improving the level of trust that the community has with the community organisation.

Trust amongst households that others will reciprocate payments (R2)

Feedback loop R2 shows the impact of trust amongst households that when they pay, others within the community will also pay for safe water to ensure collective payments are enough for sustainable operations at the kiosks. Figure 7.3 below was shown and explained to participants who all confirmed and agreed unanimously on the variable names, and contents of the loop and resulting proposition.

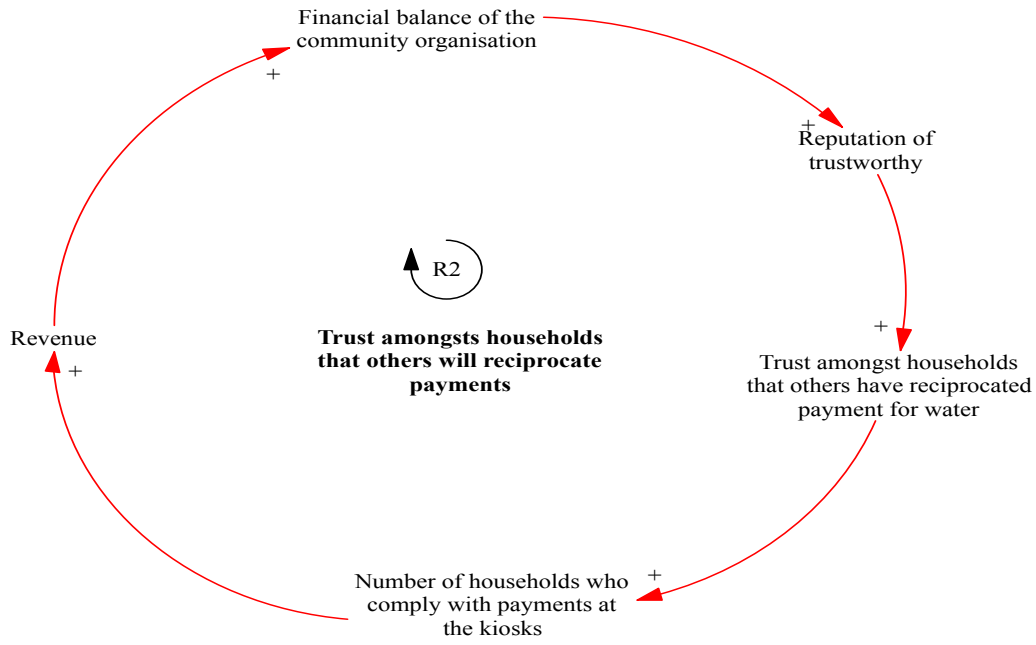


Figure 7.3: Feedback loop showing the impact of trust amongst households that others will reciprocate on water payments

When the participants in Chiringa were asked regarding recommended points of intervention on feedback loop R2, they agreed to the same intervention of using influential leaders as a way that can also ensure trust among households. This is illustrated in the following quotes,

"*I think the solution we provided in the previous diagram can also work here. From my experience, usually trust within the community is centred around an individual, and if that individual is involved, there are high levels of trust in the community*." Participant CRN 2

The use of influential leaders was further explained in Chimbiya, with one of the participants saying,

"*As I said in the previous interview we had, people know that when the Pastor is involved, he carries a lot of respect and usually people comply with project requirements*." Participant CMN 1

The point of intervention of investing in working with the grain is shown in Figure 7.4 below.

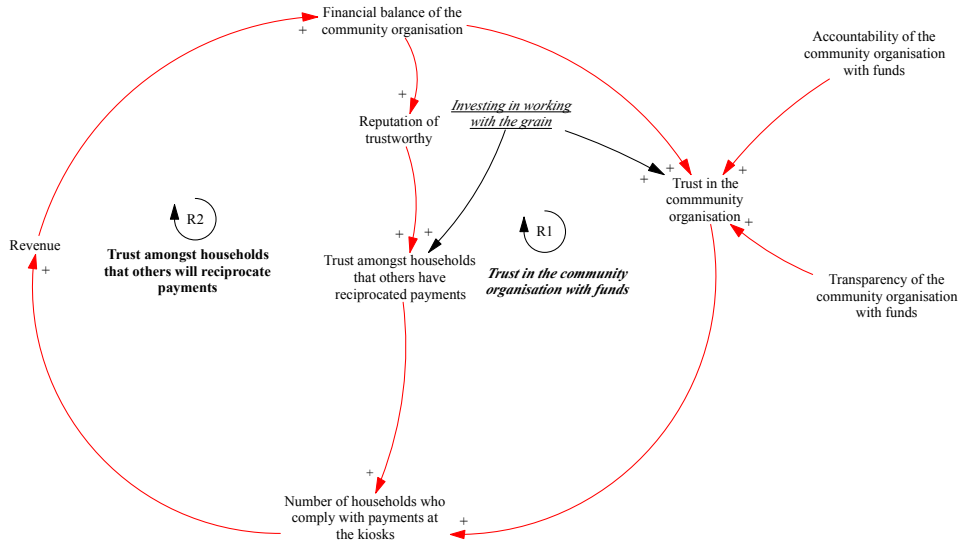


Figure 7. 4: Feedback loop showing the impact of investing in working with the grain to trust in the community organisation and trust amongst households that others have reciprocated payments

Drawing from the agreed intervention by participants, investing in working with the grain will facilitate desired change in trust in community organisation (R1) and trust amongst households that others have reciprocated payments (R2), thus R1 and R2 works as virtuous loops with all concepts increasing over time (note this considers only these loops in isolation from other loops in the wider CLD in Figure 7.21). Unintended consequences of such an intervention include issues to do with high costs and time needed to facilitate this process (see Whaley, Cleaver and Mwathunga, 2021).

Proposition ii: Levels of sense of ownership drive payment behaviours (R5)

Feedback loop R5 in Figure 7.5 below represents the impact of a sense of ownership on water payments. When the feedback loop was shown and explained to participants, they all confirmed and agreed on the variable names, contents of the loop and resulting proposition. As mentioned in the previous chapter, the red links represent relationships identified from the literature on water payments whilst, the orange links represent relationships identified from the interviews (empirical data).

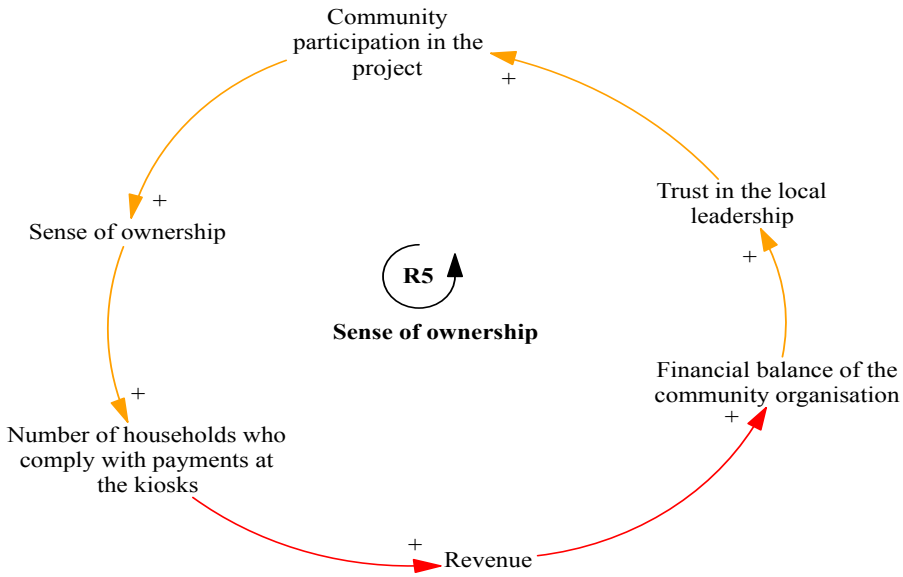


Figure 7. 5: Feedback loop showing the impact of levels of sense of ownership on water payments

When the participants at Chiringa were asked what their recommended points of intervention on feedback loop R5 are, both groups pointed to the need to involve communities in decision-making about the kiosks. Their responses are shown in the following quotes,

"*As I look at your picture there, in Chiringa, I think there is a need for more community participation to increase sense of ownership. This community participation can be increased by ensuring that they are involved in every major decision before the kiosks were installed and after*". Participant CRN3

Various studies that have investigated WASH failures in Tanzania, Zimbabwe, Malawi and South Africa found inadequate community engagement to be a key impediment to WASH outcomes (Barrington *et al.*, 2021; Chinyama *et al.*, 2021; Luwe *et al.*, 2021). If communities are consulted, this can result in unsustainable projects. For instance, a study by Chinyama *et al*. (2021) in Zimbabwe found use of solar powered systems accrued costs that were beyond the community's reach (affordability) due to high costs of replacement parts. A study by Luwe *et al*. (2021) in Malawi recommends that communities to be consulted on the level of service they want and where they should be placed. Luwe *et al*., (2021) found that lack of community engagement on such decisions results in low participation. Low participation has implications of community ownership and ultimately WASH outcomes.

When the above recommendation by Participant CRN3 was put forward, another participant responded,

"*Is the use of the committee, not community participation, I thought this committee represents the community and its needs*". Participant CRN1

The researcher asked the participants if they thought local committees were representative of the community's needs and if the election of the committee was a democratic process. This question resulted in a discussion in which a consensus was reached that mostly those who have power are chosen in the committees and that community engagement should go beyond choosing a few individuals. The impact of involving the community in key decisions about the kiosks is shown in Figure 7.6 below. In Chimbiya where there is a virtuous loop, continuous involvement of the community in key decisions enable the loop to continue being virtuous,

while investment in involving the community in key decisions about the kiosks in Chiringa could turn loop R5 from being vicious to virtuous with all concepts increasing over time.

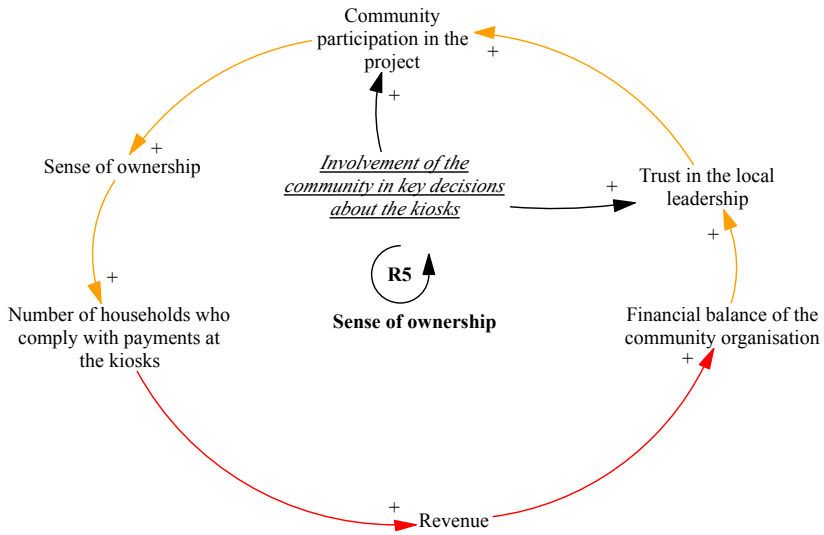


Figure 7. 6: Feedback loop showing an intervention to the sense of ownership structure

The need for community engagement to go beyond choosing a few connected individuals presents the reality in Chiringa. As mentioned in Chapter 6, the funders acknowledged that there was no community engagement, except for the initial approach by a local NGO (Care and Share) regarding a need for water in the area which resulted in them funding and installing kiosks. It was only after the kiosks were built that a local committee, known as the MWC, was recruited which took over the project from the donors and was later replaced by the Chiringa WUA. In contrast, community participation formed the backbone of the project in Chimbiya. This was emphasised in the quote below and agreed upon by other participants representing the project.

"*You know it is important for me to highlight that this project started as a result of the community themselves. It is them who came to our offices and to the Water Mission offices saying that they are suffering and need water. They said they are willing to pay, only if we provide water. They even came with their Pastor who advocated for them as well. So, this*

meant that they participated from the start. Even now, I hear they meet all the time to discuss issues on the project" Participant CMG1

Since participation is key in ensuring a sense of ownership (Marks and Davis, 2012), it becomes critical to get into details about the concept of participation and how this can be effectively fostered for a community-based system. Literature on community participation is rich in the water sector. Such literature refers to community participation in decision-making as indispensable for the sustainability of rural water supply systems (Harvey and Reed, 2006). Participation increases efficiency and effectiveness in developmental work, such as rural water supply (Ray and Bhattacharya, 2011). Community participation in capital cost and household decision-making influence better water system performance (Prokopy, 2005). Harvey and Reid (2007) argue for *'effective participation'* that goes beyond attendance to planning, implementation and monitoring from the time the project starts. However, Alexander et *al*. (2015) found contrary results that refute the notion that communities must be involved in all key aspects of the project. For instance, not consulting the community about where to construct a water system/ water point significantly increases functionality (Alexander *et al.*, 2015). The reason why this finding is contrary to literature that supports community involvement at all stages of rural water supply projects (see Katz and Sara, 1997; Harvey and Reed, 2007) is that decisions such as the location of a waterpoint do not need community consultation per se, this can be left to professional technicians who are knowledgeable about the geological benefits of one site over another. However, in terms of day-to-day management, use and sustainability, community engagement is key.

To foster participation, there is a need to enhance the role of women. The involvement of women in decision-making has been advocated for by development practitioners as key to ensuring sustainability (Fonjong, Emmanuel and Fonchingong, 2005). A study in Uganda found women to be more involved in water issues than men (Mpalanyi Magala, 2014). Since women are those who are mainly involved in the everyday collection of water, involving them in decision-making is key to ensuring sustainability.

Proposition iii: Conflicts on funds between households and community organisation members drive payment behaviours (R6)

Feedback loop R6 shown in Figure 7.7 below represents the impact of conflict on funds on payments.

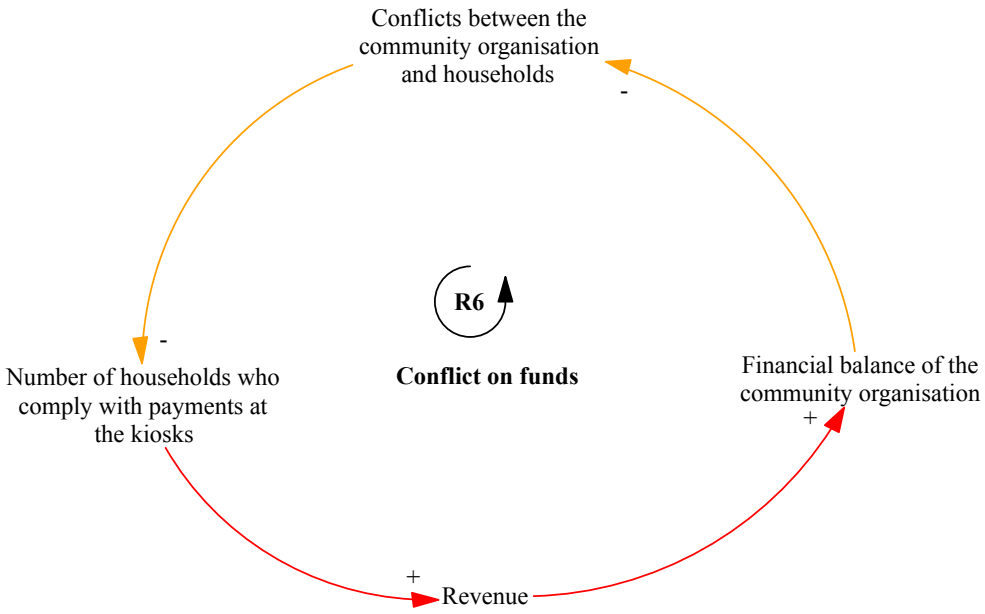


Figure 7. 7: Feedback loop showing the impact of conflict on funds on water payments

After showing the participants in Chiringa the Feeback Loop R6, they agreed to add the variable social relationships or social networks. This is illustrated in the following quotes.

