ASSESSING THE IMPACT OF PRE -PAID METERING AT BLANTYRE WATER BOARD

A MASTER OF SCIENCE DEGREE IN SUSTAINABLE ENGINEERING MANAGEMENT THESIS.

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UNIVERSITY OF MALAWI

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ASSESSING THE IMPACT OF PRE -PAID METERING AT BLANTYRE WATER BOARD

MASTER OF SCIENCE DEGREE IN SUSTAINABLE ENGINEERING MANAGEMENT (MSC SUS ENG) WATER SUPPLY THESIS

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DECLARATION

I, George Limbani Namizinga, declare that I am the sole author of this dissertation, that during the period of registered study I have not been registered for other academic award or qualification, nor has any of the material been submitted wholly or partly for any other award. This dissertation is a result of my own research work, and where other people's work was used, they have been dully acknowledged.

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DATE : September 16, 2016

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

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ABSTRACT

Blantyre Water Board (BWB) piloted an Information Communication and Technology-based metering system to improve its efficiency in water metering and collection of revenue. BWB did not make any deliberate plans to document results of the pilot. There are a number of salient factors which if not mitigated would affect the successful scaling up of such a new technology.

This research therefore provides BWB with new knowledge on the technology transfer in water metering systems and its impact on service provision. The research specifically;

1) Investigated how the transfer from post- paid to pre-paid metering technology has affected efficiency of operations of BWB; and
2) Determined the factors that need refining before starting of the next installation phase.

In the absence of documentation on the pilot, this research has filled the gap and provided new knowledge and insight that will inform BWB on the challenges and opportunities associated with pre-paid water metering technology's future scaling-up strategies.

The research adopted an exploratory study through literature review, interviewing key informants and administering a structured questionnaire to consumers. Data collected was coded using Statistical Package for Social Scientists (SPSS) and frequencies, means and variances were analysed with meanings of outcomes determined and interpreted.

The key research findings are that:

1) BWB has experienced increased revenue collections and has done away with arrears;
2) BWB has observed a reduction in operational costs and is able to save funds;
3) Households are able to monitor, control and budget their monthly water bills; and
4) Some operational aspects e.g. monitoring and credit selling need refining before commencement of the next installation phase.

The research concludes that pre-paid metering has a significant impact on the operations of BWB. It has helped improve the efficiency in water metering and collection of revenue but there is need also to improve some operational aspects. The research recommends BWB to have adequate trained staff, adopt better cost recovery options, enhance monitoring and improve credit selling options. In future, BWB should consider research on pre-paid meter performance in high density areas, conduct a comparative technology study among several water boards and look at the best options for pre-paid meter hardware and software.

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ACRONYMS AND ABBREVIATIONS

A.D	Anno Domini
AdeM	Aquas de Mozambique
AfDB	African Development Bank
AFW	African Water Facility
AMR	Automatic Meter Reader
ATM	Auto Teller Machine
AWWA	American Water Works Association
B.C	Before Christ
BPR	Business Process Re-engineering
BWB	Blantyre Water Board
COBOL	Common Business Oriented Language
EIRR	Economic Internal Rate of Return
EIRR	Economic Internal Rate of Return
EIS	Executive Information Systems
ESCOM	Electricity Supply Commission of Malawi
FN	Fixed Networks
HH	Hand Held
HHs	Households
ICT	Information and Communications Technology
IP	Internet Protocol
KFW	Kreditanstalt für Wiederaufbau
LUWSC	Lusaka Water and Sewerage Corporation

MACRA	Malawi Communication Regulatory Authority
NCWSC	Nairobi City Water and Sanitation Corporation
NRWB	Northern Region Water Board
NWSC	National Water and Sewerage Company
PLC	Power Line Carrier
PSP	Private Service Provider
SPSS	Statistical Package for Social Sciences
TV	Television
Ush	Ugandan Shilling
Vol	Volume
WASCO	Water Sewerage Company
WCC	Windhoek City Council
WSP	Water and Sanitation Program
WUA	Water User Association

APPENDICES

Appendix 1: Data Collection Instrument 1

Appendix 2: Data Collection Instrument 2

Appendix 3: Results showing Frequency Tables for Naperi and Mudi

GLOSSARY OF TERMS

Information Communication Technology - ICT refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication mediums.

Technology Transfer - Technology transfer is the process of transferring (disseminating) technology from the places and in groups of its origination to wider distribution among more people and places

Pre-paid Meters- A pre-paid meter is usually an electronic device that records consumption of water supply in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing purposes

Automatic Meter Reading (AMR)– This is a technology that allows automatic collection consumption, diagnostic and status data from water, electric and gas devices and then transfer that data to a central database for billing and analysis

CHAPTER ONE: INTRODUCTION.

Chapter one introduces the background of the research. It introduces Blantyre Water Board and its operations, introduces the impact of Information and Communication Technologies (ICTs) in general, highlights the need for water measurements and provides the status of ICT usage. The chapter also outlines the research goal, specific objectives and its associated research questions which guided the study

1.1 Background

The original Blantyre Water Board was established in January 1929 after the construction of Hynde Dam Scheme. It was reconstituted several times due to increasing service coverage until it became Blantyre Water Board on 1st April 1970. Its mandate is to supply safe water to the city of Blantyre and lately parts of Thyolo and Chiradzulu districts making 76,000 hectares the total area of coverage. A board of governors oversees the executive management which in turn is responsible for over 500 members of staff. Blantyre Water Board operates through 3 zones namely Kabula, Soche and Limbe. The zones provide customer services such as new water connections to all customer categories, fault repairing and meter reading.

As a general-purpose technology, the impact of ICTs extends well beyond productivity gains. ICTs act as a vector of social development and transformation by improving access to basic services, enhancing connectivity, and creating employment opportunities (World Economic Forum, 2015). It is becoming an important management and control tool for a variety of businesses worldwide. Its revolution holds the potential of transforming economies and societies and of addressing some of the most pressing global challenges of our time.

Globally, ICT is becoming an increasingly important tool that brings efficiency in managing water utilities. In developed countries, its application in water supply utilities is mainly for water network planning, management, operations support, customer management and back office issues. One of ICT applications that is being adopted by water utilities globally is pre -paid metering technologies. "In particular, pre -paid metering technologies will play an important role in measuring water consumption in real time, identifying leaks at the consumer level and making consumers more conscious about their water usage"(International Telcommunication Union, 2011). Pre-paid metering technologies can also provide individuals, businesses and water companies with information in near real time about their own water use, thus raising awareness about usage, locating leakages and offering better control over water demand. Other areas where ICT play a pivotal role in water supply include mapping of water resources and weather forecasting, asset management for the water

distribution network, setting up early warning systems and meeting water demand in cities of the future and just in time irrigation in agriculture and landscaping (International Telcommunication Union, 2011).

In Malawi, ICT is being adopted in different sectors of the economy. "Initiatives are currently on-going at national level in the area of eGovernment (eGovernment Programme, Electronic Legislation), Education and eLearning (Computers for African Schools Malawi, Pan African eNetwork), eInfrastructure (Regional Communication Infrastructure project, Malawi Sustainable Development Network Programme, MACRA Infrastructures projects, Malawi Research and Education Network, Electricity Supply Commission of Malawi (ESCOM) Fibre Optic project), Digital Repositories (Malawi Library and Information Consortium, National Digital Repository), eHealth and eBanking" (IST-Africa Initiative, 2015). A more dominant application existing in the e-commerce industry is the mobile money service. Mobile money services in developing countries are gaining in prominence mainly due to their effective way of conducting payments and providing access to finance, particularly in areas where access to physical bank branches or even Auto Teller Machines (ATM) machines is minimal (World Trade Organization, 2013).

Water is an essential commodity for every human being. The supply of water to citizens of any country is the responsibility of their governments which mandate specialized utilities to provide the service. Such a service entails expenditure especially on pumping and treatment of the water to acceptable standards at the consumer's tap point. To sustain such an operation utilities normally charge the consumers through periodic billing on their water supply consumption. Water utilities all over the world have been trying to find the most efficient way of billing their customers and collecting revenue. Since the early 80's several advancements have been made by a number of water utilities in the world in applying ICT for efficient billing of customers. However, ICT adoption and usage in the water supply industry in Malawi has been rather slow and mostly implemented on a pilot scale.

Blantyre Water Board (BWB) is one of the pioneering companies that adopted ICT in its financial and billing operations using Common Business Oriented Language (COBOL) spread sheet over 2 decades ago. On the other hand, its application in engineering and operations for the utility has been slow. It was only in 2013 that the BWB decided to pilot pre-paid water metering technology in two of its service areas. The Engineering Department also recently introduced remote monitoring of water levels in its storage tanks using an ICT based infrastructure. The new system is an advanced technology that has seen a shift from daily

physical inspection, and physical reading and recording of water levels by staff at each site. BWB is endeavouring to shift the traditional practice to ICT based technologies in some of its engineering operations with the aim of achieving efficiency.

BWB has embarked on a prepaid metering project in New Naperi and Mudi Estate on a pilot basis (Blantyre Water Board, 2013). The results of the pilot will in turn help BWB make informed decision whether to change from the conventional metering to an ICT based metering technology or not. BWB envisages that the technology change will be key for bringing efficiency in service and consequently increase collection of revenue. If adopted, BWB will bring in change through technological transfer that will be product and process embodied. As Cooper (1980) asserts, "introduction of such change in technology can be regarded as an innovation of a process or a product that is new to the economy of a particular country, regardless of whether it has been used before elsewhere" as cited in (Saad, 2000).

1.1.1 The Need to Measure Water Usage

Accurate water measurement is the means by which water utilities produce revenue to cover expenses, charge each customer equitably, prevent wastage of water, and minimize the load on waste water facilities (American Water Works Association, 2012). This concept is universally accepted today, but it took many years for the science of water supply and distribution to reach its present state.

1.2 Research Problem

The current manual water metering technologies are gradually becoming obsolete due to numerous problems they present. The water utilities are faced with a lot of administrative work and costs for the billing cycle and revenue collection. On the other hand, consumers complain about wrongly estimated, late or sometimes non-delivered monthly bills.

Blantyre Water Board piloted an ICT based metering system to learn the practical operational challenges associated with the introduction of the new technology before adopting it to its entire network. Although the pilot study could demonstrate workability of the new technology, BWB has not yet solicited and documented views from stakeholders. There are a number of salient factors which if not mitigated would affect the successful scaling up of such a new technology. It is a common tendency for humans to resist change.

The BWB's pilot project was executed almost at the same time with a similar project by Northern Region Water Board (NRWB). There is no historical record on their impact on a

utility company as well as on consumers in the local setting. This research has therefore provided new knowledge on pre-paid water metering systems and its impact on BWB.

1.3 Objectives

1.3.1 Main Objective

The research assessed the impact of pre -paid meters on the operational efficiency of Blantyre Water Board.

1.3.2 Specific Objectives

The specific objectives of the research were as follows:

i. To investigate how the transfer of pre-paid metering technology affected efficiency of operations of BWB.
ii. To determine key operational factors requiring improvement for successful phasing into pre-paid metering system.

1.4 Research Questions

The research answered the following questions:

i. What improvements has BWB achieved through the change in water metering technology transfer? Alternative question: To what degree has pre -paid metering technology improved operations - within BWB? and – service delivery?

ii. What key operational success factors should BWB note to ensure smooth transitioning to pre -paid metering technology?

1.5 Justification

BWB intends to roll out a large scale of pre-paid metering system installation in its service areas. This venture requires good justification of the pilot outcome with fully backed documentation in order to attract implementation support from development partners and other financiers. Secondly, documentation on the pilot outcome including lessons learnt are vital for any forward planning and consequent rolling out process. In the absence of such documentation, this research has filled the gap. It has provided new knowledge and findings that will inform water utilities and other stakeholders on the challenges and opportunities that are associated with the pre -paid meters technology's future scaling-up strategies.

1.6 Outline of the Thesis

Chapter 1 introduced the background of the research by among other things; highlighting the need to measure water and the status of ICT usage. The chapter also outlined the research goal, specific objectives and its associated research questions which guided the study.

Chapter 2 discusses the literature review which looks into individual country experiences. The chapter summarises and evaluates the literature.

This is followed by Chapter 3 which describes the research design, its adopted philosophy, approach and the strategy employed. It also describes in detail the population and sample size that was adopted, the proposed data analysis methods, research ethics and finally gives a description of the data collection methods that were employed.

Chapter 4 presents the findings which include the household characteristics, efficiency, impact, reliability, logistical arrangements, relevance and technological acceptance of the prepaid meters. The results are presented in qualitative form but also using graphics.

Chapter 5 presents the conclusion and recommendation made from research results.

CHAPTER TWO: LITERATURE REVIEW.

2.1 Introduction

Chapter two summarises and evaluates literature on ICT with specific attention to the impact of ICT on water boards, general organizations and also focuses on individual country experiences with pre-paid meters in the East and Southern African Region. The chapter summarises and evaluates the literature.

The significance of any research and what it establishes is inevitably judged in relation to other people's research and their findings, as such, it is very crucial to both map and assess the existing intellectual territory in order to establish what research has been published in the chosen area and if possible, to try and identify any other research that might currently be in progress Saunders (2007). In light of this, the literature is reviewed on the impact of ICT on organizations in general, on the water boards and on different experiences with prepaid meters. It also draws lessons from studies that have been done on pre-paid meters in South and Eastern Africa in addition to those from Malawi.

2.2 Impact of ICT on organizations

Information technology systems are used by organizations to perform various tasks. Some use IT to provide for the basic processing of transactions, while others enable customers, distributors and suppliers to interact with the organization through various communication technology systems such as the internet.

The term information technology systems in an organization is composed of four distinct parts which include: an organization, information in an organization, and information technology and information technology systems in an organization (Ramey, 2014).

Some of the impacts of information technology in an organization are listed below.

2.2.1 Facilitating Organizational Change

Jameleddine Zaidi (2006) observes that organizations change because of information received from their environments. Organizations also change because of transformations induced but not imposed by the generalized recourse to ICT and more generally by the standardization of managerial practices to the tower of the recasting of the process. To this end, many heads of organization have chosen computerization for policy re-organization. Thus methodologies for change of Business Process Re-engineering (BPR) depends on ICT

2.2.2 Transaction processing

Information technology simplifies the transaction process of an organization. At the heart of every organization are IT systems whose main role is to capture transaction information, create new information based on the transaction information. Transaction processing systems will update any transaction process and store that information in a database, so any concerned party in the organization can access that information via a centralized information storage network of internet.

2.2.3 Workgroup support

Since information technology facilitates in the creating an information sharing environment, workers can easily consult each other across different departments without any interruption. They can use emails, text chatting services to inquire something related to a given task at work. With work group support systems, group decision making becomes easier.

2.2.4 Executive support

An Executive Information System (EIS) is an interactive management information system (MIS) combined with decision support systems and artificial intelligence for helping managers identify and address problems and opportunities. An EIS allows managers to view information from different angles. Yet it also provides managers with the flexibility to easily create more views to better understand the problem or opportunity at hand.

2.2.5 Data Management

With the help of database software, an organization stores all its relevant data on a database. This infrastructure can be designed when it is internal or external. An internal centralized system can only be accessed within the organization while an external centralized system allows data to be accessed outside the organization using a remote (IP) internet protocol address or a domain name. In this case, employees or managers can use a company website to access relevant company data by use of passwords.

2.2.6 Communication

Information technology accounts in the development of communication technology. Services like electronic mail make communication within and outside the organization easy and first. Now days email communication is a default communication technology used by every organization. Communication is a great tool in business developments. With advanced

communication tools, employees and managers can easily make beneficial decisions in the organization.

2.3 Impact of ICT on Water Boards

The pre -paid metering technology became prominent from 2004. The technology is used in America, Europe, Asia and a few countries in Africa. Meeting the demand, especially in the rapidly expanding and poorly serviced settlements, requires new thinking and innovation. This is the main reason why there has been a surge in interest among sub-Saharan African water service providers in the pre -paid metering water systems. Their track record so far has been mixed. Some have been unable to sustain these systems, but others are delivering results that are sufficiently promising to mitigate potential risks (Heymans, 2014).

Due to the controversial nature of pre -paid meters, research has shown proponents seeing it as a way of improving customer relations, revenue, and access to services; critics complain about technical unreliability, high capital and maintenance costs, and a system they see as penalizing poor customers. Meanwhile in 2014, the Centre of Excellence in Water and Sanitation at Mzuzu University conducted a monitoring and evaluation for the pre-paid meters' pilot project implemented by NRWB. The study conducted a financial analysis which showed that the prepaid water metering system has a higher Internal Rate of Return at 94% compared to the 92% from the post-paid. This shows that the impact of the additional benefits derived from the prepaid water meter positively outweigh those for the post-paid meter. This survey observed that it is important for NRWB to consider the cost of the prepaid water metering since the analysis shows that despite doing away with substantive post- paid costs the benefits derived are only surpassed by a two percentage point. This point to the fact that the cost of the prepaid water meter (at three times as much as the cost of a postpaid water meter) is quite high and absorbs most of the benefits derived from doing away with the postpaid water meter. The NRWB would realize maximum benefits of the prepaid water metering system if it could source the prepaid water meter at a price lower than the 2013 purchasing price (i.e. MK90, 000.00). Therefore, the Board could also prioritize installing prepaid water meters for commercial and institutional customers whose tariffs are relatively higher than individual customers. In the long run, the high cost of prepaid water meters could be absorbed by cumulative income realized from commercial and institutional customers (Centre of Excellence in Water and Sanitation, 2014).

2.4 Conventional versus ICT Based Metering

2.4.1 The History of Water Measuring Technology

The Romans constructed the first aqueduct, called the Apian, in 312 BC. The Romans also constructed several other aqueducts and designed gadgets , called adjutages, for measuring water usages (Baker, 2004). The adjutages were simply designed with no precise form of measuring the velocity of water passing through the tube. (American Water Works Association, 2012).

The Mechanization of Meters

In 1896, Edward S. Cole developed the first mechanical meter based on the principle of Pitot tube. It was used for temporary measurement of flow rate in a large pipe. Several improvements were made over the years including designs for measuring flowing air and water and in the 1960's the Americans developed the turbine and current meter. A major contribution to the measurement of flowing water under pressure emerged later on with the invention of the venture tube (American Water Works Association, 2012).

The mechanical meters were categorized into three groups namely; displacement meters, non-displacement meters and compound meters. The grouping is based on construction type and functionality.

Automation of Water Meters

As it has been emphasized in the thesis, technology adoption has always lagged technology development. According to literature, the first remotely monitored water meter was patented in 1917 by E. H. Ford and A. Neff. It took 40 years, before the technology could be introduced for quantity sales (Global Water Intel, 2004).

Despite the fact a number of innovative water meter technologies have been introduced in the market since then, the market take-off had been dissapointingly slow. Global Water Intel (2004) points out that "Automatic Meter Reading (AMR) has only really taken off in the last four to five years, although it has been around for the last 15 to 20 years". AMR systems take readings from a meter through a device which then transmits the data to a computer for billing. AMR exists in three forms as follows:

- ***Hand-Held Systems-*** These AMR systems use hand held devices to read meters via radio transceivers. They are operated by meter men but significantly reduce human error in readings. They can read meters remotely over distances of several meters and

permit accurate reading of almost 100% customer billing, averts disputed estimate bills and raises human reader productivity (Global Water Intel, 2004).

- ***Drive-by Systems*** **–** This is another form of AMR where radio frequency meter readings are collected by equipment in a van, travelling at normal road speeds. It reduces manpower and is much quicker (Global Water Intel, 2004).

- ***Fixed Networks*** **–** The most advanced AMR systems are the Fixed Networks (FN). FN systems read and transmit meter data directly to the utility office in real time by radio signals. FN systems can constantly monitor meters, typically four times a day. They permit utilities to have a constant, clear picture of how their whole system is operating (Global Water Intel, 2004).

Pre-paid Meters

A pre-paid meter is usually an electronic device that records consumption of water supply in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing purposes. Pre -paid meters enable two-way communication between the meter and the central system. Pre -paid meters can gather data for remote reporting (Heymans, 2014). To complete the system, a complimentary infrastructure for selling credit is required and this may comprise a network of credit vendors to sell prepaid credit or "top-ups" to customers.

Blantyre Water Board embarked on a 3 months pilot of the pre-paid meters in October 2013. It allows customers to check credit depending on the type of pre-paid meter installed. Customers are allocated 2 m^3 of water as a start-up credit which is deducted from the first water purchase (Blantyre Water Board, 2013).

2.5 Pre-paid Water Meters Experiences

This section presents experiences with pre-paid meters from Malawi, the Eastern and South African Region.

