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INVESTIGATING THE IMPACT OF PREPAID METERS ON COMMUNAL WATER POINTS IN MALAWI: A CASE STUDY OF LILONGWE PER-URBAN AREAS.

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BY

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December, 2021.

STATEMENT OF THE AUTHOR

I, DON CHIUMYA by my signature below, I declare that this dissertation is my work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis, and completion of this dissertation. I have given all scholarly matter recognition through accurate citations and references. I affirm that I have cited and referenced all sources used in this document. I have made every effort to avoid plagiarism. I submit this document in partial fulfilment of the requirement for a degree from Pan African University. This document is available from the PAU Library to borrowers under the rules of the library. I declare that I have not submitted this document to any other institution for the award of an academic degree, diploma, or certificate. Scholars may use brief quotations from this dissertation without special permission if they make an accurate and complete acknowledgment of the source. The dean of the academic unit may grant permission for extended quotations or reproduction of this document. In all other instances, however, the author must grant permission.

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DEDICATION

The study is dedicated to my late sister Annie and the whole Chiumya family.

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ABBREVIATIONS AND ACRONYMS

UNICEF : United Nations Children's Fund

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Abstract

Water is usually obtained from communal water points such as kiosks in Lilongwe's peri-urban areas. Increased indebtedness, which resulted in more waterpoints being disconnected, prompted the Lilongwe Water Board to implement a new prepaid metering system, known in Malawi as the E-Madzi system, in order to provide access to water 24 hours a day, seven days a week and increase revenue collection. The purpose of this study was to look at the impact of prepaid meters on communal water points in three communities: Kawale 1, Kawale 2, and Mchezi. The study's goals were to examine the impact of prepaid meters on water affordability, people's perceptions of the new system, the influence of prepaid meters on revenue collection, and the reliability of the prepaid metering system. A total of 111 households who uses prepaid metering systems were sampled, a questionnaire and focus group discussion were used to collect data. The findings revealed that 98.2 percent of the sampled households were pleased with the new system because it has made water more affordable and people can access water on a daily basis, while the remaining 1.8 percent were dissatisfied because it does not allow residents to draw water on credit because they must pay before use, and there is low pressure at the water point when the weather is cloudy. Finally, this study recommended that the Lilongwe Water Board should consider re-sizing the system in order to calculate the energy daily requirement which will ensure water access even during the cloudy days.

Key words: Prepaid metering system, reliability and weather.

1.0 CHAPTER ONE: INTRODUCTION

All nations' progress is intrinsically related to water. Sustainable Development Goal (SDG) 6 – the 'water goal' – aims to ensure that everyone has access to clean water and sanitation. Sustainable Development Goal 6 not only aims for global water sustainability, but it also serves as a foundation for many other SDGs; attaining SDG 6 would go a long way toward accomplishing much of the 2030 Agenda (Unicef,2020).. The SDGs call for achieving a certain level of service by 2030, but it is not expected to happen overnight. As a result, each country must define intermediate goals that are tailored to the unique circumstances of distinct geographical locations(Génevaux, 2017). One of the main goals of the water development strategy is to provide safe and potable water. Various attempts have been made in recent years to enhance access to drinking water. According to Malawi Growth & Development Strategy (MGDS) II, overall water supply coverage grew from 58% in 2004 to 76% in 2009. In rural areas, the rate fell to 58 percent in 2004 from 64 percent in 2008(MGDS, 2010).Despite all this being the case three out of every 10 persons lack access to clean drinking water. Sub-Saharan Africa is home to over half of the individuals who drink water from unsafe sources (Pitzer, 2013).

Malawi is described as a water stressed country with its freshwater being less than 1,700 m3 of per capita and then Malawi is also one of the countries in Sub Saharan Africa which its fresh water faces pressure due to the alarming population growth rate (Diolasso, 2015).Malawi rural population is constituted of 84 percent of Malawian population. Drinking Water in Malawi is delivered through taps into dwelling, taps into yard/plot, community stand pipe, borehole, and protected.8.1 percent of Malawi population use community standpipes second from 61.7 percent who uses boreholes (Office, 2019). Communal water points were introduced in Malawian cities and per-urban areas in the 1980s in order to improve provision for water in informal settlements areas, even though there were problems with water-point management (Manda, 2014).The communal water points are legally managed by the water users associations. Water kiosk were introduced to low-income areas in order to deliver affordable water because most people in the low-income communities would not manage individual water connection fees.

Apparently, Waterboard uses post-paid meters and prepaid meters in delivering water to the house holds as well as communal water points e.g., standpipes. People that get their water from boreholes in rural areas frequently contribute to the maintenance of the water source (Truslove et al., 2020). Because affordability was also tied to this pricing structure, it did not gather

enough revenue for upkeep, resulting in the deterioration of water quality through salinity, which is a frequent problem with boreholes in Malawi (Rivett et al., 2019).

According to (Heymans et al., 2014) initially, prepaid water meters in Malawi were introduced for institutional customers such as government buildings and police and army barracks, who are often their biggest debtors as well as all cooperate customers and then it was extended to domestic users. The technology was adopted by the Lilongwe waterboard in order to enhance revenue collection and eradicate illegal water usage and connections by simplifying water supply services. Communal water points were also facing revenue correction problems due to poor management as there was no decentralisation of management of water points. Prior to handover of the kiosk to be managed by the Water User Associations (WUA) in Malawi, there was a loophole in the conventional billing system in the sense that tariff could vary. The new management requested that consumers settle their balances in order to begin on a new note, but the billing system was still based on traditional metering, and some water points used volumetric tariffs, also known as uniform tariffs, in which they charged per 20 litre bucket, while other water points used flat tariffs in which each household was required to contribute the agreed amount of money in order to receive service. (Aid, W. 2008)

The poor will be able to pay for the services they use once adequate policies are in place to aid in the formation of a well-organized water point committee (What et al., n.d.).This was confirmed when the Lilongwe Water Board has had problems with the payment of arrears by public and private institutions, while within a year, poor communities have paid about half their arrears after restructuring of the kiosk management.

Local communities are slowly adopting the use of prepaid meters since the water is significantly more economical than previous pricing schemes such as post-paid or household contribution. The installation of prepaid meters is still ongoing, as it began as a trial project in neighbouring localities.

1.1 Problem statement

There is an increase usage of prepaid meters in most of the developing countries. Research in other countries have shown that prepaid meters has increased access to water, revenue collection and affordability. Access to water remains the most common challenge in most developing countries. Most poor communities in Malawi are unable to access clean water. Communal water points in Malawi face a lot of challenges which lead to poor sustainability of the water points. Water kiosk face poor pricing method whereby consumers experience different pricing methods for the water consumed in some communities in the sense that other households were being priced per bucket of water collected while other households paid a fixed amount monthly despite the difference in quantity of water consumed. The communities also experienced inefficient billing systems and there was lack of monitoring of the kiosk meters. Hence, bills were collected from the estimated readings according to trend but not the actual reading and this does not bring realistic figures on the ground. Poor people in the communities were being charged twice by the private operators for re-selling water from the Lilongwe Waterboard (Water Aid, n.d.). The government established Water User Association to encourage controlled community participation in kiosk management within a previously failing politicized system, as well as to formalize accountability connections and methods (Truslove et al., 2020).

Free' supply of water historically to those living in poverty via a standpipe has faced challenges to ensure the long-term sustainability of this provision (Coulson et al., 2021) .Tracking revenue collection by the service providers has been a problem when they used to pay cash or post-payment to the communal water points management as the community leaders failed to give the correct money to the service provider. This led to poor access to clean water by the communities as communal taps were closed due to unsettled bills and there was a high number of unfunctional rate of kiosks (Jimu,2008). In Malawi, communal water points managers have to pay water boards for all water sold and most of them struggle to pay due to poor revenue collection.

Poor management of communal water points triggered the water service provider to adopt a prepaid metering system as a new technology to resolve issues pertaining to communal water point management and sustainability. Understanding that the prepaid water meter adoption is still ongoing in Malawi. This may research may tackle the revenue collection problems that

Lilongwe peri-urban residents and high-density areas of Mchezi, Kawale 1 and Kawale 2 Water User Association (WUA) and the Lilongwe Water Board (LWB) have been facing in the past.

Technology advancement including prepaid meters is one way that can help to solve challenges faced by the communities to access clean water by the service providers through communal water points such as prepaid kiosk. The main concepts of Integrated Water Resources Management, which include ensuring access to water, social fairness, and environmental sustainability, are expected to be addressed by the prepaid metering system.

While there is research evidence from other developing countries that prepaid meters are of much help in this regard, but Malawi is lacking documented research on the same, therefore it is important to establish if prepaid meters are having the same impact in Malawi. The study will fill a gap in the Malawian literature on prepaid water meters by highlighting on the, affordability of water, revenue generation by service providers and reliability of the new technology through people's perception. This research will also help to assess the main objective of the Malawi National Water Policy (2005) which aims at increasing access to clean water. Gaps in water delivery and management will be investigated in Malawi's peri-urban areas.

1.2 Relevance of the study

1.21 The Malawi Government

The study aims to emphasize pre-paid meters as a strategy for water resource management that addresses dependability, cost, and overall water supply administration. Because water in Malawi is so scarce, it is vital that people value it and do not waste it. As a result, this study will add to the body of information on public participation, particularly in developing countries.

1.22 Lilongwe Water Board

The effectiveness of prepaid water meters for debt recovery was established in this study. For many actors, the advantages and disadvantages of a household prepaid water meter were presented. Given that the installation of prepaid meters in Malawi is still ongoing due to the fact that certain areas have yet to gain access to this new technology, this study analyzed difficulties and provided guidance to service providers on how to handle the prepaid meters. This also fit with water resource management concepts, as well as determining if the new innovation is fulfilling Malawi's national water policy goals based on the locations where prepaid meters have been installed.

1.3 POSSIBLE OBSTACLES

Human movement was restricted during the study since it had place during the covid-19 pandemic. The collecting of data from the proposed sites had been postponed. Gathering data from the service provider was another stumbling point, as staff worked in shifts, making it difficult to meet the professional personnel in charge. I had to rearrange my itinerary because of concerns regarding funeral services. Because this was a purposive sampling study, some of the families chosen for it were unable to be located. In this case, the snowballing method was used to compensate for the absence of the chosen households.

1.4 THEORETICAL CONCERNS / SITUATING THE STUDY IN THE FIELD

As most African case studies have shown, prepaid meters have proven to be crucial tools for revenue collection at the household level and even at communal water points. However, there are also issues regarding these prepaid meters. For example, most consumers were not educated or sensitized about these prepaid meters, therefore they are supposed to be expensive because the prepaid meter mechanism is thought to force individuals to pay for water right away in order to receive it. As a result, the goal of this study is to determine if prepaid meters fit the Integrated Water Resources Management principle and the Malawi National Water Policy objectives, as well as to determine whether prepaid meters are acceptable for communal water points.

1.5 RESEARCH OBJECTIVES

1.51 Overall Objective

To investigate the impact of prepaid water meters on communal water points in the Malawi peri-urban and high-density areas.

1.52 Specific Objectives

- To assess the impact of prepaid meters on affordability of water on communal water points
- To assess community perceptions concerning prepaid meters on communal water points
- To assess the impact of prepaid meters on revenue collection on community water points
- To evaluate the reliability of prepaid metering system

1.6 Research Questions

- What is the impact of prepaid meters on affordability of water on communal water points?
- What are communities' perceptions towards prepaid meters?
- What is the impact of prepaid meters on revenue collection on communal water points? What is the impact of prepaid meters on reliability of water on communal water points?

1.7 TENTATIVE THESIS CHAPTER OUTLINE

There are five chapters in the thesis. The first section outlines the study's history, as well as the issue statement, research objectives, questions and hypotheses, study importance, and study organization. The literature study in chapter two includes the Malawi National Water Policy (2005), case studies of prepaid water meters in Africa, water pricing techniques, non-revenue water, drivers of prepaid water meter installation, Malawi sanitation status, and Malawi settlement pattern. The research technique and research design are covered in the third chapter. The outcomes of the study's findings are presented and discussed in Chapter 4. The study is summarized in Chapter 5, which includes major findings, limitations, and recommendations for further research. Following that are the References, Bibliography, and Appendix.

2.0 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The affordability, reliability, cost-recovery and public perception of prepaid water meters in Africa are discussed in this section. The sanitation and hygiene situation in Malawi, as well as water pricing and the peri-urban settlement arrangement in Malawi, were also covered in this part.

2.1 Malawi National Water Policy 2005

2.11 Overall policy goal

According to the revised Malawi National Water Policy (2005), its overall goal is to ensure the sustainable management and utilization of water resources, in order to provide water of acceptable quality and of sufficient quantities, and ensure availability of efficient and effective water and sanitation services that satisfy the basic requirements of every Malawian and for the enhancement of the country's natural ecosystems (Banerjee, 2011).

One of the strategies which was employed to achieve the policy overall goal was the introduction of prepaid meters in order to improve water service delivery.

2.2 Kiosk Management

According to (Agency, 2015),there is a kiosk management model which was set, and it was highlighted that since the 1980s, the Water Boards have created communal water taps to improve services in Malawi's low-income areas. While the boards own the kiosks, management of many of these stand-posts was delegated to third parties from the start. However, bill payment issues occurred, prompting both water boards to create kiosk management units (KMUs) and water users' associations (WUAs) to oversee the kiosks.

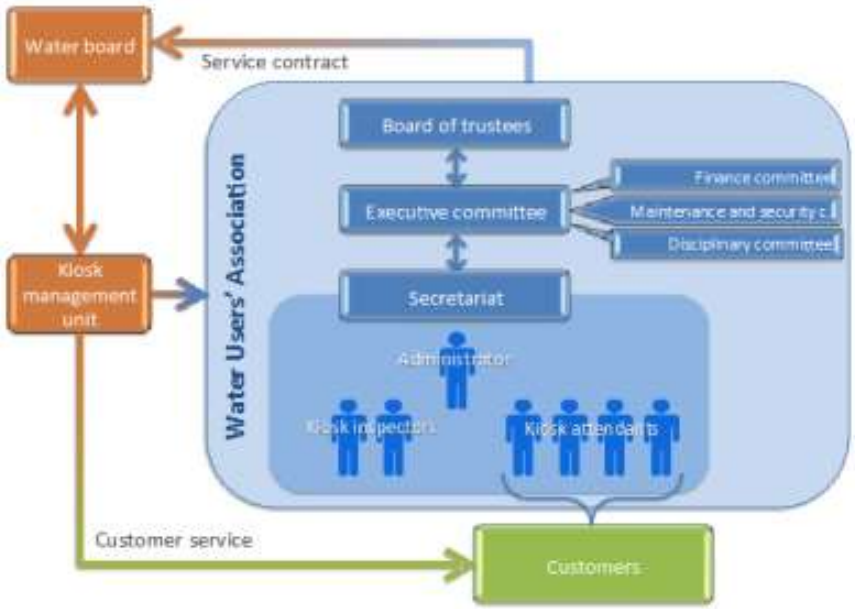

Figure 1:Kiosk Management Model

Source:(Agency, 2015)

2.3 Malawi Per-urban Areas

The figure 1 is representing how the kiosk are managed in Malawi in order to improve the governance structure. A peri-urban area is defined to be neither rural nor urban and it has borders with rural and urban areas (Butterworth et al., 2007).Mostly peri-urban areas do not have access to the benefits which are supposed to be there as the peri-urban areas. Peri-urban areas in Malawi usually do not have water points in households dwelling rather people do access water on communal water points such as; boreholes, community standpipes as well as protected wells.

In Malawi, urbanization, particularly in unplanned, peri-urban areas, is accelerating. Malawi's yearly urban population growth rate, at 4.7 percent in 2008, was among the highest in Africa, according to the 2010 Malawi Demographic and Health Survey (MDHS). According to the 2010 Malawi Demographic and Health Survey, over 91 percent of Malawian households lack access to an improved sanitation facility, which is defined as 1) a facility connected to a public sewer or septic system, or a pit latrine with a slab that isolates wastes, and 2) a facility used only by members of one household.

People living in peri-urban areas have a direct influence on their health due to a lack of better sanitation services. Human excreta pollution of water, soil, and food is a primary cause of

diarrhoea, which is the second leading cause of death among children in underdeveloped nations. Hence all this is influenced by the settlement pattern and that's the reason most peri-urban areas are targeted to have communal water points in order to avoid the spread of diseases.