"*I suggest you add the variable social relationships there, the presence of conflicts either fragments social relationships or their absence results in stronger social ties*". Participant CRG2

The suggestion was made by Participant CRG2, to which other participants in both groups in Chiringa agreed to the impact of conflicts on the social relationships that exist within the community thus affecting collective outcomes (collective water payments). When the Feedback R6 was presented to participants in Chimbiya, initially they agreed to all the variables and direction of polarities. The researcher then suggested the iteration that was made by the

other scheme to which they all agreed that the variable is appropriate and relevant. This is captured in the following quote,

"*Now that you say it, it makes sense, but here in Chimbiya, people know that the NGOs already make sure that the money is collected and used properly. I would say there are no such conflicts*". Participant CMN1

The new iteration is shown in Table 7.4 and Figure 7.8 below,

Table 7 4: Showing the addition of variable social relationships

Loop	**Type of Issue**	**Observation**
R6	Missing Variable	Participants from both schemes noted that conflicts between community organisation members and households fragment the strength of *social relationships* (social networks). These social networks influence water payments.

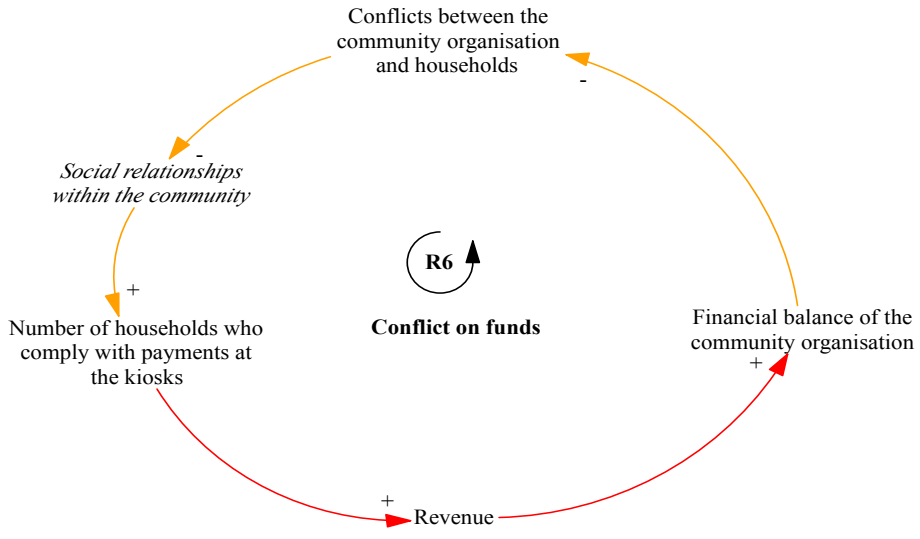


Figure 7. 8: Altered feedback loop showing the impact of conflict on funds on water payments

When participants from Chiringa were asked what interventions could be done to attempt to make this feedback loop a virtuous rather than vicious loop, they responded with a need to

ensure accountability by both the NGOs and the government as shown in Figure 7.9 below. The impact of such an intervention is that it reduces conflicts between the community organisation and households, as households know that there is a layer of accountability to the committees as they report to the NGOs and government. This will make R6 a virtuous loop in Chiringa with all concepts increasing over time.

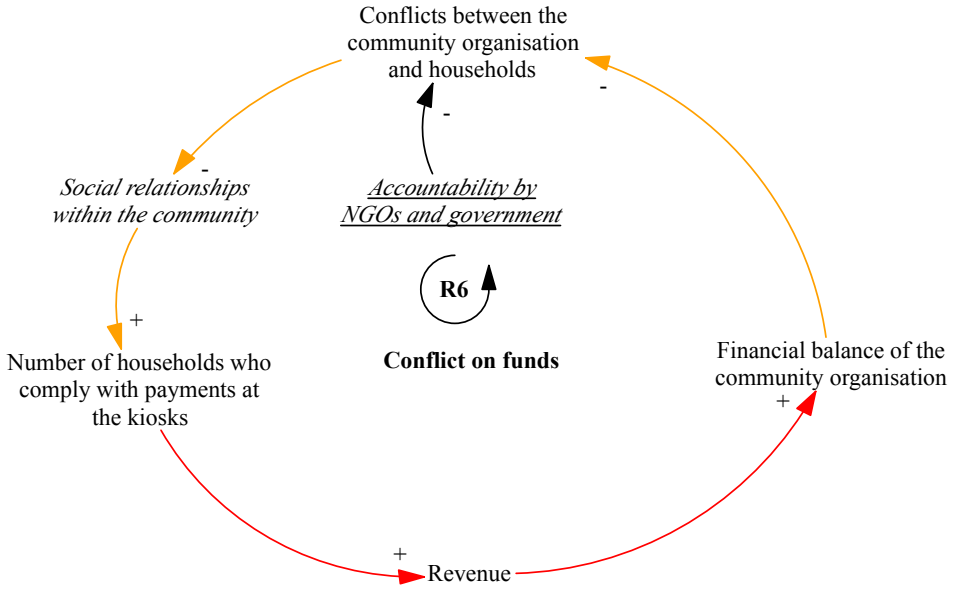


Figure 7. 9: CLD showing an intervention to the conflict on funds structure

The need to ensure accountability by both the NGOs and government is illustrated in the following quotes,

"*What I observe is that there is no way the scheme can run without this local committee, what we need to do is ensure that there is accountability. We fund the local NGO in Malawi (Care and Share). The borehole, the tank as well as other infrastructure are on their site, why don't they run the kiosks and make the committee accountable? You even mentioned in your explanation that accountability of the NGO can increase community user trust in the community organisation thus reducing these conflicts*". Participant CRN2

"*Accountability should not only come from the NGO but also the government, they know the ins and outs of the schemes and have the authority over water resources in the country*". Participant CRN1

This solution represents what was done in Chimbiya where the NGO Water Mission was more involved in day to day running of the kiosks compared to Care and Share at Chiringa. The emphasis on local NGO involvement was supported by one of the participants in Chimbiya who is quoted below.

"*We had been involved with water committees for decades, unless you are hands-on, they will misuse funds and reduce the trust of the people in the process. Therefore, we audit everything, sometimes we meet resistance, but we have the support of the district government and the church leader here*". Participant CMN2

The involvement of the funders (mainly the NGOs, donors) forms part of the broader debate on the role and responsibilities of funders in the WASH sector. Research carried out by Luwe *et al*. (2021) which aimed at identifying sources of failure in the WASH sector in Malawi through field-based research with stakeholders called for the need to change the role of the funder. They argue that some of the current roles taken by NGOs/donors should be left to local bodies at the national level such as WESNET in Malawi and not individual NGOs. These roles could include policy or direct involvement with communities. Evidence has shown that direct involvement of NGOs and community can lead to conflicts (Brown and Van Den Broek, 2020). For instance, in Uganda, Brown and Van Den Broek (2020) found the introduction of a water operator who worked with an NGO representative resulted in conflicts with some of the users who disliked the idea of a water operator benefiting from their payments. This led to non-payment based on the premise of norms that disliked someone (a chosen water operator within the community) being appointed as a water operator and having access to their payments and the benefits associated with the job. In addition, NGOs are conflicted between sustained outcomes and meeting their organisational goals and reach (Neely and Walters, 2016). For instance, their funding is related to the number of projects completed rather than sustainability of the project (Neely and Walters, 2016) . This affects long-term thinking and sustainability of projects.

Proposition iv: Interventions by NGOs/donors drive payment behaviours (R7)

Feedback loop R7 shows the impact of interventions by NGOs/donors on functionality levels by providing funds for maintenance. Initially, Figure 7.10 below was shown and explained to participants.

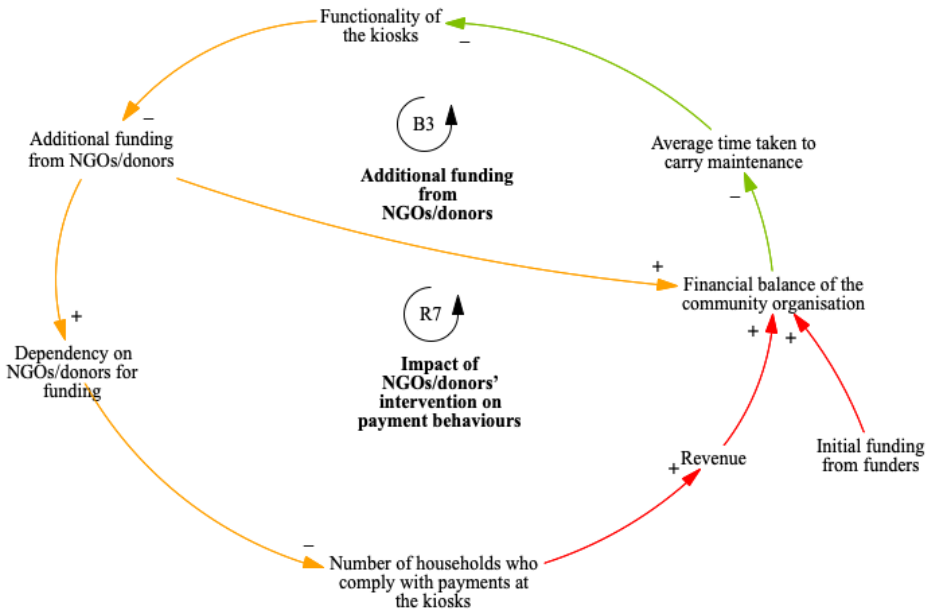


Figure 7. 10: Feedback loop showing the impact of NGOs/donors intervention on water payments

One of the participants suggested changing the name of the loop to impact of funders' intervention on payment behaviours instead of the initial title which was the impact of NGO/donors intervention on payment behaviours. This change is illustrated in the following quote,

"*I would change the name of this loop. From your explanation, the interest is in the actions of those organisations that have the power to make decisions, and, on this occasion, they are whoever is funding the project. Also, as a member of the government, we fund some of these schemes and it seems we are excluded on that title*". Participant CMG1

After the iteration shown in Table 7.5 and Figure 7.11, all the participants agreed unanimously on the variable names, contents of the loop and resulting proposition.

Table 7. 5: Showing change of variable name to impact of funders' intervention on payment behaviours

Loop	Type of Issue	Observation
R7 and B3	Change in the variable and labelling of the loop names	Participants from both schemes agreed to change the name of the feedback loop (R7) from Impact of NGO/donors intervention to *Impact of funders' intervention on payment behaviours* and (B3) from Additional funding from NGOs/donors to *Additional funding from funders*. Variable name changes were done from Dependency on additional funding from NGOs/donors to *Additional funding from funders* and from Dependency on NGOs/donors for funding to *Dependency on funders for funding*. Other variable name changes are from Initial funding from NGOs/donors to *Initial funding from funders*. The variable name changes have been made for clarity and inclusion.

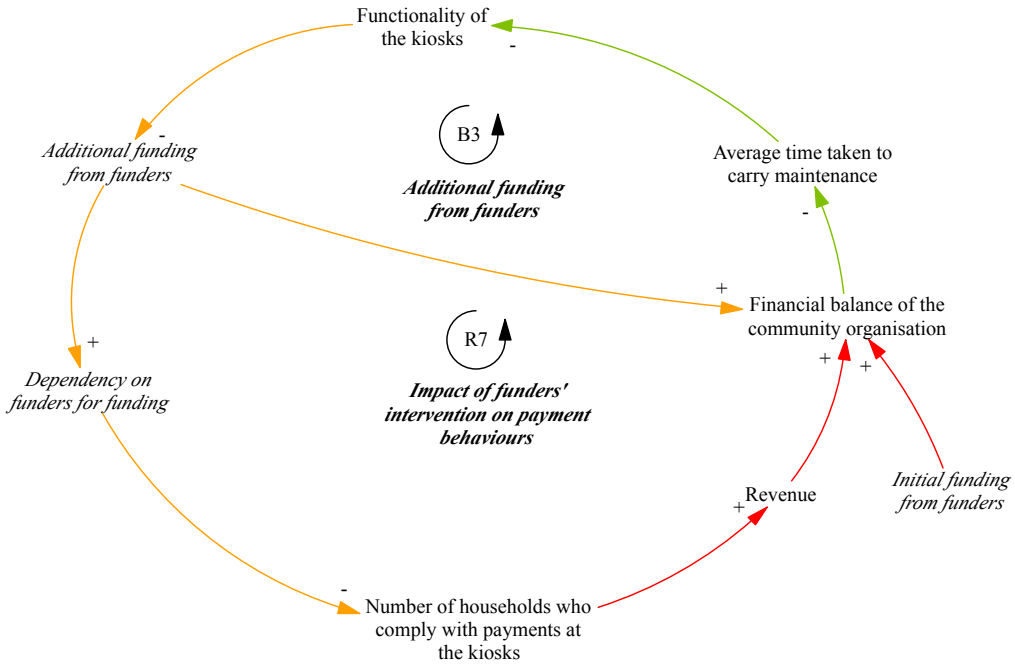


Figure 7. 11: Altered feedback loop showing the impact of funders' intervention on payment behaviours

All participants agreed that donor dependence was rampant in Malawi. In the NGO group for Chiringa, one of the participants noted that donor dependence starts from the government and goes down to communities. This is illustrated in the quote below,

"*The issue of donor dependence is not just a community problem for me, it starts with the Malawian Government which receives money every year from the Scottish and UK governments. We do not see where the result of this investment is going. I think it is high time donor governments call for accountability*". Participant CRN2

The point made by Participant CRN 2 is not only relevant in Malawi but in other countries such as Zimbabwe (see Barrington *et al*., 2024).

"*Here in Chiringa we also have issues where we have our plans, but other faith-based organisations come and make their arrangements with the people. This creates confusion*". Participant CRN1

In Chimbiya the involvement of politicians was mentioned as a threat to the sustainability of the kiosks, one of the participants was quoted saying,

"*Sometimes we have issues with opposition politicians who try to win votes and popularity by promising people that they will provide water for free. Another previous opposition politician drilled a borehole to provide water for free. Unfortunately, the borehole is now abandoned due to lack of maintenance. We always use that example when we talk to people about the dangers of such actions and encourage them that payments are critical to the sustainability of these kiosks. But I must also mention that these people prefer water connected at their homes, they are willing to pay for it*" Participant CMG1

When the participants were asked what their recommended points of intervention on feedback loop R7 are in the case of a vicious cycle experienced in Chiringa, participants from Chiringa agreed to the need for more workshops focusing on collaboration among actors to avoid sending different messages to users and ensuring planned coordinated funding. This is captured in the following quote,

"*I suggest a platform for collaboration among actors. I know such talks have been mentioned before but never came to real fruition. For instance, if we can talk to some of these faith-based organisations perhaps we can reach a common ground and avoid duplication of roles and undermining each other's work*". Participant CRN2

When the feedback loop was shown to participants in Chimbiya, one of the participants responded,

"*We work together with the NGO (Water Mission) and local leaders including Pastors. In doing so we make sure we have aligned goals that ensure sustained water services at the kiosks*" Participant CMG1

The impact of planned coordinated funding is shown in Figure 7.12 below.