Table 1: Summary Observations on Country Pre-paid Meter Experiences

Country	Motivations for venturing into Pre-paid meters	Type and Location of Connections	Observed issues with pre-paid meter	Main Lessons Learnt
Lesotho, WASCO	• Struggle to secure outstanding arrears	• Communal Stand pipes • Individual Connections	• Extensive maintenance support • Alternative for improving payment	• Associated costs are often underestimated • Ensure accreditation by local standards authority & test meters under local conditions.
Mozambique, (AdeM)	• Difficulties in collecting payments	• Public Standpipes • Communal Sanitation Blocks	• Frequent technical problems	• Meters that are initially inexpensive can prove very costly. • Ensure that meters are reparable locally. Prepaid meters can safeguard the continuity of water supply at standpipes run by tap attendants. • Provide enough places to buy credit
Namibia, WCC	• Conservation • Seeking means of fair charging to users sharing a communal standpipe • Improving collection of payments	• Communal Standpipes	• High capital and running costs • Difficult to find best model that offers reliable service	• Be cautious in piloting and capacity building • Delays in restoring a supply that users have paid for invites vandalism • Organize customers and issue tokens according to settlement area or ward. • Build in-house capacity for maintenance
Malawi, NRWB	• Growing no of debtors • High and un delivered bills • High administrative costs	• Individual Connections in middle & high income areas	• 24 hour access for credit is essential. • Bills are accurate	• Continuous awareness on meter operation is essential. It helps customers appreciate benefits & reduces complaints.
Uganda, NWSC	• Payment problems	• Public standpoints • Institutional customers	• Lack of a reliable model • High capital and maintenance costs	• Pre-paid meter offer low income customers significant benefits.

Kenya, NCWSC	• Improve water demand management chronic supply shortages in the city • Improve payment levels & reduce losses • Provide access in informal settlements • Reduce cost of collections	• Individual connections • Public Standpipes	• Frequent technical problems	• Ensure effective after sales support • Pre-paid metering entails more than just a supply contract for metering components. • Pre-payment in low-income areas with individual connections and a poor payment history carries a higher risk of vandalism and bypasses.
Zambia,	• Improve payment levels • Streamline revenue management • Reduce cost of doing business • Strengthen WDM	• Individual Connections • Public Standpipes • Institutional Connections	• Low pressure in the system and erratic power supply affecting performance of meters.	• Individual connections helped to increase pressure • Institutional connections significantly improve cash flows and reduce bad debts.

Source: 1) WSP, the World Bank, Pre-paid Meter Case Studies for Kampala, Lusaka, Nairobi, Windhoek, Maseru and Maputo, 2014

2) Centre for Excellence in Water and Sanitation, (2014) Monitoring and Evaluation of Prepaid Water Meters Project; Mzuzu University

2.6 Motivations for Venturing into Pre-paid Metering

2.6.1 Improving Revenue Collection

Table 1 above indicates that the common motivating factor among the seven countries (Namibia, Kenya, Zambia, Malawi, Mozambique, Uganda and Lesotho) was the need to increase payment levels. The experience among all the utilities that employed the pre-paid metering system shows that they had accumulated high levels of debts which were subsequently affecting their operation let alone their intention to improve or extend services. (Heymans, 2014) points out that, "WASCO, Lesotho's Water and Sewerage Company, struggles to secure payment from customers who are in arrears, and carries substantial long-term debt as a result. It singles out middle-and high-ranking civil servants living in subsidized government housing for special mention". The other countries similarly faced challenges with accumulated debts especially from government institutions and had no financial footing to meet their service challenges.

According to the NRWB in Malawi, the old system had many challenges that negatively impacted on the boards' cash-flow and operations (Board, Northern Region Water, 2013)

The National Water and Sewerage Corporation in Uganda was strongly motivated to implement this technology because it discovered that vendors at PSPs would charge rates up to five times higher than the tariff. Additionally, vendors would fail to turn in collections to the utility (7M Construction Magazine, 2010) . On the other hand the NWSC started implementing installation of prepaid meters to all government ministries and departments with focus on measures to control arrears accumulation (National Water and Sewerage Company, 2014)

2.6.2 Strengthening Water Demand Management

The second motivating factor was the need to strengthen water demand management and this was a call for water utilities in Namibia, Kenya and Zambia. Heymans (2014) observes that "Conservation is important as Namibia is a highly arid country". It further states that Windhoek and other city councils have been investing substantial time and resources over the years in seeking to minimize water wastage in an arid environment, and ensure that standpipe taps are not left running. Pre-paid meters are seen as a potentially effective way of raising awareness of the challenges of conservation among customers. Prepaid meter installations have been a helpful means of strengthening water demand management in the 3 countries.

They have been helpful in resolving leakage problems, controlling household consumption and improving pressure in water systems.

2.6.3 Reducing Cost of Doing Business

At the same time Utilities in Kenya, Zambia and Malawi wanted to reduce the cost of doing business mainly emanating from meter reading and bill processing operations. In Kenya the Nairobi City Water and Sanitation Corporation (NCWSC) concluded that it is good to target prepaid meters in high-income areas with a good payment history where access for meter readers is difficult. In these areas, meter readers often estimate consumption, which leads to billing queries. NCWSC found pre-payment to be a solution in addressing this challenge and at the same time reducing the operation cost. In agreement (Centre of Excellence in Water and Sanitation, 2014) states that the Northern Region Water Board (NRWB) of Mzuzu in Malawi, was challenged with high administration costs associated with the billing cycle and revenue collection. In response to this challenge NRWB implemented the pilot Prepaid Water Meter Project.

2.6.4 Providing Access to People Living in Informal Settlements

The third motivating factor for the countries to introduce pre-paid meters was the need to provide access to people living in informal settlements. The concerned Water Utilities in Namibia and Kenya wanted to seek means of providing access to people living in informal settlements but also seek means of fair charging to communities sharing a communal stand pipe.

It has been observed that individual connections are problematic in most informal settlements mainly due to land tenure issues and affordability therefore most utilities resort to installation of public stand pipes. The management of these public stand pipes or kiosks has often fallen into wrong hands especially in countries where water governance issues have not been prioritized. In Kenya, the NCWSC, supplies water to kiosks at discounted tariff which is then re-sold to consumers by kiosks attendants or private vendors (WSP, The World Bank, 2014 - e).

It is further observed that water vendors sell water by the jerry can for 2 to 5 shillings each, but the price can rise above 15 shillings in times of scarcity. There have been proven instances of local gangs and cartels colluding with utility officials to create artificial shortages to boost informal water prices. By introducing pre-paid meters, the NCWSC ensured that

consumers can equitably access water at a fair price without the vendors taking advantage of the consumers (WSP, The World Bank, 2014 -e).

2.7 Experiences from Different Pilot Connections

Almost all countries except Malawi targeted low income areas for the testing of pre-paid meters and connections were made on public stand pipes. On the other hand, 4 out the 7 countries experimented the pre- paid meters on individual connections. These countries include Kenya, Malawi, Zambia and Lesotho and the piloting was mainly done in middle to high income areas where collection of payment is not a problem. Finally experiments were also done through institutional connections essentially to take out outstanding arrears normally borne by government departments and institutions. Only Zambia and Uganda introduced the meters on institutions. The following sub chapters describe observations and reactions from the different market segments after introducing the meters;

2.7.1 Public Stand Pipes

2.7.1.1 Gaining Support and Cooperation of Land Lords

The experience in Uganda showed that it is vital when installing meters to gain support and cooperation of landlords since they are the ones who provide land on which the stand pipes are installed. (Heymans, 2014) indicates that "Only a small area is required one square meter for the meter, but installation entails agreeing servitudes and laying pipes, and landlords have to sign an agreement with National Water Sewerage Company (NWSC) stating that they will not bar access to anyone wanting to use the prepaid meter, and are willing to play the role of caretaker on behalf of tenants living on their land and in the vicinity". It is observed that where such arrangements are in place, the landlord gains a water connection to his or her own property at no cost, with benefits including convenience and the ability to attract tenants and perhaps charge slightly higher rents.

2.7.1.2 Emergence of Intermediaries

An important reason why NWSC introduced prepaid metering in Kampala's slums was to allow customers to buy their water directly from the utility, without intermediaries and their mark-ups. But unless every resident household that wants a token can have their own, the problem of intermediaries persists (WSP, The World Bank, 2014 - a). It is noted that a number of intermediaries including some landlords re-sell the water at a higher price and thereby denying access to some vulnerable households especially supply is not intermittent.

2.7.2 Individual Connections

Water Sewerage Company (WASCO) indicates that the first 100 individual metres it introduced for piloting performed poorly and had problems with pre-paid cards, valves , the battery and the supplier went out of business. Despite these technical problems, a WASCO customer satisfaction survey conducted at the time showed strong demand for more prepaid water meters. To ensure ease in operations all individual meters were put to run on proprietary software.

In Malawi Centre of Excellence in Water and Sanitation (2014) observed that, "The proportion of households which rated the prepaid water metering system as good increased during the monitoring and evaluation period from 87.4% in December 2013 to 95% in February 2014. Similarly, the results of the FGDs revealed that the participants, stakeholders and communities look at the prepaid water metering system as a good way of making them monitor and control their levels of water consumption, in addition to assisting them in their monthly cash flow planning". It is further stated that no customer has ever complained about the accuracy of prepaid water meters. Participants in the FGDs expressed satisfaction about the accuracy of prepaid water meters and reported that prepaid meters have helped them do away with worries about unpredictable bills, wrong billing, no bill deliveries and disconnection since they are very accurate.

In Kenya, following the pilot program, the NWSC observed that individual connections are simply not an option as the default in informal settlements, because unresolved land tenure issues make it difficult to formalize the servitude (land use arrangements across generations of owners or tenants) required to lay down reticulation networks. Residents need a more equitable alternative to kiosks and private vendors, who charge these customers substantially more than they charge customers with the convenience of a home connection.

2.7.3 Institutional Connections

The experience in Uganda indicates that institutional connections mainly on government side default payments and special arrangements have to be made to ensure payments in good time. Kampala's NWSC signed a memorandum of understanding between the utility and the Ministry of Finance and Economic Development, which focused on measures to control the accumulation of arrears". NWSC believes that prepaid metering will reduce wastage significantly. At some connections, they believe consumption can be reduced by 70 percent without any negative health impacts, as taps are often left running continuously and broken ball valves are left unattended.

Meanwhile in Zambia, the Lusaka Water and Sewerage Corporation (LWSC) observed that Prepayment for institutional customers in particular significantly improves LWSC cash flows and reduces bad debts from large customers that are often slow to pay. Since initial introduction of the first pre-paid meters to a few customers mainly from government departments and commercial customers, an instruction by cabinet saw all remaining department get pre-paid meters. According to the World Bank (2014) one challenge that surfaces was low water pressure initially compromised the performance of some meters, but once hose leaks were repaired, consumption at some sites fell by two-thirds. This, in turn, increased network pressure and resulted in a higher network leakage ratio.

2.8 Issues Observed on Pre-paid Meters Pilot Projects

2.8.1 Frequent Technical Problems

Table 1 shows that out of the 7 countries under study, 5 indicate to have experienced frequent technical problems with their meters. Most countries are still looking for a model that can provide a reliable service.

The use of prepaid meters has experienced numerous problems in Maputo as a result of interrupted water supply, low water pressure, and virtually no after-sales service by the supplier or access to spares. (WSP, The World Bank, 2014-c) indicates that "To date, Aquas de Mozambique (AdeM) has tried three types of prepaid meters, but it is not satisfied with the performance of any of them. Most failed within a year of installation. AdeM staff cannot repair the meters and simply have to remove and replace those that are faulty". In this case it is observed that the meters have performed poorly and most prepaid meter models would struggle with reliability in Maputo, given frequent supply interruptions and low water pressure.

Namibia's Windhoek City Council (WCC) has also experienced several problems with different types of water meters. Over 15 years, WCC has used different permutations of prepaid meters from three different manufacturers in the hope of finding one that offers reliable service at an affordable price. WCC moved away from one early supplier because their after-sales service was poor and increasingly expensive. Another type, installed at scale in 2010, was removed within 18 months, after a host of problems the manufacturer was unable to rectify (no water, free water, vending problems, software problems, data losses, etc. A version of the same meter was installed on several yard connections on a trial basis, but there were repeated failures. Customer feedback was allegedly very positive as this meter

supplied mainly free water. This make of meter was not reparable locally and had to be sent back to the supplier. The report further notes that WCC calculated that the cost of maintenance would be prohibitive beyond the guarantee period, and opted to replace them all. In their place, WCC installed a prepaid meter that cost as much as the meter it replaced, but offered better reliability (Heymans, 2014).

Uganda's National Water and Sewerage Company (NWSC) also experienced frequent problems with the models of meters it has been using. When prepaid meters were first introduced in 2007, breakdowns were more frequent than they are now. NWSC initially used two types of prepaid meters. One hundred meters of one type proved unreliable, with a short battery life, problems reading the token and loading credit, jammed valves, faulty seals, and leakage. "Some 20 percent failed within the first six months and were not reparable locally. All have been removed or disabled. The second type is more reliable and more readily reparable, and is used in all NWSC installations, even though the utility would prefer to have more good prepaid meters to choose from" (WSP, The World Bank, 2014 - a). It is noted that with hindsight, NWSC managers acknowledge that the utility underestimated what it would take to support and service prepaid meters.

Meanwhile in Nairobi, Kenya (WSP, 2014) points out that "the meters worked reasonably well for the first two years, but then customer complaints alerted them to a rise in the number of faults". It is further observed that NCWSC is not geared to provide a rapid response to service failures or perform regular monitoring and a growing number of meters have now been replaced with an unmetered "straight through" unmetered connection.

On the other hand LWSC of Zambia experienced problems with their meters because of poor after sales support by suppliers and low pressure in the system. LWSC first piloted prepayment for individual customers in 2007, when two types of prepaid meters were installed on the connections of a thousand middle and low-income customers in the suburb of Libala. This area had 24/7 water supply, but low water pressure averaged about 0.7 bar.

2.8.2 High Capital and Maintenance Costs

Out of the 7 countries, 3 countries (Lesotho, Namibia and Uganda) introduced meters with high capital and maintenance costs. The high capital costs were probably due to the models they settled for while high maintenance was resulting from repairs being done due to the frequent problems they were experiencing as well as the need to replace some parts e.g. batteries.

According to the operations director for Lesotho's WASCO he feels that prepaid meters are unreliable and require high maintenance, particularly in winter. The finance director acknowledges the cash flow benefits of the pre-payment, but says prepayment constrains sales. He is concerned about the high cost and the system's vulnerability to tampering (Heymans, 2014). Despite their high capital and running costs, Namibia's WCC remains convinced that prepaid standpipes are the best available option for supplying water from communal standpipe and managing waste. (WSP, 2014) This is following high expenses borne by the water utility in procurement and maintenance of the meters. Similarly Uganda experienced high capital and maintenance costs.

2.9 Lessons Learnt from Other Water Boards in the Region

2.9.1 WASCO in Maseru, Lesotho

According to the case study carried out by WSP, The World Bank, 2014-d, WASCO learnt the following lessons from their pilot activities:

i. Prepaid meters as one component of the cost of prepayment system

   Vending, management software, and maintenance are major costs that are often underestimated. Higher collection rates from individual prepaid meters are offset by lower consumption and lower revenue.

ii. Accredited Standards for meters

   Maseru's prepaid meters carry the necessary accreditation for South Africa, but Lesotho's extremely cold winters are more demanding than the meters were designed to tolerate. The meters often shut down in sub-zero temperatures, inconveniencing customers and adding to the utility's maintenance burden. It is therefore important to ensure that meters have been accredited by the relevant standards authority and have been tested under local conditions.

2.9.2 Adem in Maputo Mozambique

Following their pilot phase, WSP, The World Bank, (2014)-c reports that Aqua de Mozambique picked up the following lessons:

i. Capital costs are expensive

   Meters that are initially inexpensive can prove very costly if they fail soon and cannot be repaired.

ii. Local after-sales support

   Ensure that meters are reparable locally and that the supplier can offer good after-sales service and spares. Insist that the supplier trains utility technicians how to maintain and repair the meters.

iii. Water Supply assurance through prepayment

Prepaid meters can safeguard the continuity of water supply at standpipes run by tap attendants**,** because payments to the utility are assured, but the water is no cheaper for users.

iv. Adequate credit selling points

Provide enough places to buy credit; otherwise the inconvenience to customers incentivizes bypasses**.**

2.9.3 WCC in Windhoek, Namibia

WSP (2014) points out that Windhoek City Council (WCC) derived the following lessons from their pilot studies.

i. Cautious approach for Technology Transfer

A slow cautious approach to piloting installation and building management capacity is necessary when innovating with an unproven technology and without funding support.

ii. Quick response time

Delays in restoring a supply that users have paid for invite vandalism. With this in mind, the WCC aims for a response time of less than one hour.

iii. Involve local communities for accountability

Organize and issue tokens according to settlement area or ward, with applications for tokens countersigned by the head of the area. This improves local accountability around responsible use and reduces vandalism.

iv. Build in-house maintenance capacity

Build in-house capacity to maintain and repair the prepaid meters. External service providers are expensive, and are not always able to respond with the level of urgency that customers need. Build a database that tracks call-outs and the type of faults logged for each meter so that their maintenance and spares-needs can be managed better.

2.9.4 NRWB in Mzuzu, Malawi

The Center of Excellence at Mzuzu University cites the following lesson from the Monitoring and Evaluation exercise they carried out on the pre-paid meter Pilot Phase by NRWB:

i. Carry out regular awareness

"Continuous awareness on meter operation is essential. It helps customers appreciate benefits and reduces complaints" (Centre of Excellence in Water and Sanitation, 2014).

2.9.5 NWSC in Kampala, Uganda

The National Water and Sewerage Corporation (NWSC) list the following as their lessons on pre-paid metering:

i. Pre-paid standpipes provide cheaper water and convenience

Prepaid standpipes can offer low-income customers significant benefits, despite high upfront and ongoing costs to the utility. They could provide cheap water at a constant price without mark-ups by intermediaries and 24/7 access. Because they resolve problems over payment to the utility, the utility is more willing to install additional water points, and so prepaid standpipes can also offer closer, more convenient access and shorter queuing times.

ii. Need for a dedicated prepayment operations unit

A dedicated pro-poor unit with operational responsibilities can be a useful vehicle for coordinating resources and activities around installation, vending, and ongoing support for prepaid metering. Ready access to spares is essential to minimize the time when faulty meters are out of order. Every resident who wants a credit token should be issued (or re-issued) one to avoid new intermediaries emerging who add a mark- -up on the utility's tariff and sell from prepaid meters to people who do not have their own credit token (Heymans, 2014)

2.9.6 NCSWSC in Nairobi, Kenya

Kenya's NCWSC learnt the following lessons:

i. Ensure after-sales support and in-house training

Give special attention to contracting effective after-sales support**.** Make provision for a maintenance service contract when installing prepaid meter system, as well as in-house training of staff in maintenance and repairs.

ii. Pre-paid metering involves several components

Installing prepaid meters entails more than a supply contract for metering components**.** Effective prepayment requires an integrated management system, and extensive preparation and consultation with staff and customers to re-orientate their thinking.

iii. Invest in improving relationship with customers

Prepayment in low-income areas with individual connections and a poor payment history carry a higher risk of bypasses and vandalism**.** The Nairobi experience suggests that there is value in focusing staff resources on improving the relationship between customers and the utility, and explaining what water tariffs pay for (WSP, The World Bank, 2014).

2.9.7 LWSC in Lusaka, Zambia

According to the case study carried out by World Bank WSP, LWSC learnt the following lessons from their pilot activities:

i. Big water savings are likely for the utility.

   Reduced consumption and strong incentives to fix on-plot leaks may allow longer hours of supply, higher water pressure, and more water to serve new customers.

ii. Verify and fix network before meter installations.

   This includes checking that pipelines do indeed lie where they are believed to be, and identifying and rectifying vulnerabilities. The reduced consumption that usually accompanies prepayment will raise the water pressure and reveal vulnerabilities in the network that could increase leaks and non-revenue water (NRW).

iii. Upgrade the network to support 24/7 supply

   This should happen before installing prepaid meters. Supply interruptions introduce grit and air into the system, which impair the performance of prepaid meters and cause customers to complain that the meters are "stealing" their credit.

iv. Building customer acceptance of prepayment requires significant resources.

   Some utility staff may argue that available funds are better spent extending services to new areas, rather than on interacting with people who are already serviced. However, the value of vast investment in prepayment can be compromised if customers do not understand the tariffs and charges, are not confident using the meter, or feel they were consulted inadequately before installation.

v. Give particular attention to explaining charges and the tariff structure to customers.

   Consider introducing a fixed rate per unit of volume, rather than a rising block tariff. Where customers have previously had conventional meters, alert them to the possibility those old meters may have under read. This would amplify that measured consumption may be higher with the more accurate new meters, and they therefore may pay more (WSP,The World Bank, 2014-b)

2.10 Key Successful Factors for a Project

The study observed that for technological transfer to be successful, the following key factors have to be in place:

2.10.1 Project Champions

"Champions are recognized as facilitators for technology transfer. Champions facilitate technology transfer in a number of ways." (Harder & Benke, 2006). Champions are persistent, foresighted, foster sense of ownership, act as catalyst for change and create a faster buy-in with management and workers.