2.4 Challenges facing the Water Sector

The Department of Water Supply and Sanitation (DWSS) oversees providing safe drinking water to Malawians. The goal of the DWSS is to promote the availability and accessibility of potable water for socioeconomic growth and development, as well as to spearhead efforts to meet the MGDS III targets and SDGs for water supply and sanitation. The goal is to is to make it easier to get potable water for the local communities.

According to the Joint Review Meeting Report (2019) on the Water, Sanitation, and Hygiene (WASH) sector, the sector confronts significant problems in achieving its goals, including: inadequate revenue collection efficiency for water boards due to large government unpaid bills. There are due to the advent of the, the rate of non-functionality of rural water supply systems has increased. The Government of Malawi (GoM's) inadequate financial allocation to the water department, The Ministry's and districts' limited capability in the water and sanitation sector, with a vacancy rate of 62.2 percent and few local NGOs deforestation and environmental deterioration of catchment regions for the WASH sector, deforestation and environmental degradation of catchment areas for the WASH sector Due to a lack of water supplies, both quantity and quality of water are in short supply (JICA, 2020).

2.5 Prepaid water metering system

In Malawi the prepaid metering system is called the E-Madzi system, which means Automated water. The system has a helped a lot in fighting again covid-19 as people no longer que for long hours to access water and the use of the card has helped to reduce the cost of water by 65 percent. Water wastage due to spillage and non-revenue water is reduced with this method. The Water Management System Server collects all reports from remote kiosks and provides an easy-to-use web-based dashboard for LWB system administrators to remotely monitor the kiosk's operation and water usage (WorldBank, 2020).

According to(Herwijnen, 2012)A prepaid water meter is an electronic device which is attached at the water pipe. Consumers needs to have a card which is loaded with credit corresponding to the quantity of water depending on the credit in the card. Consumers require to buy these credits from the different vending centres and some even buy electronically depending on the

service provider. When water is being dispensed records the amount of credit used hence kit stops when the consumer has run out of credit or meter do sense the quantity of water which is set at time is reached. The good part is that the prepaid meter displays the amount of credit remaining. The prepaid meters are currently installed in several countries in Africa with the aim of solving problems concerning water management such as; revenue collection, water service delivery (Herwijnen, 2012). Some of the countries currently using prepaid meters are; Malawi, South Africa, Namibia, Zimbabwe, Kenya as well as Ghana.

There is an argument that prepaid meters compromise the users for instance, rights access to water as it is described being the new technology with high maintenance and requires a consumer to pay first before use(Heymans et al., 2014). Some scholars have argued that the prepaid meters force the poor to pay for water in order to access it right away hence infringing the poor people's rights.

This literature review brings up an analysis of different African countries which are using prepaid water metering system as a tool for water resources management and how they are faring so far.

2.6 Policy Concerns on Prepaid Water Meters in Malawi.

Citizens for Justice filed the request on behalf of other Malawian organizations and "on behalf of a number of concerned, potential, and affected residents" in Mzuzu areas where the Northern Region Water Board (NR WB) has installed and will install prepaid water meters in accordance with Malawi's National Water Policy (2005) and Malawi Resources Act (2013). The following are some of the requests that were made:

2.61 Lack of prior consultations and/or disclosure of information;

The Requesters argue that no discussions or disclosures of information were held prior to the installation of prepaid water meters in impacted homes in accordance with the Bank's stated practices (Panel et al., 20).

2.62 The Bank's failure to perform due diligence

In accordance with its policies, according to the Requesters, will damage disadvantaged households by denying them access to water and raising water-borne diseases. Malawi has a high rate of child-headed households and orphans, who lack a reliable source of income and may have a tough time adjusting to the new system. Because the new system may not be able to support the water and sanitation systems found in most public schools, street children who attend many public schools may face negative consequences. (Panel et al., 2013).

2.63 Water Pricing

The Requesters argue that the pilot has raised the water rate in two ways: (I) they feel they are paying an additional daily lee (of MK53.00, which covers meter costs but not water use); and (II) homeowners who previously paid a daily lee are now paying a daily lee (of MK53.00, covering meter costs but not water consumption). They used to pay around $10 per month on

average, but now they pay around $15 per month. They argue that this is against the water pricing.(Panel et al., 2013).

2.64 Impacts were not assessed in advance;
The Bank team said to the Requesters that they feel the potential challenges might be resolved by amending an outdated Poverty and Social Impact Assessment (PSIA). The Requesters believe that, in light of serious concerns, this response is unsatisfactory, and that proper vigilance would have warranted an ex-ante approach.(Panel et al., 2013).

2.65 Human Rights Implications:
According to the Requesters, two human rights issues are ignored. First, residents' rights to participation and free and prior informed consent were violated when the Water Board did not consult, much less seek, their agreement before piloting prepaid water meters, denying them the option to choose whether or not to participate. Second, the Requesters argue that their right to water has been violated, stating that the pilot breaches entitlements to water and denies people the same opportunity to enjoy their right to water.(Panel et al., 2013).

2.70Affordability of water

Because everyone requires access to water, the cost of water should be affordable regardless of the type of delivery provider used. Water should be affordable for each household, according to the United Nations Development Programme (UNDP), and expenses should not exceed 3% of household income (SAHRC, 2018). Beyond the provision of safe drinking water to meet fundamental needs, Agenda 21 emphasizes that water users should be compensated appropriately. To ensure that everyone has access to water, even if it comes at a small cost, the authorities must implement policies that assure an appropriate pricing strategy.

2.7.4 Prepaid water metering system reliability.

Most developing countries are adopting the prepaid meters as it reduces the cost of water per litre, even though, countries like Uganda, Zimbabwe, Kenya and Tanzania have complained of its reliability. There are a large number of prepaid meter failures, and there is little training for locals on how to handle the meters when they malfunction (Heymans et al., 2014).

2.8.0 Cost-recovery

There is a great commotion on addressing cost-recovery and having access to basic needs hence it brings confusion to water users if there are told to pay little something in order to have access to water because they feel like they are being deprived of their right.

2.71Case studies
Different case studies were from the African developing countries were analysed, this was in terms of how prepaid meters were fairing in terms of; affordability, people's perceptions, revenue collection and reliability.

2.72Kenya Case Studies

2.721Affordability
According to (Heymans et al., 2014),landlords and tenants were reluctant for the transition to go for prepaid meters, most tenants thought they have been using free water so the coming of

prepaid meters will make them pay for water now, but they didn't realise that they were paying a fee which was included in their rentals. Some of the landlords were concerning of losing the money since now tenants will have to handle money for water bills on their own. Consumers who use prepaid meters on communal water points in Nakuyu, Kenya highlighted that after the installation of prepaid meters, the consumers started paying less than half amount of what they were paying whilst using conventional meters per jerry cane(Hanjahanja & Omuto, 2018). Hence this new technology made the community to have a good access to fresh and clean water with ease. They also argued with the introduction of the prepaid meters there no long que to collect such that the consumers take almost 15 minutes which is contrary to what was happening during the use of conventional meters as consumers could take almost hour to fetch water hence serving time making the new technology affordable in monetary terms and even in kind.

2.722 Reliability

In Nakuyu, Kenya, people experience well far much better service after installation of prepaid meters because the residents who used the communal water points now could have access to water 24/7.prior to prepaid meter installation the landlords had full control of the water to the extent that they were water points were locked most of the times except some few hours just for people to fetch water and this meant if you haven't collected water at that particular time you may go the whole day without water. Most of times the water was disconnected by the service providers due unsettled bills and this made the whole compound to suffer since it was communal water point (Heymans et al., 2014).The coming in of prepaid meters has solved several issues including water point conflicts.

A Kenyan citizen has developed a standalone prepaid system for a communal water point which uses solar power at affordable price. This innovation helps in water service delivery. The citizen made sure for customers to be toping up credit using their phone in order to make the service reliable. Many consumers now have access to water services thanks to the implementation of community prepayment meters, which provide them with affordable, clean, potable, and reliable water.

2.7.2.3 Cost recovery

According to (Hanjahanja & Omuto, 2018),the pre-paid meter method has a lot of commercial possibilities in terms of supply to low-income areas. There is no provisioning for bad loans and no provisioning for collections. Write-offs. Cash processing and fraudulent activities are reduced thanks to a technology platform.in the woods. The need to print and post water bills is also eliminated with paperless transactions. Members of the community have also reported a technical fault with prepaid meters, claiming that the meters easily break, despite the fact that this was not clearly stated in order for people to understand if the breaking is due to vandalism or a technical fault.

2.7.2.4 non-Revenue water

The Kenyan case study concurs well with the Zimbabwe case in terms of non-revenue water which also prompted the government to adopt the prepaid metering system. Non-Revenue water has been a major challenge in the Kenyan cities. Non-Revenue Water levels were found to be alarming in "very large companies" which supply water to more than 35,000 connections

which are residents of the major cities in Africa(Patini, 2011). The water utility providers lost USD 44million worth of water translating to 108million cubic meters of water lost through leaks, illegal connections, meter reading errors and unbilled consumption. So, this meant that the almost half of the water which the utility companies supplied didn't reach the consumers hence making losses and one of the major losses was from the meter reading errors hence the introduction of prepaid meters would save the water lost and poor meter readings.

2.8.0 Namibia case study

2.8.1 Affordability

Users in Windhoek, Namibia, were paying US$2.00 per m3 for conventional communal standpipes, but after the installation of prepaid meters, they are paying US$0.04 per jerrycan, which is almost half of what they were paying for conventional meters, and the city council has received more requests from informal settlements for prepaid meters installation, reducing Namibia communal standpipes conflict (Heymans et al., 2014). Water is expensive for 78 percent of people who use a traditional metering system, whereas water is affordable

for those who utilize prepaid meters. Community members were also faced with the issue of non-payment of water bills, and the proposed remedy was the construction of a prepaid metering system.(Kastner et al., 2005).

2.8.2 Reliability

Windhoek, Namibia had to introduce prepaid meters on standpipes in 1998 to supply water rapidly growing informal settlements in an arid region the city aims to manage demand and wastage, to avoid high water prices rising further and avert conflict at shared water points (Heymans et al., 2014). In Karibib Town Council (KTC), Namibia installation of prepaid meters on communal tap was also triggered by overcrowding in premises which led to higher water consumption hence more bills to be paid which mostly the bills were not settled. The KTC employees were the ones managing the communal taps on selected hours of the day which meant that several hours of the day the taps were not running for people to go and collect water. The closure of communal taps was due to poor bill settlement hence they opted for prepaid meters in order to improve revenue collection so that everyone should have access to water at any given time (Iipinge, 2016).

Namibia's case study is similar to those of other developing countries, in that there have been complaints about prepaid meters breaking. People from Namibia urged the Utility operators to

have a good look into the prepaid machine and try to buy the reliable ones in order to allow people access of water for 24 hours.

2.9.0 Tanzania Case Study

2.9.1 Affordability

People in Tanzania have raised some worry, claiming that the cost of water from the prepaid metering system is slightly higher than the cost of water from the post-paid metering system, in contrast to other developing countries such as Namibia, Kenya, and Zimbabwe. However, because the water from the prepayment system is pure, people are gradually adjusting (Check et al., 2017)

2.9.2 Reliability

Two communities in Tanzania which were the early birds to access the new technology have agreed more on the increase of accessibility of water by the prepaid metering system. As now people can access water 24 hours a day, as long you should have credit in your e-smart card.

The literature supports the findings of the Namibia and Zimbabwe Case Studies, which both had complaints about prepaid meters that were not working accordingly. Despite this, they requested that the prepaid meter project be expanded to include additional nearby areas (Check et al., 2017).

2.9.3 Cost recovery

Tanzania also has adopted prepaid meters to increase access to water as well a cost recover method. Initially Tanzania invests more than $200 million per year in water infrastructure, around 60% of new water systems fail within two years of installation because of a lack of finances for upkeep and repair, many systems fail, leaving people without consistent access to water.

Resonance had to work with waterway, a social enterprise located in the United Kingdom, to extend their revolutionary digital water metering technologies to two villages in Tanzania's Kilosa District, where it is improving community water management and increasing access to water for 23,000 people (McClure, 2020).

In Tanzania, agents who sell water receive small commission of the sell and the rest is deposited to the Utility provider bank account. These funds are used for maintenance and even expanding the local system hence ensuring reliability and access to water.

Using the eWaterPay system, one water system with newly developed water infrastructure experienced strong good results, according to the review. The E-Water Pay service increased monthly revenue by 15%, and 97 percent of consumers were satisfied (McClure, 2020).

The second water system had previously encountered issues with outdated water infrastructure, resulting in periodic water delivery interruptions at several neighbourhood public taps. This had an influence on customer satisfaction (77%) and the COWSO's capacity to collect revenue. Water availability was extended to 24 hours a day in both water systems, with shorter wait times at operational water taps (McClure, 2020). Prepaid meters have increased access to water and revenue collection in Tanzania, as seen by these findings.

3.0 Zambia Case Study

3.0.1 Affordability

One of the most important advantages of prepayment highlighted, according to many consumers, was that it alleviated concern about getting water bills they couldn't afford. People can now afford to receive clean water as well as pay for what they have used thanks to the installation of prepaid meters. Customers realize when they have a leak quickly since their credit lowers quickly when they pay in advance (Water et al., 2014)

3.0.2 Reliability

Water supply in peri-urban areas is based on groundwater extracted from boreholes; electricity is sporadic, and storage capacity is limited. As a result, the water pressure is lower than the prepayment meter can withstand, and frequent supply disruptions bring grit and air into the system, resulting in failures(Water et al., 2014).

4.0.0 South Africa case study

4.0.1 Cost recovery

In South Africa the water policy was facing the same tension when they are trying to address the two concepts of cost-recovery as well as having access to water probably this mis-understand dwells in low-income communities. The Water Supply and Sanitation White Paper had a focussed-on community water supply, but then they realised that it won’t be possible to achieve the particular go is quite free so they had to include a cost on water to help for maintenance and good service delivery (Peters & Oldfield, 2005).Hence the South African policy highlighted than there should be provision of free 6000 litres of water by the water service authority within the 200 meters of person home. The operating cost were to be covered

by the government subsidy and block tariff. For those people who have not paid for water they a system called drip to limit the amount of water dispensed from their taps and this was regarded as a first method in cost recovery.

The second method for cost recovery was cutting off access to water for households who have not paid any penny and this was too controversial as well (Hanson, 2015).Then now there was introduction of prepaid metering system which consumers are required to buy tokens loaded with credit equivalent to the amount of water required. This is third method of cost recovery method and this paper focuses much on this particular method as part of the assessment of the impact of prepaid meters mainly on communal water points which are mostly found in low in come communities such as the peri-urban areas. According to (Kumwenda, 2006) the south African water policy indicates that metering system should be compulsory to all in order to ensure revenue collection. Prepaid meter on water points was initiated and it has proven to be one of the best methods in ensuring revenue collection by the water authorities.

5.0.1 Zambia Case Study
5.0.2 Reliability

In Lusaka, Zambia, peri-urban communities use communal water points for water use. It was highlighted by the Tap attendants that the post-paid system was not being cost-effective as they must also to pay the utility provider 60 percent of the revenue generated. Hence this led to introduction of prepaid meters to solve the challenges of revenue collection.

Lusaka Water and Sewerage Corporation (LWSC) aspires to enhance payment levels to fund its operations, streamline revenue management, lower the cost of doing business, and strengthen water demand control through prepayment. The prepaid meters had too many defects during the trial period, to the extent where the cost recovery goal was not attained, which is in contrast to other developing countries. Despite this, the system was capable of providing water 24 hours a day, seven days a week, but at a very low pressure, and there was no skill transfer, so the flaws could not be fixed (Water et al., 2014).

6.0 Zimbabwe Case Study

Revenue Water (NRW)is defined as the water loss which comes before to the consumer from Transmission Mains.

Figure 2:non-Revenue water calculation

Source:(Djalia 2019).

The figure 2 shows how non-revenue water is calculated. Mostly the losses are caused by customer meter under registration, data-handling errors and theft of water in various forms. Unbilled water also includes the Unbilled water used by the utility for operational purposes, for instance the water used for firefighting, and water which is provided for free to certain consumer groups including unbilled non-Metered consumption. Non-Revenue Water is major challenge for water utilities in developing countries where technology and resources to address the problem are often limited such as the prepaid metering (Wainaina, 2018).