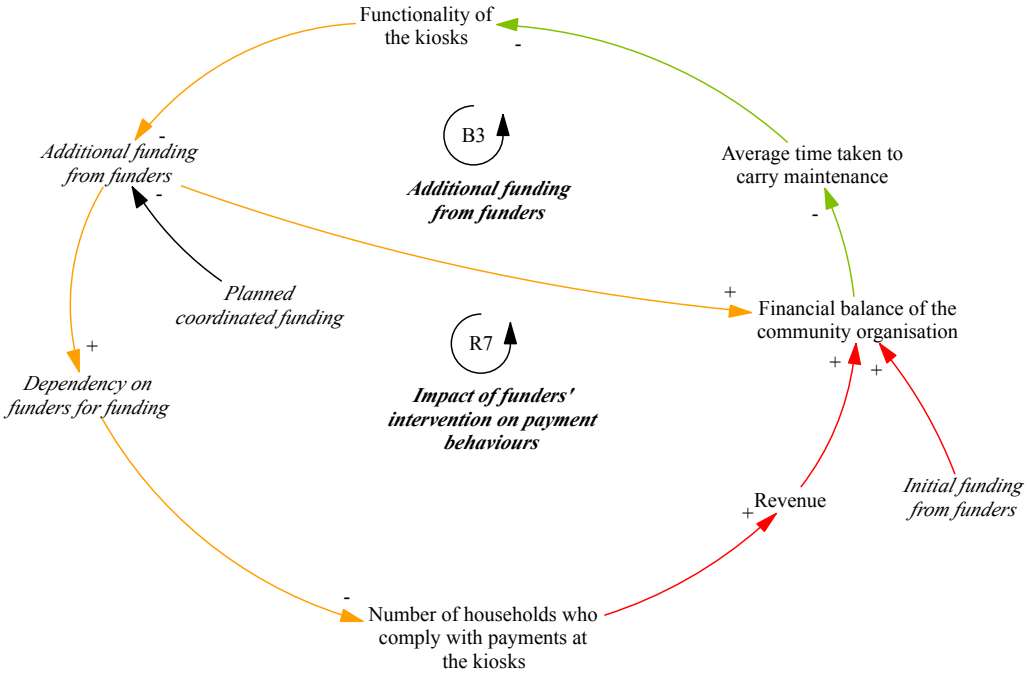


Figure 7. 12: Feedback loop showing the impact of planned coordinated funding

Proposition v: Payment for water is driven by the coping strategies (R2, R3) that users employ when faced with a changing water service level (B1, B2)

Before focusing on the coping strategies structures (R2, R3), the study first explains how the water service level changes with demand as represented by loops B1 and B2.

Feedback Loop B1 and B2

Feedback loop B1 shown in Figure 7.13 below represents the impact of demand on quantity and collection time. The green links represents relationships obtained from literature on water service attributes in Chapter 3. When the feedback loop was presented to participants, they all unanimously agreed on the variable names, contents of the loop and resulting proposition.

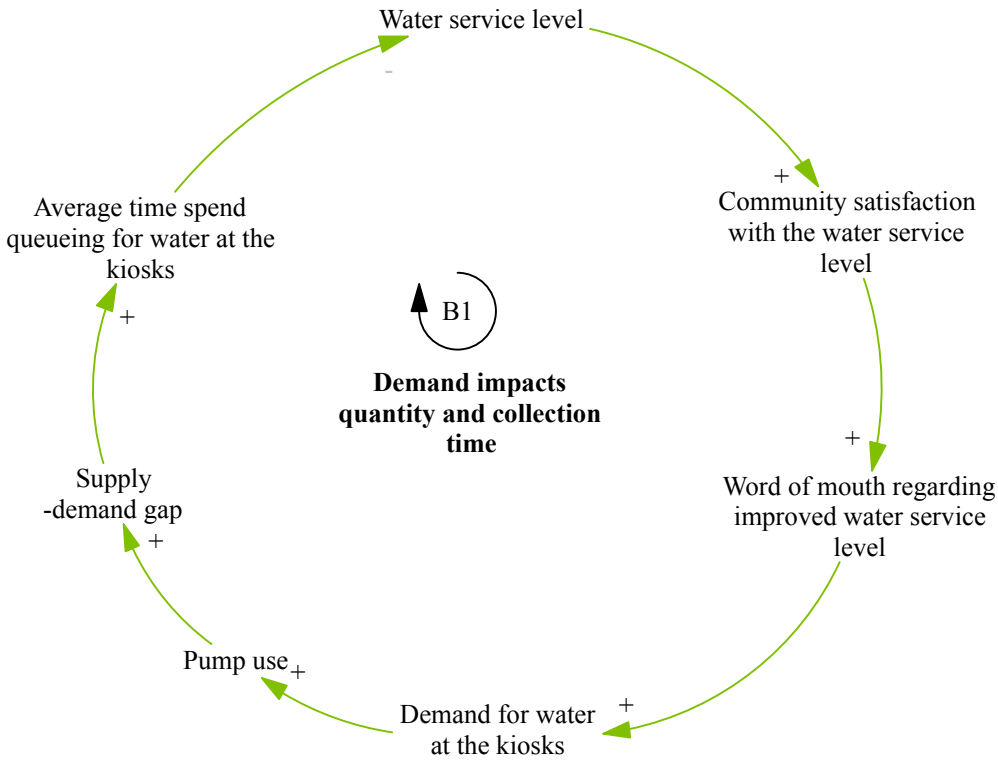


Figure 7. 13: Feedback loop showing the impact of demand on quantity and collection time

After that, participants were also presented with loop B2 shown in Figure 7.14 below. All the participants unanimously agreed on the variable names, contents of the loop and resulting proposition.

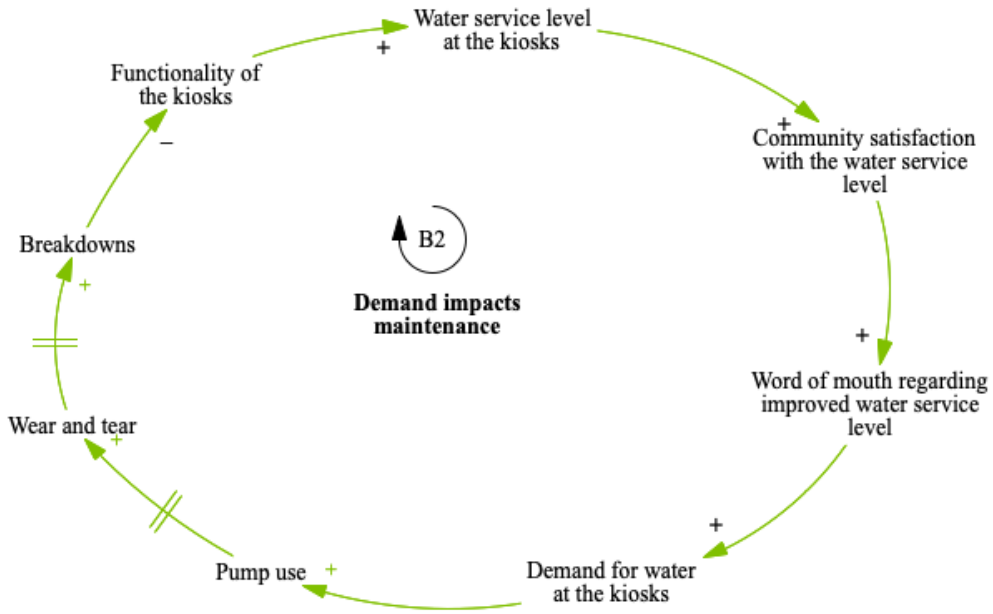


Figure 7. 14: CLD showing the impact of demand on maintenance

After the above CLDs (B1 and B2) were shown to participants of both groups in Chiringa and Chimbiya, a combined structure showing the impact of demand on attributes of drinking water services (rivalrous nature of water supply at the kiosks) in Figure 7.15. below was shown to participants.

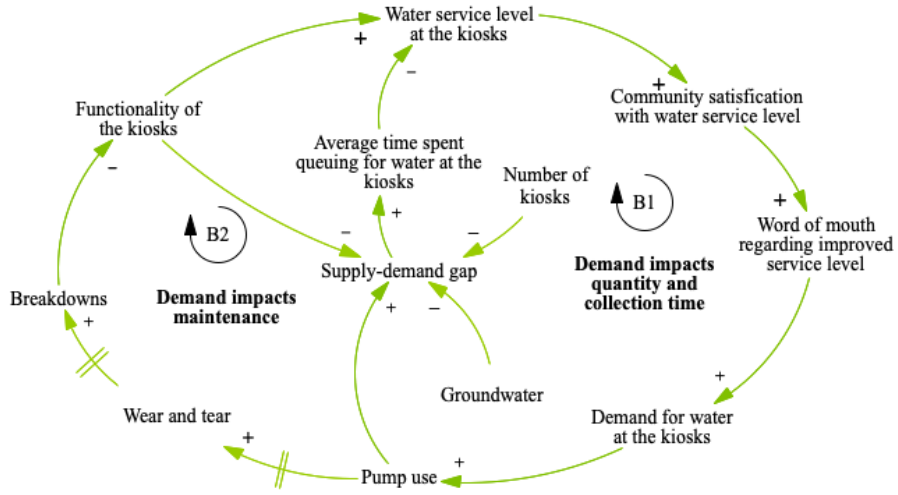


Figure 7. 15: Combined feedback loops showing the rivalrous nature of the kiosks water supply

The rivalrous nature of water means use by one person imputes an additional cost to the next user (Ostrom, 1990). These costs can include time or finances. This concept was explained to the participants to provide understanding and clarity. Before participants were asked for possible interventions, it is important to mention that a balancing loop is usually a good situation for sustainability (if there are no delays). However, in the combined feedback loop 7.15, there are delays which might cause oscilliatary behaviour. In our study, issues of unfulfilled demand are reported. This means that oscialliation might be more around a reduced demand. The gap between supply and demand present means that demand has reduced over time to match supply, thus a reduced fulfilment of demand. Therefore, if more people are to benefit from the water supply there is a need to increase the level where the balancing loop stabilises. This means increasing the level of supply in line with demand. The above explanation justifies and explains why there is a need for interventions to the balancing loop in this case.

The researcher asked participants for interventions that might increase supply. There was a unanimous agreement that the recommendation they would advocate for was an increase in the number of kiosks. They believed that this solution would cover all the trade-offs shown in both B1 and B2. This is represented in some of the quotes from the session,

"*For me, the solution remains the need to increase the number of kiosks in line with the increasing population. I have mentioned this earlier, even after seeing the combined picture, for me, it would be like killing two birds with one stone. This will not only lead to an increase in the number of kiosks users can access, but also eases congestion and reduces pressure on a limited number of kiosks thus reducing maintenance costs*". Participant CRN1

Another participant added,

"*I agree to this point, this would lower maintenance costs, and breakdowns will be reduced since fewer people use a kiosk at a particular time*" Participant CRN3

"*We want to appeal to the donors to increase the number of kiosks, as you know Chiringa is a trading centre which means the centre attracts a lot of people. We are also close to the border which means some people from Mozambique sometimes come and stay here*". Participant CRG2

Regarding Chimbiya, one of the government officials who has a high-ranking position in the government said,

"*Well, the idea of increasing the number of kiosks to deal with issues of spatial distribution is on our cards already. Working together with the SADC GMI, there are calls to increase the number of kiosks, which I think addresses some of the trade-offs you have shown us*"
Participant CMG1.

These sentiments were also shared by other participants making the idea of increasing the number of kiosks the recommended solution to the rivalrous nature of rural water supply from the participants. This intervention is supported by other studies that call for the need to increase the number of kiosks to avoid congestion and breakdowns (see Gedo and Morshed, 2013). As mentioned previously, in literature increasing the number of kiosks reflects the coverage/project mentality that is instilled in most NGOs, where their success and financial backing from donors is based mainly on coverage (building of infrastructure to increase reach and organisational growth) rather than sustainability (see Neely and Walters, 2016). The impact of the intervention is shown in Figure 7.16 below.

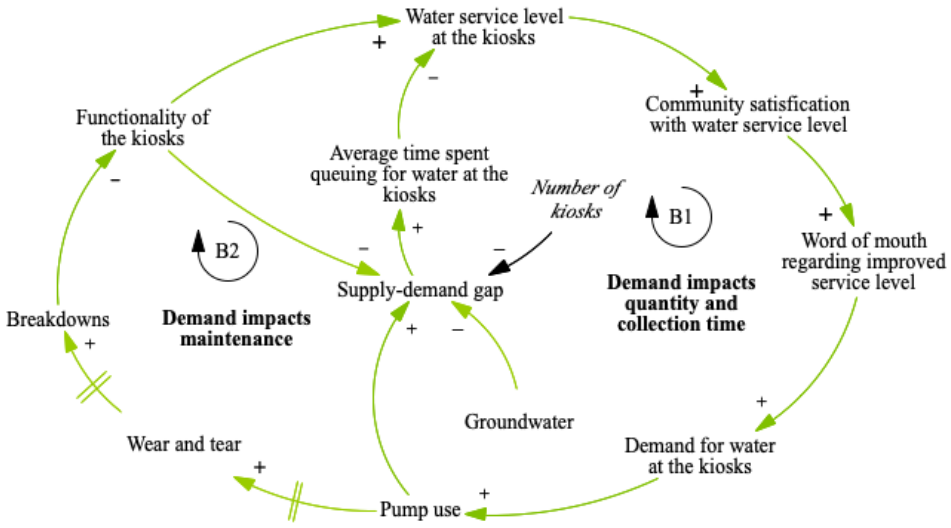


Figure 7. 16: Combined feedback loops showing an intervention to the rivalrous nature of kiosks water supply structure

While the issue of increasing the number of kiosks as suggested by the participants might have some positive outcomes in the short term, they will eventually have unintended consequences. These unintended consequences are shown with blue arrowed colours in the final model in Figure 7.21 below. Increasing the number of kiosks might also increase costs leading to another problem of stranded assets which is a significant issue in Malawi. A study done by Kalin *et al*. (2019) identifies the existence of unaccounted stranded assets (partially/non-functional/ abandoned water points) in Malawi. Stranded assets are defined as

> "*Water Sector infrastructure assets that have prematurely lost financial value or are devalued before the end of design lifetime, assets still within design lifetime but due to improper policy or management do not provide the intended service provision and/or have been abandoned, and assets that are converted to a social, environmental or financial liability before the end of design lifetime*" (Kalin *et al.*, 2019, p. 2).

Kalin *et al*. (2019) found functional water points to constitute 52. 9 per cent, partially functional (21.6%), non-functional (22.3%), no longer exist or abandoned (3.2%). These assets/ water points pose health and well-being risks to communities dependent on them (Kalin *et al.*, 2019). The high prevalence of stranded assets means that poor communities are left with the burden of maintaining inherently unsustainable assets (Truslove *et al.*, 2020). Chowns (2015) found massive variations in functionality between water points properly installed with those that do not meet standards. This means that improperly installed assets are prone to breakdowns, putting a financial burden on the community which are already poor. Another unintended consequence can be the depletion of the stock of groundwater since groundwater resources are finite, thus creating a shortage of water and leading to more waiting times.

Feedback loops R2, R3 shown in Figure 7.17 below show how users cope with alternative sources when there are water shortages (R2) and high collection time (R3).