2.10.2 Pilot Projects and Demonstrations

Pilot projects and demonstrations are another factor for success and are considered a valuable addition to the strategies for facilitating introduction of a projects. They are also a means for increasing the consumers' awareness of the technology. Using pilots, or functionality playbacks is effective for difficult to understand processes system demonstrations. This technique can significantly reduce meeting times and increase customer satisfaction. The use of prototypes has been found to make ideas tangible, iterate quickly at a low cost, and develop a shared language (Wood, 2012). Demonstrations are part of the change management process and can help to bring the broader organization along in the process. The advantages of piloting are as follows:

i. System demonstrations focus on delivering what is important while allowing for early adjustments.
ii. Complex or difficult functionality demonstrations help reduce the overall amount of meeting time.
iii. System demonstrations identify gaps and problems earlier reducing the number of testing defects and rework time.
iv. Early demonstrations help ensure scope is properly accounted for and last minute process surprises are reduced.
v. Some performance problems are exposed.
vi. Possible schedule and work completion issues may be exposed while they might still be manageable.

2.10.3 Senior Management Support

Because of the lead and interest of senior managers, junior employees feel encouraged to participate or adopt a new technology. The support of the senior managers draws attention to the program, providing additional program credibility for the organization as well as others not familiar with the new technology and heightens the priority for organizations considering the technology. They are uniquely different from the technology champion, although they may also endorse the innovation. They provide resources and guidance, and they lead by example. They are accountable for the outcomes and, in some cases, through personal experience, readily identify with the technology transfer process (Harder & Benke, 2006).

2.10.4 Technology Transfer or Implementation Plan

Many organizations require implementation plans to initiate the process for funding implementation or technology transfer efforts associated with adoption of an innovation. Additionally, implementation plans become working documents that are used to guide the

implementation process. Harder & Benke(2006) point out that, "Committing to planning-up front saves later problems that arise in the form of costs, delays, and rework". For the most part the implementation plans are short and relatively easy to prepare. If the plan is easy to complete, it has a higher likelihood of being done.

2.10.5 Qualified Technical Personnel in Lead Roles

Without technical expertise little transfer of knowledge and understanding of an innovation would occur. The credibility of most research centres is based on the quality of the expertise and the ability to convey to the prospective user sufficient knowledge and information for decision making to affect change**.** The credibility of a Technical Assistance Program is based on the quality of the expertise and the ability to convey to the prospective user sufficient knowledge and information for decision making to affect change. Other Technical Assistance Programs clearly link success with "qualified instructors," "qualified people assigned to the lead role," and "a dedicated team of instructors/assistants who are available for technical assistance." (Harder & Benke, 2006)

Research units and programs have often identified the technical expertise in the researcher or through a lead technical expert. They are already associated with the innovation. Furthermore, in the case of research results implementation, the users are brought into the research at an early stage, thus beginning the process.

2.10.6 Progress Monitoring and Committed Funding

Progress monitoring and committed funding have influence on success as Bikson (1996) asserts "Dedicated funding has traditionally been a primary booster for technology transfer activities" as cited by (Harder & Benke, 2006). It is important to note that funding is a catalyst for success; it contributes to stable, sustainable programs.

2.10.7 Marketing and Communications

Effective marketing and communications are key success factors of technology transfer. Every successful technology transfer activity in some manner involves the packaging or marketing of the innovation to suit the intended audience or user. Additionally, effective communications techniques are required to convey the knowledge and skills for users to promote change in their respective settings. Marketing and proper packaging of information streamlines the approval processes, professional communication tools assist in program effectiveness, and knowing the users and customers of the program is an important factor for facilitating project implementation and research results.

The technology marketing phase of is concerned with disseminating the technology beyond the research centre. Key actions for science liaison involve the talents of scientists, business leaders and marketing specialists to educate potential consumers to the social, economic and environmental benefits of the new technology. Frequent interaction between research and marketing personnel is suggested; and the benefit of establishing a demographic profile of anticipated consumers before organising communication channels. Knowing where the potential client usually gains knowledge of specialised products and or services will influence the selection of communication methods (Penny, 1992)

2.10.8 Benefits of the Technology in Meeting Users' Needs

In addition to the techniques and methods used to accomplish technology transfer; there is one essential success factor that should not be overlooked-the benefits of the technology to be transferred. Supplying what the user needs, when the user needs it, in a form that can be used, at a cost that is reasonable is a compelling success factor. According to Harder & Benke (2006), a survey carried out by many of the respondents indicated that benefits of the innovation or the technology to be transferred were a significant success booster. They reported that:

i. "The innovation was cost-effective."
ii. "The project involved cost savings and was an environmentally friendly solution to a common problem."
iii. "We saved money."
iv. "The project involved an accurate identification of needs."
v. "This was a safety project that we expect will reduce accidents"
vi. "The project involved the bicycle community and demonstrated an effort to address concerns."

2.11 Evaluation

The key success factors outlined in Section 2.8 provide a good framework to guide an efficient and effective technology transfer approach and a good basis to compare between water utility companies.

Among all the service providers in the 7 countries under study, there is no utility that has a definite position on pre-paid meters. Despite the piloting of the meters starting as early as 1998 e.g. in Windhoek, Namibia, it is obvious that no single country has complete and adequate experience to help determine a way forward on pre-paid meters as until now all are still "*trying-out*". Namibia's WCC has yet to identify the perfect meter brand that meets their

needs as well as the consumer's and still more they are exploring the feasibility of pre-paid meters on individual connections. This is also a similar experience with Adem of Maputo, Mozambique which has tried out three types of meters but it is not satisfied with performance of any of them.

Whilst the lessons learnt in most countries agree in many areas, they are all limited to either use of the meters on communal stand pipes or on individual connections. Additionally if a country has some experience on both segments of the consumers, it is limited to a few years and not worthy a basis for determining a forward looking strategy.

The literature reviewed herein, while relevant to the study because of the geographical positions of the cited cases and economical similarities among the countries involved, shows that the problems experienced are well known and there is need for a cautious procession with employment of the meters. This is in consideration that it is a new technology that is being introduced to Africa. The literature review also shows lack of a defined or set strategy for approaching both the low and high-income areas.

CHAPTER THREE: METHODOLOGY.

3.1 Introduction

Chapter 3 describes the research design, its adopted philosophy, approach and the strategy employed. It also describes in detail the population and sample size that was adopted, the proposed data analysis methods, research ethics and finally gives a description of the data collection methods that were employed in the study.

3.2 Research Design

The research design maps-out the way research questions were answered. It describes the overall plan used for carrying out this study. The research design concentrated on a strategy that is well informed by the research questions, the choice of data collection techniques and analysis procedures and the time horizon over which the research was undertaken.

In light of the nature of the issue that was investigated and the fact that there were few or no previous studies in Malawi, the research adopted an exploratory study that was conducted through interviewing experts in the water supply business and administering a questionnaire to key informants and consumers to gain an insight into issues around the pre-paid meters. This was a valuable means of finding out what is happening.

The exploratory study was chosen due to its flexibility and adaptability to change. Exploratory studies are also said to be deductive. As Saunders (2007) observes that, "focus in exploratory studies is initially broad and becomes progressively narrower as the research progresses".

3.3 Research Philosophy and Research Approach

Research philosophy relates to the development of knowledge and the nature of that knowledge. This research adopted a positivism philosophy with particular assumptions made that underpinned the research strategy and methods. It is assumed that the phenomena observed will lead to production of credible data (Saunders, 2007).

The positivist philosophy entails that the research was undertaken in a value-free way as far as possible with the researcher being external to the process of data collection in the sense that little could be done to alter the substance of the data collected.

3.4 Strategy

It is important for the strategy employed to be able to answer research questions and meet objectives. The extent of existing knowledge, time available, resources available and philosophical underpinnings also play a big role in determining which strategy to use.

In light of the above, this research used a survey as the main strategy. It is perceived as authoritative by people in general and is both easy to explain and understand (Saunders, 2007). With the use of survey, the research produces data based on real-world observations (empirical data).

3.5 Sampling Size

Blantyre Water Board piloted the pre-paid metering system in 287 households (HHs) in Naperi and 280 in Mudi residential areas. Since the pilot population was small, the study was conducted on the entire population in both service areas i.e. 567 HHs.

3.6 Data Collection Methods

The study collected secondary data from BWB reports and primary data from questionnaires administered to the households. The study also examined the operational side by administering a questionnaire to key informants. The detailed data collection methods used are described below:

3.6.1 Data Collection Tools

The study developed two different questionnaires focusing on the supply side and the demand side. The supply side questionnaire examined the operational issues by investigating efficiency, logistical arrangements, costs, potential benefits, relevance and acceptance of the pre-paid metering technology. This questionnaire was administered to key informants from BWB.The supply-side questionnaire is attached in Appendix 1.

The second questionnaire examined the demand side. This involved gauging the consumer's view on the efficiency, impact, logistical arrangements and relevance of pre-paid meters. A questionnaire was chosen because of its ability to collect large amounts of information from a large number of people in a short period of time and in a relatively cost effective way. The demand side questionnaire is attached in Appendix 2.

3.6.2 Pre-testing the Questionnaire

The data collection tools were pretested to ensure that they provided the desired information in line with the research objectives and questions. Therefore, the final questionnaires that were used for this study (Appendix 1 and 2) incorporated feedback from the pretesting exercises.

3.7 Data Analysis

Quantitative data was entered, cleaned and analysed using the Statistical Package for Social Scientist (SPSS) and the results were transferred to MS Excel to create tables, charts and

graphs. In searching for consistent patterns or themes among data, frequency distribution was used and results were expressed in form of tables, pie charts and histograms. In each case the number of households/respondents was expressed as a percentage of the population used for the study. The analysis also included the coding means and variances to identify average values and measures of dispersion respectively.

On the other hand Qualitative data from Key Informant Interviews (KII) was transcribed manually in MS Word based on thematic areas of discussions. Key issues were drawn out and their significance and meaning appropriately arrived at. Then, basing on the issues that came out of the analysis, conclusions were developed.

3.8 Validity and Reliability

In general, reliability refers to the extent to which data collection techniques and analysis procedures will yield consistent findings. It was anticipated that several threats to reliability such as subject error, subject bias, and observer error and observer bias would have been experienced. The research took extreme care when analysing data to ensure that data is indeed describing what it is. A high degree of structure to the interview schedule was introduced to lessen threats to reliability. In addition, data triangulation in questionnaire design was also used. This involved administering questionnaires to BWB key informants and questionnaires used ranking to provide respondents with ability to rate particular aspects rather than responding with a yes or no.

3.9 Research Ethics

The research design considered research ethics by ensuring that the design of the research is both methodologically sound and morally defensible to all those involved. Among other considerations, the research maintained privacy of possible and actual participants, maintained the confidentiality of data provided by individuals or identifiable participants and their anonymity; and upheld voluntary nature of participation and the right to withdraw partially or completely from the process.

CHAPTER FOUR: FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of the research. These are described under household characteristics, efficiency, impact, reliability, logistical arrangements, relevance and technological acceptance of the prepaid meters. The results are presented in qualitative form but also using graphics.

The survey was administered to the entire population of households in each of the two areas (New Naperi and Mudi) totalling 567 households. The response rate was 81% for New Naperi and 39% for Mudi. The response rate in Mudi was low because most respondents being business people demanded more time. Although this was provided, the response rate did not significantly improve. Key Informant Interviews were also conducted to triangulate the data collected from literature review and household survey. The key Informants mainly included key staff at BWB directly involved with operations of the pilot project.

4.2 Household Characteristics

In this section, the report presents findings on household characteristics; gender, period of meter usage and number of occupants per given time.

4.2.1 Gender

Table 2 shows gender distribution of the respondents.

Table 2: Per cent of Respondents in Population Households by Sex, 2015

Gender of Respondent	**Service Area**	
	Naperi	Mudi
	n=122	*n=58*
Male	54	89
Female	46	11

The results show that the majority of respondents were male with Mudi (89%) and Naperi (54%). Only 46% of females responded in Naperi and 11% in Mudi. The results show lack of interest among females on the new technology likely due to a variety of reasons. In light of these results, it is important for BWB to consider targeting female members of the households when they are holding their education campaigns on pre-paid meters.

4.2.2 Period of Usage

Figure 1 shows the percentage in population of households by usage.

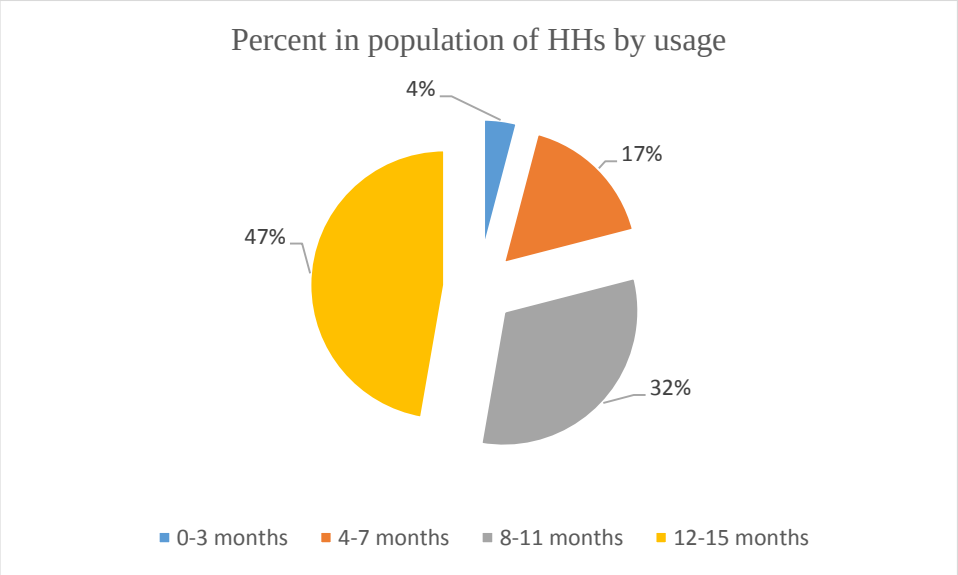

Figure 1: Per cent in Population of Household by Usage

The research established that the majority of respondents (47%) had used the pre-paid meter for a period of 12-15months, (32%) had used the meters for a period of 8-11 months, (17%) had used the meters for a period 4-7 months and lastly (4%) used the meters up to 3 months only. The results indicate that a high majority of the respondents had very good experience with pre-paid meters after using them over 8months and therefore right targets for the study. Their experience with the meters would give practical and meaningful information to the research.

4.2.3 Number of House Occupants per given time

Figure 2 below shows the number of house occupants per given time.

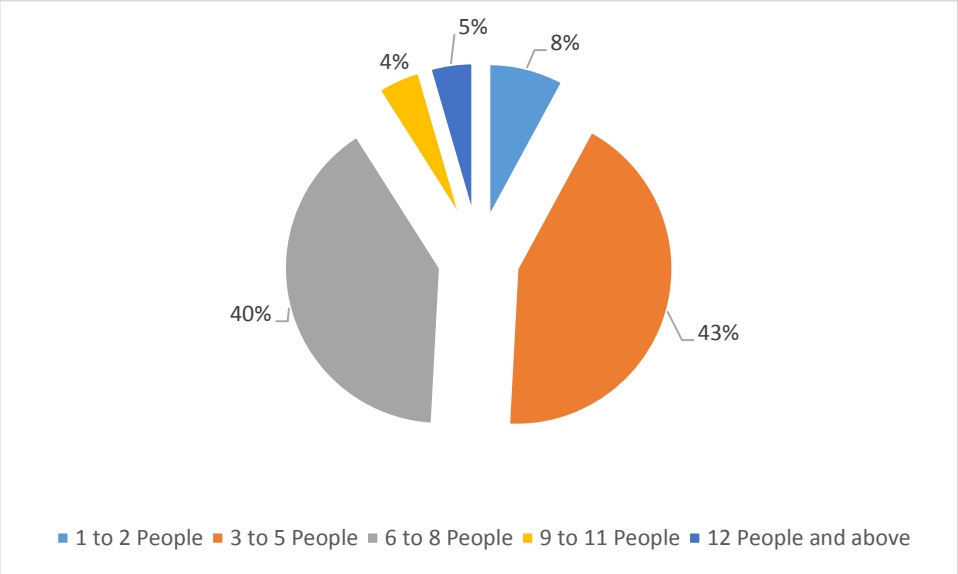

Figure 2: Per cent Population of Households by Occupants

Figure 2 shows that the majority of households (43%) usually have 3 to 5 occupants per given time, 40% have 6 to 8 occupants, 8% have 1 to 2 people, while 5% have 12 people and above and 4% have 9 to 11 people. With the majority of households having a significant number of occupants in the house per given time (3 to 5) and (6 to 8), it is easier to monitor changes in consumption trends and any significant patterns. This is a helpful setting for the research. At 43% or 3-5 people per give time, the number of house occupants compares very well with the national average. Overall, the mean size of households in Malawi is 4.0 in urban areas (Ministry of Health and the DHS Program, 2015).

4.3 Efficiency

4.3.1 User Perception of Pre -paid meters

Figure 3 below shows the user perception of accuracy of pre-paid meters.

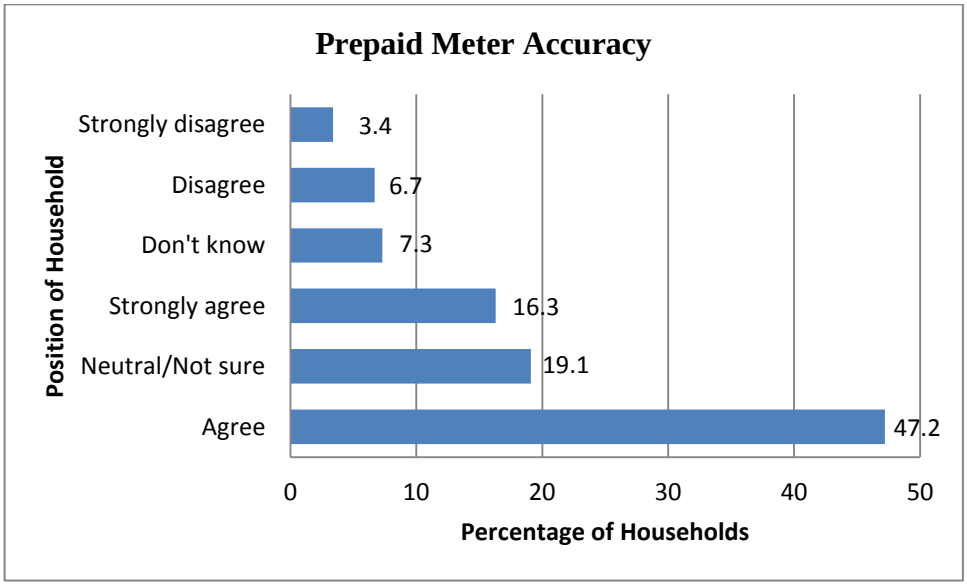

Figure 3: User Perception of Accuracy of Pre-paid Meters

Figure 3 shows that a majority of the households (47.2%) agreed that pre -paid water meter consumption charges relate accurately to the amount of water consumed while (19.1%) were not sure, (16.3%) strongly agreed, (7.3%) didn't know, (6.7%) disagreed and (3.4%) strongly disagreed.

Results of interviews with key informants agreed with the observations made under the household survey. The BWB staff indicated that, the introduction of pre-paid meter has resulted in no complaints arising from over charging or bills not relating to water consumed. This observation shows that pre-paid water meters are a solution to erroneous bills that plague the board from consumers using conventional meters. In future, BWB should consider rolling

out pre-paid meters to more customers as this system also reduces human resource capital required to handle the related paper work associated with conventional meters.

4.3.2 User Perception of Reliability of Prepaid Meter

Figure 4 shows the user perception of reliability of pre- paid meter.

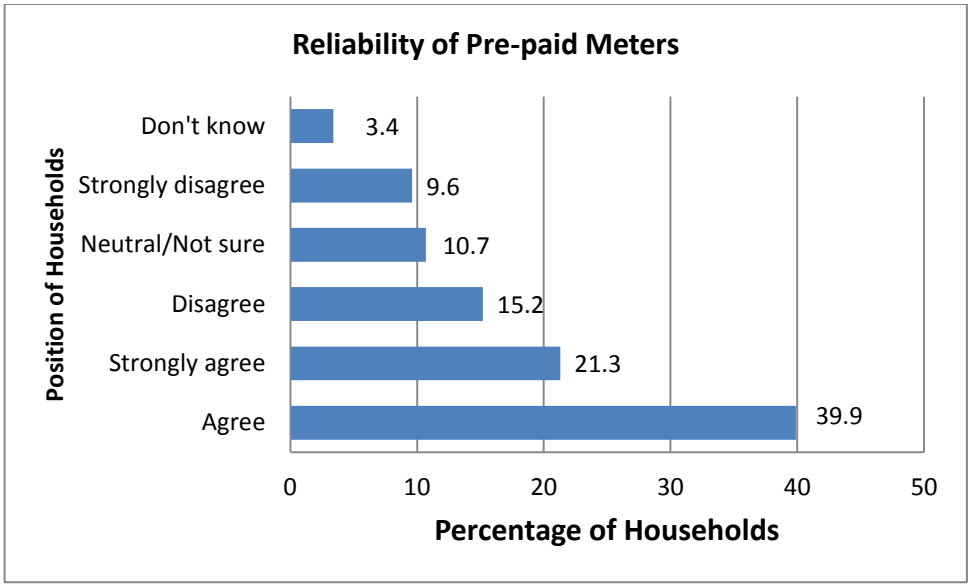

Figure 4: User Perception of Reliability of Prepaid Meters

Figure 4 shows that (39.9%) agree that the reliability of pre-paid meters owes to that fact that no mechanical failures have been experienced since installation while (21.3%) strongly agree, (15.2%) disagree, (10.7%) are not sure, (9.6%) strongly disagree and (3.4%) don't know.