Non-revenue water (NRW) accounts for between 40% and 60% of available supplies due to deteriorated water distribution networks and water theft, but Harare Water (a department under the City of Harare responsible for water purification and distribution) is struggling to collect meaningful water revenue from residents that can be used to fund water supply. Hence this pushed the Harare water supply to adopt prepaid metering system which will help to recover the cost of water which the water supply loses due to non-revenue water (Gambe, 2015).

7.0 People's perceptions on Prepaid metering system in developing countries

Prepaid standpipes aren't a cure-all for the problems that come with supplying low-income areas. The technology is cutting-edge. There's also the fact that it's pricey, still maturing, and prone to flaws. There is still more to be done to provide clients with a solid service. And a

useful service. Furthermore, it was highlighted that there should be an option where people should still access water if they run out of credit to avoid inconveniences.

There is a large body of critical literature on the commercialization of water and the effects of a cost-recovery-focused approach on low-income people. Prepaid cards are appealing to some people. Water meters are an example of neoliberal thought, and they are widely used as putting basic human rights at risk by restricting access a right to water conditioned on payment in advance.

Many people believe that prepaid meters are punishing the poor because they have historically been targeted at the poorest households. Because if people don't have enough money to buy credit, they won't be able to get water that day, making it difficult to meet the Sustainable Development Goal 6 (Heymans et al., 2014).

Prepaid meters in Lusaka, Zambia, impacted consumer behaviour because taps were never left running and people were forced to check the quantity of water they needed, minimizing water waste. The paper also noted that there were varied reactions to prepaid meters, with some consumers stating that they are fine for small families but that they would rather utilize volumetric tariffs for larger families (Water et al., 2014).

7.1 Sanitation status in Malawi

A UNICEF report (UNICEF, 2020) highlighted that; UNICEF supports the Malawian government's goal of delivering safe drinking water to everyone by 2030. (SDG 6.1.) Increased coverage of basic water supplies to deliver services on a large scale, water quality and safety, and strengthening operation and maintenance to increase functionality and sustainability are among UNICEF's top priorities.

Even though 67% of Malawian households have access to drinking water, distribution is uneven among districts and between urban and rural areas. Urban areas have 87 percent of improved drinking water sources compared to 63 percent in rural areas. In rural areas, 37% of households spend more than 30 minutes fetching drinking water, compared to 13% in urban areas.

Only 77% of water points in the United States are operational. The rest are no longer functional due to deterioration of the catchment, negligence, a lack of spare components, and insufficient community-based water management institutions. Women and children bear the brunt of insufficient water access since they must frequently walk long distances to fetch water for their households (UNICEF, 2020).

Only 6% of the population engages in OD, and only 26% have access to basic sanitation. Sanitation services are also dispersed unevenly throughout the country. Rural households account for 7% of OD households, whereas urban families account for 1%. Changing behaviour around the usage of latrines, as well as handwashing, has proved difficult. Only 10% of households have hand washing facilities (UNICEF, 2020).

UNICEF Malawi supports the development and renovation of water facilities to provide safe water to underprivileged communities and institutions. The goal is for women and children to have to travel less than 30 minutes round trip to get safe water from facilities. Water point committees and area mechanics are also being strengthened as part of the initiative (*U. N. I. C. E. F. 2018)*

7.2 Water pricing on communal water points in Malawi.

Financial sustainability and cost recovery; efficient deployment of scarce sector resources; income distribution and fiscal viability are the primary water tariff objectives established by Laredo.

The Integrated Block Tariff (IBT) for water networks is a popular tariff in developing nations like Malawi. Rather than being a payment for the water itself, the tariff is a charge for the provision of a networked water delivery service. Covering the costs of providing services, such as operations and maintenance a network with pipes.

According to government guidelines, the price of water from a kiosk in Malawi is planned to be very low, hence the WUA is intended to be run on a non-profit basis. This adds to the deficit.

8.0. Concluding remarks.

Despite a few obstacles, most developing countries benefit from the deployment of prepaid meters, according to the literature assessment. As a result, prepaid meters are one of the most effective strategies for reducing revenue collection costs and increasing water availability.

3.0 CHAPTER THREE: METHODOLOGY

3.10 A conceptual framework

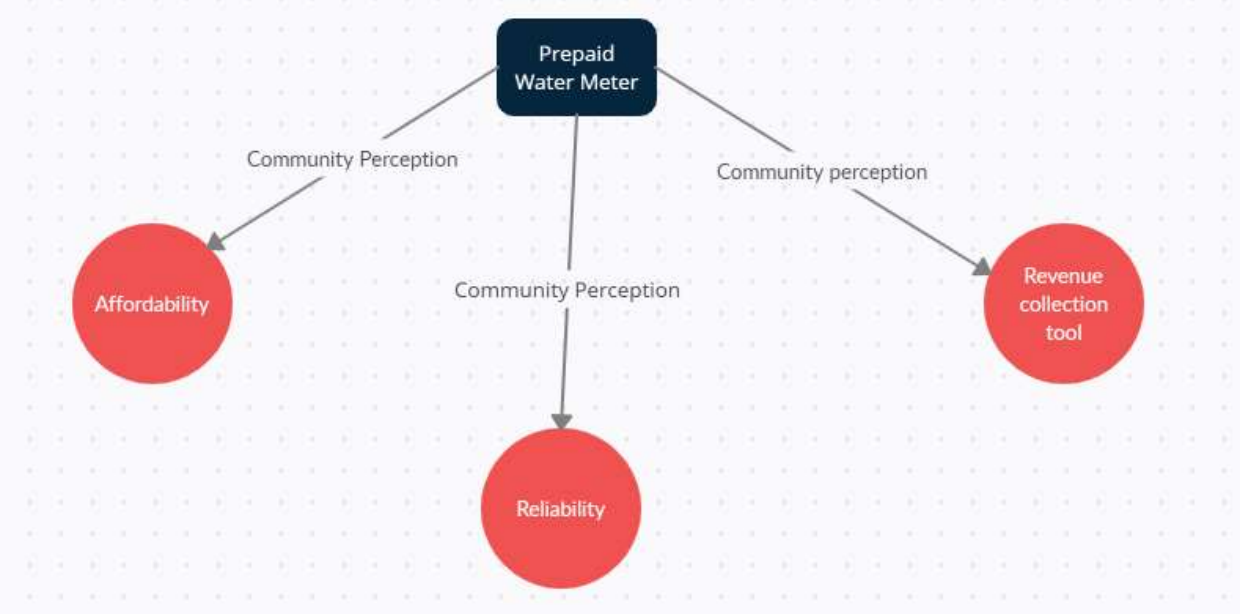

Figure 3:Conceptual frame for the impact of prepaid metering system on communal water points.

3.20 Study area sampling

The research was carried out in three peri-urban informal settlements in Malawi's capital, Lilongwe. The informal settlements have a number of traits that make them particularly well-suited to our research which are;(1) access to potable water is severely lacking ,(2) residents rely on public water kiosks with fluctuating hours of operation,(3) poverty rates are extremely high, and 4) they have extremely dense populations. The three settlements chosen were Kawale

1, Kawale 2, and Mchezi, which had 302, 302, and 491 households, respectively (according to Lilongwe Water Board numbers).

Households was be sampled purposively; these are households who their main source of water is the communal prepaid water point. The total household sampled were 111.

$$Sample\ size\ (s) = \frac{p * q * z^2}{e^2} \qquad equation\ 1$$

Where S=Sample Size is the selected critical value of desired confidence is the proportion, the population having characteristics q=1-p ,e is the sampling error is the proportion of the population with a particular characteristic while q denote the proportion of the population without a particular characteristic,

3.21 A Map of the study Area

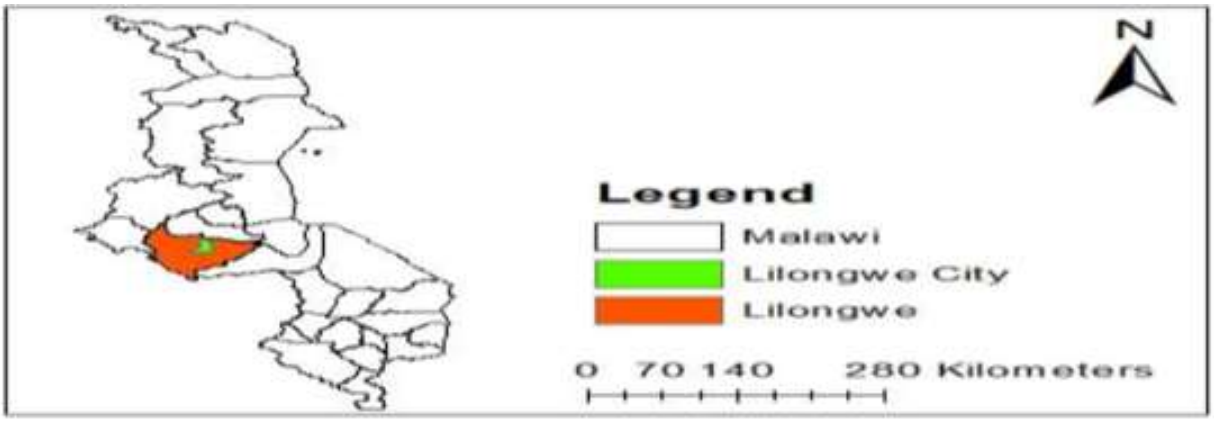

Figure 4:The Lilongwe City Map showing study area

Source: (Ngumbira 2020)

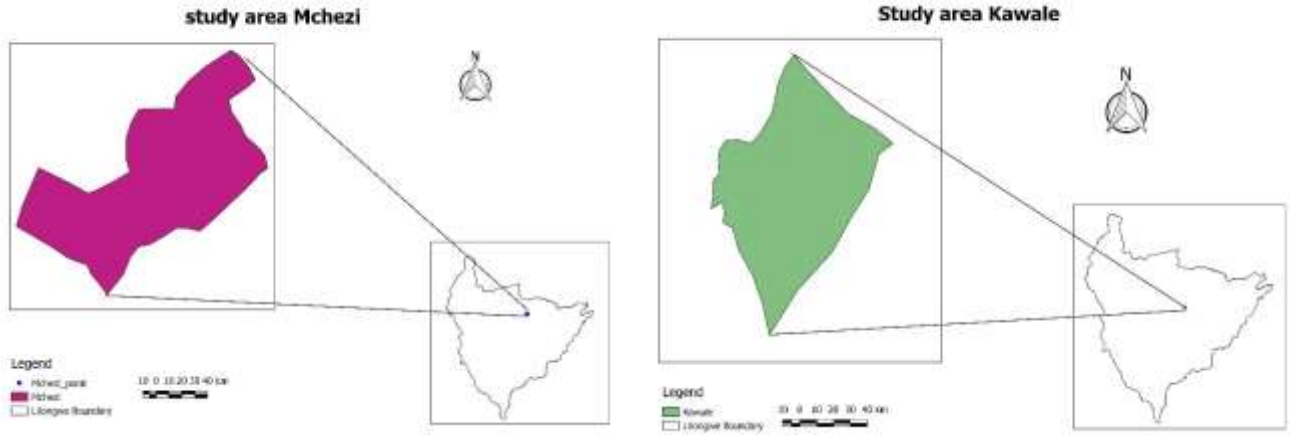

Figure 5:A Map showing the sampled communities

The figure 5 shows the study area where the households were sampled and data was collected. A digitalized semi-structured questionnaire was used to collect data from different households. The application for data collection will be collected using survey CTO. Three focus group discussion with a checklist will administered in the three peri-urban areas in order to check if some answers resonate with the data collected from the households. One sample t-test and frequencies were used to analyze the data and come up with valid results.

3.30 Data Collection procedure

We primarily used data from a structured household survey, but we also used information from focus groups, policy documents, and participant observations. In each family, the target respondents were the household heads, in whose absence we spoke with a spouse or other household member over the age of 18. For ease of contact, surveys were given face-to-face and in Malawi local language which is Chichewa. The survey had numerous elements, including information on location and identification, demographic and socioeconomic data, drinking water sources and access, affordability, water attitudes, and the reliability of the water source with prepaid meters. There were also sanitation facilities to be observed.

3.40 Data analysis

A Statistical Package for Social Science (SPSS) package and Microsoft Excel was used to analyze quantitative data which is already coded. After the Questionnaire was administered, it was sent directly to the server called Kobo collect toolbox. The data collected was downloaded and analyzed using A Statistical Package for Social Science (SPSS). The qualitative data was analyzed using thematic data analysis. This was used to analyze transcripts.

4.0 CHAPTER 4: RESULTS AND DISCUSSION

4.1 The prepaid meter system

The survey was carried out in three communities: Kawale 1, Kawale 2, and Mchezi, all of which employ the E-Madzi prepaid metering system, which is powered by solar energy. They all use prepaid cards which they scan on the meter in order to disperse water on the taps. They all use prepaid cards to disseminate water from the taps, which they scan on the meter. The figure 6 shows the E-Madzi metering system and its interface.

Figure 6: E-Madzi prepaid meter

4.2 Demographic and socio-economic characteristics of respondent

The researchers conducted a survey to profile the homes that use Prepaid metering system in 111 households. The study was conducted in all three towns (Kawale 1, Kawale 2 and Mchezi), and this is also similar to the study which was conducted in Namibia and three low density areas were chosen(Iipinge, 2016).Results of the study are provided below.

4.2.1 Population distribution

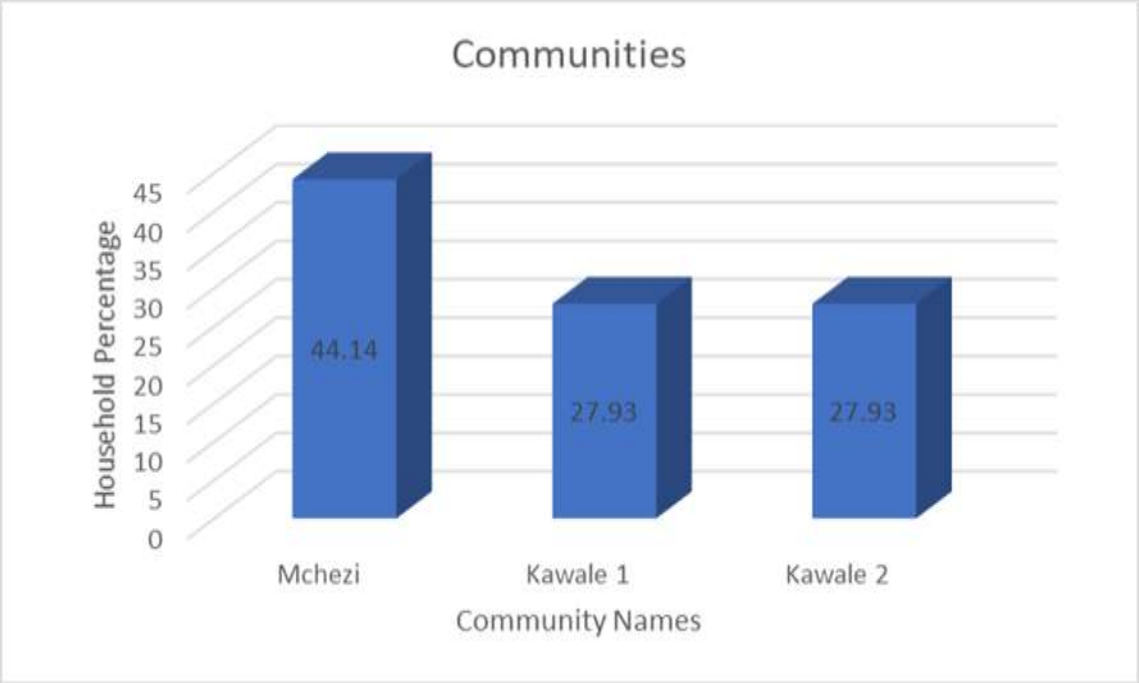

Figure 7:The population distribution of the sampled communities

The figure 7 depicts the population distribution of the sampled area. Mchezi has the highest respondent constituting of 44.14% while Kawale 1 and 2 registered the equal number of respondents which 27.93% for each. Malawian population has the highest population than Namibia, but the studies have shown that Namibia and other developing countries in Africa have adopted the use of prepaid meters than Malawi(Heymans et al., 2014). This is so because, in Malawi the system is still new so the adoption rate is gradual.