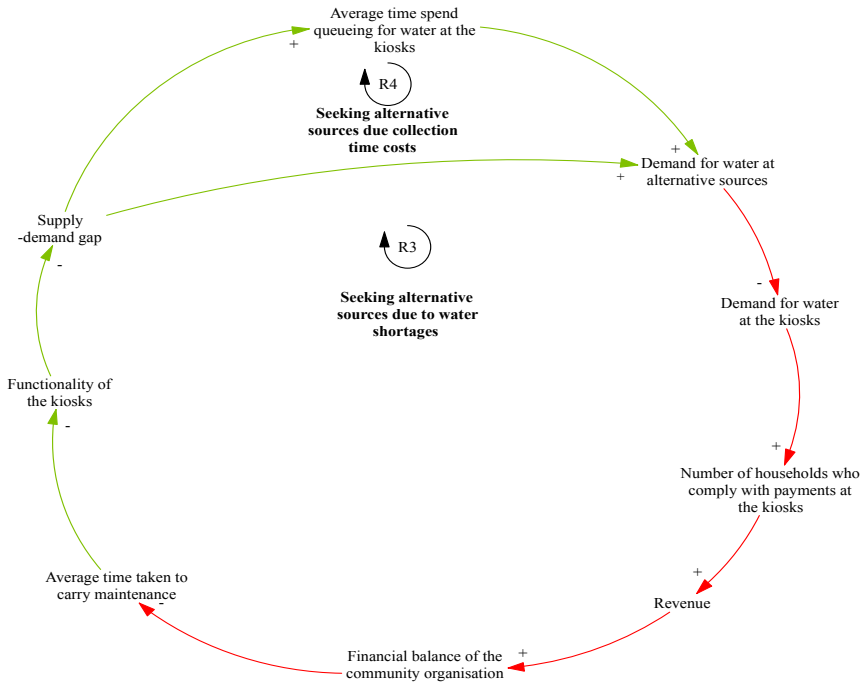


Figure 7. 17: Combined feedback loops showing coping strategies of users to the rivalrous nature of kiosks water supply

The feedback loops were presented to participants, and all agreed to the variable names, contents of the loop and resulting propositions. The participants also confirmed the use of alternative sources. The use of alternative sources was high in Chiringa where there are government-supplied community boreholes which are unreliable but provide water, especially during the rainy season when water tables are high. The availability of alternative sources especially during the wet seasons creates a social dilemma for users (Contzen and Marks, 2018). Social dilemmas are, "*situations in which short-term individual interests conflict with long-term collective interests*" (Contzen and Marks, 2018, p. 45). The social dilemma emanates from households being faced with a decision on whether to consider short-term individual interests or long-term collective interests. Short term interest includes using alternative sources such as rain-harvested water which reduce time spent fetching and walking to water sources (collection time), eliminates queueing and above all, except initial investments on infrastructure, are free. On the other hand, long-term collective interests are where they continue regularly using safe water from the kiosks thus maintaining the operational sustainability of the kiosks, where kiosks operate throughout the year (Contzen and Marks, 2018).

When the participants were asked what their recommended points of intervention on feedback loops R2 and R3 are, most of the participants pointed to the use of price in changing payment/water use behaviours. This can be done by lowering prices and changing the payment method. Responses are illustrated in the following quotes,

"*Maybe we can lower prices so that the opportunity costs of waiting a bit longer at the kiosks is lower and incentivised by lower prices*". Participant CRN2

"*I would say the most determinant for water use at kiosks is the issue of price and costs to the household. One would ask why I should pay more if I am going to spend more time in a queue. Therefore, lower prices can compensate for these inconveniences. I give an example of the rainy season, why would I choose to go to the kiosks when I can just harvest water? These are the questions that I think households would ask themselves, even though harvested water is prone to contamination*". Participant CRN1

In the government group at Chiringa, the conversation of pricing went on to suggestions to change the payment method from Pay as you fetch (PAYF) to seasonal or monthly payments. One of the participants responded to the idea of lowering prices by saying,

"*On top of lowering prices to encourage more users and make the kiosks water more attractive to users, we can also change the payment method, users do not have money all the time to pay for water. We can change to monthly or yearly payments*". Participant CRG1

The need to use prices to regulate behaviour was agreed upon by all the participants except one of the participants in the NGO group of Chiringa who commented on this issue,

"*I have been following our conversations since we started, first the number of people who pay is not enough to cover meaningful costs, second, there are these questions that are highlighted by Participant CRN1, it makes me wonder if we should have these tariffs in the first place. It is not working and making people use water from unimproved sources*". Participant CRN3

This response was rejected by other participants in the NGO group at Chiringa who argue that the sustainability of the kiosks depends on some sort of contribution from the users. Their argument is supported by practitioner-led literature that argues for tariff collection from users as critical to sustainability (Harvey and Reed, 2007; Foster, 2013). In such literature, tariffs are believed to promote equity and efficiency (Briscoe and Ferranti, 1988) and improve community ownership (Briscoe and Ferranti, 1988). Furthermore, the justification of water payments is based on the need to eradicate what Winpenny (1994) and the World Bank Water Demand Research (1993) called the 'entitlement syndrome', where free water provision to households (supply side solutions of government/NGO subsidised provision) are regarded as unsustainable due to their hydrological, environmental, and financial risks/limits. In such literature, the feasibility of water payments was supported by evidence that consumers are willing to pay for an improved service, as long as tariff structures reflect consumer needs and service provided (quality, quantity, accessibility, affordability, and reliability) (Cardone and Fonsceca, 2003). This even applies to the poor who are assumed to value a reliable supply much more than they value an unreliable water supply (World Bank Water Demand Research, 1993). Furthermore, poor customers have already proven their willingness to pay as they often rely on private profit-oriented providers which operate based on full cost recovery (see Rusca and Schwartz, 2018).

When participants were asked to choose which point of intervention, most of them agreed to the need to use the price to control behaviour. This is illustrated in one of the following quotes,

> "*The solution remains to use prices, I am certain if we, for example, half prices in the wet seasons, users will be more inclined to use safe water from the kiosks*". Participant CRG2

The impact of using prices to control behaviour is shown in Figure 7.18 below

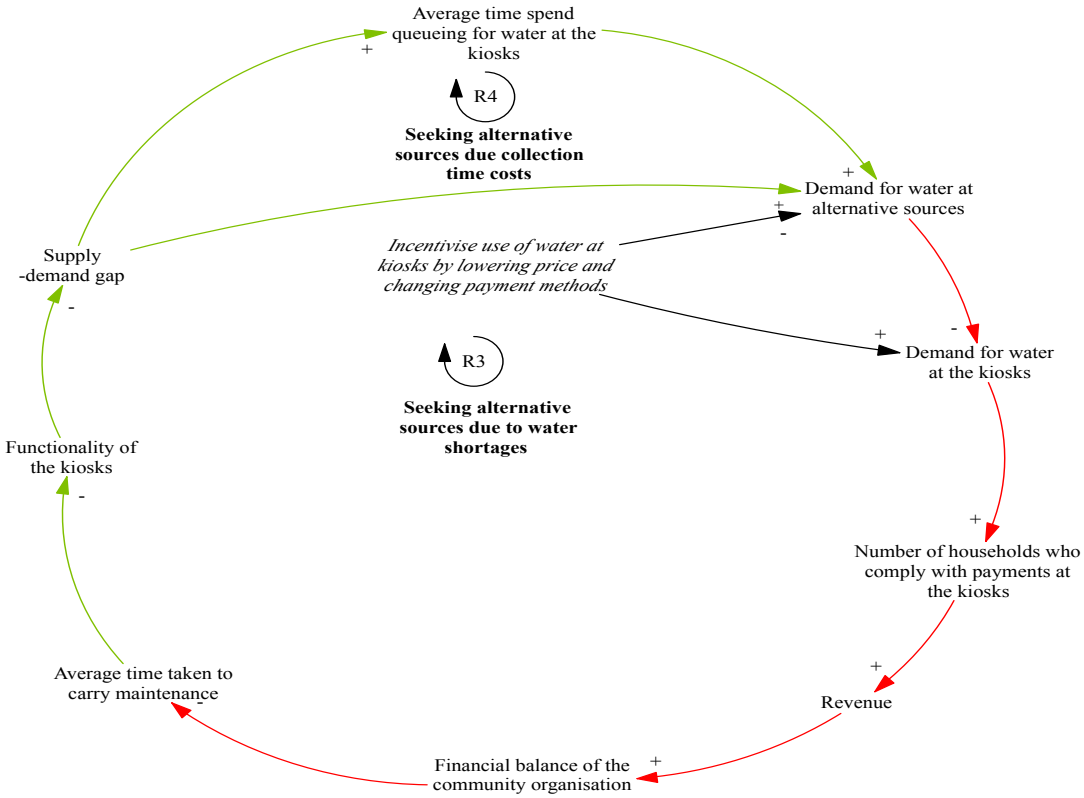


Figure 7. 18: Feedback loops showing an intervention to the seeking alternative sources structures

The solution is supported by a study by Ingram and Thomson (2022) which promotes a strategy known as weather-dependent pricing. Weather-dependent pricing involves reducing volumetric prices at water ATMs (or at kiosks in this study) during the rainy season to incentivise users to keep collecting (demanding) water at improved groundwater sources (Ingram and Thomson, 2022). This can be done for the whole season through a seasonal block or during periods of heavy rainfall through responsive pricing (see Ingram and Thomson, 2022). Not only does this improve the well-being of users by incentivising the use of clean groundwater, but it will also improve demand and ensure revenue continues to flow during this period. However, it is important to note that there is evidence that even a lower tariff reduce use of clean water (Null *et al.*, 2012). Furthermore, as mentioned previously tariffs reduce the uptake of public health interventions including drinking water (Yates, 2009). In addition to the above, tariffs are contrary to other sectors such as health and education which offer services for free (Chowns, 2015). Furthermore, there exist other social norms such as class struggles which are ranked higher than paying for water (Brown and Van Den Broek, 2020) as such it's not certain that

lowering the price will supersede these socially ingrained norms. These contrary findings to the usefulness of tariffs perhaps speak to the argument by Participant CRN3 that it seems community financing (making users pay for water) is not working but leading people to use alternative unimproved water sources.

In contrary to using lower prices as a reward for using water at the kiosks during wet seasons, Contzen and Marks (2018) argue that the use of rewards or punishments as structural solutions has failed to deal with the social dilemmas, where the social dilemma refers to the decision by users of either using alternative sources which have short term benefits (cheaper, reduce water collection time) during the wet season or sticking to using kiosks even during the wet season which provide safe water throughout the year thus maintaining its operational sustainability (long term benefits). They argue that the social dilemma structure faced by the kiosks model can be changed by fostering collective psychological ownership. Drawing from the work of Pierce and Jussila (2010), Contzen and Marks (2018, p. 45) define collective psychological ownership as "*the collectively held sense (feeling) [among group members] that there is an 'us,' and a collective sense that the target of ownership (or a piece of that target) is collective 'ours'*". Their study investigated the potential of collective psychology ownership (collective sense of ownership) in increasing collective behaviour on resource use (collective regular use at water kiosks) in Kenya. Their study found that, the more people felt they owned the kiosks, the better they valued the quality, were more willing to make sacrifices on collection time, the more they felt social pressure from their relatives also using the kiosks and the more they consumed water from the kiosks (Contzen and Marks, 2018).

All the above-named recommended solutions are meant to increase water use at kiosks thus ensuring that R3 and R4 work as a virtuous loop.

Proposition vi: Demand funds maintenance (R8)

Feedback loop R8 shown in Figure 7.19 below was presented to participants from both schemes. All the participants unanimously agreed on the variable names, the contents the loops and the resulting proposition.

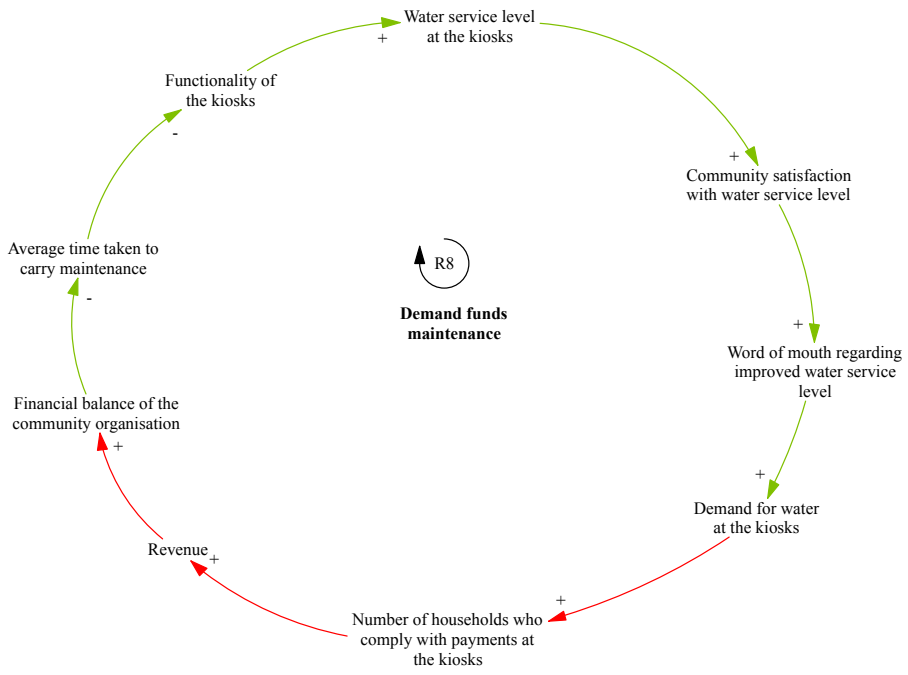


Figure 7. 19: Feedback loop showing how demand funds maintenance

All participants agreed that the money collected from both schemes for drinking purposes is not enough to cover the full life cycle cost of providing the water service over time. The participants from Chiringa, said,

"*It is clear that the payments collected are far from the target, however, if compliance was high, the figures could have improved. I mean a little more money is better, even though with 100 per cent compliance they still need some help*". Participant CRG1

The participants from Chimbiya where payments were comparatively high said,

"*Even with good compliance numbers, when there are major repairs, we have to look into our coffers, as mentioned earlier we have money in our accounts to cover these costs for now, but for sustainability, more is needed*". Participant CMG2

Participants in Chimbiya offered to invest in the productive uses of water as a solution to supplement the financial balance at Chimbiya. Participants were quoted saying,

"*With the project in Chimbiya, we are planning to encourage gardening and selling of packaged water in the hope that once we align water to livelihoods, more and more people can use the kiosks taps*". Participant CMG1

"*I think as said by my colleague, this will work since alternative sources are not reliable here. As a hydrological officer, I do however worry about the water tables in the Chimbiya area*." Participant CMG2

The productive uses of water or multiple uses of the water system as often referred to in rural water literature is well established in the literature (Renwick *et al.*, 2007; Kativhu *et al.*, 2021). The approach is based on the idea that water users are likely to pay for a water service that is critical for their livelihoods (see Foster and Hope, 2016). This approach aligns with most water policies in SSA including in Zimbabwe National Water Policy of 2013, which recommends integrating rural WASH programs with productive uses of water, such as irrigation, to raise funds for water point management.

Appraisal of the approach has been highlighted by Hall, Vince and van Houweling (2015) who investigated whether additional income from providing water for productive uses such as gardening, or livestock rearing is greater than the costs of upgrading a water system. In particular, the study sought to answer the question of whether additional water provided can theoretically pay for itself. The contribution of the study was a methodology that could assess this inquiry using an Incremental income cost analysis. Data were collected in the northern and central regions of rural Senegal using 1860 household surveys, 15 focus groups and 137 interviews on 47 water systems and information for costs on upgrading water systems are based on EPANET models that consider water availability in Senegal. One of the findings of the study was that out of the 47 water systems, only six had a negative annual benefit when the variable productive income was used. This outcome indicated that in the remaining systems the incremental income from productive water use was more than the cost of upgrading the water systems over 10 years, thus water could theoretically pay for water (Hall, Vance and van Houweling, 2015). As detailed above, this study implies that people are likely going to pay for a water service that is critical for their livelihoods (Foster and Hope, 2016), especially considering that between 60-70 per cent of rural households have an asset that depends on water (Renwick *et al.*, 2007).