The results show that a majority of the households have never experienced mechanical failures with the prepaid meters. This is in agreement with information obtained from the key informants from BWB. It is worth noting that some respondents indicated other problems they face with the prepaid meters. The most occurring problem is formation of mist on the meter glass cover. This obscures the view such that it is difficult to take readings. Consequently, the meter cuts off the supply without owners knowing or making advance credit purchase in good time.

4.3.3 Response to Mechanical Failure

Figure 5 shows the knowledge of consumers on response time by BWB staff to mechanical failure.

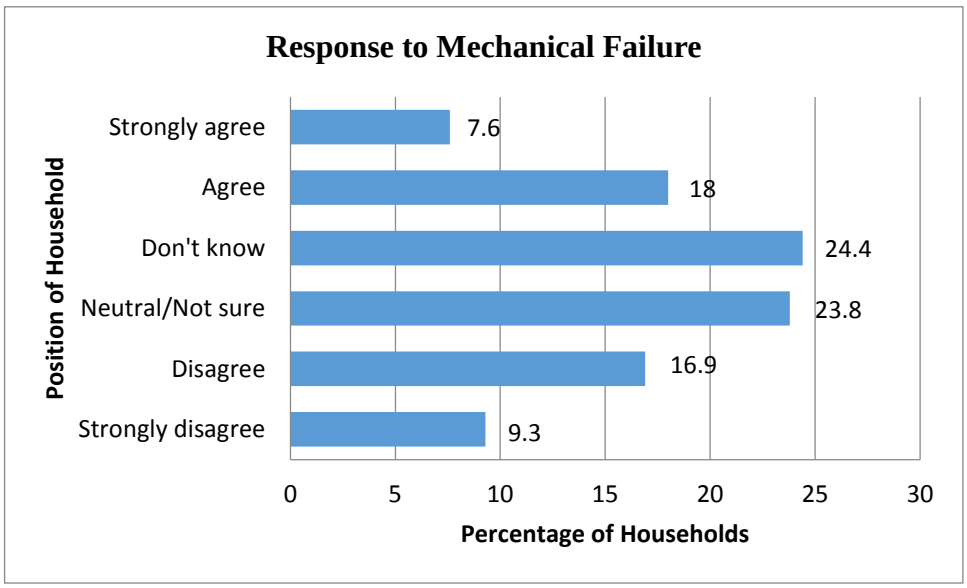

Figure 5: Response to Mechanical Failure

Figure 5 shows that (24.4%) don't know if BWB responds in a day in the event of a mechanical failure while (23.8%) are not sure. On the other hand (18%) agree that BWB responds within a day in the event of mechanical failure while (16.9%) disagree, (9.3%) strongly disagree and only (7.6%) strongly agree. The observation above indicates that most consumers have experienced very little mechanical failures with pre-paid meters. On the other hand, consumers in Mudi attributed the failure by BWB to respond in good time to shortage of expertize at the utility.

4.3.4 Stocking of Maintenance Materials

Figure 6 below shows the stocking of maintenance materials by BWB.

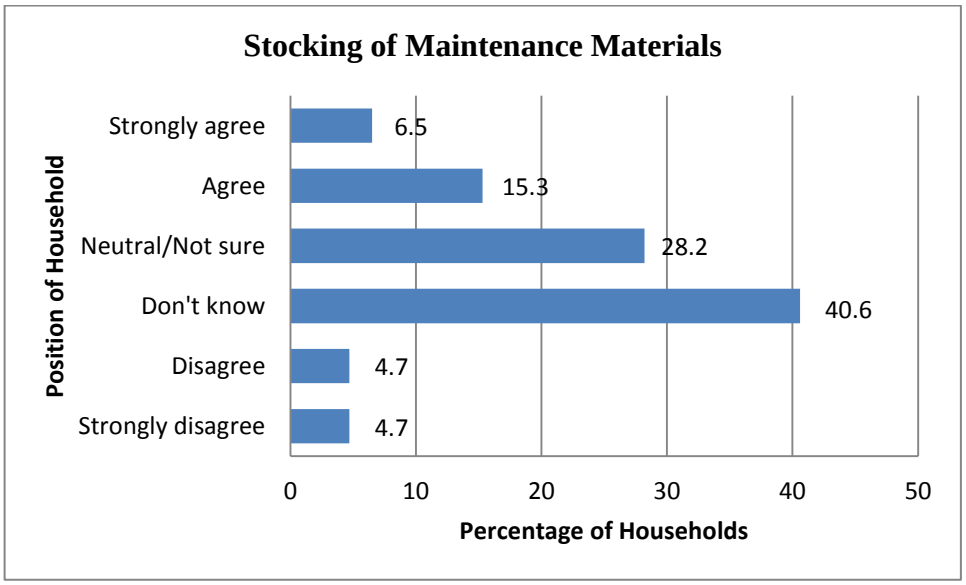

Figure 6: Stocking of Maintenance Materials

Figure 6 shows that (40.6%) of the households do not know if BWB stocks adequate maintenance materials for the pre-paid water meters while (28.2%) are not sure, (15.3%) agree with the statement, (6.5%) strongly agree and (4.7%) strongly disagree and another 4.7% disagree. The results show that the majority of households don't have any knowledge on stocking of maintenance materials because they have not experienced any fault with their meters. On the other hand key informants from BWB indicated the presence of a dedicated unit that responds to faults and is adequately supplied with materials. The unit keeps in stock items such as tokens, cards and batteries. BWB should maintain the dedicated faults unit with back-up supplies and consider scaling it up with the advent of additional installations.

4.3.5 Familiarity with Theory and Operation of Meters

Figure 7 shows the user perception of BWB's staff of familiarity with theory and operation of meters.

The research also wanted to establish how conversant are the personnel of Blantyre Water Board with the theoretical and practical knowledge of plumbing works and pre-paid water meter operation.

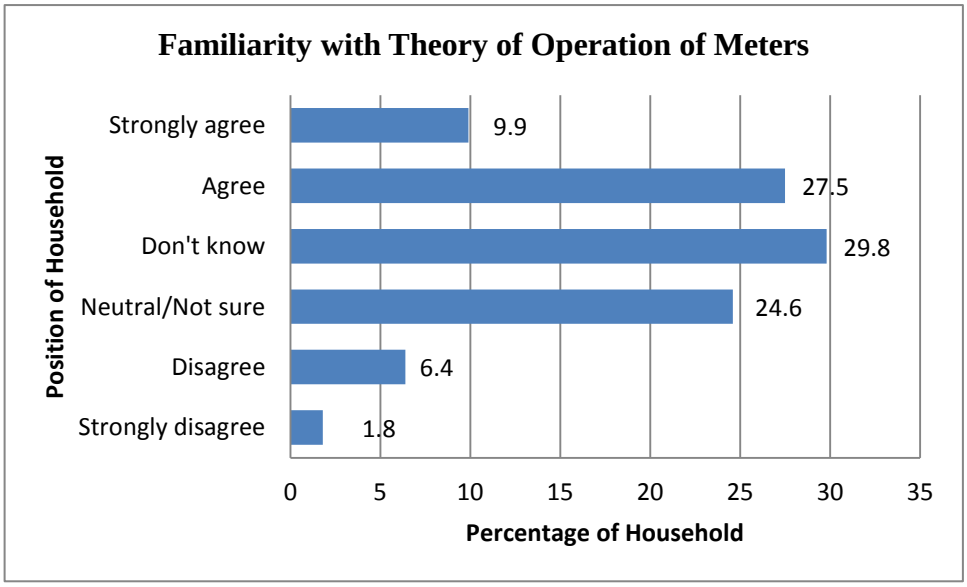

Figure 7: Familiarity with Theory and Operation of Meters

Figure 7 shows that the majority of households (29.8%) don't know if the personnel are conversant , (27.5%) agree, (24.6%) are not sure, (9.9%) strongly agree while (6.4%)disagree and (1.8%) strongly disagree.

These results agree with the findings that most households have not experienced faults with their meters hence the majority not being sure about BWB's personnel's familiarity with the theory and practical knowledge of the meters. Interviews with BWB staff however indicated

that all personnel involved with prepaid meters were thoroughly trained by the suppliers and they are still in touch with them. Field observation showed that all pre-paid meters were still working. Those that had faults were rectified locally.

It is crucial that BWB should periodically train its staff on maintenance of the meters and regularly update them on associated theory since they may likely need to explain to household owners and users.

4.3.6 Convenience of Meters

Figure 8 shows the user perception on convenience of pre-paid meters

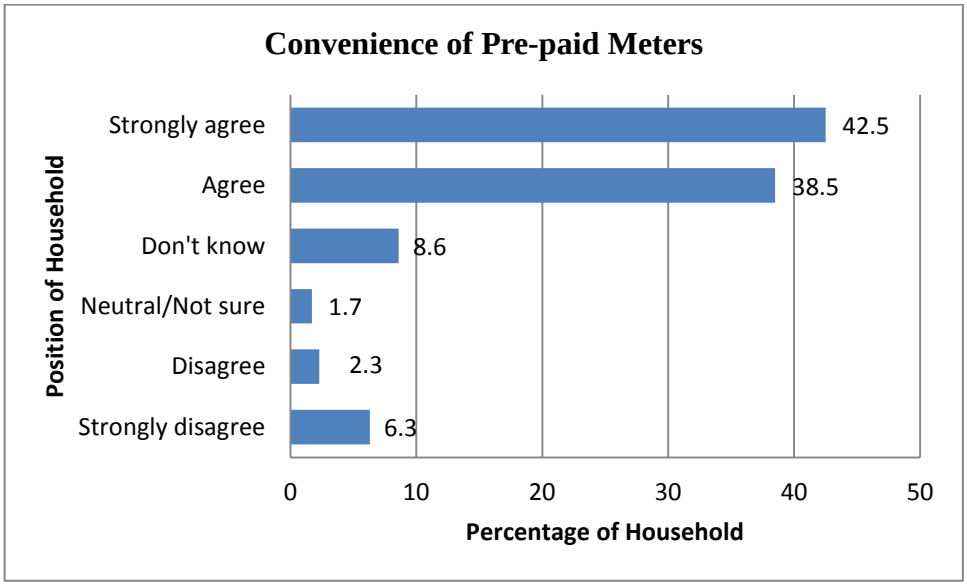

Figure 8: Convenience of Pre-paid Meters

The majority of respondents (42.5%) strongly agreed that the lack of physical disconnection and reconnection fees make pre-paid meters all the more convenient for the consumer while (38.5%) agree, (8.6%) don't know, (6.3%) strongly disagree, (2.3%) disagree and (1.7%) were not sure. The results indicate that households agree that pre-paid meters are indeed convenient. Most respondents mentioned the lack of disconnection and reconnection as contributing to the convenience of the meters. In agreement with the user's perception, key informants from BWB also found the meters to be very convenient especially in reducing their meter reading operations. Self –monitoring[1] aspect by the meters was regarded as a great contribution in reducing their workload. The reduction in paper work for billing is also hailed as a great convenience for the utility.

[1] Pre-paid meters are self-monitoring because owners report to the board faults that may occur at any given time. If they are tampered with, they cut-off supply and the board does not loose water but household owners still have to report for re-connection of the supply.

The reduction in paper work should eventually translate in less human resources and consequently more efficiency and an improved bottom line for BWB. This will be a major impact ICT will brings along to BWB through the pre-paid metering system.

4.4 Impact

4.4.1 Prepaid Meter as a Cash-flow Management Tool

Figure 9 shows user perception of a pre-paid meter as a cash-flow management tool.

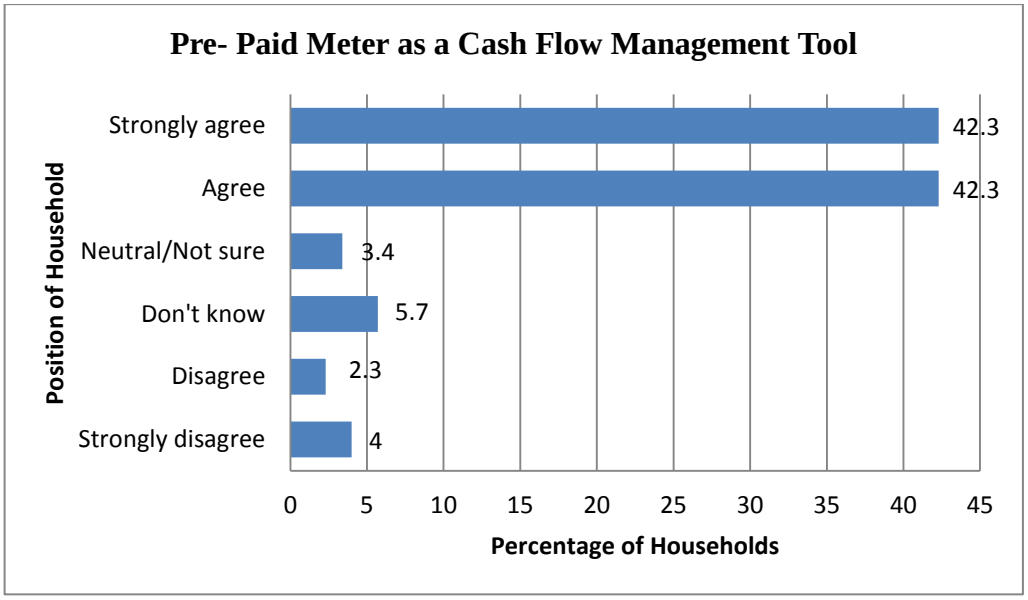

Figure 9: Pre-paid Meter as a Cash-flow Management Tool

The results show that the majority of respondents (42.3%) agree and (42.3%) also strongly agree that a pre-paid water meter is a good tool for assisting consumers in monitoring and controlling water usage as well as planning monthly cash flow. About (5.7%) don't know, while (4%) strongly disagree, (3%) are not sure and (2.3%) disagree.

The results indicate that the majority of respondents are now able to budget their expenditure on water bills. This is a result of the ability of the meter to instantly show consumers the credit at hand, volume of water in cubic meters and also the availability of monthly consumption patterns**.**

Thus, pre-paid metering system is hugely having a bearing on the consumers' ability to manage their cash flow. This is another impact attributed to prepaid meters on Water Boards.

4.4.2 Existence of Problems

Figure 10 shows the existence of problems with prepaid meters.

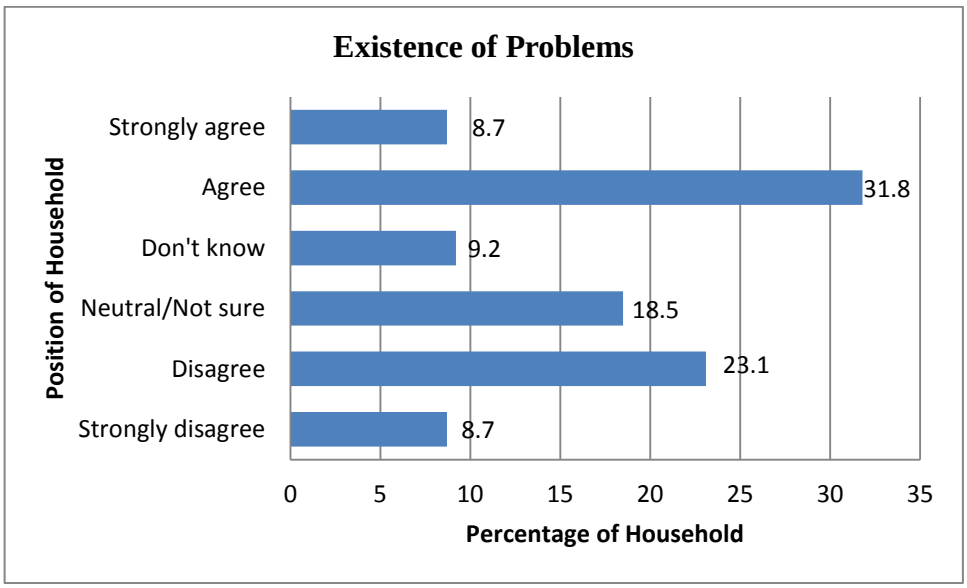

Figure 10: Existence of Problems

The research results shows that (31.8%) of the respondents agree that the pre-paid metering systems has no problems, (23.1%) disagree, (18.5%) are not sure, (9.2%) don't know while (8.7%) strongly agree and another (8.7%) strongly disagree. The results show that a majority of respondents have not experienced any problems with the pre-paid meters. On the other hand some respondents gave feedback indicating that they do experience problems with the meters. The users complained about having difficulties in collecting information from the meters.

An interview with a plumber responsible for installation revealed that Naperi Households use the meter in figure 11 below. This type of meter registers simple faults like obscured viewing pane, card error, pulse error and in some cases customers observe high consumption rate.

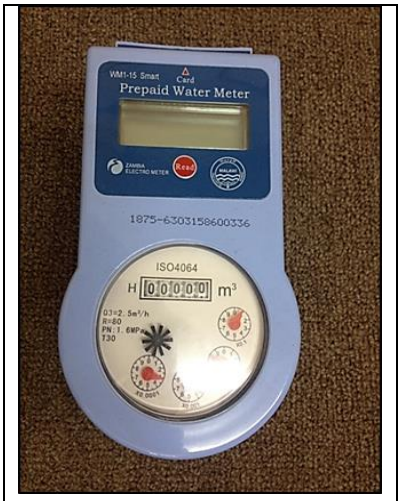

Figure 11 Pre-paid Meter in Naperi

Accordingly BWB is able to respond within a day to most of the faults through its dedicated pre-paid metering unit except the high consumption error whose remedy so far has been meter replacement. Key informants revealed that this error arises due to a mismatch in software. The meter's proprietary software is not in sync with the software being used by the board for billing such that it does not recognize the stepped-up tariff set up arrangement. Additionally, there is no technical back-up from the suppliers for this type of meter.

In Mudi, BWB has been piloting a different prepaid meter model shown in figure 12 below.

Figure 12 Prepaid Meter in Mudi

Accordingly, this type has less operational problems and has a good back-up service from the suppliers. The most registered problem with this type is the need to change batteries. Over 150meters had their batteries changed within 2 years of operation apparently because the supplier had produced this type of meter for the first time. On the other hand households using this meter cited frequent errors as very inconveniencing since they often have to be rectified by BWB staff and results in supply being cut-off. BWB staff recognized most errors as a result of tampering with the meter. Others have also complained of the meter not showing the amount of money available. This necessitates consumers to keep reserve credit handy all the time. In many instances households complained of intermittent supply due to the water supply system rehabilitation being undertaken by BWB.

There was generally a lack of understanding on how the pre-paid meter works. This result means most households were not part of the earlier education campaign. The technology on the water meters is ICT based but needs improving especially on the faults being experienced by some customers. BWB should ensure perfection of this technology before rolling out to more areas. This will ensure customers approving the technology and avoid resorting to the old system or indeed other alternative sources. The picture in figure 13 shows a typical mechanical meter used in the rest of service areas in BT.

Figure 13 Conventional Meter

4.4.3 Lack of Water due to Malfunctioning

Figure 14 shows the lack of water due to malfunctioning of the meter.