4.2.2 Gender

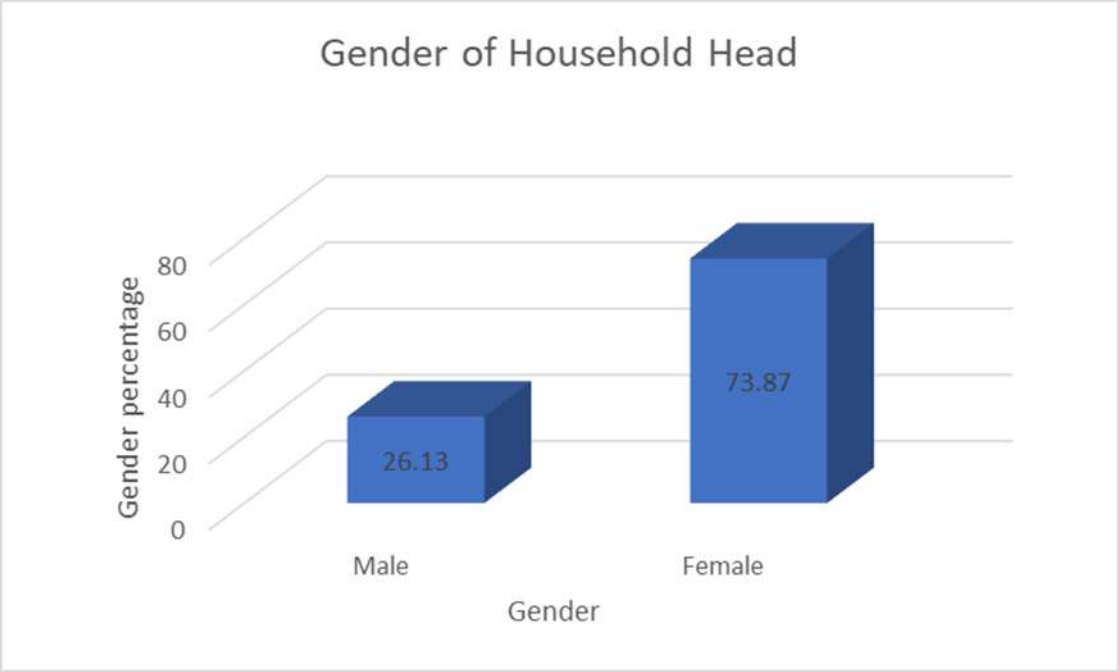

Figure 8*:The gender distribution of the respondents*

Male-headed households accounted for 26.13 percent of the households in the three localities examined, while female-headed families accounted for 73.87 percent. This was also a benefit to this study because women are the ones who collect and consume the most water, hence the necessary data was gathered. The results gathered are concurring with graham who did the analysis of the major water collectors in Sub-Saharan Africa between males and females and then it was find out that females are the ones who consume and collect the most water(Graham et al., 2016).

4.2.3 Age distribution

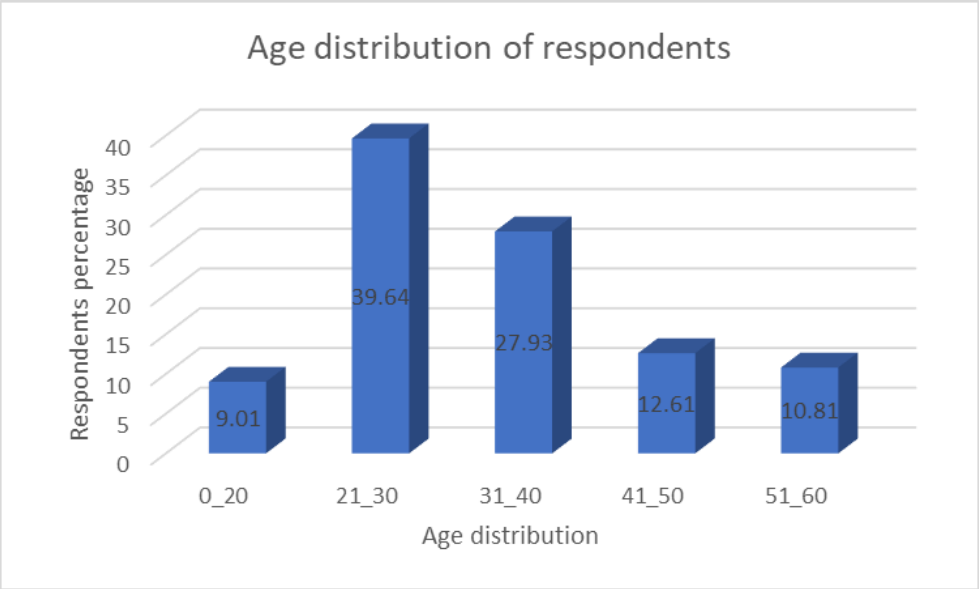

Figure 9:The age distribution of the respondents

Table 1: Age distribution

Value	Frequency	Percentage
21_30	44	39.64
31_40	31	27.93
41_50	14	12.61
51_60	12	10.81
0_20	10	9.01

The table 1 reveals that the majority of respondents (about 39.64 percent) were between the ages of 21 and 30. In all communities, the category of 0 and 20 years old had the smallest number of respondents. Because most old people reside in rural areas or villages, and most youth move to town for a greener pasture, they can't afford to live in low- or intermediate-

income densities, therefore they end up in high densities or peri-urban areas running small businesses, the results are similar to the study which was conducted in Ghana as it was highlighted that small and medium scale industries to earn a living(Dapilah et al., 2019)

4.2.4 Household Size

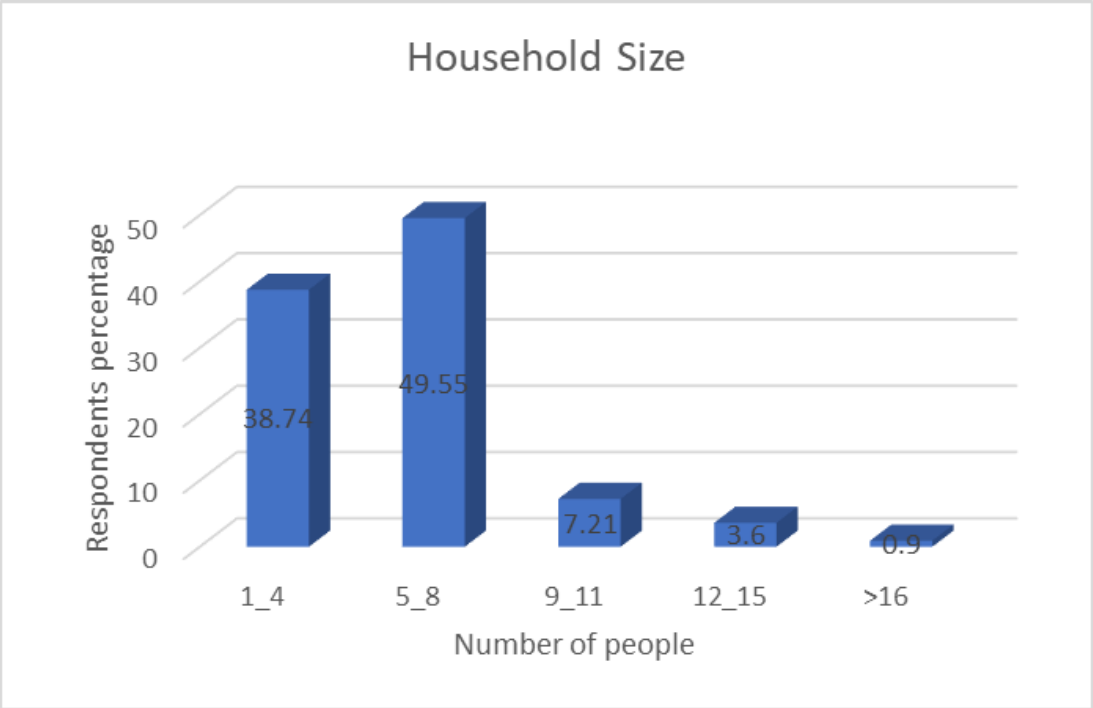

Figure 10: The size of each household in the study area

The figure 10 represents the size of the household in the three communities. The average household size in the sampled communities is depicted in the graph above. 49.55 percent of respondents live in a 5 to 8-person home. These results corelate with the average household size in sub-Saharan Africa which is between 5 to 8 people (Africa: average household size by country 2021 | Statista, 2021)

4.2.5 Source of Income

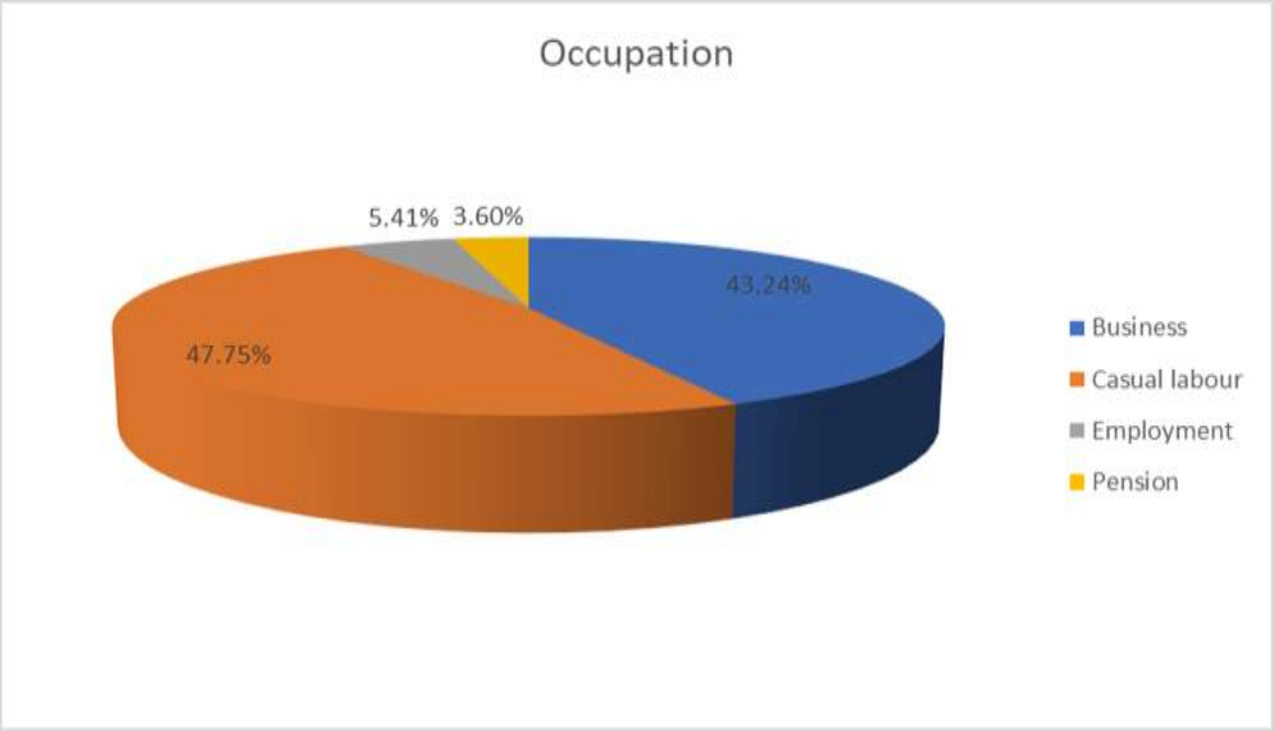

Figure 11:The source of income in the study area

In the figure 11 the occupations of the respondents in the three communities are depicted in . The majority of respondents engage in casual labor (47.75 percent), followed by business (43.24 percent), while the least amount of respondents make money through pensions (3.60 percent). There is a link between age distribution and occupation, as mentioned in the age distribution. Because the youth are in the energetic age group, the study's respondents are youth who live in low density areas and peri-urban areas and are generally involved in business and casual labor this concurs well with the study which was carried out in Ghana on peri-urban transformation which highlighted more on the income generating sources that people venture into small businesses.

4.2.6 Education level of the head of the household

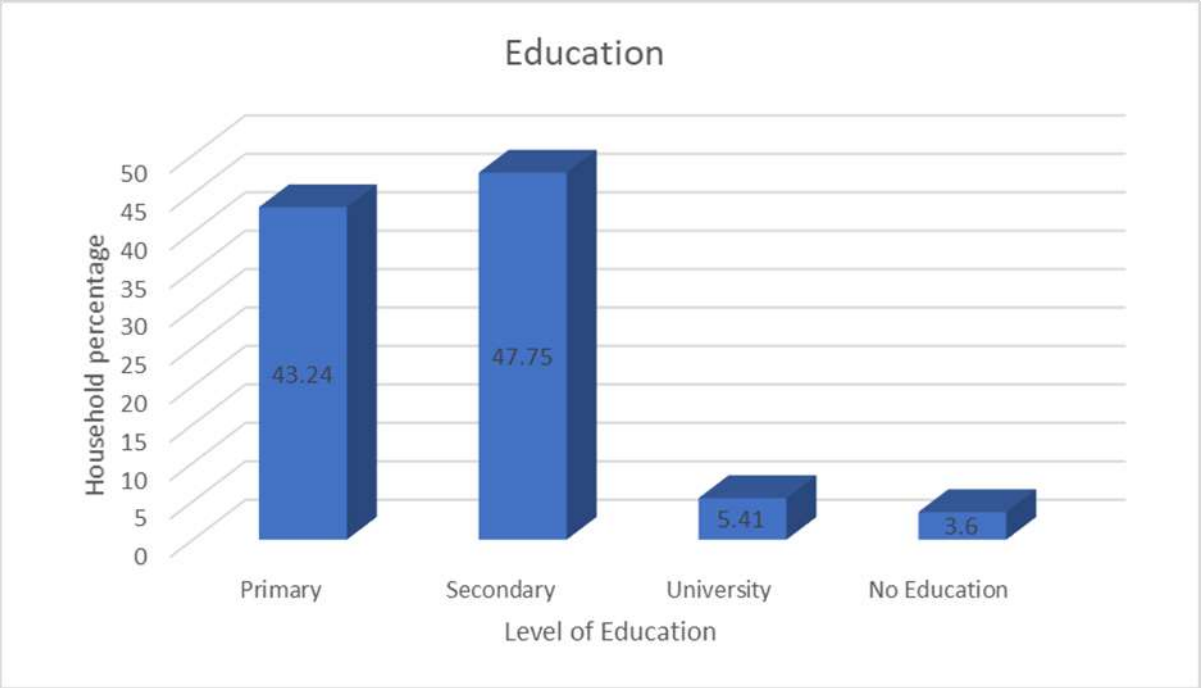

Figure 12: The Level of Education for the respondents

It has shown that the majority (47.75 percent) of the respondents had completed high school, while 3.76 percent had no formal education (Figur12). Prepaid meters necessitate reading and comprehending the technology; therefore, the majority of respondents are able to read and write, indicating that the technology is user-friendly.According to Malawi housing census (2019) report, the Malawi literacy levels is 68.6 percent,showing that most people in Malawi can read and write. Hence this data compliment with data collected from this study.