The success of the approach (productive uses of water) has been achieved in countries such as Zimbabwe at rural communal gardens. Kativhu *et al*. (2021) compared the sustainability of water points used for domestic purposes only versus those used for multiple purposes (productive uses), such as community gardening, in Zimbabwe. Their findings revealed that households in areas where water points were used for gardening contributed significantly (financially) towards O&M activities, with 81 per cent of them using the money generated from selling their produce to make monthly payments. This resulted in a significant reduction in downtime, with water points used for multiple purposes averaging only one week of downtime compared to two months for those used for domestic purposes only. However, the approach comes with various risks. One of the risks has to do with issue conflicts (Kativhu *et al.*, 2021). Kativhu *et al*. (2021) found conflicts between garden farmers and non-gardening farmers, with the latter refusing to pay for access to water and blaming garden farmers for frequent breakdowns due to the high usage of the water point. Furthermore, during dry seasons, conflicts often arose between garden farmers and community members due to the former's continuous watering of their produce, which deprived the latter of water for domestic purposes.

In Chiringa, participants suggested external funds as a solution to low financial balance. One of the participants responded,

I think what we need here are external funds, this project is not sustainable from payments by household users alone. Participant CRG1

"*We are a poor country and do not have the resources to provide water on our own. Our people are poor and cannot afford to pay to access water sustainably, the only solution I see is external funding from donor governments. I would also want to say companies are operating here from China and other countries, maybe it's time we make them cover these costs, they are busy extracting resources and damaging the environment, yet they do not provide basic service to the people*". Participant CRG2

The idea of multinational companies investing in the provision of social services in areas they operate is known as impact investing. Impact investing involves investing with the intention of generating social and environmental impact alongside financial return (Impact Investing for Water, 2018). While some companies choose to embark on impact investing voluntarily,

governments can also make it a prerequisite for operation, particularly for extractive companies.

The solution of additional coordinated funding beyond current investment was also suggested by participants in the other group made up of the NGO/donor in Chiringa where all except one of the participants agreed to the issue of external funding as a panacea to financial sustainability. The participant who was cautious about this recommendation said,

"*Look we have been covering costs at Chiringa for a long time, when can we say it's enough? As we all know we have provided lots of money together with the Scottish Government to other projects as well, yet these projects are not sustainable. In my opinion, I do not think adding more money is the solution. What I think should be done is coordinated sort of funding which involves all the stakeholders where we can discuss how much and how long such funding will last. We need an end date to avoid the dependency of the people on funding. If you read history, you will know about the Marshall Plan where money was provided for a period. This for me creates accountability*". Participant CRN2

This recommendation was rejected by other participants who argued that the dynamics are different in the African context since such an approach was done in Europe which had better governance and was at the macroeconomic policy level. It is worth noting that Participant CRN2 suggestion aligns with aid critic development literature which is critical about aid and its effects on development in Africa (see Moyo, 2009).

The recommended solutions of the productive use of water and additional coordinated funding beyond current investment are shown in Figure 7.20 below. The productive use of water and additional coordinated funding beyond current investment all increase the financial balance of the community organisation, thus making money available for maintenance (if not misused) and ensuring that loop R8 works as a virtuous loop with all concepts increasing over time.

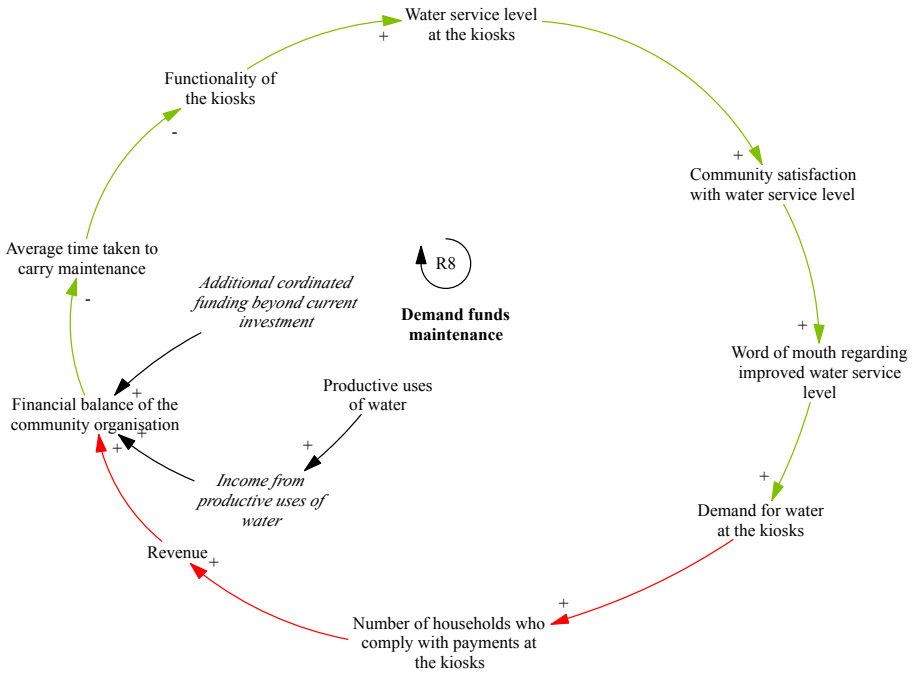


Figure 7. 20: Feedback loop showing interventions to the demand funds maintenance structure

Other recommendations in the literature include the need to increase demand by providing users with water service attributes they value and are willing to pay for (Bhatnagar *et al.*, 2017; Hope and Ballon, 2021). In the previously mentioned study exploring the potential of safe water enterprise by Bhatnager *et al.* (2017), a value asymmetry was found where the business model of these enterprises is based on the provision of the value of clean water (water quality attribute), yet most of the customers were found to value convenience rather than quality. In other water provision models, similar trade-offs have been found (see Shisanya, 2005; Hanatani and Fuse, 2012; Hope and Ballon, 2021). A study by Shisanya (2005) in Kakamega district in Kenya investigated the accessibility to domestic water in terms of distance, time, rate at which households are willing to pay for the water from various sources and the different distances from home. Data was collected from documentation and 300 respondents using key informant interviews, focus groups and questionnaires. Analysis was done through descriptive and inferential statistics. The study found that households spend on average two hours collecting water. The reason was not entirely because of scarcity but a function of the amount of water used, the number of households using a particular water point, the nature of the terrain, mode of transport, distance to the water point and the nature of the water point. Furthermore, the study found respondents to be willing to pay for water based on the type of water source (taps

preferred) and based on its closeness to the household. The reason why a household might choose a closer water point was found to do with social externalities obtained by reduced time taken, energy used, ill health, and the general opportunity cost of collecting water that is closer (Shisanya, 2005). Another study in Nigeria found that 75 per cent are willing to pay for a better quantity and 57 per cent for better quality (Ogunniyi, Sanusi and Ezekiel, 2011). The challenge with this recommendation is it does not consider the dynamics of water service attributes. For instance, if users value closeness of kiosks, what happens when demand increases during a pandemic or dry seasons and they start to spend a lot of time queueing for water, or what happens when demand is low during the rainy season when they switch to harvesting water.

7.5 Analysis of the Chapter

The study has found the following structures to determine payment behaviours at water kiosks. These are i) trust in the community organisation with funds and trust amongst households that others will reciprocate payments ii) sense of ownership iii) conflicts between community organisation and households iv) interventions by funders v) coping strategies that users employ when faced with a changing water service level. These structures, proposed interventions (in italics) and unintended consequences (blue links) are shown in Figure 7. 21 below.

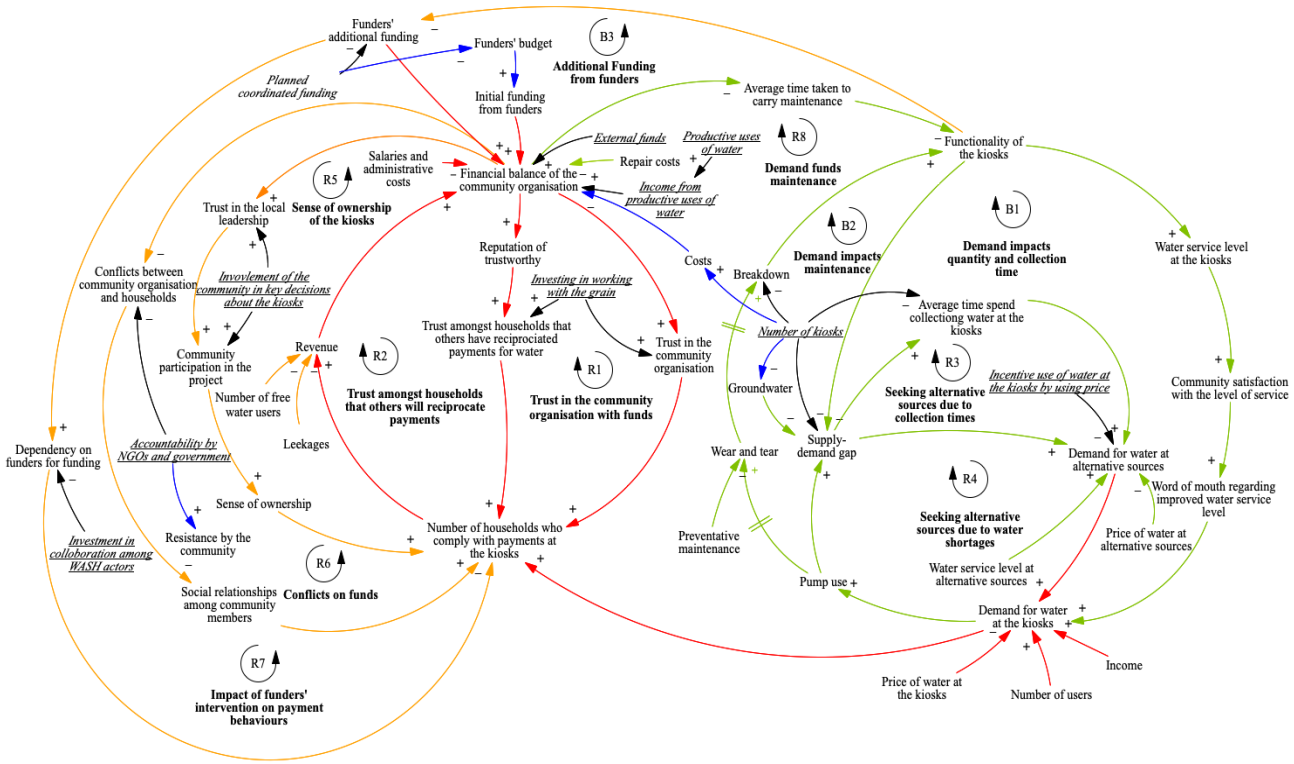


Figure 7. 21: CLD showing validated dynamics of payment behaviours model with proposed interventions (variables in italics) resulting in desired changes in key variables and facilitating the current dynamic behaviour of the individual loops to be desirable

The proposed interventions, their desired change and unintended consequences are summarised in Table 7.6 below.

Table 7. 6: Showing summary of proposed interventions

Feedback Loop	**Proposed Intervention**	**Desired Change**	**Potential unintended consequence**	**Additional Interventions from the Literature**
Trust in the community organisation with funds (R1) and trust that others will reciprocate payments (R2).	Investing in working with the grain.	Increasing trust in the community organisations by households that their money is safe and used for intended purposes. Increasing trust amongst households that others are also paying and not free riding. In the case of a vicious cycle, the intended purpose of these interventions is to change the R1 and R2 to operate in a desirable direction. These interventions align with the leverage point 7 on the leverage Points framework by Meadows (2008). Leverage point 7 focuses weakening vicious loops and changing these loops to virtuous (Meadows, 2008).	Expensive leading to cuts in other expenditures critical for sustainable water services.	Delegated management models (Nzengya, 2015). Removal of local committees (Chowns, 2015). Back to government control (Chowns, 2015).

Sense of ownership (R5).	Involvement of the community in key decisions about the kiosks.	To improve community participation in the project. The intention of involving the community in key decisions is to change R5 from operating as a vicious loop to a virtuous loop, where the current dynamic behaviour created by the loop operates in a desirable direction. This aligns with the leverage point 7 on the leverage Points framework by Meadows (2008).	Increased costs	
Conflict on funds (R6).	Accountability by NGOs and government.	To ensure that funds are collected and used appropriately by the community organisations. This changes the loop from being vicious to virtuous. Such a change aligns with the leverage point 7 on the leverage Points framework by Meadows (2008).	Resistance by the community to outside interference (Brown and Van Den Brook, 2020).	

Impact of funders' intervention on payment behaviours (R7, B3).	Planned coordinated funding.	Reduce duplication of funding by different interested organisations (R7) and dependency by users (B3). Planned coordinated funding acts to reduce the issue of dependency (aligns with leverage point 7) and to balance lack of funds for maintenance. (aligns with leverage point 8 where a leverage is found by strengthening of the balancing loop to keep the desired stock near or at its goal). As such, additional funds can be provided to avoid the deficit from community funds needed for maintenance.	Increased costs and time-consuming.	
Demand impacts quantity (B1) and Demand impacts maintenance (B2).	Increasing the number of kiosks.	Increase the supply of water to meet demand and convenience. A balancing loop is usually a good thing to the system. The most notable leverage point is to strengthen the balancing loop to ensure sustainability. However, B1 and B2 are happening under reduced demand, hence resulting in shortages. Therefore, increasing the number of kiosks to provide cushion in demand was recommended by participants in the confidence building	Increased costs. Depletes stock of groundwater. Potential financial complexity.	

		process. This leverage point aligns with the leverage point number 11 on the Leverage Points framework by Meadows (2008). In leverage point number 11 the goal is to increase the capacity of the buffer (can be a resource). In this study, the aim of the intervention is to provide cushion in the quantity of water that users can have.		
Seeking alternative sources due to water shortages (R4) and Seeking alternative sources due to time costs (R4).	Incentivise the use of water at the kiosks by lowering prices and changing payment methods.	Increase water use at the kiosks, especially during wet seasons when the alternative source is abundant. Changing the price (rule on agreed tariff) to incentivize water use aligns with the leverage point 5 from the Leverage points framework by Meadows (2008). Under the leverage point number 5, rules of the system determine behaviour. It is the rules that incentivise, punish or constrain users in a system. In this study the rule of changing the price to incentivise use of clean and safe water, instead of free rainwater which is subject to contamination is meant to change behaviour in water use (see Ingram and Thomson, 2022).	Restoring the price to the agreed point might be met with resistance.	Collective psychological ownership (Contzen and Marks, 2018).

Demand funds maintenance (R8).	Additional coordinated funding. Productive uses of water.	Increase the financial balance of the community organisation. Additional coordinated funding and productive uses of water are all parameters that increase the stock of funds to be used for O&M. This leverage point aligns with the leverage point number 12 from the Leverage points framework by Meadows (2008) which focuses on numbers, that is constants and parameters that change the size of the stock (Meadows, 2008). However, it should be noted that Meadows (2008) highlights that changing parameters rarely result in significant change over time. As mentioned earlier, adding more funding can result in dependency. Furthermore, it can result in more corruption.	Increase in dependency Increase in corruption.	Provide users with water service attributes they value and are willing to pay for (Hope and Ballon, 2019)

The use of CLDs to identify leverage points is subject to debate. They have limitations discussed in Chapter 3 where the exact impact on behaviour over time cannot be identified using a qualitative diagram (see Schaffernicht, 2007) with simulation preferred. However, in this study the focus is on individual loops (structures). Other benefits of using CLDs are explained in detail in Chapter 3.