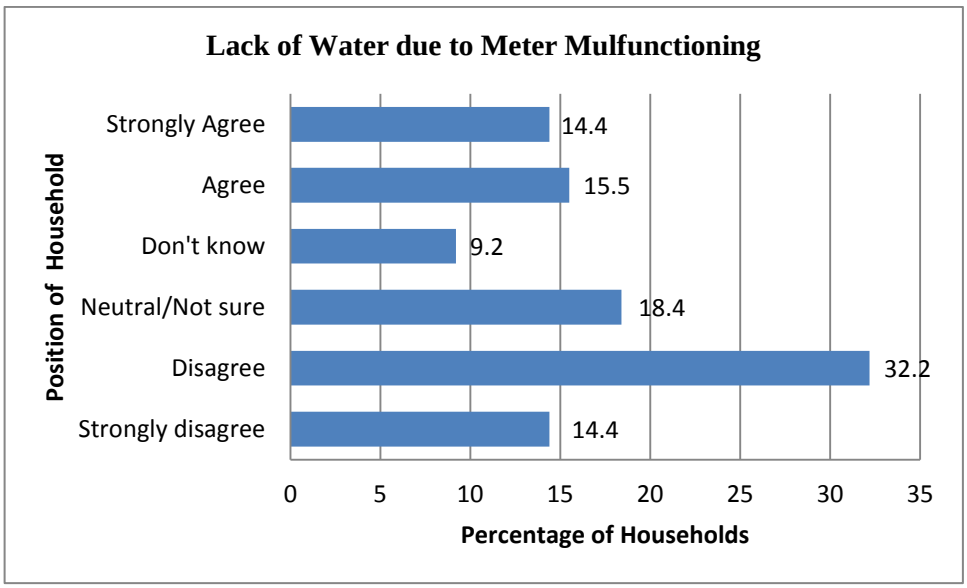

Figure 14: Lack of Water due to Meter-Malfunctioning

The research investigated if malfunctioning of the meter leaves some households without water. Figure 14 shows that 32.2% of the respondents disagreed, 18.4% were neutral, 15.5% agreed, 14.4% disagreed while 10.3% strongly agreed and 9.2% didn't know. The results show that malfunctioning of the meter does not necessarily leave a household to have no water. In agreement with this, BWB key informants hinted that once the fault is reported, they quickly attend to it. On the other hand a majority of the respondents commented that water interruption due to faults not associated with the meter, frequently disrupts their water supply. Observation show that BWB embarked on the pre-paid meter pilot alongside a major rehabilitation of the entire Blantyre City water supply system. This has had some effects on the performance of the pre-paid meters. Households expected a seamless supply of water owing to the fact that they had paid for the water in advance.

In future, BWB should ensure a constant supply to their service areas before embarking on new installations.

4.4.4 Lack of Water Supply due to Lack of Credit

Figure 15 shows the households' response on whether lack of credit can result in lack of water supply.

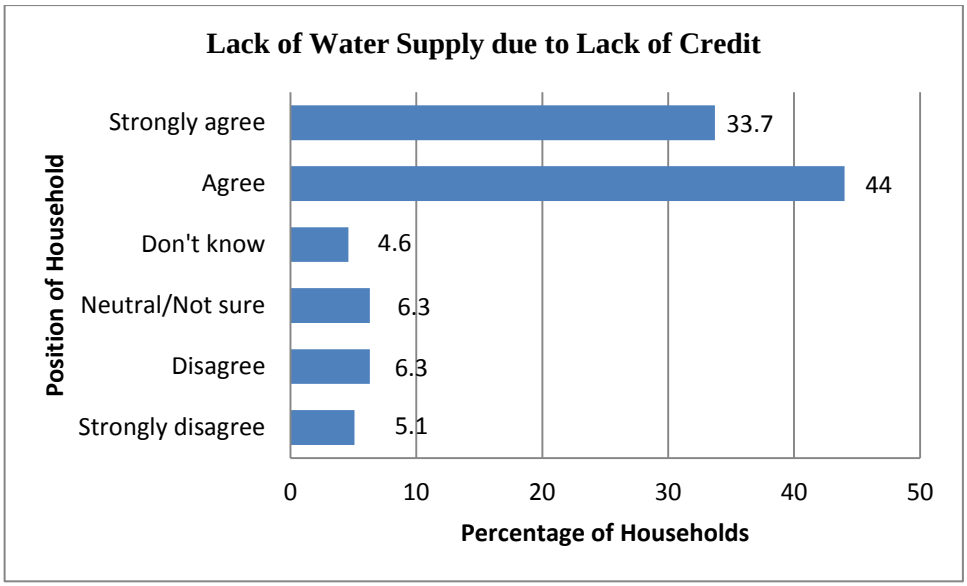

Figure 15: Lack of Water Supply due to Lack of Credit

The results show that the majority of respondents agree that in contrast with the conventional metering system, one big disadvantage with the pre-paid system is that, you can only have water if you have credit. (About 44%) of the respondents agree while (33.7%) strongly agree, (6.3%) disagree, (6.3%) were not sure, (5.1%) strongly disagree and (4.6%) don't know. According to key informants from BWB, prepaid meters were programmed such that water is supplied when there is credit only. Apparently, further investigation showed that not all users have this information handy. Some respondents observed that when credit runs out, the meter automatically disconnects the supply. While this arrangement ensures the utility collects its money in advance, it is a huge disadvantage to some households whose finances may be irregular.

Meters used under the NRWB were programmed to provide a credit line to be used during emergencies. During such periods, a consumer triggers the reserve mode to activate supply. Additionally, the prepaid water metering system has a provision where a proportion of the units bought are kept in reserve mode. It means the customer can load these units during awkward hours when the meter runs out of units and cuts the supply. In times of crisis such as fire and where a customer has run out of units, they are assisted through triggering of the fire mode.

This is a positive impact ICT brings along with the pre-paid system. A similar arrangement has been hailed by mobile phone users where local service providers give credit which is deducted from a subsequent air time top up.

4.4.5 Health Risk due to Lack of Credit

Figure 16 below shows the user's perception associated with lack of credit.

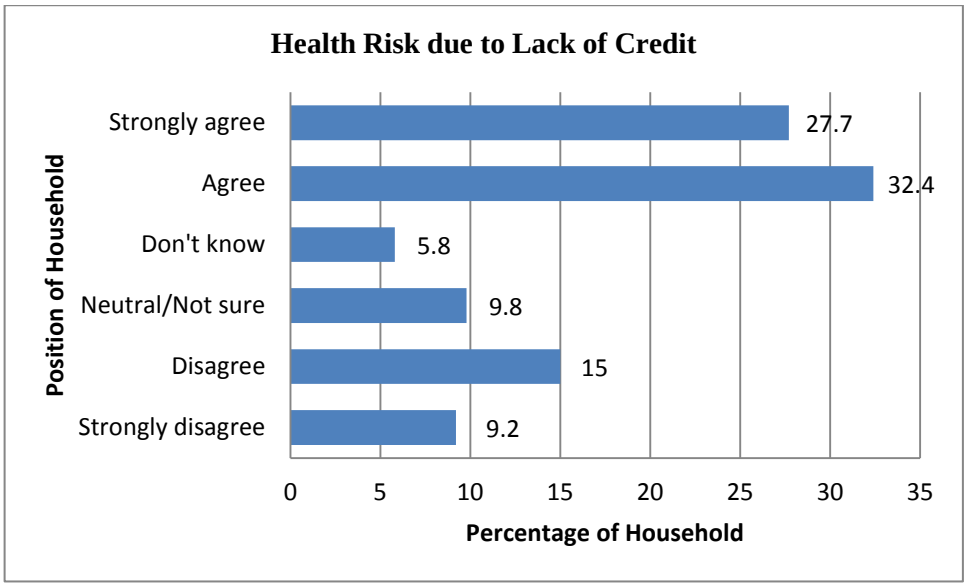

Figure 16: Health Risk due to Lack of credit

The majority of the respondents (32.4%) agree that the new delivery service through pre-paid water metering system poses a health risk to vulnerable groups especially those with little or irregular income as they may "self-disconnect" when credit runs out and turn into water sources that are not safe for human consumption. Figure 13 shows that 27.7% of the respondents strongly agree, 15% disagree, 9.8% is not sure while9.2% strongly disagree and 5.8% don't know. The results show that lack of credit for pre-paid metering system may result into a health risk especially for the vulnerable group with irregular earnings. The pilot area has not experienced this because of their earning potential however this experience could be a downside of ICT on the delivery of water supply to consumers.

4.4.6 Reduction of Operational Costs

Figure 17 shows reduction of operational cost with use of pre-paid meters.

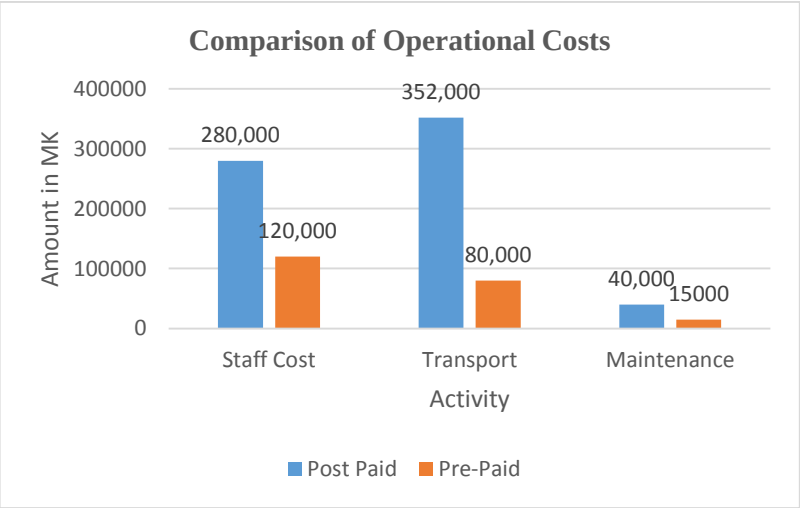

Figure 17: Comparison of Operational Costs

The research investigated on the differences in operational costs between the prepaid meters and conventional meters. Figure 17 shows that monthly staff cost for conventional meter average about MK320, 000 while pre-paid meters average MK120, 000. Transport cost for conventional meters cost MK352, 000 while prepaid costs MK80, 000. Maintenance costs for conventional meters average about MK40, 000 while pre-paid meters average MK15, 000.

The results in Figure 17 show that generally operational costs for pre-paid meter on staff are (57%) lower than for conventional meters while transport costs are lower by (77%) and maintenance (63%). The study shows that that pre-paid meters don't require a lot of human resources considering that the billing cycle is completely taken out while for conventional meters it has a 30 days cycle which attribute to most of the staff costs. Transport costs are cut down heavily since meter reading is not a requirement.

Key informants pointed out that pre-paid meter performance is easier to track and monitor since the consumers report faults immediately but also the operational software detects any kind of problem occurring on the meter. On the other hand, BWB key informants indicated that the pre-paid metering system has completely taken out private arrears that were a headache for the utility. Collection of revenue has improved within the pilot areas but significant improvement is expected when more meters are installed in future.

Table 3 below analyses the total savings if BWB goes full scale on pre-paid metering.

Table 3: Potential Savings in Operational Costs.

#	**Items**	**Units**	**Calculation**	**Value**	**Source**
A	Current number of pre-paid meters	No	Sum	567	BWB
B	Monthly operational expenditure on pre- paid meters	MWK	Sum	215,000	Figure 14
C	Monthly operational expenditure on conventional meters	MWK	Sum	672,000	Figure 14
D	Total No of customers	No		40,000	www.bwb.mw
E	Monthly operational cost on full scale pre-paid metering	MWK	(B x D)/A	15.2million	BWB
F	Current monthly operational cost for conventional meters	MWK	(39433[2]x C)/A	46.7million	BWB
G	Savings through pre-paid meter operations	MWK	F - E	31.5million	BWB

Given the prevalent economic conditions remain unchanged, the results show that BWB can potentially save MK31.5million a month with the prepaid metering system. However caution should be taken since different consumer segments will behave differently towards the pre-paid metering system. The reduction in operational costs is a significant impact of ICT on operations of BWB. It is anticipated that BWB will improve its efficiency in future should the utility roll out pre-paid meters to more service areas.

[2] The difference from the total number of customers i.e. (40,000 -567)

4.5 Logistical Arrangements

4.5.1 Satisfaction with Credit Selling System

Figure 18 below shows consumer's satisfaction with the credit selling system.

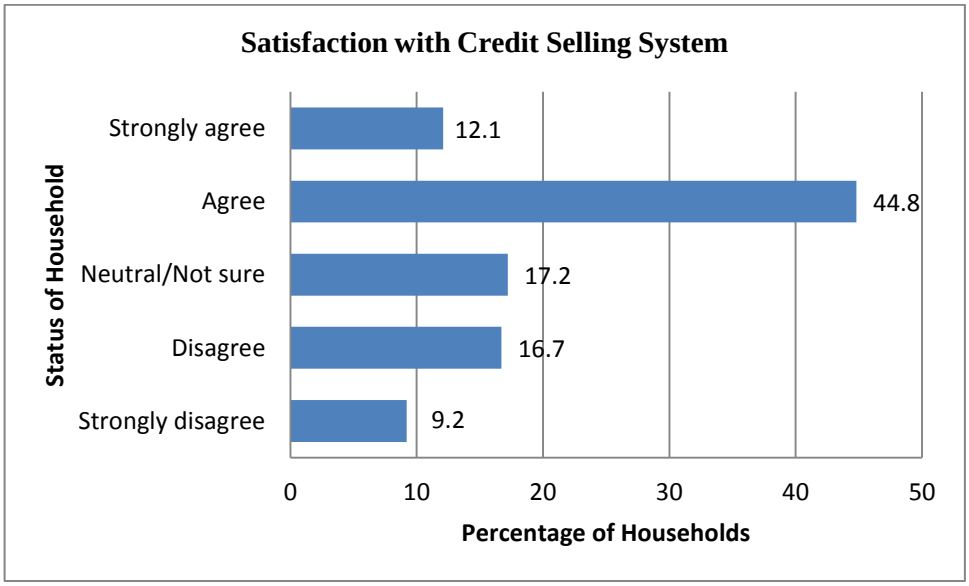

Figure 18: Satisfaction with Credit Selling System

Figure 18 shows that the majority of consumers are satisfied with the current credit selling system with (44%) of the respondents agreeing that it is satisfactory, 17.2% not sure,16.7% disagreeing, while 12.1% strongly agreeing and 9.2% strongly disagreeing.

Interviews with BWB key informants indicated that currently there are only three selling points for credit which are operated by merchants on behalf of BWB. There are two merchants within Soche area serving Naperi consumers while customers from Mudi are served by one merchant based in Limbe. On the other hand, respondents complained of difficulty to access credit especially when needed at awkward hours especially for Naperi customers. The merchant shop in Naperi operates daily from 7am to 5pm. Most of the consumers recommended extension of the business hours preferably to 24hrs. Another complaint from Naperi customers was the need to physically present the card to the selling point when topping up credit. Consumers felt this is a little awkward since credit may run out when one is far from home where the card is normally kept.

BWB should consider improving on credit purchase by extending the business hours and also upgrade or improve credit purchase modality by requesting consumers to present the meter number only. This has been successful with pre-paid electricity meters, mobile phones and proven to be extremely convenient.

4.5.2 Convenience of Credit Selling Points

Figure 16 shows the convenience of credit selling points.

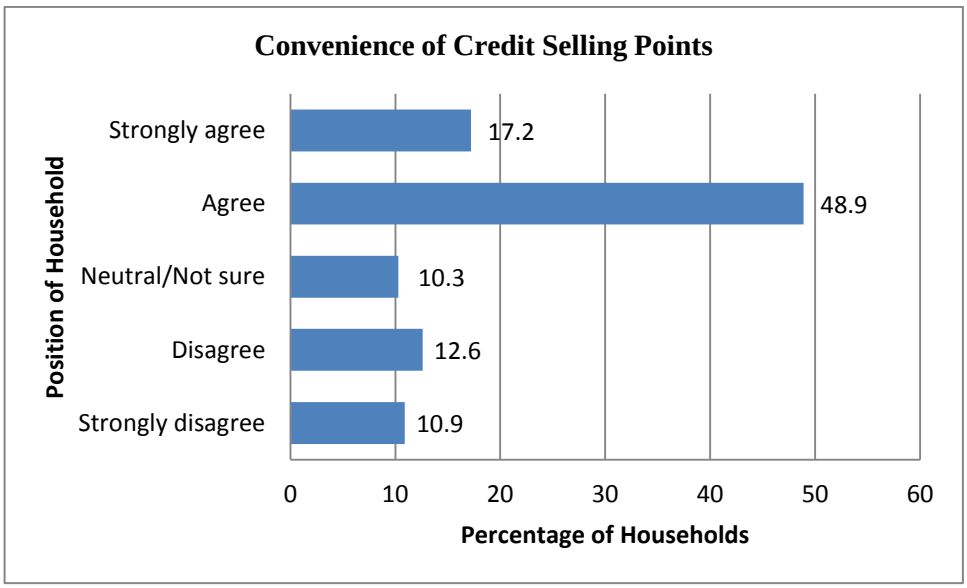

Figure 19: Convenience of Credit Selling Points

Figure 19 shows that 48.9% of the respondents agree that the selling points for credit are conveniently located while 17.2% strongly agree, 12.6% agree, 10.9% agree and 10.3% are not sure.

The results show that respondents are happy with location of credit selling points since they are close to their locations. Other than difficulties with the limit on business hours for the credit selling point in Naperi, respondents complained of lack of different modes of selling the credit.

In future, BWB should consider establishing more selling points located closer to service areas so that consumers can easily access them.

With regards to impact of pre-paid meters on the utility, BWB is enjoying the benefits of outsourcing the credit selling service. In view of the reduction in operation costs observed in Section 4.3.5, the savings can be utilized in improving other sectors within the Board or indeed investing in expansion to needy areas. Significant impact on this will only be realized when future installations are implemented.

4.5.3 Other Alternative Credit Selling Options

Figure 20 below shows other alternative credit selling options.

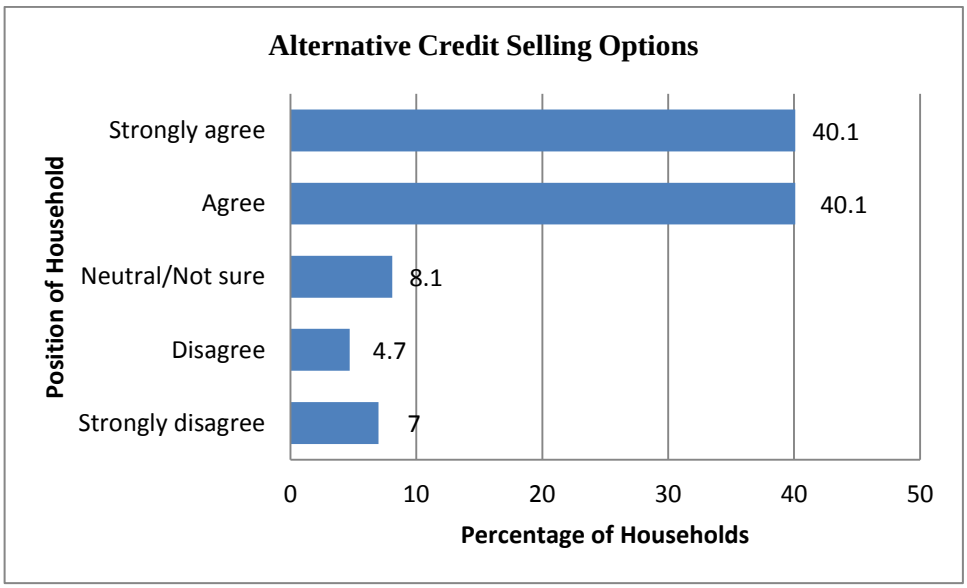

Figure 20: Alternative Credit Selling Options

Figure 20 shows that more than half of the respondents agree that other credit selling means should be provided by BWB with (40.1%) agreeing, another 40.1% strongly agreeing, 8.1% not sure while 7% strongly disagree and 4.7% disagree. Most respondents highlighted the need for other alternative means of purchasing credit. They felt inconvenienced to be going to the fixed selling points when they could easily use other facilities with ease and comfort. A BWB key informant also indicated their intention to introduce other means of purchasing credit in future.

It is important for BWB to consider other options in order to keep up with the improving market trend which most consumers are already accustomed to. With the current development in ICT, other credit purchasing options can be availed and subsequently bring a positive impact on BWB by reducing its operational costs for the same function.

4.5.4 Convenience of Credit Purchasing Means

Figure 21 shows the user's perception on the convenience of credit purchasing means.

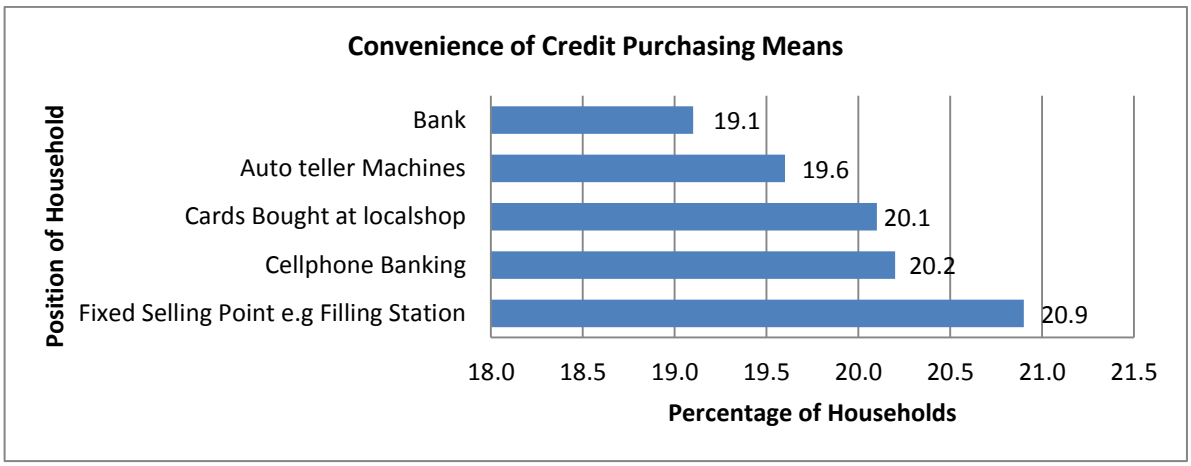

Figure 21: Convenience of Credit Purchasing Means

Figure 21 shows that 20.9% of the respondents ranked purchasing credit from a fixed selling point e.g. BP Service station as the most convenient, 20.2% ranked mobile phone banking as the next most convenient, then 20.1% ranked cards bought at local shops, followed by use of ATMs 19.6% and lastly the least convenient means was purchasing credit from the bank 19.1%.