4.2.7 Period of stay in the study area

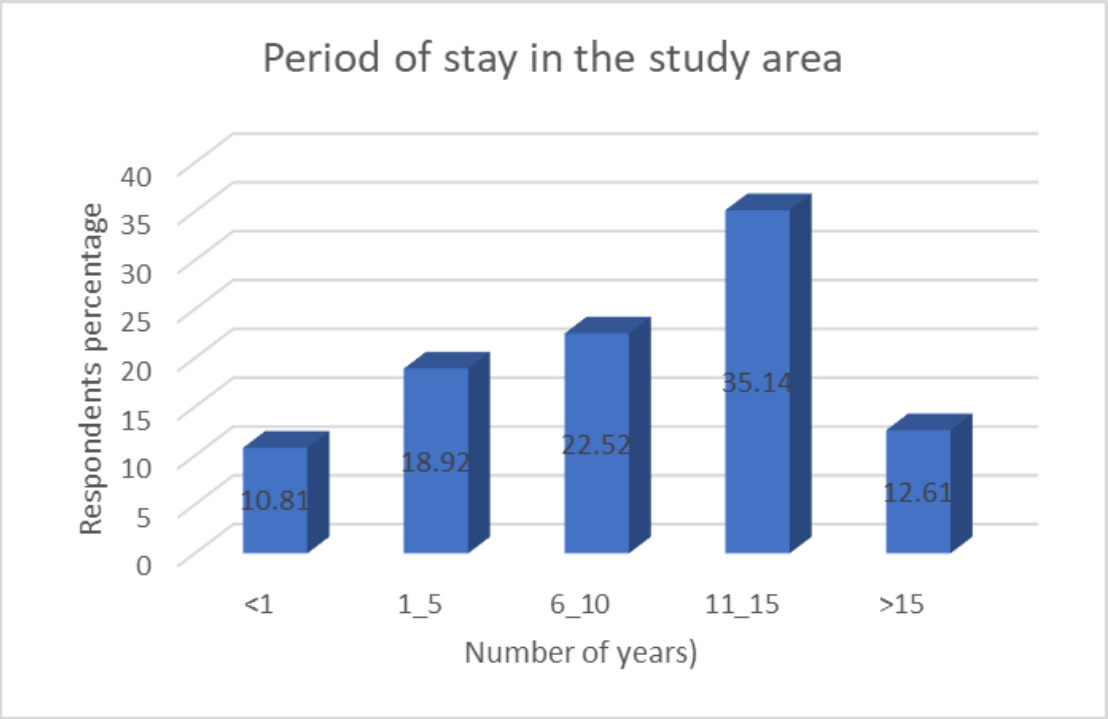

Figure 13: The Period of stay in the study area

According to figure 4.8, The majority of respondents (70.27 percent) said they had lived in the area for more than 6 years, while the remaining (29.73 percent) said they had only resided in the area for less than 5 years. Prepaid meter installations have been in place for four years, which implies that most of the respondents have used prepaid meters since they were first installed and can provide a detailed explanation of how they work. This is more or less similar to the study which was conducted in Namibia that showed that most people who have access to prepaid meters have lived in the areas for more than 5 years and the areas is also highly dense hence the respondents gave valid information to the study(Iipinge, 2016).

4.3 Impacts of prepaid water metering system on residents

4.3.1 Affordability

The price of water per 20 litre bucket varies greatly between prepaid metering system and standpipes which use the increasing block tariff systems on conventional metering systems. Water is sold at 7 Malawi kwacha (0.01 USD according to June and July 2021 currency rate)

per 20 litre buckets on the prepaid meter standpipe, and at 50 Malawi kwacha (0.06 USD according to June and July 2021 currency rate) per 20 litre buckets on the conventional standpipe. This means the introduction of prepaid meters have reduced the price of water. This is supported by the World Bank (2020) study on Malawi prepaid meters, which stated that the adoption of prepaid meters lowered water prices by 65 percent.

4.3.2 Monthly income and water expenditure per month

Table 2:Monthly income expenditure on water

Average household Monthly income (Mwk)	**Monthly Water expenditure (mean) Mwk**	**Water expenditure as a percentage of household income (%)**
95501 (117.63 USD)	1719.85 (2.12 USD)	1.8%

Table 2 represents the monthly income and water expenditure per month, the average household expenditure on water from the sampled communities is 1.8 percent of total household income, indicating that the prepaid metering system is affordable, according to (SAHRC, 2018), which states that the household should spend less than 3 percent of total income per month on water. The OECD and multilateral development banks, which have set monthly water spending requirements of between 3% and 5% of total household income, agree with these findings (Measurement, 2021).

The Chi-Square Tests of monthly money spent on water and the size of household for the different prepaid metering system users.

Table 3:Chi square results on water expenditure

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
On_a_monthly_basis_ehold_spend_on_water * What_is_the_average_ze_of_your_household	111	100.0%	0	0.0%	111	100.0%

Table 4:p-value results for income expenditure on water

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	141.951[a]	116	.051
Likelihood Ratio	88.503	116	.973
N of Valid Cases	111		

A cross tabulation was conducted to analyse the relationship between the monthly money spent on water and size of a household of the different prepaid water users. The table shows a p-value (0.051), This shows that there is no significance difference between the average household size and monthly expenditure on water. This could mean the water is much affordable where by consumption does not depend on household size. These results differ with the study conducted in Namibia on prepaid meters and basically the house size had an impact on the water consumed and hence on the money spent on water as well(Iipinge, 2016).

4.3.3 Running out of water due to lack of funds

A question was asked to respondents on how often they have run out of water in their household due to lack of funds.

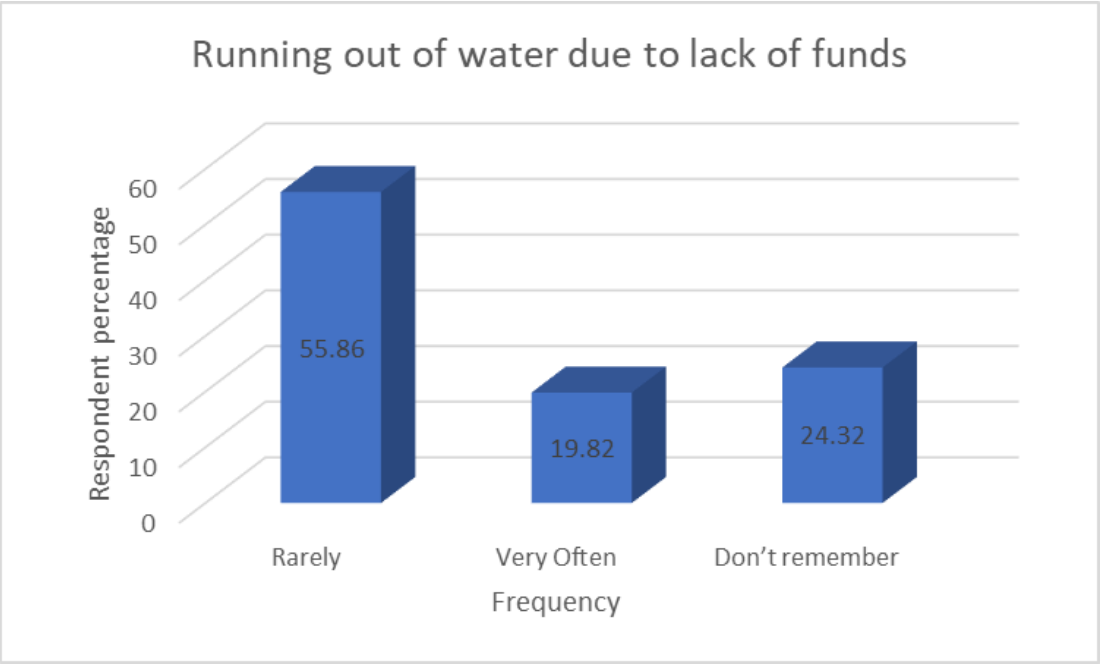

Figure 14: Running of water due to lack of funds

The figure 14 shows how frequently residents in the tested town run out of water due to a lack of cash. More than half of the inhabitants said they had only a few times gone without water owing to a lack of cash, while 24.32 percent said they cannot remember. These findings revealed that the system is substantially cheaper, hence improving water access. Which relates well with most developing African such as Ghana, Zambia and Tanzania as now they expressed to say rarely experience water shortages after installation of prepaid meters(Heymans et al., 2014).

4.3.4 Community perception towards prepaid meters

A question was presented to the responders in order to learn how the new system is being received by the inhabitants. In terms of its benefits and drawbacks. Residents were given the choice of supporting or opposing the new system.

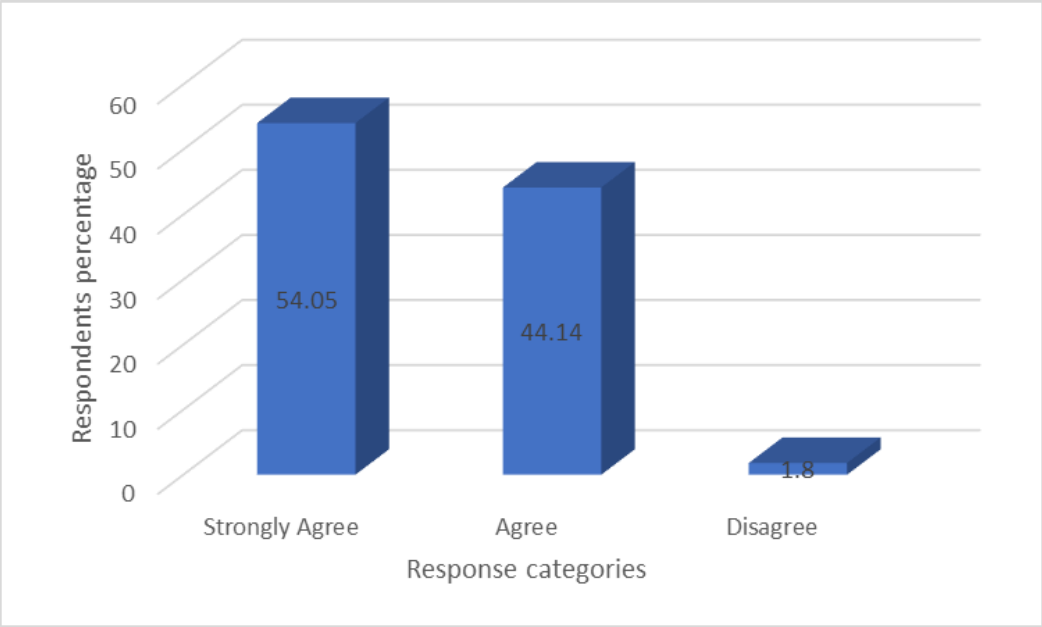

Figure 15:The extent to which people like prepaid meters

The figure 15 indicates that the majority (54.05 percent) of the respondents strongly agree with the use of the prepaid system and 44.14 percent agrees with the use of the system. Then cross tabulation was conducted to check the relationship of household monthly income and the preference to use the prepaid system, this was borrowed from the study which was conducted

in Namibia, and there is high similarity with the results of this study as both studies indicated that the residents liked to use the system in terms of efficiency of the system and the affordability as the price of water has reduced per jelly cane (Herwijnen, 2012).

Count

		I_like_to_use_commun_prepaid_water_meter			
		Strongly Agree	Agree	Disagree	Total
What_is_the_total_mo_ome_of_the_household	17000_35000	16	22	1	39
	35001_50000	13	16	0	29
	50001_65000	6	7	0	13
	>65001	14	15	1	30
Total		49	60	2	111

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.555[a]	6	.956
Likelihood Ratio	2.221	6	.898
N of Valid Cases	111		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .23.

The p-value of the chi-square test is 0.956, indicating that there is no significant relationship between the preference to utilize the prepaid metering system and household income. As a result, the results reveal that choice is not based on household income, as inhabitants with a lot more money and those with less money both appreciate the system, demonstrating that it is inexpensive.

Residents were asked to say if the prepaid meters are actually good to impact on personal behaviour change on water usage. Previous studies have shown that the prepaid meters are one of the tools for behavioural change on water usage. Tanzania, Namibia and Uganda case studies have shown that people conserve water because they exactly know the amount they are using(Iipinge, 2016).

4.3.5Prepaid water meters are a good way of encouraging people to conserve water

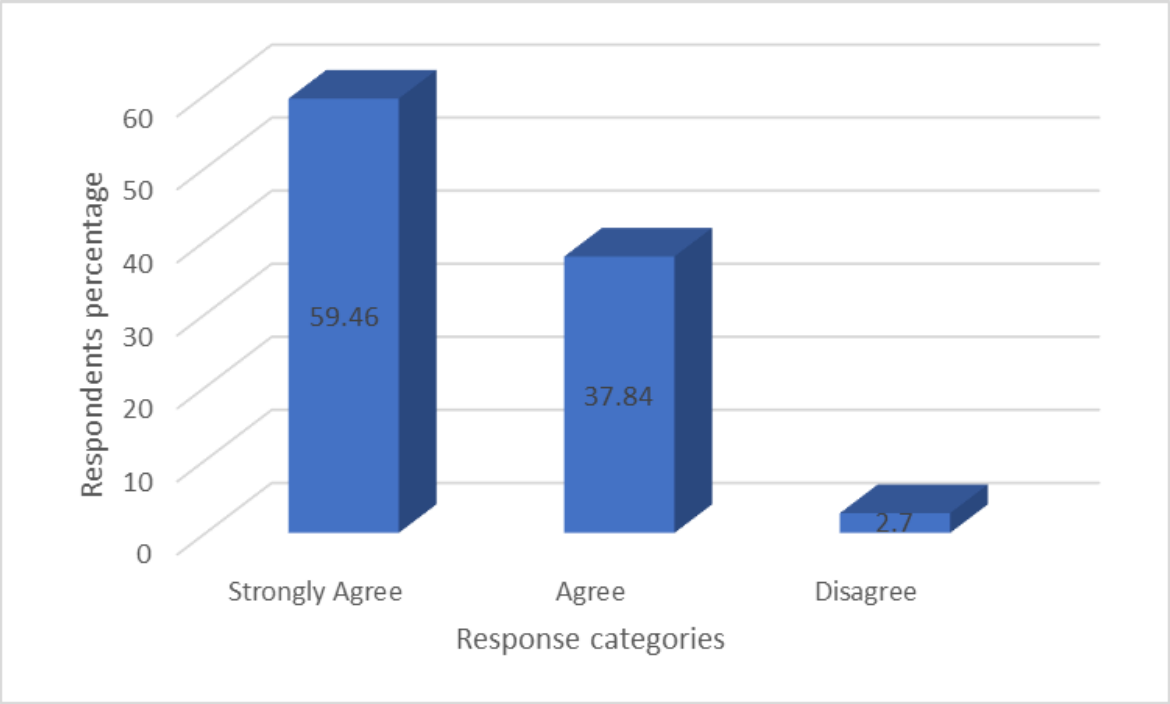

Figure 16:Prepaid meters as a tool for conserving water

Figure 16 depicts that the majority (59.46%) of the respondents strongly agreed that the introduction of prepaid meters have an impact on water usage behavioural change, while on 2.7% of the respondents disagreed with the fact that the prepaid meters have an impact on water usage behavioural change. So, a focus group discussion was conducted to understand why most residents said the prepaid system has an impact on behavioural change on water usage. The common answer was that, the prepaid meters show how much money is left in the card and its equivalent to the amount of water you can draw from the standpipe, hence this helps in tracking household water usage therefore it's hard to use a lot of water knowing that you may easily run out of it anytime which is different to conventional meters where people do not monitor the amount of water they are using and its equivalent to the money which will be required to pay at the end of monthly, While a few others disagreed with the fact that the prepaid water meters will have an impact on behavioural change with their backing to say, people who have a lot of money on their household can still use the water anyhow knowing that they will easily purchase the water tokens at any given time. The results agrees with the studies conducted in South

Africa that highlighted that most households reduced the unnecessary water usage under prepaid metering system compared to post-paid metering system(Kumwenda, 2006).

4.3.6 Perceived water use changes after the installation of prepaid water meters on certain activities

All household jobs were grouped into one category called "Household chores," and watering plants was another activity because most people in the neighbourhoods have backyard gardens. The different water uses changes were categorised as; Increased (Showing that after the prepaid meter installation they have increased the water use), Decreased (To show that the they have started using less water after the installation of prepaid meters) No change (Showing that they have noticed any change since the installation of prepaid meters).