7.6 Summary of the Chapter

The chapter built confidence in the feedback loops using interviews with selected participants. The participants also proposed interventions after observing the structures. The validated model and suggested leverage points are shown in Figure 7.21.

Chapter 8: Discussion

8.1 Introduction

This chapter presents a discussion of the research. Chapter 5 provides financial information from the two comparative cases, Chapter 6, tests, amends, and extends feedback loops and propositions from the model developed in Chapter 3, and in Chapter 7, selected participants of NGOs and government were involved in group sessions to validate the feedback loops and propositions. This chapter compares research findings from the previously mentioned chapters with existing literature. Research findings are also evaluated in relation to the research questions.

8.2 Research Findings

Proposition i): Trust in the community organisation with funds (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.

Trust in community organisation with funds (R1) and trust that other community members will reciprocate (R2) were found to determine payment behaviours at communal water kiosks. As mentioned in Chapters 6 and 7, the loops in Chiringa represent a vicious cycle (reinforcing feedback loop where the current dynamic behaviour created by the loop is undesirable) while the loops in Chimbiya represent virtuous cycles (reinforcing feedback loop where the current dynamic behaviour created by the loop is desirable).

The impact of trust in collective action is widely reported in the broader collective action literature (Ostrom, 2009). In rural water supply literature, the influence of trust in the community organisation on water payments (R1) was laid bare by the work of Chowns (2015). Other studies where issues of trust with the community organisation were raised include the work by Van Den Broek and Brown (2015), where users blamed the community organisation members of misusing money each time there were non-functioning water points. Studies by Chowns (2015) and Van Den Broek and Brown (2015) shows the importance of trust in any model that involves collective action. Household users need to trust their leaders so that when they contribute to a scheme, they feel reassured that their finances are going to be safe. They

want to see accountability and transparency. For instance, as mentioned in Chapter 6, transparency and accountability are enforced in Chimbiya by the NGO Water Mission through auditing of books. Household users also want to see action taken against those in power if they misappropriate funds. For instance, as mentioned in Chapter 6, a chief in Chiringa used his position to use funds for his own benefit over a long period of time. The matter was resolved in 2022, and the leader was reprimanded, however there is evidence that he is still partly involved with the scheme due to his position, reflecting the issues of power dynamics in collective action.

With regards to trust that other community members will reciprocate payments (R2), the relationship between trust that others will pay, and water payments was shown in the work of Hanatani and Fuse (2012). The findings by Hanatani and Fuse (2012) shows how people's behaviour in collective action is interdependent on other's actions. Household users will not want to contribute to a collective benefit when they know others are not also contributing. As mentioned previously in the study by Contzen and Marks (2018) in Chapter 7, individual households sharing a communal water kiosk are faced with social dilemmas. This social dilemma emanates from the choices which they are faced with. They can either make decisions based on short term or long-term interest. The short-term interest/ benefit involves using alternative sources especially during the rainy season where they can harvest water and use other alternative sources. The individual benefit in this case is brought by reduced collection time and access to cheaper water (only cost of initial infrastructure to harvest water accounted for). On the other hand, the long-term interest is continuous use of clean safe water at the kiosks which are operated throughout the year and contributing to their operational sustainability (through payments for cost recovery). If most individual households choose the short-term interest, this will affect the operational sustainability of the kiosks (less revenue collected). The ideal situation is for users to choose long term interests with collective benefits. However, for household to choose this option (long term interests) they need to trust that others are also paying, since the outcome of the operational sustainability of the kiosks depends on meeting cost recovery targets at affordable tariffs. If a critical mass (the minimum number of participants needed to maintain collective behaviours) of individuals consistently contributing to the water points is met, the water point is highly likely to be operational over time (Foster, 2017). The study by Forster (2017) has identified this point to be around 75 per cent subject to the payment method and that rate at which additional revenues are used. The benefits of

reaching the critical mass point include the pooling of payments to cover high fixed and variable costs and lower tariff payment prices.

When NGOs and government officials who participated in the validation group sessions were asked to suggest points of intervention for this issue, they suggested investing in working with the grain, where efforts must be made to identify influential leaders that influence behaviour in the community. The impact of such an intervention is shown in Chapter 7 Figure 7.4. This is based on the belief that they possess referent and authoritative power that can be harnessed to influence others on water payments. As mentioned in Chapter 7 the idea of working with the grain can be aligned to the notion of CLTS in sanitation literature, where identification and training of these natural leaders leads to reduction in open defecation (see Crocker *et al*., 2016). Arguments can also be made for ensuring general collective efficacy by understanding community dynamics before a solution (working with the grain) is implemented. The desired change from this intervention would be to establish trust that the funds collected by community organisations will be safe through the oversight of these individual(s) and that their influence can influence others to reciprocate payments.

Proposition ii): Levels of sense of ownership drive payment behaviours (R5)

The study found a sense of ownership to drive payments. In Chiringa where the level of sense of ownership was low, water payments were also low. On the contrary, in Chimbiya where the level of sense of ownership was high water payments were higher compared to Chiringa. While the impact of a sense of ownership on collective activities is widely reported concerning community participation in rural water systems (Marks and Davis, 2012;Kelly *et al.*, 2017), it does not always lead to willingness to pay (Harvey and Reed, 2017). For instance, the study by Harvey and Reed (2007) in Zambia mentioned in Chapter 2 found an inverse relationship between a high sense of ownership and the operational performance of the scheme (including water payments), thus casting doubt on the notion that a sense of ownership increases willingness to pay. However, Harvey and Reed (2007) did not generalise their findings but admitted that a sense of ownership can lead to a willingness to pay in some cases. They did not give a reason for this admission nor the circumstance upon which it occurs. Nevertheless, this admission by Harvey and Reed (2007), aligns with the finding in this work that levels of sense of ownership determine payment behaviours at communal water kiosks. As found from the empirical data, a sense of ownership is instilled at the start of the project and is continuously

installed through the participation of households in collective decision-making. Therefore, in any community-based decentralisation water provision model, a case can be made for the participation of beneficiaries in key decisions relating to the success of the projects. This participation should include women who are normally not included in decision-making in highly patriarchal societies yet are the main users of the water system (Boateng and Kendie, 2015).

When NGOs and government participants who participated in the validation group sessions were asked to suggest points of intervention to this issue, they suggested the involvement of the community in key decisions about the kiosks. The impact of such an intervention is shown in Chapter 7 Figure 7.6. By this they meant that communities must also be involved in the initial stage of the project to determine if the kiosks model is their choice in the first place as done in Chimbiya. Lack of community engagement in such issues leads to WASH failures (Barrington *et al.*, 2021; Chinyama *et al.*, 2021; Luwe *et al.*, 2021). As mentioned in Chapter 7, inadequate community engagement leads to implementation of projects that might be unsuitable with context (Barrington *et al*., 2021). For instance, use of solar systems in Zimbabwe was found to be beyond their reach of community users in terms of costs (see Chinyama *et al*., 2021) and not consulting communities on the level of service they demand might result in low participation in Malawi (Luwe *et al.*, 2021). Another important element of participation to consider is to determine whether communities buy in to the project or have the project thrust upon them. As mentioned earlier, the two projects started differently. In Chiringa, it is the NGO Care and Share that approached the donors (NGO-led), while in Chimbiya where there is comparable success, it is the community that approached the water office (community-led)

Proposition iii): Conflicts on funds between community organisation members and household users drive payment behaviours (R6).

The study found conflicts on funds between community organisation members and household users to impede payments in Chiringa. Such conflicts were not found in Chimbiya because of accountability and transparency instilled by the NGO in the handling of books by the community organisation members. In Chiringa, the disbanded MWC who were no longer part of the committee (except the two that joined the WUA) had trust issues with the way the WUAs were running the scheme. As such they had infiltrated the belief that the new committee

(WUAs) were misappropriating funds, which became a common reason not to contribute towards the kiosks among the general users. In a related study, conflicts were found between disbanded WUC members and the caretaker in the study by Brown and Van Den Broek (2020) in Uganda. These conflicts arose mainly because the disbanded WUC members were no longer benefitting from not paying their contributions, and syphoning money for their personnel use. Therefore, they accused the appointed caretakers of misusing their funds, creating mistrust and jealousy which led to non-payment. In the same study, caretakers and water operators faced physical violence from some users if they attempted to enforce sanctions on non-payers. They also feared witchcraft and being hated by the community. Other studies such as Olaerts *et al*. (2019) found intra-conflicts between community organisation members to influence water payments. The implication of these findings relates to the risks of social divisions with regards to how funds are collected and managed by the community organisations (Olaerts *et al.*, 2019; Brown and Van Den Broek, 2020). Conflicts become inherent wherever there is no accountability and transparency.

When NGOs and government representatives who participated in the validation group sessions were asked to suggest points of intervention to this issue, they suggested increasing the accountability of the community organisation by NGOs and government. This is meant to ensure that funds are collected and used for the intended purposes by the community organisations. However, the role of NGOs and donors in community organisations is up for debate. For instance, research done by Luwe *at al*. (2021) in Malawi advocate for roles such as policy or direct involvement with the community to be left for national bodies such as WESNET and not individual NGOs. The impact of the intervention of increasing the accountability of the community organisation by NGOs and government is shown in Chapter 7 Figure 7.9. It is critical to note that because of the project mentality associated with NGOs (Walters and Javernick-Will, 2015) and that NGOs are not permanent, a case can be made for this accountability to be taken by government officials such as DWOs.

Proposition iv): Interventions by Funders drive payment behaviours (R7, B3)

The study found interventions by funders to drive payment behaviours. For instance, in Chiringa the funder always responds with money or equipment in the event of even minor breakdowns such as small leaks. This is a situation that led to a sense of entitlement and dependence by the community users. In 2022, when there was no financial intervention by the

NGO, only one kiosk was in full operation as the community did not have money to fix the others. Previous research in WASH found that collective action (in this study collective payments) is hindered in areas where there are prior subsidies (Kar and Chambers, 2008). As mentioned in Chapter 6, The reason for this continued intervention during the early years of the project is in line with project mentality were NGOs do whatever is possible to ensure the project is rendered a success in line with their thresholds. For instance if the water points function for two years, that can be considered a success by an NGO, thus they provide as much help as possible throughout this time without taking into account the unintended consequence such as dependency, or perceptions among communities that the project is a short term intervention and after the project is completed they get back to the WASH situation they were in before (see Luwe *et al*., 2021). The focus of NGOs is how many projects have been achieved so far, thus, this affects long-term thinking and sustainable outcomes. Due to the need to have as many projects as possible, most NGOs bypass or rush through existing structures and frameworks that are meant to provide sustainable and maintained services in the long term (Barrington *et al.*, 2021; Luwe *et al.*, 2021).

On the contrary, in Chimbiya the NGO continually ensures accountability and only supports major breakdowns which requires funding beyond what can be collected using money from tariffs. This funding is coordinated with the SADC GMI which is the main funder of the project and government officials. This shows long-term thinking at this scheme where the focus is on the sustainability of the project.

The recommended intervention that came from the group sessions participants in this Chapter 7 was to ensure coordinated funding to avoid confusion and ensure that the objective of sustainability of the water service is met. The impact of that intervention is shown in Chapter 7 Figure 7.12. At the end of the day, the goal is to ensure that users have access to sustainable water services which they can afford. However, bringing everyone together and aligning goals is time-consuming and expensive and ways can be found to reduce costs while allowing for coordination between organisations. These may include, among others, a shift from in person meetings to use of technology such as zoom for selected meetings amongst development partners, government officials and the private sector.

Proposition v): Payment for water is driven by the coping strategies (R3, R4) that users employ when faced with a changing water service level (B1, B2)

The study found water payments to be driven by the coping strategies that users employ when the level of water service changes. As users compete for water services, water service attributes (collection time, quantity of water and functionality) change with demand. Users respond to these changes by seeking alternative sources of water, thus affecting the amount of revenue that can be collected at the kiosks. As mentioned in Chapter 7, from a systems perspective, the balancing loops (B1, B2) can support sustainability as they act to protect outcomes such as depletion of groundwater, however, the level where the balancing loop stabilises in this case is insufficient to meet the required demand.

When selected NGO/Funder and government participants in group sessions were asked to suggest points of intervention to these loops, they advocated for strategies that increase supply such as an increase in the number of kiosks (see Chapter 7 Figure 7.16). With regards to discouraging users from using alternative sources that might be unimproved, NGO/Funder and government participants advocated for strategies such as lowering prices and changing payment methods to incentivise users to trade the costs of high collection time and the lower cost of using free water during the rainy season for use of improved services at the kiosks. The impact of incentivising use of water by lowering price and changing payment methods is shown in Chapter 7 Figure 7.18. The nexus between demand, changing water services and coping strategies (use of alternative sources) is supported by literature mentioned previously in Chapters 2 and 6. These include studies by Adams (2018) in Malawi and Mofwe, Kapulu and Tembo (2014) in Zambia where, an increase in demand led to competition for water services attributes (either high collection time, low quantity, functionality issues) and ultimately led to users using alternative unimproved sources. The broader implication is that water consumption by one person reduces consumption by the other (rivalry) as users compete for water services. As they compete, water service attributes change (increase and decrease), as users decide either to bear the costs of high collection time, have less quantity of water or choose to use an alternative source. The use of an alternative source depends on its attributes such as whether it is located nearby (see Olaerts *et al*., 2019) or during the rainy season users have abundant free water that they can harvest from their rooftops (Ingram and Thomson, 2022). It is also dependent on the water quality of the alternative source (Hope *et al*., 2020)

Proposition vi): Demand funds maintenance (R8)

The feedback loop (R8) highlights the impact of the previously mentioned structures on water payments, revenue and ultimately functionality of the kiosks. This study found that the money collected from both schemes was not enough for cost recovery. However, payments were better at Chimbiya as compared to Chiringa. The failure of communities to raise enough funds to cover at least operations and maintenance costs is widely reported in rural water supply literature (Harvey, 2007; Van Den Broek and Brown, 2015; Brown and Van Den Broek, 2020). To clearly show the issue, much of the reporting is done on handpumps (Carter, Harvey and Casey, 2010; Foster and Hope, 2016) which one might argue can be a less attractive water point compared to communal water kiosks. For instance, research undertaken in five SSA countries on 92 594 handpumps reveals limited collection of revenue (Carter, Harvey and Case, 2010) and non-compliance with payments by WPC (Foster and Hope, 2016). Even so, in other water point types (models) such as kiosks which have better institutional arrangements (such as efficient payment models which are assumed to cater for free riding and in some cases use of prepaid technologies) collected funds are still insufficient for cost recovery (see Komaketch, Kwezi and Ali, 2020). This study's findings show that various existing collective action-induced structures are present in any decentralised models that are shared by the community. Another reason is that water is priced below its economic value due to political reasons (Fonseca and Njiru, 2003)

Indeed, some communities will perform worse in payments, revenue collection and functionality such as in Chiringa and some communities will be better such as in Chimbiya, but in most of the cases full cost recovery is far from being achieved. This issue is laid bear by, Komaketch, Kwezi and Ali (2020) in their study in Tanzania on communal water kiosks that used prepaid technologies. Their study found that users were not able to raise sufficient funds for cost recovery. Even with the improvements in revenue collection technologies such as the use of prepaid technologies that improve transparency and remove money from the hands of community organisation members, cost recovery was still an issue. Komaketch, Kwezi and Ali (2020) argue that the costs of maintaining infrastructure are way beyond what can be collected.