The results show that consumers have a diverse preference on credit purchasing options. It is noted that the most and least convenient means only differ by a negligible 1.8% of the respondents. This indicates that all options are favorable depending on the consumer's choice. In future BWB should consider all the four extra options in order to cater for all consumers' preferences.

The availability of such a diverse choice is another impact the pre-paid metering technology has on the current water supply modality. This is a positive development for BWB since it reduces operational costs but also increases the convenience to the consumer.

4.5.6 Participation in Education Campaigns

Table 4 below shows the percentage of respondents who participated in BWB's Education Campaign.

Table 4: Percent of Respondents' Participation in Education Campaign

No	Status	Percentage
1	Yes	14.1
2	No	85.9

The research found out that the majority of respondents (85.9%) did not participate in education campaigns on usage of the pre-paid meters while only (14.1%) participated. The results show that most respondents did not participate in the education campaigns resulting to lack of adequate knowledge of the use of the pre-paid meters. This is evident through some of the faults registered by the meters. According to BWB plumbers, some consumers have inadvertently tampered with the meter ending up with disconnection of the supply.

BWB should endeavor to conduct more education campaigns which will benefit the user as well as the utility itself and consequently the number of faults will decrease. Conducting of campaigns should also be on-going to accommodate new tenants who may be using the meters for the first time.

4.5.7 Need for another Education Campaign

Figure 22 below shows the need for another education campaign.

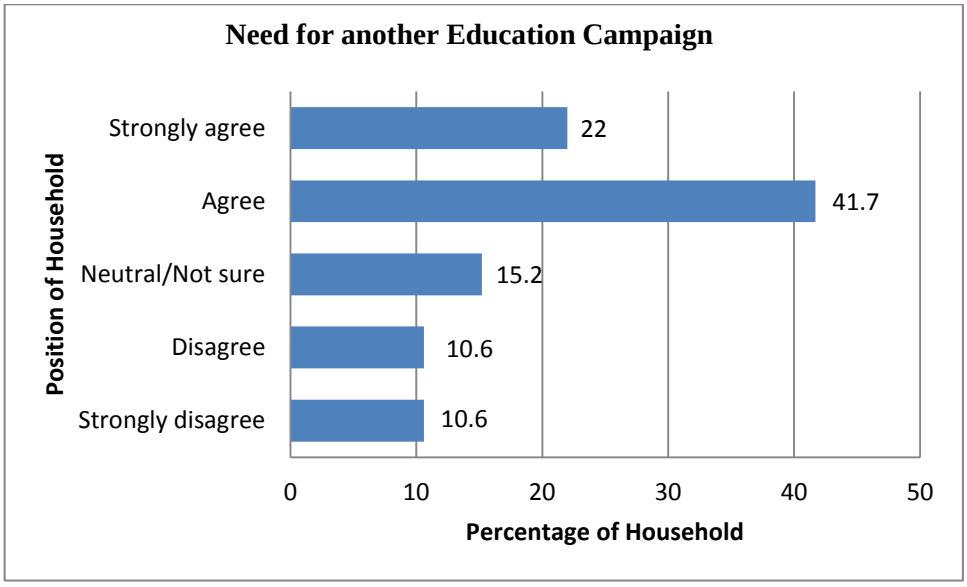

Figure 22: Need for another Education Campaign

The research results show that the majority of respondents need another education campaign of pre-paid metering technology with (41.7%) agreeing, 22% strongly agreeing, 15.2% not sure while 10.6% strongly disagree and 10.6% disagree. There is need for BWB to conduct additional educational campaigns to both Mudi and Naperi service areas. This will help iron out the problems consumers have been experiencing.

4.6 Relevance

4.6.1 Privacy with Use of Prepaid Meters

Figure 23 shows the user's perception of privacy with use of pre-paid meters.

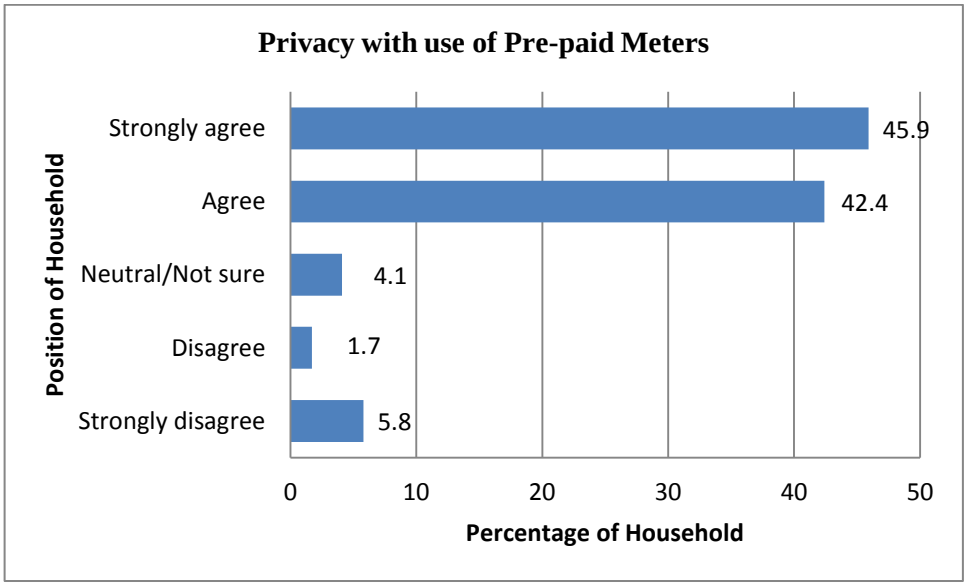

Figure 23: Privacy with Use of Pre-paid Meters

The research results show that (45.9%) of the respondents strongly agree that the use of pre-paid meters suits their privacy requirements since they don't need meter readers to trespass their properties. About 42.4% agree, while 5.8% strongly disagree, 4.1% are not sure and 1.7% disagreed.

Many of the respondents pointed out privacy as a key advantage they have realized from use of pre-paid meters. They mentioned that knocks on their gates by meter readers was an inconvenience which is now long forgotten. It is worth noting that all transactions are self-administered by the consumer, making the pre-paid metering system more fitting for most consumers' privacy needs. The prepaid-metering system has positively impacted on the BWB's operation by embracing a technology change that brings along privacy in consumers premises. Additionally this privacy has helped increase security by eliminating potential would-be thieves that masquerade as utility operators but with hidden motives.

4.6.2 Prepaid Meter & the Current Technology Trend

Figure 24 shows the pre-paid meter and current technology trend.

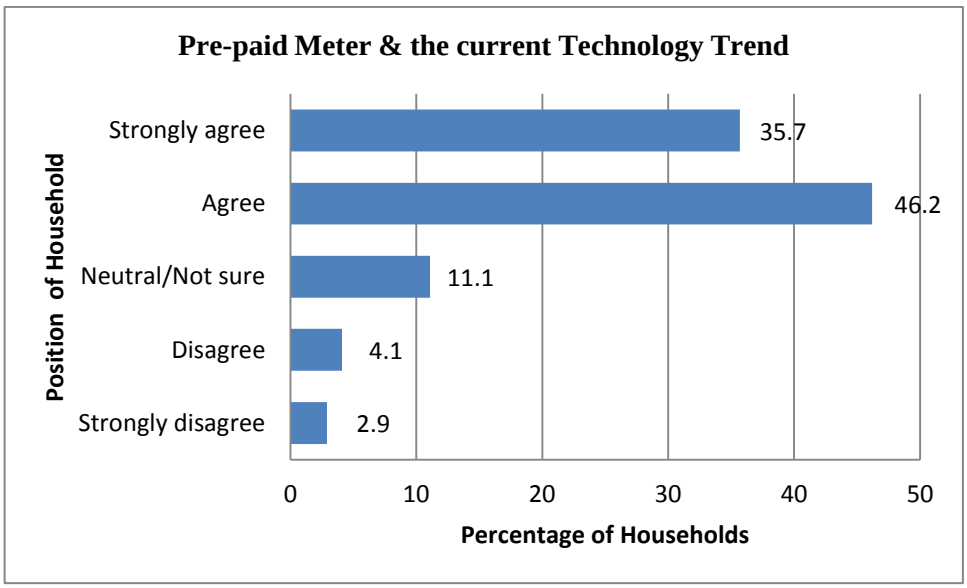

Figure 24: Prepaid Meter & the Current Technology Trend

Figure 24 shows that the majority of respondents admit that the use of interment based platform for sale of credit and monitoring water usage in line with the current technology trend and therefore fits the modern day consumer's life style. About (46.2%) of the respondents agree, 35.7% strongly agree, 11.1% are neutral while 4.1% disagree and 2.9% strongly disagree.

Most respondents felt that the internet based technology is being adopted by most service providers in the country e.g. banks, mobile phone operators, TV service operators and the electricity supply company. With such development, consumers feel BWB has equally done well in adopting the technology trend as most consumers have already adjusted their life style in line with the changes.

While consumers have the buy-in on the technology, BWB needs to improve on their service delivery especially where pre-paid system is concerned since it entails advance payment for a service to be delivered later on.

With regard to internet based technology trend, pre-paid metering system has appositive impact on both the consumer and BWB by saving time and costs through e-based payment for services and several other associated operations/transactions.

4.6.3 Transparency & Trustworthiness of Prepaid Meters

Figure 25 shows the user's perception of transparency and trustworthiness of pre-paid meters.

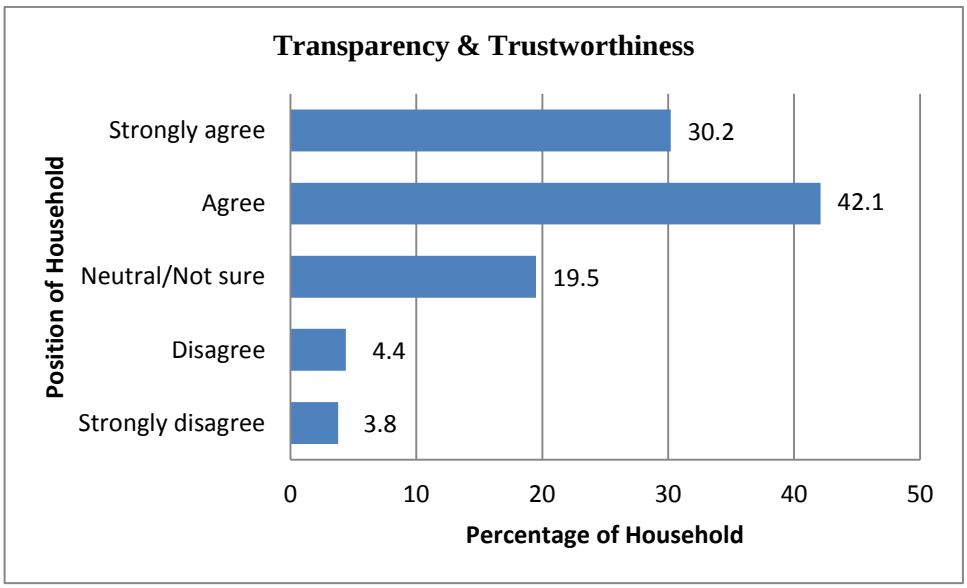

Figure 25: Transparency and Trustworthiness of Prepaid Meters

Figure 25 that 42.1% agree that pre-paid meters are trustworthy and transparent, 30.2% strongly agree, 19.5% are not sure while 4.4% disagree and 3.8% strongly disagree. Figure 25 shows that over half the respondents admit that the ability to enable consumers to instantly check the current recharge amount, volume in cubic meters used from the recharge that is in use, price of water (tariff) per cubic meter and remaining credit or amount of water remaining makes the pre-paid metering system transactions very transparent and trustworthy. Although the pre-paid meters are able give such information to the consumer, not all are able to extract it due to lack of education or awareness on the technology. At the same time some respondents indicated that during the transition period post-paid bills transferred to the pre-paid system were continuously being deducted beyond the amounts due. According to BWB key informants, such occurrences were small in number and were normalized once they were brought to their attention. For BWB, transparency and trustworthiness has had a huge impact on its operations by removing the numerous queries e.g. estimated or wrong bills previously associated with conventional meters.

4.7 Technology Acceptance

4.7.1 Experience with Conventional Meters

Table 5 below shows the percentage of respondents with conventional meter experience.

Table 5: Percent of Respondents with Conventional Meter Experience

No	Status	Percentage
1	Yes	71.9
2	No	28.1

Table 5 shows that 71.9% of the respondents have previously used conventional meters while 28.1% had never used the meters before. The results form a good basis for ensuring a reasonable comparison since over half the consumers had experience with both types of meters.

4.7.2 Preference for Conventional Meters

Figure 26 shows the preference for conventional meters.

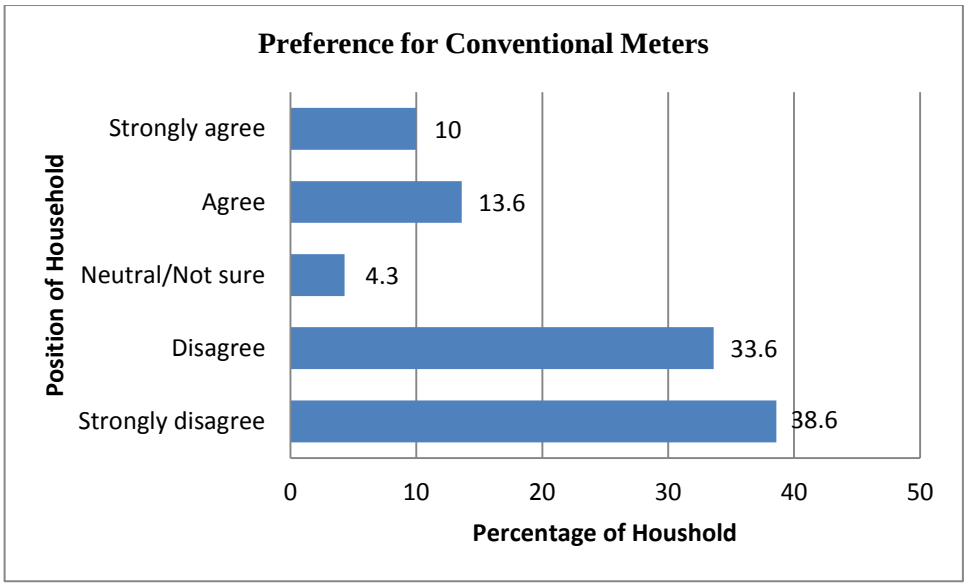

Figure 26: Preference for Conventional Meters.

Figure 26 shows that (38.6%) of the respondents strongly disagree to going back to the conventional meters, (33.6%) disagree, (13.6%) agree to go back, while (10%) strongly agree and (4.3%) are not sure. The results indicate a high degree of confidence consumers have with the pre-paid metering system. Similarly key informants from BWB are happy, confident and looking forward to working with this new technology.

With regard to rolling out to new services areas BWB should polish-up the slippages occurring in with the current meters in pilot areas. This will enable the board to achieve a high degree of acceptability for the new technology by the consumers.

4.7.3 Need for Good Services

Figure 27 shows the need for good services.

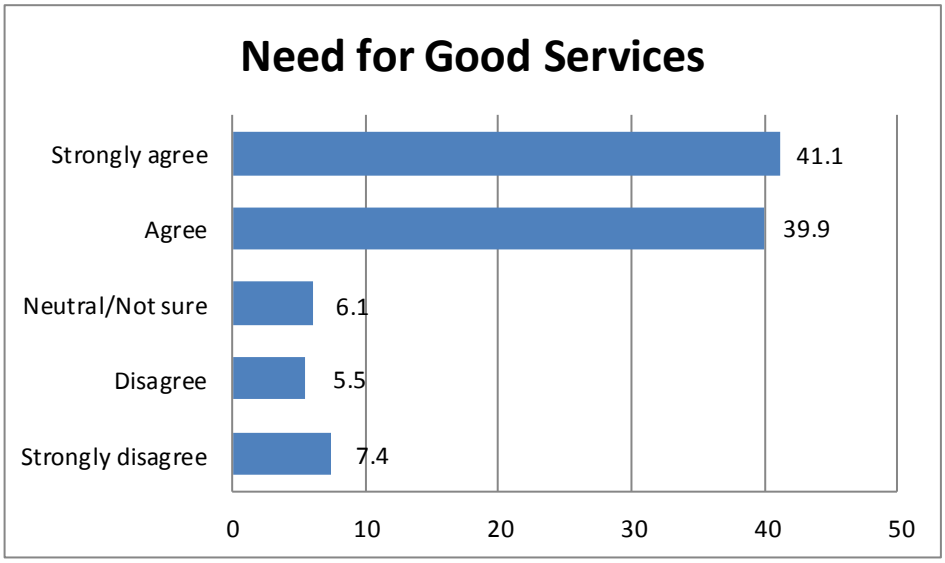

Figure 27: Need for Good Services

Figure 27 shows that 41.1% of the respondents agree that there is need for good services. 39.9% agree, 7.4% strongly agree while 6.1% are not sure and 5.5% disagree. The results indicate that over half the number of respondents concedes that the primary interest is not in the technology. Good services delivered at affordable prices are what consumers want.

While appreciating the advantages of the pre-paid metering system, some respondents indicated that ultimately what they want is water delivered constantly and at an affordable rate. This notion surfaced due to the frequent disruptions experienced by the consumers.

In future, BWB should install pre-paid meters in new service areas only when the rehabilitation of the intake works, pumping stations and trunk mains is completed. Completion of rehabilitation will ensure constant supply to service areas and therefore easy buy-in of the technology from the consumers.

4.7.4 Complexity of Prepaid Meters

Figure 28 shows the complexity of pre-paid meters.

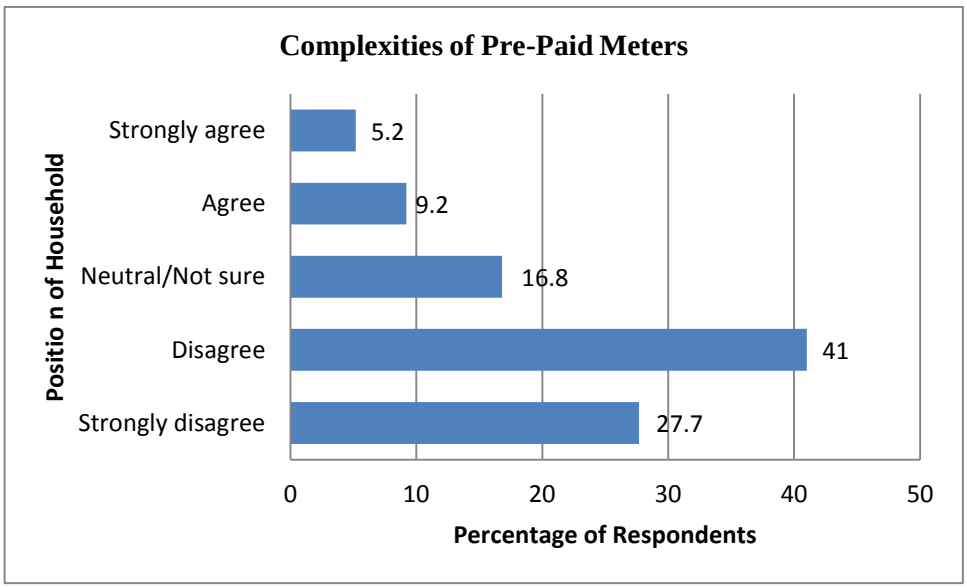

Figure 28: Complexities of Pre-paid meters

The research investigated how consumers rate the complexity in operating of the pre-paid meters. Figure 28 shows that 41% of the respondents disagree, 27.7% strongly disagree, 16.8% are neutral while 9.2% agree and 5.3% strongly agree. The results indicate that the majority of consumers don't agree that pre-paid metering systems transactions are complex and difficult to manage.

4.7.5 Appreciation of the Tariff Structure

Figure 29 shows the appreciation of tariff structure.