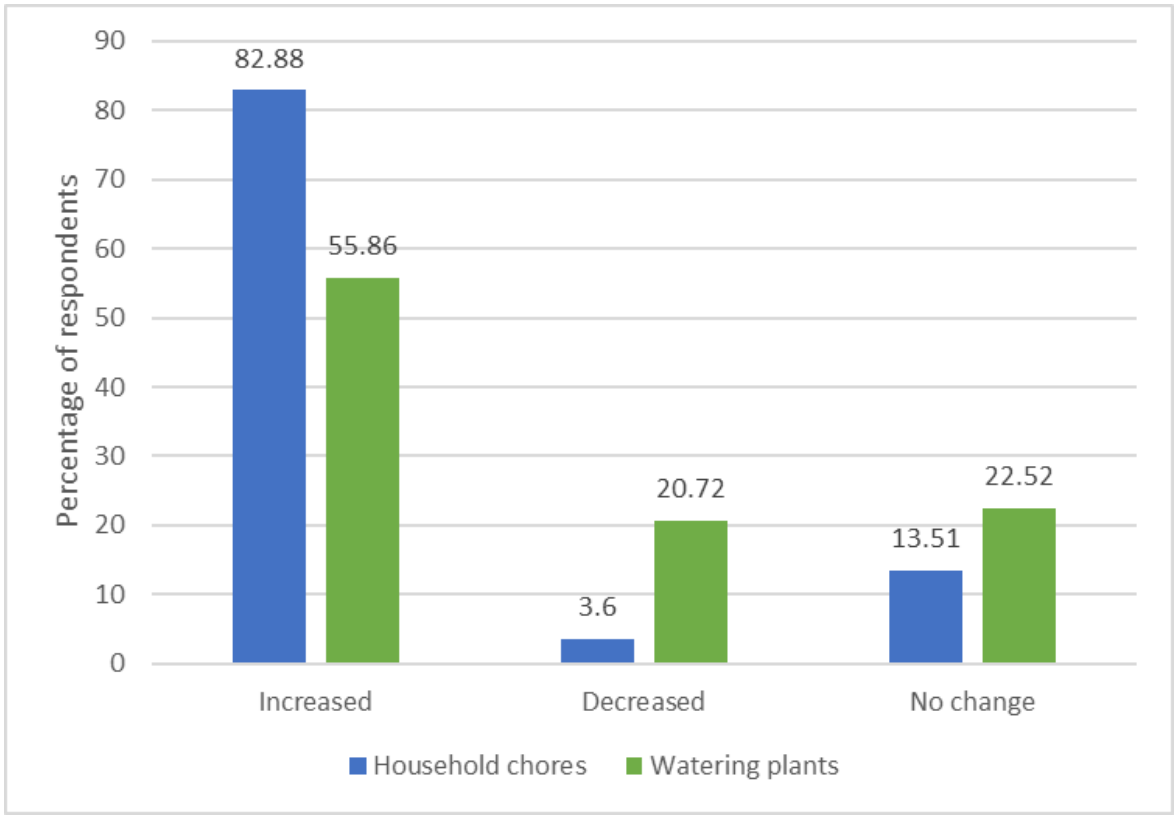

Figure 17: A change in water usage for household activities

The figure 18 depicts change in water usage for the household activities. Most families have increased their water use after the installation of prepaid meters, as shown in the graph above. This is because the introduction of prepaid meters has made water extremely affordable,

especially in low-income communities. The increase in water usage in this case is not considered water waste because each household consumes the amount of water they have already paid for, resulting in no debts; at the same time, water utilities provide water based on population size, so they do not complain because people can afford it. When compared to a study conducted in Namibia's peri-urban areas, it was discovered that residents who collect water from communal standpipes have increased their water usage, with the reason being that they can now easily pay for the water and no one is forfeiting water payment, unlike before the installation of prepaid meters. It suggests that the outcomes are identical, implying that prepaid meters are effective(Iipinge, 2016).

4.3.7 The challenges faced by the communities and Utility operators

During a focus group discussion with the water user's association and community members, some participants highlighted the difficulty of using this prepaid metering system because it does not allow people to buy water on credit, forcing some people who cannot afford to pay for water that day to go without water or use unsafe water sources.

The Water User Association (WUA) and community residents agreed on one point regarding the technical issues that arise during inclement weather, such as when the sky is too cloudy, it becomes difficult for the standpipes to dispense water because the system is powered by solar energy. When the weather is severe, the taps may have low pressure.

The Water User Association has reported vandalism, claiming that certain members of the community have stolen the batteries that are attached to the solar power system. Because of the lack of security on the standpipes, vandalism is prevalent. These are challenges which most developing African countries are facing after the installation of prepaid meters, countries like Tanzania,Ghana,Zambia and Kenya are facing the same (Heymans et al., 2014).

Figure 18: The vandalised kiosks in the study area

The figure 19 shows how some prepaid meters have been vandalised in the Malawian community. Other respondents complained that some water business owners still have the conventional water point close to the prepaid meters, and they own both. Because the prepaid metering system and the conventional system have such a large price difference, the water business owners sometimes turn the prepaid system off. As a result, residents are forced to purchase water from the traditional system. As a result, the business owner makes unfavourable profits while negatively impacting the community.

Other sites, such as Kawale 2, lack an appropriate governance structure for how kiosks are handled, owing to a struggle between business owners and the Water User Association (WUA). The business owners refuse to be led by the Water User Association (WUA) since they claim ownership of the kiosk, while the Water User Association claims they do not receive the agreed-upon shares from the business owners. This is in contrast to certain studies that argue that prepaid meters have made kiosk governance much easier because every household has a

card to draw water and vending machines make it easy for E-cash to be sent to utility operators(Heymans et al., 2014).

4.3.8 Revenue collection

Members of the Water User Association as well as business owners from all three communities participated in a focus group discussion. Residents were asked to explain the differences between traditional meters and prepaid meters in terms of revenue collection.

The revenue collection has considerably grown, according to the members of the water user association, because people no longer forfeit the payment because you have to pay first before you consume. The advantage of this method is that consumers do not have to pay for the cards to draw water; instead, the cards are supplied to residents for free. Because everyone is now expected to be accountable on their own, this method has minimized conflicts between utility providers and consumers. Residents who used a post-paid metering system were more likely to default on payments, resulting in water points being disconnected by utility operators. Other residents who might afford to pay for water without penalty may be affected.

Some citizens stated that, while the method is less expensive, it forces individuals to pay for water, violating their human right to water. Utility operators agreed, but emphasized that the system isn't intended to force people to pay for water; rather, it was implemented in good faith to ensure water access while also relieving other residents who were being denied access due to unpaid bills by residents who couldn't afford or forfeited the bills. This brought up a follow up question to the sampled housed to see if the system forces people to pay for water.

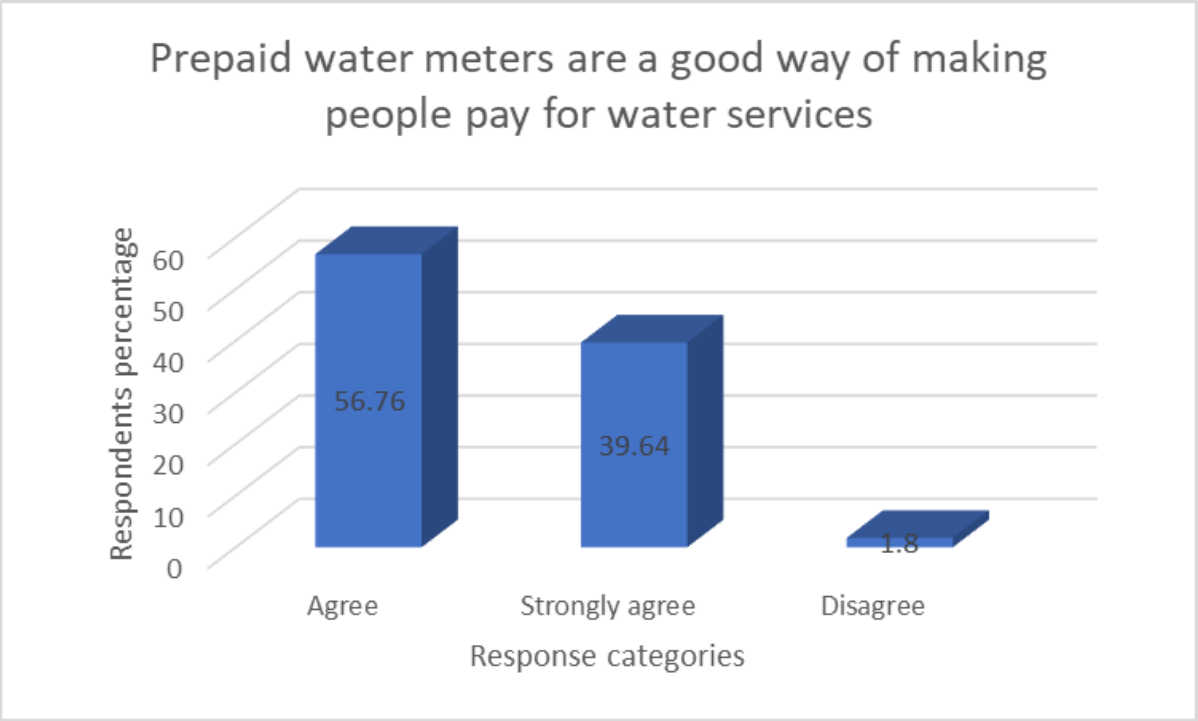

Figure 19: Prepaid metering system making people to pay for water.

The figure 20 is depicting the influence of prepaid meter in making people to pay for water. According to the graph above, 56.76 percent of respondents thought that prepaid meters are a decent way to get people to pay for water, and hence the device is a good cost recovery tool. Only 1.8 percent disputed that the new system is not acceptable, agreeing with a few members of the focus group discussion who stated that prepayment meters violate people's human right to water access. Prepaid meters, according to studies in Namibia, are a good technique to get people to pay for water, so this study agrees with this report. (Iipinge, 2016).

4.3.9 The Reliability of Prepaid meters.

The study looked on the reliability of prepaid meters in terms of water access and functionality at Communal Water Points in three different communities. Residents highlighted worries about the newly implemented system of supplying water through prepaid meters, known as E-Madzi meters, in this study. Madzi is a native dialect that means "water."

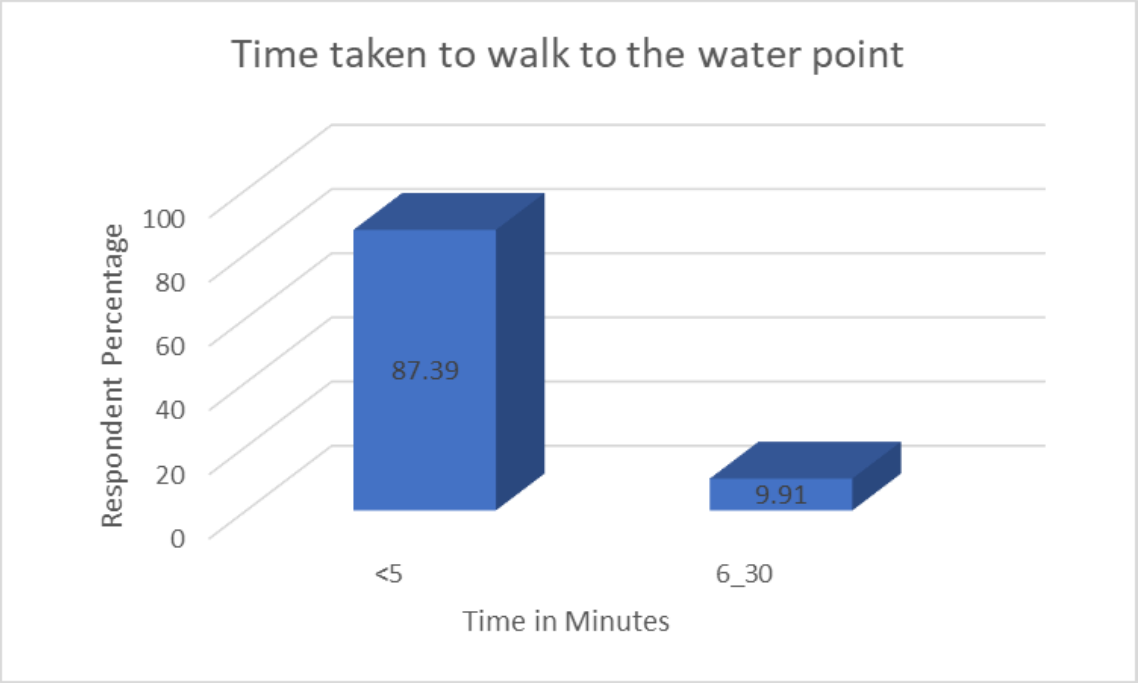

Figure 20:: The vandalised kiosks in the study area

The figure 21 represents the time taken by the residents to draw water from their nearest water point. The majority (87.39 percent) of water customers in all communities walk less than five minutes to the nearest standpipe and utilize prepaid meters. This shows that the water point is quite accessible to most of the residents. The findings of the study are compared to those of the United Nations, which state that the time required to walk to the nearest water source should not exceed 15 minutes. (UN, 2012).

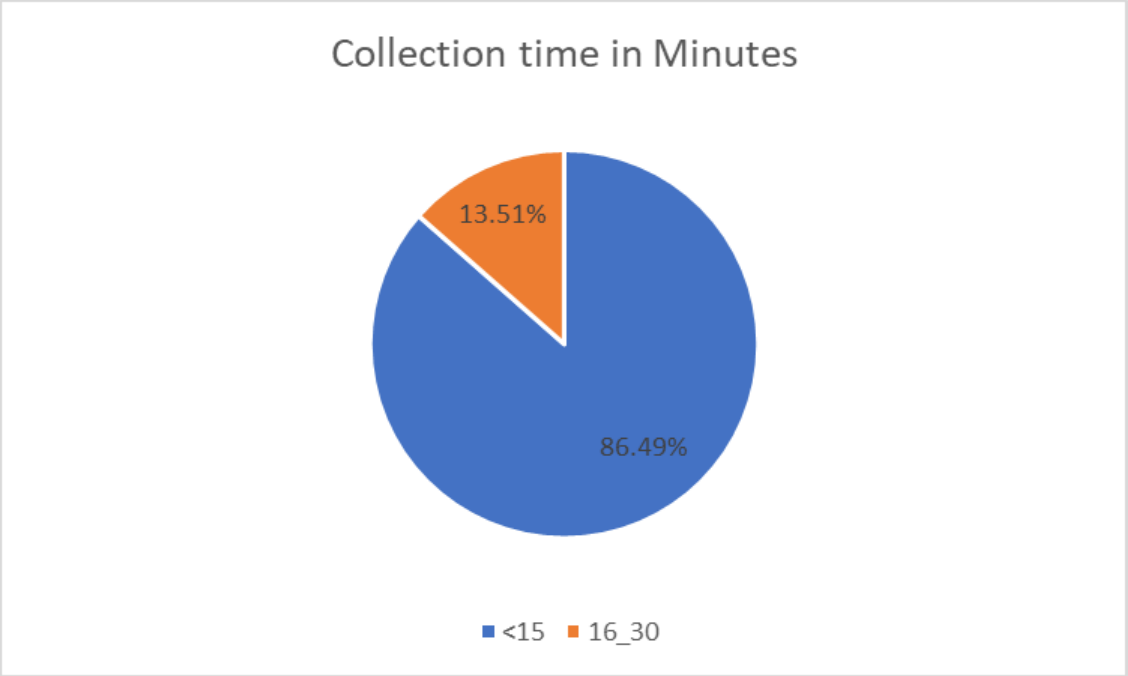

Figure 21: Water collection time

The figure 22 depicts the collection time on the nearest water point. The statistic above reveals that more than 86.49 percent of the respondents actually take less than 15 minutes to collect water to the nearest water station. The data suggest that water accessibility in the communities is within the recommended bands of United Nations as is highlighted to say collection time for water should be within 30 minutes(UN, 2012).

4.3.10 Functionality of prepaid meter

The respondents were asked to say if they have ever encountered the prepaid meter failing to due to different circumstances.