Various points of intervention were recommended by participants in the validation group sessions. These recommendations include the productive use of water (also known as multiple water use systems) and additional coordinated funding beyond current investment. Productive uses of water or multiple water use system is an approach where income from water related projects is used to cover maintenance of the water point (Kativhu *et al*., 2021). For instance,

some of the income from gardening where the water point has been used to water the crops is ploughed back into maintenance of that water point. With respect to the recommendation of additional coordinated funding beyond current investment, questions need to be raised on the models of funding that can be used, for instance, should this involve donors funding governments and making governments accountable or continuing with direct funding to communities under the government's existing frameworks. The answer to these questions remains unclear, but what is clear is that the current model of funding is not working. The impact of productive uses of water and additional coordinated funding beyond current investment are shown in Chapter 7 Figure 7.20.

8.3 Research Process and Questions

The research takes a systems approach, facilitates theory development using case study research (Kopainsky and Luna-Reyes, 2008) and has practical implications. This empirical research has been explanatory in its nature (Yin, 2018), adopting a critical realism perspective and using a multiple case study approach (Yin, 2018). To further enrich our findings and ensure methodological rigour various innovations have been implemented such as deducing propositions using CLDs built from the literature and testing the propositions using empirical data. This study's research questions have been answered as follows:

1) *What factors influence payment for water?*

This research question was answered using literature from rural water supply in SSA. This strand of literature argues that the challenge of inconsistent payments at communal water points is a collective action problem and employs various collective action and CPR theories to identify factors that influence collective water payments (see Hanatani and Fuse, 2012; Naiga and Panker, 2014; Koehler, Thomson and Hope, 2015); Forster and Hope, 2016). The factors identified are presented in Table 2.3 in Chapter 2.

2) *What are the attributes of drinking water services at water kiosks?*

This research question was answered using literature from rural water supply in SSA. The strand of literature employed identifies attributes of drinking water services that people value

(see WHO/UNICEF, 2017), the perceptions of people towards these attributes (Kapulu and Tembo, 2014; Kituku, Gichuhi and Nzengya, 2020; Cherunya, Janezic and Leunchner, 2015) and has measured some of these attributes such as water quality to determine if they meet international standards (Opryszko *et al*., 2013). The attributes of drinking water services are presented in Table 2.5 in Chapter 2.

3) *How can the dynamic interaction between factors that influence payment for water and attributes of drinking water services be captured and represented?*

This research question arises from a research gap in the literature. After the identification of the factors that influence payment for water in one strand of literature and the identification of attributes of drinking water services in another, a research gap was identified. The literature strands are fragmented in capturing and representing the dynamic interaction between factors that influence water payments and attributes of a drinking water service and how their interactions drive payment behaviours. This research question was answered by capturing relationships from the literature and representing them using CLDs (systems thinking tool) as recommended by rural water supply literature (see Walters and Javernick-Will, 2015; Libbey *et al*., 2022).

4) *Which propositions can be derived from the dynamic interaction between factors that influence payment for water and attributes of drinking water services?*

This research question arises as a need to identify specific areas of theoretical relevance from the CLDs. The study identified a gap where there is no theory or framework to explain payment behaviours at improved shared decentralised water service provision models in the literature. As such the study uses propositions for theory building and testing as recommended in case study research (see Yin, 2018) and SD (Kopainsky and Luna-Reyes, 2008). The study identified the following propositions which were found to have theoretical relevance,

i) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
ii) Payment behaviours are driven by the coping strategies (R3, R4, R5) that users employ when faced with a changing water service level (B1, B2, B3).
iii) Demand funds maintenance (R6).

The general insight from the propositions was that several structures drive/determine payment behaviours at water kiosks (or any decentralised model which involves collective action).

5) *Are the identified propositions on the dynamic interaction between factors that influence payment for water and attributes of drinking water services present in practice at selected case studies?*

This question arises as a need to ensure that the propositions identified in the literature are supported by empirical evidence. These propositions were tested using case study data from 45 semi-structured interviews and project documents following a methodology detailed in Chapter 4.

6) *Are there any other propositions that emerge from case studies at rural trading centres in Malawi that can provide more insights into the dynamic interaction between factors that influence payment for water and attributes of drinking water services*?

This question was answered by inductively developing emerging loops from the case study data from 45 semi-structured interviews and project documents following a methodology detailed in Chapter 4. The results from this process also resulted in other loops added inductively from the data. Following extending the CLDs, and the propositions based on the case studies, confidence was built in the CLDs through four group sessions with selected members of NGOs/donors and the government. The full list of the propositions from literature (tested and amended loops and resulting propositions) and those that emerged from data are shown below.

i) Trust in the community organisation with funds (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
ii) Level of sense of ownership drive payment behaviours (R5).
iii) Conflicts on funds between community organisation members and households drive payment behaviours (R6).
iv) Interventions by funders drive payment behaviours (R7, B3).
v) Payment behaviours are driven by the coping strategies that users employ (R3, R4) when faced with a changing water service level (B1, B2).
vi) Demand funds maintenance (R8).

7) *How can payment for water be sustained at communal water kiosks?*

This question arises as a need to identify points of intervention to improve payment outcomes. The question was answered by allowing selected NGOs and government participants to suggest points of intervention after being introduced to feedback loops and then shown the extended CLD. These proposed interventions and their unintended consequences are discussed in Chapter 7 and summarised in Table 7.6.

Addressing the overall research Question

The overall research question *why are household user payments at communal water kiosks in rural trading areas inconsistent*? is answered by the development of a payment behaviour dynamic model shown in Figure 7.21. The model shows various structures that drive payment behaviours. These structures are trust in the community organisation with funds, trust amongst households that others will reciprocate payments, sense of ownership, conflicts on funds between community organisation members and household users, interventions by funders and coping strategies that users employ when faced with a changing water service level. The structures exist in any shared decentralised model that involves collective action, thus explaining the inconsistent payment challenge.

8.4 Summary of the Chapter

The chapter compares research findings with existing literature. The chapter also shows how the study has answered the research questions that are presented in Chapter 3. The next chapter concludes the study.

Chapter 9: Conclusion

9.1 Introduction

This chapter concludes the thesis. The chapter begins by summarising the research. This is followed by details on the theoretical, methodological, and empirical contributions of the research in the field of rural water management. In addition, the policy implications are provided. Furthermore, the limitations of the study are highlighted. The chapter ends with opportunities for future research.

9.2 Research Summary

The problem of focus in this study is that of inconsistent payments by users at communal water kiosks in rural trading areas. The study employs the Explanation Analytic building Technique (Yin, 2018) where research is grounded in propositions. First the study identifies two strands of literature relevant to the problem. These strands of literature were found to be fragmented. The interaction of factors that influence payment for water and attributes of drinking water services have not been considered. Furthermore, there is no theory that provides insights into dynamic payment behaviours. This results in an incomplete understanding of payment behaviours leading to investments into models that are not sustainable, thus having a wider impact of the health and social well-being of users (especially women and children). To capture the interaction of factors and to provide insights into dynamic payment behaviours, the study uses CLDs. Propositions are derived from the feedback loops from the CLDs. These propositions were then tested, amended and extended using interviews and documents from case studies in Malawi. This led to a payment behaviour model which was further validated by a confidence building process with selected groups. The result is a complete validated model explaining and providing insights into dynamic payment behaviours. The model also highlights proposed interventions that result in desired changes in key variables, thus facilitating the dynamic behaviour of individual loops from vicious to virtuous (desirable). Such a model can be widely applied to any shared decentralised model that involves collective action.

9.3 Contributions

Considering the previously identified gaps in Chapters 2, this study makes theoretical, methodological, and empirical contributions.

9.3.1 Theoretical contributions

This study contributes to theory in the field of rural drinking water management in two ways explained below,

i. This study extends our understanding of the relationships between water payment and the water service level at improved decentralised water service models. To the best of the researcher's knowledge, this study is the first to consider the dynamic interaction of the factors that influence payment for water and attributes of drinking water service and, the resulting feedback mechanisms (structures) that drive payments.

ii. This study develops a model that represents and provides insights into dynamic payment behaviours at communal water kiosks. This model can be widely applied to any shared water supply institutional arrangement that involves collective action. The model shows that there are collective action inherent structures that determine payment behaviours at decentralised communal water provision systems. These structures operate in communities where poverty is a common challenge in Malawi and the wider SSA.

9.3.2 Methodological Contributions

From a methodological perspective, this study contributes to the field of rural drinking water management where system thinking tools in the form of CLDs are used for phenomena explanation (theory building and testing). The combination of the Explanation Building Analytic technique (case study approach) where analysis is grounded in the use of propositions and CLDs presents an innovative method that can improve theory building and testing in water management case study research.

9.3.3 Empirical Contributions

This research makes an empirical contribution by employing cases in rural Malawi, where the involvement of policymakers in the confidence-building process, enabled them to recognise and appreciate the benefits of systems thinking. This appreciation is illustrated in the following quote by the participants,

"*These pictures you have shown to us have assisted in identifying the impact of some of our decisions on outcomes*". Participant CRN3

"*I would say that the diagrams add visibility and provide us with an opportunity to suggests interventions that can improve financial and operational sustainability of the project*". Participant CMG1

Participants in the group sessions had the opportunity of learning what is and is not working from the cases in Malawi. Policymakers and practitioners were able to learn from the virtuous and vicious loops. This enabled them to identify ways in which virtuous loops can be maintained and interventions needed to facilitate a desired change in vicious loops so that they can operate as virtuous loops. They also had the opportunity to learn about the role of balancing loops in a system.

9.4 Practical and Policy Implications

Inconsistent water payments at communal water kiosks present a fundamental challenge to policymakers, funders, and water practitioners. However, this research and the dynamic payment behaviour model present several opportunities for these stakeholders. These opportunities are listed below,

i. To both policymakers and water practitioners, this research and dynamic payment behaviour model provides an understanding of the reality of financial sustainability for decentralised water provision in rural Africa, which is characterised by various collective action structures that drive payment outcomes. The structures are present in any model that involves community shared water points. Therefore, this research and

the dynamic payment behaviour model provided an opportunity for the named stakeholders (policymakers, funders, and water practitioners) to understand how these structures work.

ii. To funders and donor governments, this research provides insights into investment decisions on whether increased investment in communal water kiosks will elicit higher and more regular payments for their sustenance (see Hope and Ballon, 2019), thus having a wider implication on whether promoting more investment in decentralised water provision providing a basic water service is a sustainable option.

iii. To policymakers, the understanding of the dynamic nature of payment behaviours at communal water kiosks using CLDs provides them with an opportunity to devise holistic solutions to water issues (in this case financial sustainability) that are dynamic and systemic in nature (see Walters and Javernick-Will, 2015).

iv. This research and the model allow water practitioners to explore points of intervention into how user payments can be unlocked. This information can be used to attract alternative forms of sustainable funding where funders understand the system they are working in and can plan in line with the realities of rural water provision in Africa.

9.5 Recommendations

This study makes the following recommendations that are assumed to weaken some of the collective action structures found in the study,

Water-Fund Village Savings and Loan Associations

Village Savings and Loan Associations (VSLAs) are registered self-managed investment groups that offer members a safe place for their money, access to small loans and accrued interest (Namata, 2016;Marshall *et al.*, 2023). These VLSAs can be used to support water system sustainability using what are called Water Fund VLSAs (see Marshall *et al.*, 2023). Water fund VSLAs (herein VSLAs) have a separate account for savings and loans, and water fund (Marshall *et al.*, 2023) . In a study by Marshal *et al*. (2023), VSLAs (ten water points under VSLAs) contributed between 47 to 221 USD annually for the water point upkeep

compared to times before the introduction of VLSAs. In Malawi Chikwawa District, the NGO Water for People adapted the VSLAs model to operate as Borehole banks under the borehole banking concept (see Mbewe, 2018). Under the pilot in Chikwawa, borehole banking has increased funds for maintenance and functionality rates from 64 per cent in 2015 to 94 per cent in 2017. In one of the water points in Chikwawa, 1,641 USD has been accumulated from 2015 to 2017. The average savings over 159 water points under the borehole banking system is 72,29 USD compared to 7,57 USD for water points without borehole bank. Both models employ trained personal (groups) to manage funds rather than the traditional community organisations. VLSAs weaken vicious loops found in the study in the following ways,

i. First, they can improve trust in the use of funds by replacing voluntary community organisations which are found to be ineffective with respect to managing and collecting user payments (Marshall *et al.*, 2023). Research done in Africa has shown that VSLAs perform better than voluntary WUC (Prottas, Dioguardi and Aguti, 2018). This can be attributed to the fact that VSLAs have strong accountability and transparency practices that promote trust (Prottas, Dioguardi and Aguti, 2018; Marshall *et al.*, 2023). Trust (represented by social capital) can also be built through solidarity, empowerment, friendships, and knowledge sharing (Marshall *et al.*, 2023) especially among women who are many of the members (Namata, 2016), thus improving collective outcomes (Ostrom, 2007). Therefore, VLSAs can be harnessed to ensure proper financial management (Prottas, Dioguardi and Aguti, 2018; Marshall *et al.*, 2023) improves water use payment behaviours (Trust, 2020) and will ultimately result in higher revenues.

For illustration, the benefit of replacing the community organisation with VLSAs can be represented in the following loop in Figure 9.1.

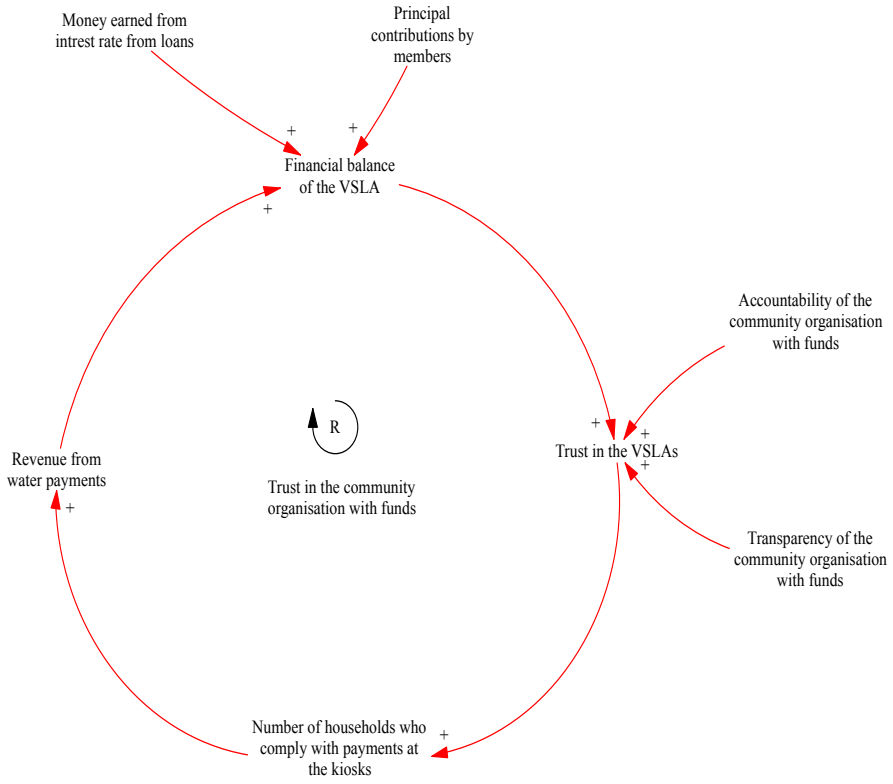


Figure 9. 1: Feedback loop showing VLSAs intervention to the trust structure

ii. One of the requirements of VLSAs membership is that members commit to contribute a certain amount towards the two funds. Although some cases of non-compliance are recorded, usually the accounts in arrears were cleared before the end of the year (see Marshall *et al.*, 2023). The availability of water funds throughout the year provides a buffer to the water system for maintenance.

Manage communal water kiosks as club goods.