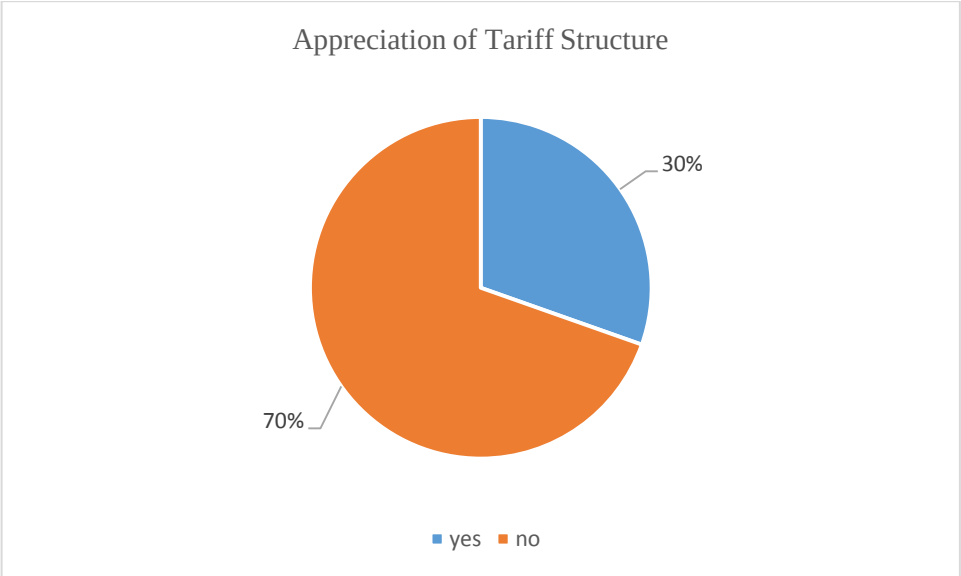

Figure 29: Appreciation of Tariff Structure

Figure 29 shows that the majority of respondents (70%) do not appreciate the tariff structure while only (30%) do. With BWB using a block tariff, there have been cases among respondents not understanding consumption volumes against equivalent credit bought on different months (Blantyre Water Board, 2014). While BWB key informants explained that they had conducted a door to door explanation on the tariff, many respondents seemed to have missed out as they may have been at work.

For future expansion programs, BWB should conduct a detailed briefing to consumers on the tariff structure. Emphasis should be on how a block tariff works.

4.7.6 Comparison of Costs

Table 6 below shows comparison of costs on conventional and pre-paid metering

Table 6: Cost Comparison for Conventional and Pre-paid Meters

Item	**Purchase Cost (MK) 2013**	
1	**Pre-paid**	**Conventional**
2	130,000	25,000
3	**Useful Life in Years**	
4	**15**	**5**

Source: Blantyre Water Board

Table 6 shows that that pre-paid meters used by BWB cost 5 times more than conventional ones. Meanwhile internet search for meter suppliers indicate a range of costs from diferent suppliers around the globe. Many suppliers have set minimum orders with price ranging from 20 to 70US$ (Alibaba, 2013) while in South Africa costs range from 156US$ (Effective Technologies, 2014) to 308US$ (Prepaid meters, 2014) with a 15% discount offered on purchases beyond 1000 meters.

The lifetime of pre-paid meters is 15years while conventional ones work up to about 5 years.

Pre-paid meters are more expensive than conventional meters but have a longer life span which would help BWB save costs. The research found out that the most basic prepaid meters have automatic meter reading and tamper detection components. In most cases additional features are optional, and are likely customized upon ordering meters. Though optional features may add to the unit cost of the meter, the additional benefits of the features may be well worthwhile.

Table 7 offers a financial analysis to check if the meters bought by BWB make a good investment decision.

Table 7: Payback Period Analysis

No	Item	Units	Calculation	Value	Source
A	Price of pre-paid meter	MK		130,000	BWB
B	Household consumption	cu.m/day		0.33	Sogreah for capital consumption per individual connection for Blantyre and NSO for people per household (66litres /capita/day)
C	Water tariff	MK/cu.m		333	BWB
D	Water expenditure per household	MK/year	B x C x 365	40,110	
E	Collection Rate	%		80	Blantyre Water Board (Ministry of Agriculture, Irrigation and Water Development, 2011)
F	Losses per Individual Connection	MK/year/connection	(1-E) x D	8,022	
G	Payback period	Years	A/F	16	
H	NPV of savings for individual connections	MK	NPV of meter costs (A) – NPV of losses per connections (F)	121,978	
I	EIRR of investment for household meter	%		-	

The results show that at a cost of MK130, 000 or (US$288) per meter, the pay- back period is 16 years. This implies the purchase does not make economic sense since the payback period is too long and beyond the useful life of the meter. Consequently this means the NPV is not worthy while. The Economic Interest Rate of Return (EIRR) is by implication too low to enable repayment and any meaningful profits. Further calculations show that at a cost of MK45, 000 or (US$150) per meter, the payback period drops to 8 years. In consideration of the present tariff, the collection rate and losses per individual connections, BWB should consider purchasing meters costing not more than US$150 for the utility to make an investment with financial sense.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the outcome of the study; points out the key findings from the study; recommends what can be done to utilize the findings and make them practical for implementation.

5.2 Conclusions

The results have addressed the two research questions identified in the study. Through literature review and analysis of results, the study concludes that ICT plays a major role in improving the performance of water boards. Pre-paid metering in particular is the way forward for enhancing operational and financial efficiency at Blantyre Water Board. However, BWB must provide associated training for the human resource to successfully adapt to the technology change before rolling out into the next installation phase of the pre-paid meters.

The key conclusions are presented as follows:

5.2.1 Increased Collections and Doing away with Arrears

BWB has experienced increased revenue collections from Naperi and Mudi due to the pre-paid metering system. At the same time BWB has done away with arrears in both service areas due to incorporation of new system. This is a key achievement considering that BWB has accumulated a lot of arrears from both the private and public sectors. Meanwhile it is still challenged by mainly public sector arrears especially from state houses, some government offices and military and police institutions. At full scale implementation, BWB will completely avoid arrears and be able to expand to other needy areas because of increased collections from the pre-paid system.

5.2.2 Accuracy in Readings and Charges

Prepaid water meters are accurate in their readings and consequently the monthly charges. This observation was agreed to by the majority (66%) of the respondents. In light of this observation, the buy-in of the technology by customers has been huge as it has completely taken out problems of high or estimated monthly bills and associated complaints with human errors on meter reading. Therefore ICT improves accuracy in meter readings and monthly bills.

5.2.3 Reduction in Operation Costs

Blantyre Water Board has observed a reduction in operation costs. The results show that operational costs for pre-paid meter on staff are (57%) lower than for conventional meters while transport costs are lower by (77%) and maintenance (63%). While this has been observed on the pilot area, it is evident that, significant savings can be realised if the roll out into the next phase covers most of the service areas. A simple analysis shows projected savings up to MK31.5Million a month. At present only 1.4% of the customer base utilizes the pre-paid metering systems i.e. 567 out of 40,000 connections.

5.2.4 Convenience to Customers and BWB

The study has shown that ICT offers a lot of convenience. The pre-paid meters are convenient to the operations of BWB because of the reduction in workload and effectively the operation reconnection (when credit runs out) is convenient for customers as it eliminates the embarrassment one goes through while using conventional meters. Pre-paid meters therefore offers customers the convenience they need through the meters' ability to be self-operated by the customer as well as enabling consumers to obtain transactions details from the meter.

5.2.5 Water Use and Cash-flow Management

The ability of the meter to instantly show consumers the credit at hand, volume of water in cubic meters and also the availability of monthly consumption patterns is an important facility that enables consumers to obtain handy information. There is need however for BWB to educate users and landlords on operation of the pre-paid meters.

The research concludes that the use of ICT in water metering enables customers to monitor, control and ultimately budget their monthly expenditure on water supply.

5.2.6 Need for Alternative Credit Selling Options

The majority of respondents agree that other credit selling means should be availed with (80.2%) agreeing. Respondents prefer purchasing of credit through alternative means that suit their lifestyles e.g. such as ATM, phone, bank internet or at service stations.

The research concludes that BWB should avail more credit selling options to suit the lifestyle of the consumer.

5.2.7 Salient Issues Regarding the Technology

The research picked up some significant issues surrounding the technology transfer preparedness that BWB needs to work out to enable smooth assimilation of the technology among its staff. The research concludes that the following issues need attention:

i) **Billing Irregularities**- Key Informants from BWB indicated that during the transition period, old bills were posted to the pre-paid system and deducted on monthly basis each time new credit is purchased. However several customers complained of continuous deduction even though they had settled their bills. There is need for perfection in this area.

ii) **Performance Monitoring**- Lack of monitoring of the pre-paid meters by BWB staff. Respondents indicated that there is absence of BWB staff visiting their premises to check performance of the meters. The research concludes that close monitoring of the pilot project would help to notice most of the issues coming out and rectify them in good time.

iii) **Technology Specification** - BWB staff noted a mismatch in software between the meters installed in Naperi and that used for billing by the utility. This is resulting in BWB incurring losses every other month. There is need to provide the right specifications in line with client needs when procuring meters.

5.2.8 Capital Costs for Meters

There is a varying range of costs for meters on the market. However a simple financial analysis for the prepaid meters indicate an optimal cost at which investment would make financial sense. The study therefore concludes that all being equal, BWB should make a good investment decision by using meters with a small payback period and higher economic internal rate of return.

5.3 Summary of Conclusion

The main research conclusions are as follows:

i) ICT has a significant impact on the operations of Blantyre Water Board through the use of pre-paid meters.

ii) On the positive side, the use of pre-paid metering systems has completely removed outstanding arrears. This is consistent with findings of the literature review especially for the case of WASCO in Maseru Lesotho, NRWB in Mzuzu Malawi, Adem in Maputo Mozambique, NCWSC in Nairobi Kenya where the utilities had accumulated lots of arrears form both public and private sectors.

iii) Pre-paid meters have also significantly reduced the workload and increased collection of revenue for most countries cited in the literature review.

5.4 Recommendations

The following recommendations have been proposed.

5.4.1 Customer Care

Blantyre Water Board should train adequate staff on the new technology and ensure they respond timely to faults reported by consumers. With the pre-payment arrangement, customers expect a seamless operation and speedy rectification of faults if any.

5.4.2 Financial

The utility must take out meter rentals and learn from other service provider on best options for cost recovery. Additionally, BWB should consider providing an emergency life-line for customers when the supply is cut-off during awkward times i.e. at night or when cash is not available. For instance meters used on the pilot by NRWB allow for emergency supply as a social safeguard. BWB should consider another campaign and endeavour to iron out the problems being experienced with the meters.

5.4.3 Operational

Monitoring of the meters should be enhanced at the beginning to ensure BWB is able to identify frequently occurring faults and means of repairing. Monitoring will also build trust and buy in of the technology from the consumers.

5.4.4 Technological

Blantyre Water Board should opt for credit purchasing systems that don't require consumers to present meter cards at the point of sale as this is cumbersome and inconveniencing to the consumer. BWB could consider using an already established credit selling platform used by other service providers. BWB needs to improve on educating the consumers on how to use the meters especially in reading information on credit or water volume balances. This will assist BWB in getting a significant buy-in from the consumers and ease future acceptance of the technology from new customers

5.4.5 Investment Decision

Blantyre Water Board should make invest in meters that make financial sense. All things being equal, BWB should purchase meters under US$150 as these would have a small payback period and a higher economic internal rate of return.

5.5 Recommendation on Further Researchable Areas

The study recommends further research in the following areas:

i) In order to complete the picture, the research should be expanded to other socio-economic areas e.g. High density areas where consumers use communal taps, high density areas where consumers have a yard tap, industrial areas and middle income areas.

ii) A study should be carried out on meter model that suits the requirement of both BWB and the consumer.

iii) A preferred system for purchase of credit which is convenient to the majority of customers.

The results would influence decisions and direct BWB investment options and possible strategy to apply.

5.6 Study Limitations

The study encountered challenges with response especially from Mudi service area. Although copies of the questionnaire were distributed to all households, the response was low. Frequent reminders through home visitations did not yield much as household owners continuously gave unconvincing excuses. Additional time was allocated to resolve the problem, but this did not yield any significant results . This may have slightly impacted the accurancy of findings. A higher response rate in Mudi would have helped to potray a true reflection of the pre-paid meters on the pilot.

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APPENDIX 1: DATA COLLECTION INSTRUMENT 1

QUESTIONNAIRE ON THE ASSESSMENT OF THE IMPACT OF APPLICATION OF ICT IN WATER BOARDS: THE CASE OF PRE -PAID METERING AT BLANTYRE WATER BOARD

Blantyre Water Board is one of the pioneering companies that adopted ICT in its financial and billing operations using COBOL spreadsheet. However, ICT application in engineering and operations has been rather slow. It was only recently that the BWB made a decision to pilot pre-paid water metering technology in Naperi and Mudi areas.

This questionnaire is part of a research that seeks to find out information on the outcome of the pilot project on the new technology whose main objective is to investigate the impact of using pre -paid metering technology on operations of the Blantyre Water Board.

The research study has dual purposes. The first and the principle purpose is to fulfill part of the academic requirements for Master of Science in Sustainable Engineering Management (Water Supply) degree with the University of Malawi. The information collected and analyzed will be treated with strict confidentiality and for academic purposes only. Generalizations will be made and no findings will be attributed to particular names of informants or interviewees.

If you have any questions, queries or would like further information, please contact me through any of the contact details below.

Thank you in advance.

George Namizinga

MSc Engineering Management (Water Supply) Student,

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QUESTIONNAIRE FOR KEY INFORMANTS

SECTION A- PERSONAL DATA

1. Name……
2. Position in organization……...
3. Department/Section attached to……..
4. Length of involvement in the water supply industry……..
5. Length of involvement with pre-paid water metering system…….

SECTION B – EFFICIENCY

6. How many members of staff were allocated or are being allocated per consumer using the old/ current system?
7. How many members of staff are allocated per consumer using the prepaid meter system?
8. How many technical problems are reported on a) pre-paid meters b) mechanical meters? per month?
9. Mention the common customer complaints or faults that are normally reported on pre-paid meters. List and tick as many as are applicable.

Nature of complaint	Applicable Case
High consumption	
Meter requiring service	
Pulse error	
No water supply	
Low pressure	
Lost card	
Leaking meter	
Blank LCD and low battery	
Unloaded units	

10. Does BWB allocate stand-by personnel to respond to faults at any time of the day?
11. What materials are in stock for maintenance and repairs of the pre-paid meters?

12. How conversant are the technical/maintenance team members with theory, operation and maintenance of pre-paid meters?

13. Has the board ever experienced technical problems with meters beyond the competence of its personnel? If so, how was this handled?

14. In the event of a technical fault registered by a consumer, how long does it take BWB to respond?

15. What sort of training did technicians undergo for the pre-paid metering system?

16. What type of training were managers involved in?

17. Who else was trained for use of information on pre-paid metering system? e.g. on billing, IT, Accounts.

SECTION C – IMPACT

18. What are the benefits of using pre-paid meters over conventional meters? List as many as you know.

19. How long is the billing cycle with conventional meters? How long is the billing cycle with pre-paid meters?

20. What are the plans for scaling up the pre-paid metering system?

21. What benefits does the customer get from the pre-paid metering system?

SECTION D – LOGISTICAL ARRANGEMENTS

22. What is mode of selling credit to consumers who are using pre-paid water meters?

23. Has BWB ever considered other selling modes of credit? If so, please mention and rank them in order of priority by the Board. One (1) being the most convenient to 5 being the least convenient to you in the spaces provided below

Bank	Auto Teller Machines	Cellphone Banking	Cards Bought at local shops	Fixed Selling Point .e.g. BP Filling Station

24. How many fixed selling points were established and what is the proximity to Mudi and Naperi service areas?

25. Do customers complain of travelling long distances to the credit selling points?

26. What time do selling points open and close for customers? Have you ever received requests to extending business hours for selling credit?

27. What problems are often registered with the credit selling system? List potential complaints and tick as many as they apply.

28. What advantages does the board get on the pre-paid credit selling system over the post- paid payment arrangement?

SECTION E – RELEVANCE

29. How is the pre-paid metering system relevant to current technology trend or modern-day working practice?

30. With most systems computerized at BWB e.g. Accounting, Water level Monitoring, how does the pre-paid metering system fit in?

31. In what way does the pre-paid metering system ensure transparency and trustworthiness to consumers?

32. Due to fiscal problems and in order to be efficient most companies are downsizing or rightsizing. How well has the pre-paid metering system assisted BWB to downsize or right size?

33. In what way does the pre-paid metering system fit into the consumer's modern day lifestyle?

SECTION F – PERFORMANCE

33. In your own opinion how has the pre-paid water metering system performed?

34. What issues have affected performance of the prepaid metering system if any?

    Probe on: I) Intermittent supply due to on-going water system rehabilitation

    II) Lack of internet connectivity at times when customers want to purchase credit.

35. What is the life expectancy of the meters? Probe if supplier offers guarantee or back-up service in case of problems.

36. Are the meters powered by batteries? If so, what is the life expectancy of the batteries?

37. One of BWB's teething problems is network losses and un-accounted for water. How has the pre-paid metering technology assisted the Board in checking and controlling such losses?

SECTION G – ACCEPTANCE OF TECHNOLOGY

38. What drivers were considered very significant for BWB to consider the pilot project?

39. How much does it cost BWB to install, maintain and operate a pre-paid meter as well as a mechanical meter in a year?

40. How does the BWB utilize the old meter readers?

41. Was there any resistance in the introduction of prepaid meters?

42. What measures are put in place before new technology is introduced?

43. Does the board envisage any conflict between the technology and meter readers?

SECTION E – POTENTIAL BENEFITS

44. What are the benefits of using the pre- paid water metering system that have been noted so far by Blantyre Water Board?

45. Is the BWB applying the lessons learnt immediately to inform its operations?

46. To what extent do the benefits of pre-paid meters outweigh those of mechanical meters?

47. In regard of the benefits experienced, how does BWB plan to capitalize on them in order to enhance operating efficiency of the Board?

SECTION F – COSTS

48. What is the current market value of a new pre-paid and a mechanical meter?

49. In regard to the present experience from the pilot, how long will it take for BWB to repay the cost of a new meter?

50. What types of costs are associated with both pre-paid and mechanical meters?

51. With regard to monthly operations, how much does BWB spend on one prepaid meter compared to a mechanical meter?

52. What is the internal rate of return for the pre-paid meters that were used in the pilot project?

APPENDIX 2: DATA COLLECTION INSTRUMENT 2

QUESTIONNAIRE ON THE ASSESSMENT OF THE IMPACT OF APPLICATION OF ICT IN WATER BOARDS: THE CASE OF PRE -PAID METERING AT BLANTYRE WATER BOARD

Blantyre Water Board is one of the pioneering companies that adopted ICT in its financial and billing operations using COBOL spreadsheet. However, ICT application in engineering and operations has been rather slow. It was only recently that the BWB made a decision to pilot pre-paid water metering technology in Naperi and Mudi areas.

This questionnaire is part of a research that seeks to find out information on the outcome of the pilot project on the new technology whose main objective is to investigate the impact of using pre -paid metering technology on operations of the Blantyre Water Board.

The research study has dual purposes. The first and the principle purpose is to fulfill part of the academic requirements for Master of Science in Sustainable Engineering Management (Water Supply) degree with the University of Malawi. Secondly, the findings will inform the BWB on the challenges and opportunities that the pre-paid water meters technology's future scaling-up strategies. The information collected and analyzed will be treated with strict confidentiality and for academic purposes only. Generalizations will be made and no findings will be attributed to particular names of informants or interviewees.

If you have any questions, queries or would like further information, please contact me through any of the contact details below.

Thank you in advance.

George Namizinga

MSc Engineering Management (Water Supply) Student, The Polytechnic

Cell 0888 860 854 or gnamizinga@yahoo.com

SECTION A: DEMOGRAPHIC INFORMATION

1. Name……

2. Gender (Tick Appropriate Box below)

Male	Female

3. Physical location. (Tick Appropriate Box below)

Mudi-Estate	New Naperi

Plot No.: _____

4. Period of pre-paid meter usage since installation in months. (Tick Appropriate Box below)

0 – 3	4 - 7	8 - 11	12 - 15	Other

5. How many people stay in your house per given time? (Tick appropriate box)

1 to 2	3 to 5	6 to 8	9 to 11	12 and above

6. Which of the following categories apply to you? (Tick appropriate box below).

Housewife /husband	Full-time student	Self-employed	In part-time, paid employment	In full-time, paid employment	Other (please specify)

7. Who is responsible for paying your water bills? (Tick appropriate box below).

Myself	My company	Other (Please specify)

SECTION B- EFFICIENCY

The following statements are related to efficiency of pre-paid water meters. To what extent do you agree with the following statement with regard to efficiency?

NOTE

1 Strongly disagree

2 Disagree

3 Neutral/Not sure

4 Agree

5 Strongly agree

8. Pre–paid water meter consumption charges, relate accurately to the amount of water consumed.

1	2	3	4	5	6

9. The reliability of prepaid meters owes to the fact that no mechanical failures have been experienced since installation.

1	2	3	4	5	6

10. In the event of a reported mechanical failure, Blantyre Water Board responds within the same day.

1	2	3	4	5	6

11. Blantyre Water Boards stocks adequate maintenance materials for the pre-paid water meters.

1	2	3	4	5	6

12. Maintenance personnel from Blantyre Water Board are conversant with the theoretical and practical knowledge of plumbing works and pre-paid water meter operation.