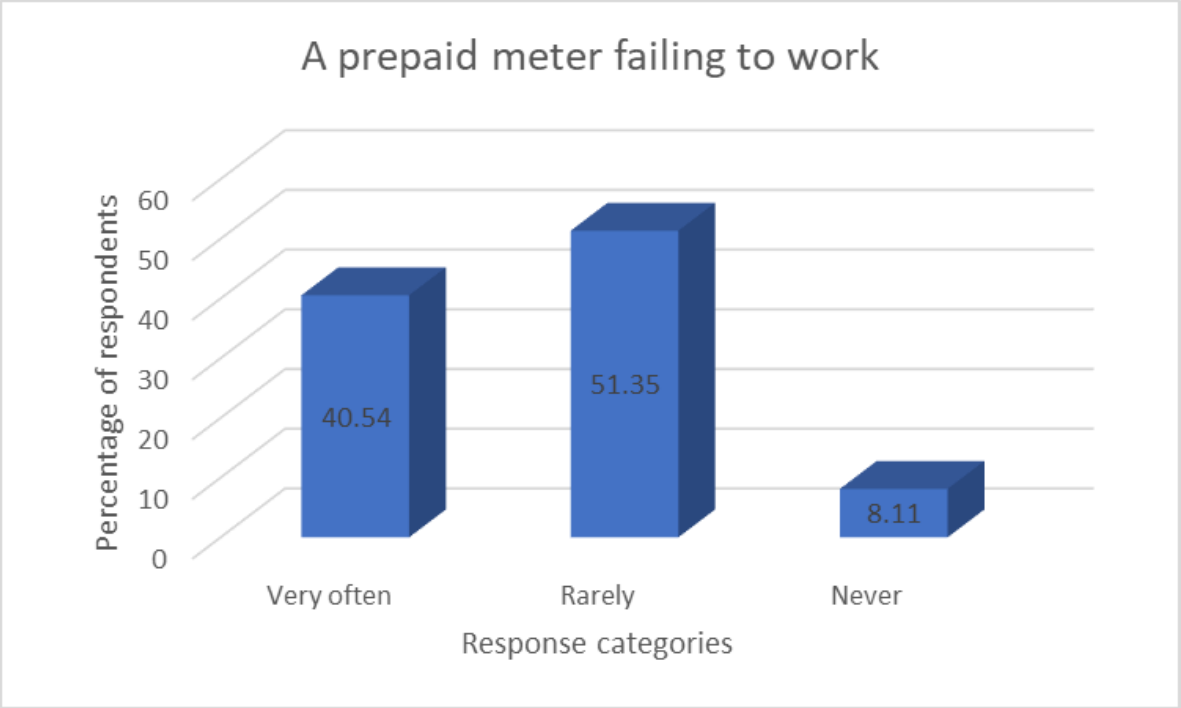

Figure 22: A prepaid meter failing to work

The figure 23 depicted the residents' responses on prepaid meters functionality. Prepaid meters fail to work on a rare basis, according to 51.35 percent of respondents, while 8.11 percent have never experienced it and the remaining 40.54 percent have experienced it more frequently. Then we dug deeper into the problem of prepaid meters failing to work. As described in the issue's residents face with prepaid meters on objective 2, vandalism, weather and the vending machine failure were the most common causes of prepaid meters failing to work. These are similar problems in Uganda, Kenya and Tanzania(Heymans et al., 2014).

4.3.11 Having no access to water for 24 hours.

Another question on the reliability of prepaid meters was administered; respondents were asked on how often have they experienced a 24-hr dry taps on the prepaid metering system kiosks.

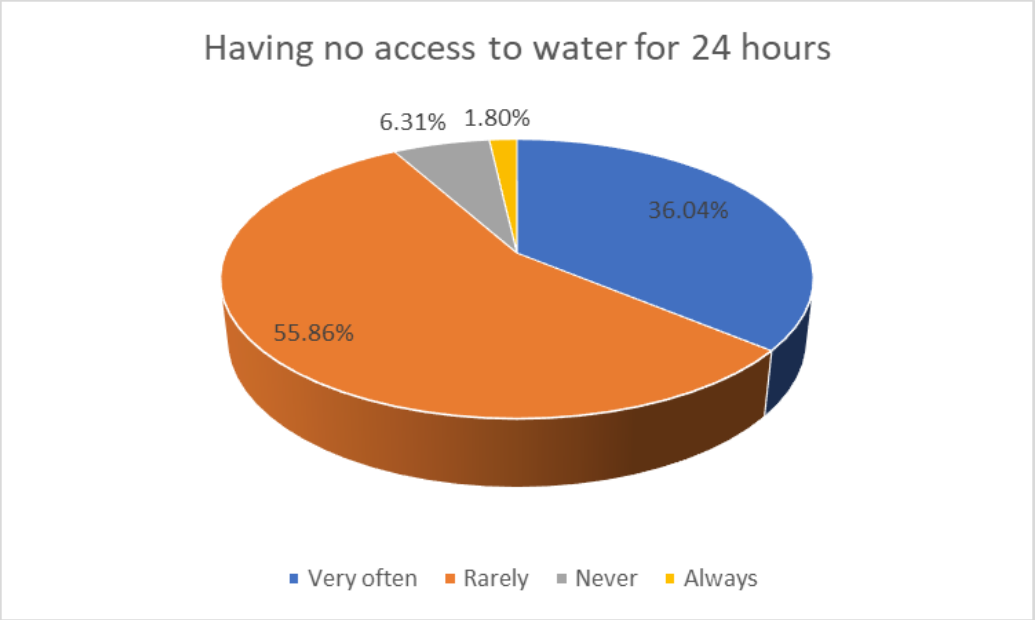

Figure 23:Having access to no water for 24 hours

According to the figure 24 above, it is extremely rare for inhabitants to be without water for more than 24 hours. Residents who responded "always" to having no water flow for 24 hours were questioned. These are the residents who receive water from other sources, even dangerous water sources, because they cannot afford to pay for water. Countries like Namibia have also experienced an improvement on their taps, they rarely experience dry taps for 24 hours hence resonating with this study(Iipinge, 2016).

4.3.12 Alternative Sources of water when there is no water flow from prepaid meters kiosks

Respondents were asked where they get water when they are experiencing challenges with prepaid meters, be it waterflow or failing to buy tokens. Multiple answers were provided from the 3 sampled communities.

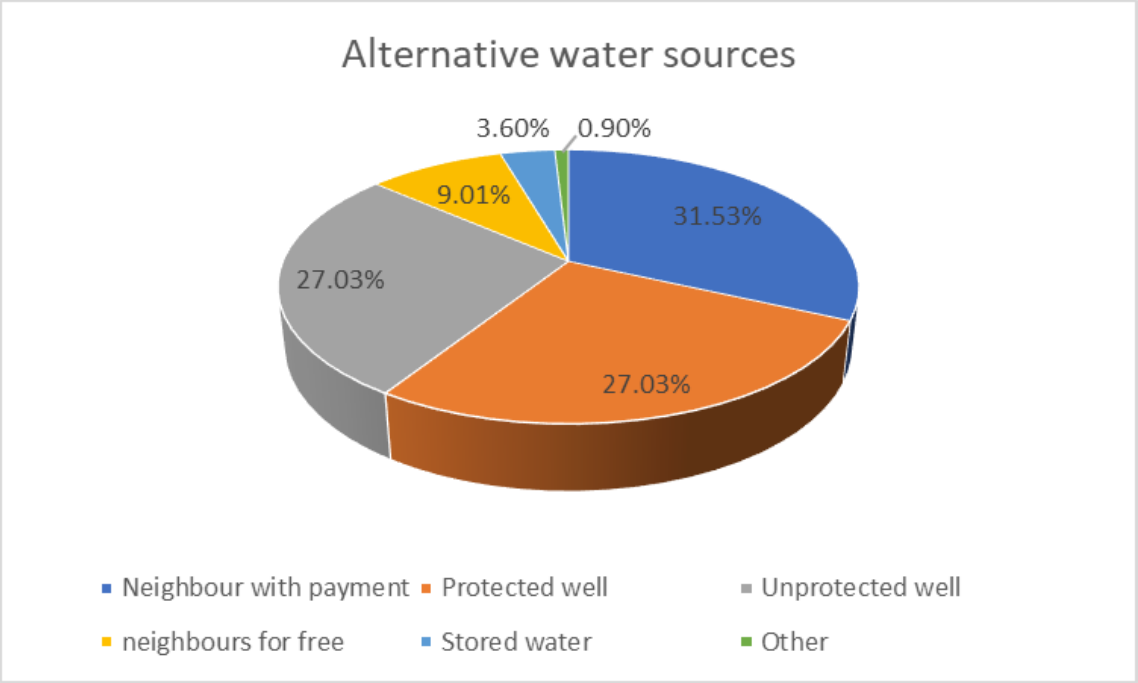

Figure 24:Alternative sources of water

The figure 25 expresses the common alternative water sources found in the area. While 31.53 percent of respondents get water from their neighbours, they do pay for it. Some of the neighbours have drums in which they stockpile water, which they sell at a slightly higher rate during a crisis than the prepaid meter kiosk. While 27.03 percent of people receive their water from protected wells and 27.03 percent from unprotected wells. Those who acquire their water from unprotected wells, for example, are at a very high risk of contracting waterborne infections. These are residents who, on occasion, are unable to obtain water from prepaid meters, not only because the meters are malfunctioning, but also because they do not have sufficient funds to obtain water from the kiosk. This is comparable to the findings of a research conducted in Nakuru, Kenya, where people seek water from unprotected sources, putting them at risk of contracting water-borne diseases. (Hanjahanja & Omuto, 2018).

4. 3.13 Response to fix the prepaid meter kiosk by the Municipality

The respondents were asked a question to see if the municipality responded swiftly to the difficulties with the water kiosk with prepaid meters.

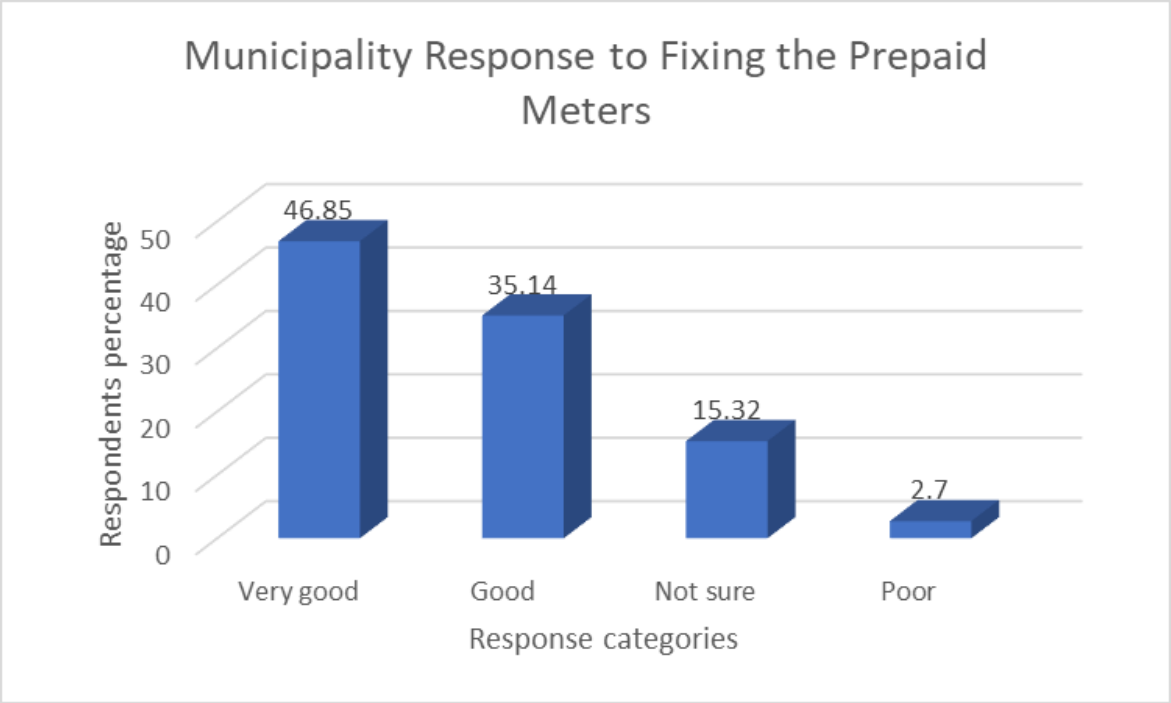

Figure 25: Municipality response to fixing prepaid meters

The figure 26 depicts the respondents experience with municipality on their response to fix the prepaid machine when it is faulty. The Municipality has done skills transfer to men dwelling in the specified study area, according to 46.8% of the respondents. Some respondents rated themselves poorly because some of the issues can only be resolved by the utility service provider. These findings contrast with World Bank research that said that most countries have difficulty repairing prepaid meters due to the high cost(Heymans et al., 2014).

4.3.14 Prepaid meters operation training

This study looked into how the municipality handed over the prepaid meters to the community once they were installed, including skills transfer and prepaid meter operation.
‘Who trained to operate the prepaid metering system as it is a recently introduced technology?' was one of the questions asked in this study.

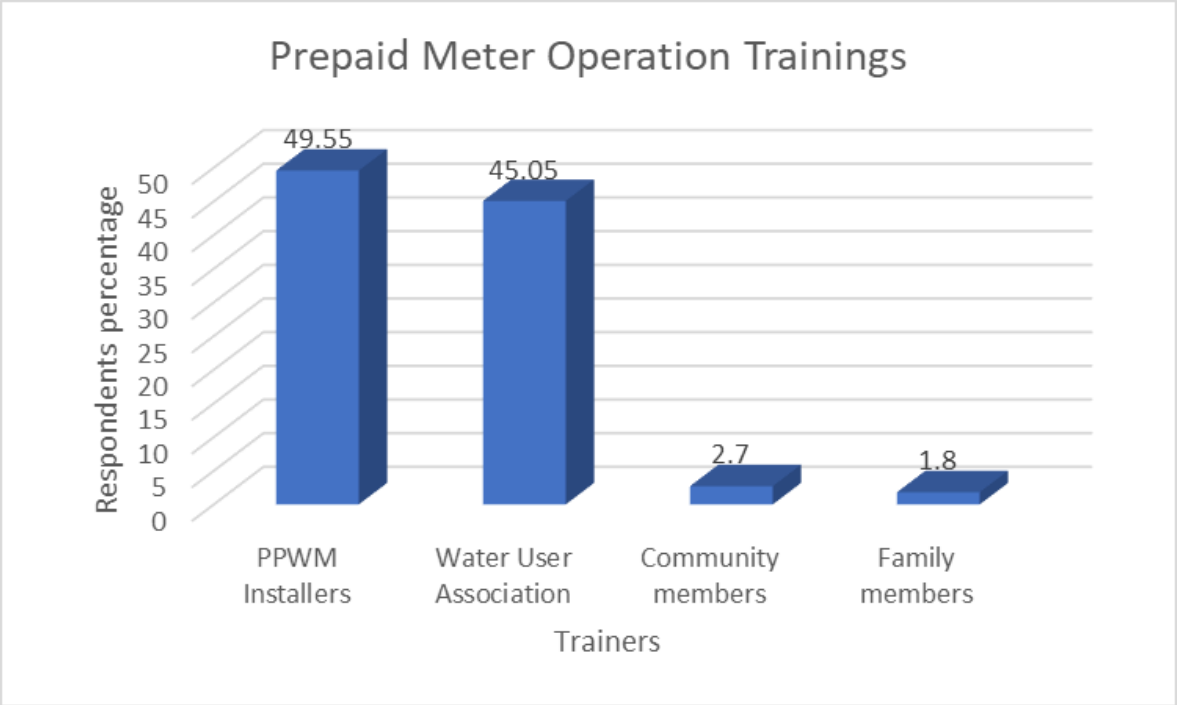

Figure 26: Prepaid meters operation trainings

The figure 27 depicts the results of the ones who offered training to the sampled communities as they were categorised according their work. Prepaid Meter installers trained 49.55 percent of respondents, while Water User Association trained 45.05 percent of respondents, and the rest respondents were trained by community and family members. The findings revealed that the Water User Association underwent skills transfer training in order to be able to train their members because they are readily available in the community and according the Malawi water supply governance structure which focuses on decentralisation of duties, the Water User Association are supposed to handle operations of kiosk at a local level according Malawi Decentralisation Policy (*MALAWI*, n.d.)

4.4 SANITATION

Sanitation facilities were observed in each of the studied households in this study. Toilets were classified as single-user or multiple-user since some people lived in the same compound and shared sanitation facilities. Also observed with the detergent were hand washing basins; the presence of detergent and hand washing basins was a signal that the families had access to water.