Similarly to VSLAs are groups that manage water as clubs. Club goods (discussed in Chapter 2) in rural water services involve users coming together and devising institutional arrangements to manage water points. Such arrangements include setting subscription prices and higher prices for water and having security measures to avoid free riding. Such groups are exclusive and often have tighter financial regulations to generate sufficient revenue for cost recovery and maintenance. A study mentioned in Chapter 2 by Koehler, Thomson and Hope (2015)

investigated these clubs and compared them with other more open groups (CPR groups) and found more exclusive groups to have better financial sustainability.

For illustration, the benefit of replacing the community organisation with kiosks clubs can be represented in the following loop in Figure 9.2

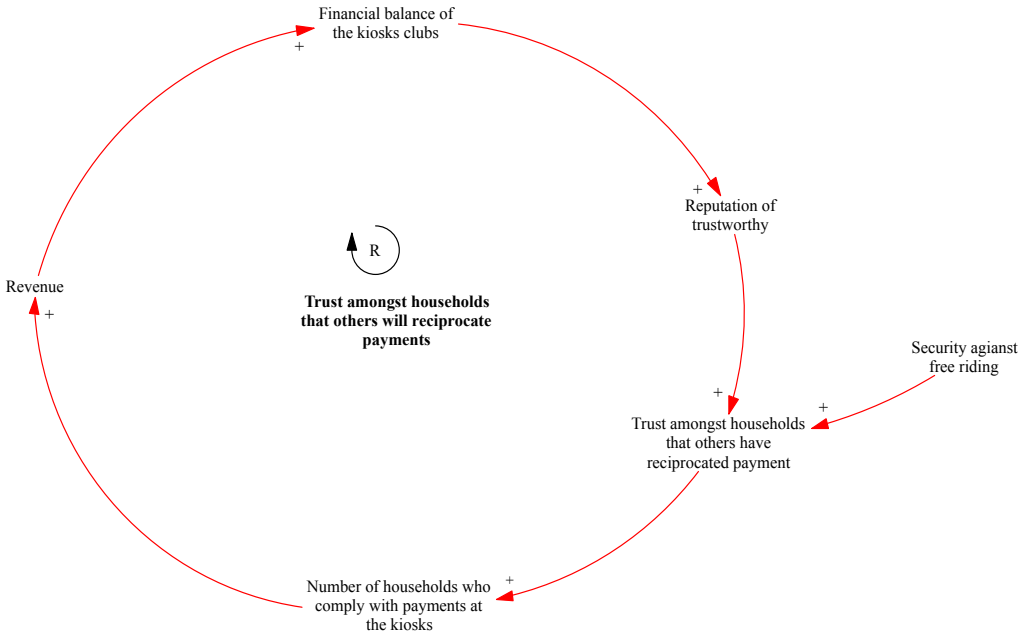


Figure 9. 2: Feedback loop showing managing water as club goods intervention to the trust structure

Additional External Funding

The reality is that money collected from rural water users is not enough for cost recovery, which in part requires preventative maintenance. There will always be a need to support rural households to meet the cost recovery (Chowns, 2015). Therefore, finding ways to provide subsidies to communities or subsiding service providers such as area mechanics in Malawi can make maintenance more affordable. Even so, such funding must be coordinated and done in a way that does not promote dependency by users. Additional funding will add to the financial balance of community organisations (represented in the model in Figure 7.21), however, the disbursement of these funds for O&M depends on the level of accountability and transparency

in place. Community development funds provided by the government can also be used to support financial balances of community organisations.

Transition resources towards providing safely managed water services

The treatment of water service attributes as static, and not considering how they change in demand, overly simplifies the assumptions concerning the relationship between value and payments in decentralised shared rural water provision. For instance, if users value closer water points, and begin to use the water points, this might result in congestion and long queues, eventually forcing people to use distant water points. Even so, there is no evidence that increased payments outweigh the maintenance expenditure considering the already low water prices paid by rural water users (see Foster and Hope, 2016). As such, investing in providing a safely managed water service where users have access from an improved source which is accessible, readily available, and free from contamination (see WHO/UNICEF, 2017) should be of paramount importance. However, the researcher acknowledges that there will always be areas where decentralised basic water service will be the best option, especially in dispersed rural areas where piped water services to households are unlikely to be feasible in the short term. In such cases, moving towards self-supply can be an option where low-cost protected wells can be provided especially in areas where there are fewer people, an abundance of rain and where groundwater sources can be shallow (Sutton, 2009). However, concerns are often raised on the quality of water under self-supply with several governments such as Malawi undertaking a need for drillers to make themselves known to water and health departments that can assess the quality of water. The transition towards safely managed water services will help in escaping collective action structures identified in the study. There is a greater initiative for households to invest in a water source that provides water services to their household.

9.5.1 Review of the Recommendations

The above recommendations all offer a way to attempt to turn loops from being vicious into virtuous. The use of VSLAs and Club goods offer strong institutional arrangements that ensure accountability and transparency thus increasing trust in those handling community water funds and trust that others are paying respectively. However, they result in exclusion of the poor, inequality, and implications to the human right to water (Koehler, Thomson and Hope, 2015).

This conflicts with the requirement under sustainable development goal 6.1 which aspires to, "*by 2030, achieve universal and equitable access to safe and affordable drinking water for all*" (WHO/UNICEF, 2017, p. 6). Failure by a user to pay for water should not be a reason to deny access (UN, 2018). However, in cases where VSLAs and clubs are possible and socially acceptable, this can be a way to reduce collective action dilemmas. The other recommendation, gaining additional external funding, fills the existing shortfall of meeting the full life cycle cost of providing improved water services to rural dwellers. Transition to safely managed water services is the ultimate solution that escapes the collective action dilemmas represented by the identified structures in the study.

9.6 Limitations and Future Research

9.6.1 Limitations

The study only focused on two comparable cases in Malawi. An increase in the number of cases would have improved the replication logic as recommended by Yin (2018), where more case studies provide a compelling support for findings from the outlined propositions.

Another limitation of the study is that interviews carried out by the researcher were carried out online due to COVID-19 pandemic. During the online Zoom interviews there were difficulties in connection with the selected participants. Furthermore, it was not possible for other participants (community organisation members and household users) to be contacted through Zoom. As such to mitigate this limitation the researcher used an experienced research assistant sourced from contacts who have done research in Malawi. Although using another a research assistant is plausible in such circumstances, the researcher acknowledges that interviewing the participants himself would have allowed him to pick up other opportunities to gain information and data as he is well immersed in the study and its objectives. Another limitation is that, during the process of building confidence in the CLDs, group sessions were carried out with only two groups (government and NGO/donors). The community and its leadership were not involved in the process due to practical challenges. As such, the study recommends further studies to also include the community and its leadership in the confidence building process. Involving a wider group of people would have ensured that a broader range of perspectives are considered. However, whilst those from the community were not included, the candidate believes that the

participants involved in the confidence building process had broader knowledge of the problem.

The study only considered CLDs and did not quantify, and simulate, the relationships contained within the CLD. The limitations of CLDs have been mentioned in Chapter 3 section 3.3. These include, issues with errors in loop polarity (Schaffernicht, 2007; Lane, 2008), misleading polarity (Richardson, 1986) and their failure to distinguish between stocks and flows, and between conserved flows and information links (Schaffernicht, 2007; Lane, 2008). These shortfalls can be mitigated by use of simulation. The benefits and how simulation can be used in this study is explained in section 9.6.2 below.

9.6.2 Opportunities for Future Research

The potential of Village Savings and loan Associations

In line with funding communal water kiosks, future research can investigate the potential of harmonising payments between members of VSLAs and non-members to reduce tension and avoid morale issues where members feel cheated by non-members who are not held to the same standard and can free ride (see Marshall *et al*., 2023 for such dilemmas). Research should focus on the extent to which some of the strategies identified by Marshall *et al*. (2023), such as larger contributions by non-members, can be widely adopted and their impact on social networks.

Use of simulation

The researcher identifies simulation as the next step that can be taken in the research. In extending this work, the dynamic payment behaviour model can be converted into a stock and flow simulation model to test some of the interventions/strategies suggested in the study by the participants. This is in line with the argument by Richardson (1986) that simulation can be used to enhance the causal loop model by ensuring rigour and accessibility. Furthermore, simulation caters for other inadequacies of the CLDs mentioned in Chapter 3.

For instance, simulation can be used to assess the effect of VSLAs to contribute to the financial sustainability of kiosks (decentralised water provision models in general) over time. The simulation can be run under different conditions such as giving the VSLAs initial funding rather than them using the contributions of users as start-up capital.

Loop dominance

Further research can also engage in the process of identifying which of the feedback loops identified in the study are dominant. This is important when trying to identify potential points of intervention to improve water payments (financial sustainability) and the resulting operational sustainability at communal water kiosks. Future research can explore various ways in which dominant loops can be identified. These may include, among others, using Cross Impact Analysis (Walters and Javernick-Will, 2015); Algorithm for loop dominance (Ford, 1999) and Loops that Matter method (Schoenberg, Davidsen and Eberlein, 2020).

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Appendix 1: Interview Protocol

Introduce self and research, and secure informed consent (go through Participant Information Sheet and Consent Form).

Interview to be conducted in English if possible, otherwise in Chichewa with Research Assistant translating.

Interview to be voice recorded, if consent is given.

Date:

Interviewee:

Consent form attached? **Yes / No**

The following questions are derived from the conceptual model

1. Please could you tell me who you are and what is your role in ensuring sustainable rural water supply services?
2. Can you give more details on management arrangements at the scheme?
3. Can you give more details on the financial arrangements for the scheme?
4. Can you give details on how the following factors influence payment compliance outcomes?
    - Trust in the local community organisation.
    - Trust amongst households that others will reciprocate payments.
    - Income/Affordability
    - Any other factors you might want to highlight?
5. In your view, do communities respond/demand improved water services (quantity, quality, accessibility, reliability)? If yes, are they willing to pay for it?
6. Are there instances of water shortages? If yes, what are the causes, and how do users respond to them?
7. Are there instances of long queues at the kiosks? If yes, what are the causes, and how do users respond to long queues?

8. Are there any water quality issues? If yes what are the causes, and how do users respond to poor water quality issues?
9. How long does it take for the water point to be repaired, and do you carry out preventative maintenance?
10. How do people respond to non-functional water kiosks?
11. Do water readings on meters align with revenues collected?
12. Do you think the expansion of the project to other areas will improve your financial position?
13. Do you have any other information you want to share about water payments or the level of water service at your scheme?

Thank you for your Participation.

Appendix 2: Case Study Protocol

Section A: Overview

Problem

Small water enterprises (herein communal water kiosks) are critical in providing clean, safe water in unserved and underserved areas (Opryszko *et al.*, 2009; Sima and Elimelech, 2013). Research has shown that they provide improved services (represented by water service attributes) (Opryszko *et al.*, 2009; Cherunya, Janezic and Leuchner, 2015). Increasingly, they are being used in rural areas (Huttinger *et al.*, 2017), including small rural towns (herein trading areas)(see Whittington *et al.*, 1989). However, demand is inconsistent (Contzen and Marks, 2018; Hope *et al.*, 2020; Hoque, 2023), which represents inconsistent willingness to pay for an improved water service (Hope *et al.*, 2020). Inconsistent payments at water kiosks affect their financial and operational sustainability, risking the health and welfare of usersc(Hunter, Zmirou-Navier and Hartemann, 2009; Adams, 2018). Considering that water payments depend on the level of water services(Koehler, Thomson and Hope, 2015; Hope and Ballon, 2019; Hope *et al.*, 2020), this led to the overall research question: ***why are household user payments at communal water kiosks in rural trading areas inconsistent***?

Propositions to be tested

iv) Trust in the community organisation (R1) and trust amongst households that others will reciprocate payments (R2) drive payment behaviours.
v) Payment behaviours are driven by the coping strategies (R3, R4, R5) that household users employ when faced with a changing water service level (B1, B2, B3).
vi) Demand funds maintenance (R6).

Rationale for Choosing Cases

Malawi was selected for several reasons. Malawi is one of the countries that have been found to have issues maintaining services due to non-payment compliance (Chowns, 2015). In addition, the country has ties with the Scottish Government and the University of Strathclyde

where several projects have been carried out in the country. Malawi is one of the few countries in SSA that has available data on water points. The country has data on the MWater database (see www.mwater.co) provided by the Scottish Government through the work of the Climate Justice Fund (CJF) and the University of Strathclyde.

The selected projects in the study are the Chiringa Borehole Project and Southern African Development Community Groundwater Management Institute (SADC GMI) Chimbiya Project. Introduction to these projects was facilitated by a senior researcher within the University of Strathclyde who has extensive experience with the rural water sector in Malawi. Upon their introduction, the projects offered significant comparative insights into how kiosks were managed and the associated payment behaviours.

Section B: Data Collection Procedures

The first interviews will begin in October 2021 and will be conducted via (Zoom) by the researcher. The second tranche of interviews will be carried out by the research assistant on behalf of the researcher between February and April 2022. Each interview is expected to last between 30 to 60 minutes and will be carried out in either English or Chichewa. During the interview process, the researcher will have a note to capture thoughts and body language highlighted by the interviewees and to provide reference and backup to the recorded data in the event the recording equipment fails to function(Creswell and Creswell, 2018). Table 1 below will provide aspects of the data management plan.

Table 1: Aspects of Data Management Plan

Data type	Original format	Preservation format*	Estimated volume	IPR Owner	Active storage location	Completed storage location
Interview recordings	MP3	MP3	10GB	UoS	OneDrive/Strathcloud	Pure
Intrview transcrips	.docx	TXT	10GB	UoS	OneDrive/Stratcloud	Pure
Coded interview Transcripts	NVP (NVivo)	NVP. HTML	1GB	UoS	OneDrive/Strathcloud	Pure
Handwritten field notes	Paper	TXT	1GB	Student	OneDrive/Strathcloud	Pure
Research /Policy publications	Documents	Pdf/.xlsx	4GB	UoS	One Drive/Strathcloud	Pure

Section C: Protocol Questions

Several questions will guide the interviewer (the researcher or research assistant). These are questions that the interviewer will pose to themselves to ensure they collect the right kind of data (Yin, 2018). These are outlined below,

For each case, collect data in relation to the financial performance of each scheme. These include,

- The current state of the financial balance of the community organisation at communal water kiosks
- The underlying reasons for the level of the financial balance
- Structures that drive payment outcomes at communal water kiosks
- Any other information in relation to water payments at communal water kiosks
- Evidence from bank statements, books and other written records from community organisations

The sources of data will be semi-structured interviews and project documents. The above questions will be accompanied by questions posed to the participants attached in Appendix 1, which are derived from propositions.

Section D: Tentative Outline for the Case Study Report

The case study will be presented as a thesis. The thesis audience will be water practitioners, academics, and stakeholders at the selected case studies. The researcher followed Strathclyde Havard's referencing style.

Case study Protocol Reference list

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Appendix 3: Confidence Building Interview Guide

Introduction

My name is Derek Mavesere, a Doctoral student at the University of Strathclyde. As part of the model validation process, I present my findings from the research on **Understanding Payment Outcomes at Communal Water kiosks in Malawi: A Causal Loop Approach.** You have been selected to participate in this process because you have contributed to the findings of the study. The purpose of this process is to ensure that the correct information is captured and presented in the model. First, I would like to ask for your consent to participate in this process.

Validation Process

The researcher will explain each loop and resulting proposition to the participants. Tell the story and have discussions.

Validation Questions

The following questions are in respect to each of the feedback loops presented to you during this process,

i) Do agree with the feedback loops and resulting propositions? If not, what would you add?
ii) Which interventions do you suggest on each loop?

Thank you for your Participation.