1	2	3	4	5	6

13. The lack of physical disconnection and re-connection fees make pre-paid all the more convenient for the consumer.

1	2	3	4	5	6

SECTION C- IMPACT

The following statements are related to the impact of using the pre-paid water metering system. To what extent do you agree with the following statements as regards the impact of using the pre-paid water metering system?

NOTE

1 Strongly disagree

2 Disagree

3 Neutral/Not sure

4 Agree

5 Strongly agree

6 Don't Know

14. Pre-paid water meter is a good tool for assisting consumers in monitoring and controlling water usage as well as planning monthly cash flow.

1	2	3	4	5	6

15. The pre-paid metering system has no problems.

1	2	3	4	5	6

16. Frequent malfunctioning of the pre-paid meter sometimes leaves our household without water.

1	2	3	4	5	6

17. In contrast with conventional metering, the one of the pre-paid system's disadvantage is that you can only have water if you have credit.

1	2	3	4	5	6

18. The new water delivery service through pre-paid water metering system poses a health risk to vulnerable groups especially those with little or irregular income as they may "self-disconnect" when credit runs out and turn to water sources that are not safe for human consumption.

1	2	3	4	5	6

SECTION D: - LOGISTICAL ARRANGEMENTS

Logistical arrangements relate to consideration of services associated with use of prepaid meters, but not necessarily inherent in the technology. These may include e.g. selling system for pre-paid credit.

In terms of logistical arrangements, to what extent do you agree with the following statements on the arrangement for selling of credit with regard to the pre-paid water meters?

NOTE:

1. Strongly disagree
2. Disagree
3. Neutral/Not sure
4. Agree
5. Strongly agree

19. The current credit selling system is satisfactory.

1	2	3	4	5

20. The credit selling points are conveniently located.

1	2	3	4	5

21. Sometimes I cannot buy credit due to connectivity problems with internet.

1	2	3	4	5

22. The extension of business hours for selling credit would be very convenient for most of consumers.

1	2	3	4	5

23. Credit selling system could have been better by availing other alternative means apart from fixed selling points.

1	2	3	4	5

24. Please rank the following alternative credit purchasing means in order of convenience. One (1) being the most convenient to 5 being the least convenient to you in the spaces provided below.

Bank	Auto Teller Machines	Cellphone Banking	Cards Bought at local shops	Fixed Selling Point .e.g. BP Filling Station

25. Did you participate in the pre-paid metering education campaign?

Yes	No

If yes go to Q26. If no go to Q27.

26. The education campaign on pre-paid water metering technology conducted by Blantyre Water Board was satisfactory.

1	2	3	4	5

27. It is important to have another education campaign on pre-paid water metering technology.

1	2	3	4	5

SECTION E- RELEVANCE

The following statements are related to the relevance of the pre-paid metering system to the customer's needs. To what extent do you agree on relevance of the system with regard to these statements?

NOTE

1 Strongly disagree

2 Disagree

3 Neutral/Not sure

4 Agree

5 Strongly agree

28. The use of pre–paid meters suits my privacy requirements since it doesn't need meter readers to trespass my property.

1	2	3	4	5

29. The use of internet based platform for sale of credit and monitoring of water usage is in line with the current technology trend and therefore fits the modern-day consumer's life style.

1	2	3	4	5

30. It is convenient for consumers to purchase water credit from alternative sources other than queuing at the Water Board's central designated pay point at Chichiri Shopping Mall.

1	2	3	4	5

31. The ability to enable consumers to instantly check the current recharge amount, amount of water in cubic meters used from the recharge that is in use, price of water (tariff) per cubic meter and remaining credit or amount of water remaining makes the pre-paid metering system transactions very transparent and trustworthy.

1	2	3	4	5

SECTION F - TECHNOLOGY ACCEPTANCE

The following statements are related to technology acceptance of the pre-paid metering system. To what extent do you agree with the following statements with regard to technology acceptance of water meters?

NOTE

1 Strongly disagree

2 Disagree

3 Neutral/Not sure

4 Agree

5 Strongly agree

32. Have you used conventional water meters before?

Yes	No

If yes go to Q33. If no go to Q34

33. Having used both metering systems, given a chance I would still go back to the conventional meters.

1	2	3	4	5

34. The primary interest is not in the technology. Good services delivered at affordable prices are what consumers want.

1	2	3	4	5

35. Pre- paid metering systems transactions are complex and difficult to manage.

1	2	3	4	5

36. Do you understand the tariff structure?

Yes	No

35. Do you have any other comments you would like to raise?

_____

_____

_____

_____

THANK YOU

APPENDIX 3: RESULTS SHOWING FREQUENCY TABLES FOR NAPERI AND MUDI

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	112	62.6	65.1	65.1
	Female	60	33.5	34.9	100
	Total	172	96.1	100	
Missing	System	7	3.9		
Total		179	100		
Physical location					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mudi-Estate	58	32.4	32.6	32.6
	New Naperi	120	67	67.4	100
	Total	178	99.4	100	
Missing	System	1	0.6		
Total		179	100		
Period of prepaid meter usage since installation in months					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-3 months	6	3.4	4.1	4.1
	4-7 months	25	14	16.9	20.9
	8-11 months	47	26.3	31.8	52.7
	12-15 months	70	39.1	47.3	100
	Total	148	82.7	100	
Missing	System	31	17.3		
Total		179	100		

Period of prepaid meter usage since installation in months					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		161	89.9	89.9	89.9
	1year 8 months	1	0.6	0.6	90.5
	20	1	0.6	0.6	91.1
	more than 15 months	1	0.6	0.6	91.6
	more than 2 years	1	0.6	0.6	92.2
	not sure	1	0.6	0.6	92.7
	Other	10	5.6	5.6	98.3
	since installation	2	1.1	1.1	99.4
	since pilot started	1	0.6	0.6	100
	Total	179	100	100	
How many people live in your house per unit time?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 2	14	7.8	7.9	7.9
	3 to 5	76	42.5	42.9	50.8
	6 to 8	71	39.7	40.1	91
	9 to 11	8	4.5	4.5	95.5
	12 and above	8	4.5	4.5	100
	Total	177	98.9	100	
Missing	System	2	1.1		
Total		179	100		
Which of the following categories apply to you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Housewife/Husband	32	17.9	19.6	19.6
	Full-time student	7	3.9	4.3	23.9

	Self-employed	48	26.8	29.4	53.4
	In part-time, paid employment	4	2.2	2.5	55.8
	In full-time, paid employment	72	40.2	44.2	100
	Total	163	91.1	100	
Missing	System	16	8.9		
Total		179	100		

Which of the following categories apply to you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		169	94.4	94.4	94.4
	Company	1	0.6	0.6	95
	Family	1	0.6	0.6	95.5
	Lodge	1	0.6	0.6	96.1
	Other	2	1.1	1.1	97.2
	Pastor	1	0.6	0.6	97.8
	Retired	1	0.6	0.6	98.3
	retired officer	1	0.6	0.6	98.9
	Retiree	2	1.1	1.1	100
	Total	179	100	100	

Who is responsible for paying your water bills?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Myself	154	86	91.1	91.1
	My company	15	8.4	8.9	100
	Total	169	94.4	100	
Missing	System	10	5.6		
Total		179	100		

Who is responsible for paying your water bills?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		172	96.1	96.1	96.1
	Company	1	0.6	0.6	96.6
	government department	1	0.6	0.6	97.2
	Husband	2	1.1	1.1	98.3
	my husband	1	0.6	0.6	98.9
	my tenant	1	0.6	0.6	99.4
	Parents	1	0.6	0.6	100
	Total	179	100	100	

Pre-paid water meter consumption charges, relate accurately to amount of water consumed?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	6	3.4	3.4	3.4
	Disagree	12	6.7	6.7	10.1
	Neutral/Not sure	34	19	19.1	29.2
	Agree	84	46.9	47.2	76.4
	Strongly agree	29	16.2	16.3	92.7
	Don't know	13	7.3	7.3	100
	Total	178	99.4	100	
Missing	System	1	0.6		
Total		179	100		

The reliability owes to the fact that no mechanical failures have been experienced since installation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	17	9.5	9.6	9.6
	Disagree	27	15.1	15.2	24.7

	Neutral/Not sure	19	10.6	10.7	35.4
	Agree	71	39.7	39.9	75.3
	Strongly agree	38	21.2	21.3	96.6
	Don't know	6	3.4	3.4	100
	Total	178	99.4	100	
Missing	System	1	0.6		
Total		179	100		

In the event of a reported mechanical failure, Blantyre Water Board responds within the same day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	16	8.9	9.3	9.3
	Disagree	29	16.2	16.9	26.2
	Neutral/Not sure	41	22.9	23.8	50
	Agree	31	17.3	18	68
	Strongly agree	13	7.3	7.6	75.6
	Don't know	42	23.5	24.4	100
	Total	172	96.1	100	
Missing	System	7	3.9		
Total		179	100		

Blantyre Water Boards stock adequate maintenance materials for the pre-paid water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	8	4.5	4.7	4.7
	Disagree	8	4.5	4.7	9.4
	Neutral/Not sure	48	26.8	28.2	37.6
	Agree	26	14.5	15.3	52.9
	Strongly agree	11	6.1	6.5	59.4
	Don't know	69	38.5	40.6	100
	Total	170	95	100	

Missing	System	9	5		
Total		179	100		

Maintenance personnel from Blantyre Water Board are conversant with the theoretical and practical knowledge of plumbing works and pre-paid water meter operation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	3	1.7	1.8	1.8
	Disagree	11	6.1	6.4	8.2
	Neutral/Not sure	42	23.5	24.6	32.7
	Agree	47	26.3	27.5	60.2
	Strongly agree	17	9.5	9.9	70.2
	Don't know	51	28.5	29.8	100
	Total	171	95.5	100	
Missing	System	8	4.5		
Total		179	100		

The lack of physical disconnection and re-connection fees make pre-paid meters all the more convenient for the consumer					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	11	6.1	6.3	6.3
	Disagree	4	2.2	2.3	8.6
	Neutral/Not sure	3	1.7	1.7	10.3
	Agree	67	37.4	38.5	48.9
	Strongly agree	74	41.3	42.5	91.4
	Don't know	15	8.4	8.6	100
	Total	174	97.2	100	
Missing	System	5	2.8		
Total		179	100		

Pre-paid water is a good for assisting consumers in monitoring and controlling water usage as well as planning monthly cash flow					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	7	3.9	4	4
	Disagree	4	2.2	2.3	6.3
	Neutral/Not sure	6	3.4	3.4	9.7
	Agree	74	41.3	42.3	52
	Strongly agree	74	41.3	42.3	94.3
	Don't know	10	5.6	5.7	100
	Total	175	97.8	100	
Missing	System	4	2.2		
Total		179	100		
The pre-paid metering system has no problems					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	15	8.4	8.7	8.7
	Disagree	40	22.3	23.1	31.8
	Neutral/Not sure	32	17.9	18.5	50.3
	Agree	55	30.7	31.8	82.1
	Strongly agree	15	8.4	8.7	90.8
	Don't know	16	8.9	9.2	100
	Total	173	96.6	100	
Missing	System	6	3.4		
Total		179	100		
Frequent malfunctioning of the pre-paid meter sometimes leaves our household without water					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	25	14	14.4	14.4

	Disagree	56	31.3	32.2	46.6
	Neutral/Not sure	32	17.9	18.4	64.9
	Agree	27	15.1	15.5	80.5
	Strongly agree	18	10.1	10.3	90.8
	Don't know	16	8.9	9.2	100
	Total	174	97.2	100	
Missing	System	5	2.8		
Total		179	100		

In contrast with conventional metering, the one of the prepaid system's disadvantage is that you can only have water if you have credit

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	5	5.1	5.1
	Disagree	11	6.1	6.3	11.4
	Neutral/Not sure	11	6.1	6.3	17.7
	Agree	77	43	44	61.7
	Strongly agree	59	33	33.7	95.4
	Don't know	8	4.5	4.6	100
	Total	175	97.8	100	
Missing	System	4	2.2		
Total		179	100		

The new delivery service through pre-paid water metering system poses a health risk to vulnerable groups especially those with little or irregular income as they "self-disconnect" when credit runs out and turn to water sources that are not safe for human

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	16	8.9	9.2	9.2
	Disagree	26	14.5	15	24.3
	Neutral/Not sure	17	9.5	9.8	34.1
	Agree	56	31.3	32.4	66.5

	Strongly agree	48	26.8	27.7	94.2
	Don't know	10	5.6	5.8	100
	Total	173	96.6	100	
Missing	System	6	3.4		
Total		179	100		
The credit selling system is satisfactory					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	16	8.9	9.2	9.2
	Disagree	29	16.2	16.7	25.9
	Neutral/Not sure	30	16.8	17.2	43.1
	Agree	78	43.6	44.8	87.9
	Strongly agree	21	11.7	12.1	100
	Total	174	97.2	100	
Missing	System	5	2.8		
Total		179	100		
The credit selling points are conveniently located					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	19	10.6	10.9	10.9
	Disagree	22	12.3	12.6	23.6
	Neutral/Not sure	18	10.1	10.3	33.9
	Agree	85	47.5	48.9	82.8
	Strongly agree	30	16.8	17.2	100
	Total	174	97.2	100	
Missing	System	5	2.8		
Total		179	100		
Sometimes I cannot buy credit due to connectivity problems with internet					

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	14	7.8	8.2	8.2
	Disagree	33	18.4	19.3	27.5
	Neutral/Not sure	40	22.3	23.4	50.9
	Agree	48	26.8	28.1	78.9
	Strongly agree	36	20.1	21.1	100
	Total	171	95.5	100	
Missing	System	8	4.5		
Total		179	100		

The extension of business hours for selling credit would be very convenient for most of consumers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	9	5	5.1	5.1
	Disagree	7	3.9	4	9.1
	Neutral/Not sure	11	6.1	6.3	15.4
	Agree	72	40.2	41.1	56.6
	Strongly agree	76	42.5	43.4	100
	Total	175	97.8	100	
Missing	System	4	2.2		
Total		179	100		

Credit selling system could have been better by availing other alternative means apart from fixed selling points

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	12	6.7	7	7
	Disagree	8	4.5	4.7	11.6
	Neutral/Not sure	14	7.8	8.1	19.8
	Agree	69	38.5	40.1	59.9

	Strongly agree	69	38.5	40.1	100
	Total	172	96.1	100	
Missing	System	7	3.9		
Total		179	100		

Please rank the following alternative credit purchasing means in order of convenience.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	2	1.1	1.3	1.3
	Auto teller Machines	8	4.5	5.1	6.3
	Cell phone Banking	89	49.7	56.3	62.7
	Cards Bought at local shop	16	8.9	10.1	72.8
	Fixed Selling Point e.g. Filling Station	43	24	27.2	100
	Total	158	88.3	100	
Missing	System	21	11.7		
Total		179	100		

Please rank the following alternative credit purchasing means in order of convenience.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	3	1.7	3.2	3.2
	Auto teller Machines	28	15.6	29.8	33
	Cell phone Banking	14	7.8	14.9	47.9
	Cards Bought at local shop	31	17.3	33	80.9
	Fixed Selling Point e.g. Filling Station	18	10.1	19.1	100
	Total	94	52.5	100	

Missing	System	85	47.5		
Total		179	100		

Please rank the following alternative credit purchasing means in order of convenience.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	13	7.3	15.5	15.5
	Auto teller Machines	20	11.2	23.8	39.3
	Cell phone Banking	13	7.3	15.5	54.8
	Cards Bought at local shop	20	11.2	23.8	78.6
	Fixed Selling Point e.g. Filling Station	18	10.1	21.4	100
	Total	84	46.9	100	
Missing	System	95	53.1		
Total		179	100		

Please rank the following alternative credit purchasing means in order of convenience.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	15	8.4	17	17
	Auto teller Machines	28	15.6	31.8	48.9
	Cell phone Banking	5	2.8	5.7	54.5
	Cards Bought at local shop	20	11.2	22.7	77.3
	Fixed Selling Point e.g. Filling Station	20	11.2	22.7	100
	Total	88	49.2	100	
Missing	System	91	50.8		
Total		179	100		

Please rank the following alternative credit purchasing means in order of convenience.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bank	54	30.2	58.7	58.7
	Auto teller Machines	7	3.9	7.6	66.3
	Cell phone Banking	8	4.5	8.7	75
	Cards Bought at local shop	10	5.6	10.9	85.9
	Fixed Selling Point e.g. Filling Station	13	7.3	14.1	100
	Total	92	51.4	100	
Missing	System	87	48.6		
Total		179	100		
Did you participate in the pre-paid metering education campaign?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	13.4	14.1	14.1
	No	146	81.6	85.9	100
	Total	170	95	100	
Missing	System	9	5		
Total		179	100		
The education campaign on prepaid water technology conducted by Blantyre Water Board satisfactory.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	2.8	9.6	9.6
	Disagree	7	3.9	13.5	23.1
	Neutral/Not sure	15	8.4	28.8	51.9

	Agree	18	10.1	34.6	86.5
	Strongly agree	7	3.9	13.5	100
	Total	52	29.1	100	
Missing	System	127	70.9		
Total		179	100		

It is important to have another education campaign on pre-paid water metering technology.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	14	7.8	10.6	10.6
	Disagree	14	7.8	10.6	21.2
	Neutral/Not sure	20	11.2	15.2	36.4
	Agree	55	30.7	41.7	78
	Strongly agree	29	16.2	22	100
	Total	132	73.7	100	
Missing	System	47	26.3		
Total		179	100		

The use of pre-paid meters suits my privacy requirements since it doesn't need meter readers to trespass my property

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	10	5.6	5.8	5.8
	Disagree	3	1.7	1.7	7.6
	Neutral/Not sure	7	3.9	4.1	11.6
	Agree	73	40.8	42.4	54.1
	Strongly agree	79	44.1	45.9	100
	Total	172	96.1	100	
Missing	System	7	3.9		
Total		179	100		

The of internet based platform for sale of credit and monitoring of water usage is in line with the current technology trend and therefore fits the modern-day consumer's life style					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	5	2.8	2.9	2.9
	Disagree	7	3.9	4.1	7
	Neutral/Not sure	19	10.6	11.1	18.1
	Agree	79	44.1	46.2	64.3
	Strongly agree	61	34.1	35.7	100
	Total	171	95.5	100	
Missing	System	8	4.5		
Total		179	100		

It is convenient for consumers to purchase water credit from alternative sources other than queuing at the Water Board's central designated pay point at Chichiri Shopping Mall					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	8	4.5	4.7	4.7
	Disagree	2	1.1	1.2	5.8
	Neutral/Not sure	7	3.9	4.1	9.9
	Agree	69	38.5	40.1	50
	Strongly agree	86	48	50	100
	Total	172	96.1	100	
Missing	System	7	3.9		
Total		179	100		

The ability to enable consumers to instantly check the current recharge amount, amount of water in cubic meters used from the recharge that is in use, price of water (tariff) per cubic meter and remaining credit or amount of water remaining makes the pre-					
		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	Strongly disagree	6	3.4	3.8	3.8
	Disagree	7	3.9	4.4	8.2
	Neutral/Not sure	31	17.3	19.5	27.7
	Agree	67	37.4	42.1	69.8
	Strongly agree	48	26.8	30.2	100
	Total	159	88.8	100	
Missing	System	20	11.2		
Total		179	100		

Have you used conventional water meters before?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	120	67	71.9	71.9
	No	47	26.3	28.1	100
	Total	167	93.3	100	
Missing	System	12	6.7		
Total		179	100		

Having used both metering systems,given a chance I would still go back to the conventional meters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	54	30.2	38.6	38.6
	Disagree	47	26.3	33.6	72.1
	Neutral/Not sure	6	3.4	4.3	76.4
	Agree	19	10.6	13.6	90
	Strongly agree	14	7.8	10	100
	Total	140	78.2	100	
Missing	System	39	21.8		
Total		179	100		

The primary interest is not in the technology. good services delivered at affordable price are what consumers want					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	12	6.7	7.4	7.4
	Disagree	9	5	5.5	12.9
	Neutral/Not sure	10	5.6	6.1	19
	Agree	65	36.3	39.9	58.9
	Strongly agree	67	37.4	41.1	100
	Total	163	91.1	100	
Missing	System	16	8.9		
Total		179	100		
Pre-paid metering systems transactions are complex and difficult to manage					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	48	26.8	27.7	27.7
	Disagree	71	39.7	41	68.8
	Neutral/Not sure	29	16.2	16.8	85.5
	Agree	16	8.9	9.2	94.8
	Strongly agree	9	5	5.2	100
	Total	173	96.6	100	
Missing	System	6	3.4		
Total		179	100		
Do you understand the tariff structure?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	51	28.5	30.4	30.4
	No	117	65.4	69.6	100
	Total	168	93.9	100	
Missing	System	11	6.1		

Total		179	100		