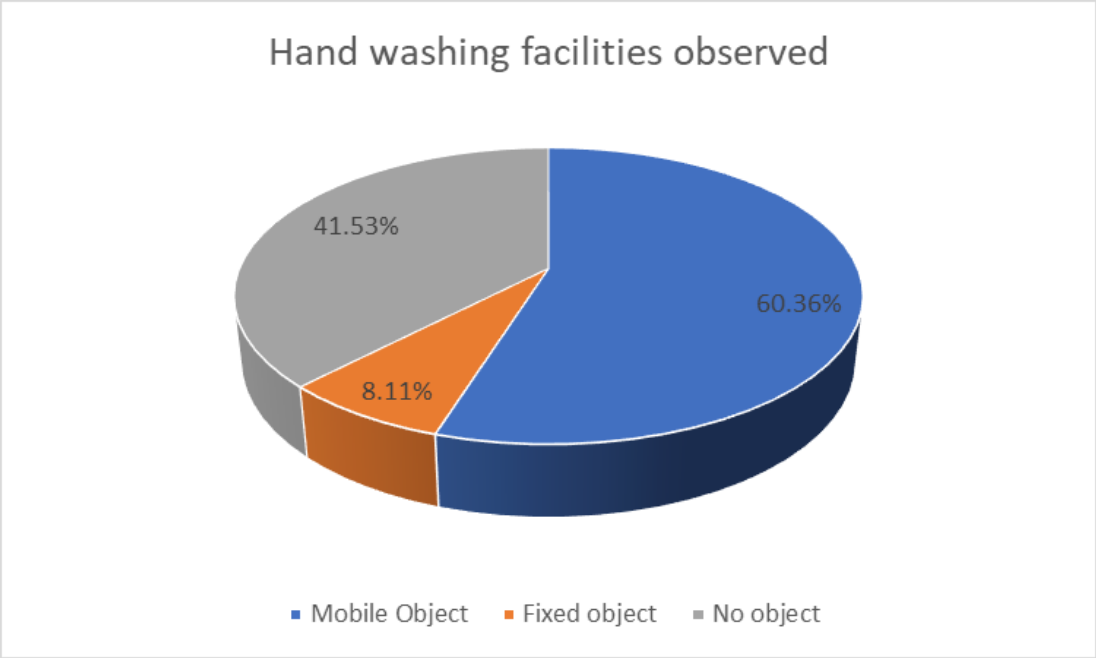

Figure 27: Hand washing facilities

The figure 28 shows the common hand washing facilities found in the sampled communities. The majority (60.36 percent) of responders demonstrated the movable bucket, whereas 8.11 percent demonstrated the sink where individuals wash their hands. Because they live in a peri-urban setting, most families cannot afford to build houses with washing sinks, so they buy buckets instead. When asked why they don't have buckets or a fixed sink in their residence, 41.53 percent of respondents indicated they use cups to pour water for each other anytime they want to wash their hands. Since water is now available in the communities, the majority of people now can use the sanitation facilities with ease. According to (Unicef,2020), For example, nearly half of urban South Africans, or 18 million people, lack basic handwashing facilities at home, with the wealthiest city dwellers about 12 times more likely to have access which in contrast to this study finding as people in the peri-urban areas have access to sanitation facilities.

4.5.1 Sharing of toilet facilities.

A question was asked to the respondents if they do share the toilet facilities.

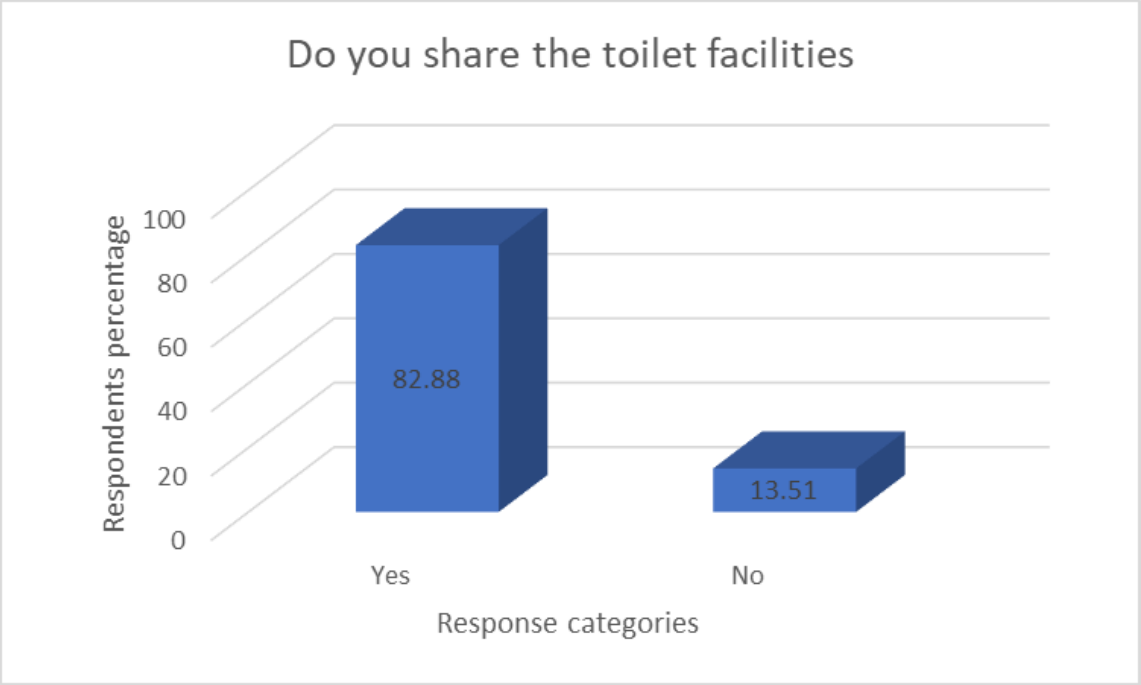

Figure 28: Hand washing facilities

According to the figure 29 above, 82.88 percent of respondents share toilet facilities with other families, whereas 13.51 percent of respondents do not share toilet facilities with other households. Because most households are in a compound of two or more households, this explains the peri-urban group. Because various people handle sanitation facilities differently, sharing bathroom facilities may induce waterborne infections to some level. In comparison with the study conducted in Lusaka Zambia, it showed that on average,2 household share one toilet, hence this also contribute to the outbreak of waterborne diseases(Nyambe et al., 2020).

The summary of the impact of prepaid meters for Malawi in comparison with other African countries

Country	Metering system	Affordability	Reliability	Revenue collection	Community perception

Malawi	**Prepaid**	**Sampled communities spend 1.8% of their total income per month hence the system is affordable**	**The prepaid meters is more reliable during summer**	**Income generation has improved**	**98% are willing to pay**
Namibia	**Prepaid**	**Affordable since you only pay for the consumed water**	**Prepaid meter is reliable because it has improved access to water**	**Income generation improved**	**People are willing to pay hence they like it**
Kenya	**Prepaid**	**Water is affordable than postpaid metering**	**Unreliable when its faulty but it has improved the access to water**	**There are no billforfeiters hence the revenue collection has improved**	**People like the system but there is a problem in buying credit when the vendor is away**
Zambia	**Prepaid**	**Water is affordable as customers no longer receives bills, they can't afford to pay**	**Yes, there is increase access to water**	**Revenue collection has improved**	**Its abit expensive for people with larger families**
Tanzania	**Prepaid**	**It has increased accessibility to water**	**It has improved accessibility to water hence the system is reliable**	**Revenue collection has improved**	**System is good but people fail to access water when they do not have money**

5.0 CHAPTER: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Based on the research objectives and findings, this chapter summarizes the findings and gives recommendations. As previously stated, the study focuses on the influence of prepaid meters on communal water points, as well as the affordability of water, people's perceptions of prepaid meters, revenue collection from prepaid meters, and overall prepaid meter reliability.

5.2 Conclusion

The primary goal of installing prepaid meters was to boost citizens' access to water in the peri-urban area by observing UNICEF proximity to water points and extending the number of hours people could get water, as well as to increase revenue collection and eliminate non-revenue water.

The study found that the introduction of prepaid meters improved a variety of factors, including water accessibility, as individuals can now obtain water 24 hours a day in most circumstances and do not have to walk a considerable distance to fetch water. The studies also revealed that revenue collection has improved because customers must pay for water before using it. People's perceptions have revealed that the price of water has decreased by 65 percent, making it more affordable than ever before. As a result, most households have improved their sanitation.

Since the project to install prepaid meters is underway, there is a need for more perfection in the functionality of prepaid meters because there are a few challenges that residents are encountering and that need to be addressed, such as low pressure or even no water on the water point when the weather is cloudy, vandalism in other kiosks, battery leakages and poor management of water kiosks. In a nutshell, inhabitants in peri-urban areas are pleased with the introduction of prepaid meters because it has resolved their typical water difficulties.

5.3 Recommendations

1. Because prepaid meter systems employ solar power, Lilongwe Water Board should consider re-sizing the system in order to calculate the energy daily requirement which will ensure water access even during the cloudy days
2. The Lilongwe Water Board should continue to monitor the system study in order to conduct a technical diagnostic study of the battery leakage issues, which will also allow the system to be fixed.
3. When the kiosk is not in use, the Water User Association should make sure it is firmly locked to prevent vandalism and theft of the communal water point's batteries.

4. Because some kiosks are owned by people, the Lilongwe water board should educate the water user association and business kiosk owners on the governance system. This will assist the water user association's revenue collecting percentage be more accountable.

5.4 Future works

Future research could focus on prepaid meter functionality throughout the winter and rainy seasons, with a particular focus on the technological inputs of prepaid meters.

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APPENDIX

QUESTIONAIRE

PART A: DEMOGRAPHIC INFORMATION

a. What is the sex of the head of household?

Male ☐ Female ☐

b. What does the head of household do to earn a living?

Employed ☐ Unemployed ☐ Business person ☐ pensioned ☐ casual worker ☐

c. What is the highest level of education for the head of the household?

No education ☐ Primary ☐ High school ☐ University ☐ Other (Specify)……

d. age, what is age group

below 20 years ☐ >20 to 30 years ☐ >31 to 40 years ☐ >41 to 50 years ☐ >51years ☐

e. What is the total monthly income of the household?

Below Mwk35,000 ☐ Mwk35,001- Mwk50,000 ☐ Mwk50, 001-Mwk65, 000 ☐ Mwk65, 001 and above ☐

f.How long have you been staying here?

Less than a year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ More than 16 years ☐

g. What is the average size of your household?

1-4 people ☐ 5-8 people ☐ 9-11 people ☐ 12-15 people ☐ Over 16 people ☐

h. Have your household used a prepaid water meter before?

Yes ☐ No ☐

i. Which Prepaid Water Meter (PPWM) does your household use?

If communal standpipe prepaid water meter, proceed answering the questionnaire

PART B: PRE-PAID WATER METERING

1

Question	**Less than 5 minutes**	**6 mins- 30 mins**	**31 mins to an hour**	**Greater than an hour**	
How far away is your closest functioning standpipe?					

2

How long does it take to wait in the queue to get water?	**Less than 15mins**	**15 mins- 30 mins**	**30 mins to an hour**	**30 mins to an hour**	**Greater than an hour**

3

USE	**Increased**	**Decreased**	**Has not changed**	**Not Applicable**	
Domestic Chores					

Watering plants					
Other(Specify)					

4

On a monthly basis, how much does your household spend on water?	**Amount(Kwacha)**				

5.How often do you need to purchase water units?

Daily ☐ Weekly ☐ Monthly ☐ Other specify……...

6.Have you ever encountered these problems at your household?

Statement	A=Yes If Yes, How often?		B=No	
	Always	Very often	Rarely	Never
a. Running out of water due to no water credit				
b. A prepaid meter failing to work properly				
c.Failing to buy water because the machine for				

selling credit had problems.				
d.Having no water for more than 24 hours				

7.To what extent do you agree or disagree with each of the following statements;

Statement	**strongly agree**	**Agree**	**Not Sure**	**Disagree**	**Strongly Disagree**
a. Prepaid water meters are good.					
b. Prepaid water meters are a good way of encouraging people to conserve water.					
c. Prepaid water meter are a good way of making people pay for water services.					
d. I like to use communal waterpoints with prepaid water meter					
f. My household was happy with a prepaid water meter on communal water point					

8.How do you rate the following about a prepaid water meter?

Statement	Very good	Good	Not sure	Poor	Very poor
a. Response of the municipality to solve the problems with your prepaid water meter.					
b. The billing system for the water services.					
d. Allowing you to access water every day.					
e. Encouraging you to avoid wasting water					
f. Ensuring that you pay for water					

9.When you do not have water units, where do you get water from?

Neighbors for free ☐ Neighbor with payment ☐ Protected well ☐ Unprotected well ☐Stored water ☐ Others, specify……

10a. Do you feel that the prepaid metering system is better than conventional system?

Yes ☐ No ☐ No difference ☐

b.Please, Explain…….

11. Who gave you the training on how to use the Prepaid water meters?

Municipality ☐ Community members ☐ Family members D= PPWM installers

PART C:SANITATION

HAND WASHING FACILITY OBSERVATION	

Can you please show me where members of your household most often wash their hands?	Fixed facility observed (sink/tap) Yes/No	
	In dwelling	
	In yard/plot	
	Mobile object observed (bucket/jug/kettle)	
	No permission to see	
	Other reasons specify	
SOAP OBSERVATION		
Observe availability of soap or detergent at the place for handwashing	Soap or detergent available	
	Soap or detergent not available	
TOILETS		
Do you have a toilet facility?	Yes	
	No	
Do you share this facility with others who are not members of your household?	Yes	
	No	
Where is this toilet facility located?	In own dwelling	
	In own yard / plot	
	Elsewhere	
EMPTYING OF ON-SITE SANITATION FACILITIES		
Has your (pit latrine or septic tank) ever been emptied?	Yes emptied	
	Never emptied	
	Don't know	
DISPOSAL OF EXCRETA FROM ONSITE SANITATION FACILITIES		

The last time it was emptied, where were the contents emptied to? Was it removed by a service provider?	Removed by service provider	
	to a treatment plant	
	buried in a covered pit	
	to don't know where	
	Emptied by household	
	buried in a covered pit	
	to uncovered pit, open ground, water body	
	Other (specify)	
	Don't know	

FOCUS GROUP DISCUSSION GUIDE

What do think about the pre-paid water meters on communal water point?
What do you think about how the community thinks about a pre-paid water meter?
Why were conventional billing system removed?
What were the problems you encountered with using a pre-paid water meter?
What are the advantages for using pre-paid water meters on communal water points?

What is the disadvantage of prepaid meters on communal water points?
Given a chance to use either a pre-paid water meter or a conventional water meter, which one would you choose? Why?

Question Guide for Water user Association 1

Question	**Very good**	**Good**	**Not sure**	**Poor**	**Very poor**

How do you rate ppwm over conventional billing system in terms of revenue collection?					

2.What are the advantages for using pre-paid water meters on communal water points?

3.What is the disadvantage of prepaid meters on communal water points?

4.What do you think consumers prefer in terms of billing system between ppwm and conventional?

S/No.	**Item**	**Unit**	**Quantity**	**Rate (Unit price)**	**Amount*(USD)**	**Link to Research Activity*****	**Comment*** (For Evaluator Only)**	**Invoices (in order with PDF version)**
(A) Material and Supplies								
1	Internet Recharge		5 months		193.46 USD	It was used for data		**Page 6-page 8**
2	Printing Copy of consent form		111 copies		76.00 USD	This is the consent form which is signed by every interviewed person during data collection		**Page 9**
3	Printing copy of clearance form		1 copy	1.52	1.52 USD	This is the consent form which is signed by the the authority to allow to collect data		**Page 9**
4	Face Mask and Hand sanitisers		5 months		150.00 USD	This was used as a healthy safety measures during covid-19		**Page 10**
5								
6								

	Sub Total				**420.98 USD**			
(B) Equipment								
	Sub Total				0.00 USD			
(C) Travel + Visa Costs								
8	Airticket		2		1,555.04 USD	This was a round trip airticket from Algeria to Malawi		**Page 11**
9	Taxi		1		22.22 USD	This was a taxi from Tlemcen to Algiers		**The procurement officer paid**
10	Covid Test		1		113.00 USD	I did covid test in Tlemcen prior to my travel		**Page 12**
11	Field Visit		6 trips		427.13USD	I booked taxi for 3 days to 3 different sites to collect data for my thesis		**Page 13**
12								
13								

	Sub Total				**2,117.39 USD**			
(D) Special Activities e.g. course, etc…								
14								
15								
	Sub Total				0.00 USD			
(E) Contingencies (%) (reserve at least $100 from which eventual bank transfer fees will be taken from								
Contingencies						Unexpected cost events that may arise during the research		
TOTAL								

A	Personnel				
B	Material & Supplies	420.98 USD			
C	Equipment	0.00 USD			
D	Travel	2,117.39 USD			
E	Special Activities	0.00			
F	Contingencies (%)	0.00			
	Grand Total	**2,538.37 USD**			