UNIVERSITY OF LUSAKA

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THE EFFECTIVENESS OF THE SOMAP MODEL TO SUSTAIN RURAL WATER SUPPLY IN ZAMBIA - A CASE OF CHONGWE DISTRICT

BY

JAVAN NKHOSI

MSCPM 1613049

SUPERVISOR:

ENG. MICHAEL KALUMBU NSEFU

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DECLARATION

I, **Javan NKHOSI**, hereby declare that this work is wholly my own and all the work of other people have been dully acknowledged; and that is has never been previously produced or presented at this University or indeed any other institution for similar purpose.

_____ _____

Javan NKHOSI Date

MSCPM 1613049

This research project report has been submitted for examination with my approval as University Supervisor.

_____ _____

Eng. Michael Kalumbu Nsefu Date

DEDICATION

I dedicate this study to God, the Father of our Lord Jesus Christ, through the Lord Jesus Christ, for His grace upon my life, to my wife Jane Senwa, the girl of my youth for these one and half score but one years, to my children Kondwelani, Margaret, Patricia and Mkhuzo for being supportive to me during my studies.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADC	Area Development Committee
AfDB	African Development Bank
APM	Area Pump Minder
CBOs	Community Based Organisations
CMC	Chongwe Municipal Council
CPs	Co-operating Partners
CSO	Central Statistics Office
CU	Commercial Utility
Danida	Danish International Development Agency
DAPP	Development Aid from People to People
DHID	Department of Housing and Infrastructure Development
DLA	District Local Authority
D-WASHE	District Water and Sanitation Health Education
DWSS	Department of Water Supply and Sanitation
E	East
ECZ	Electoral Commission of Zambia
EHTs	Environmental Health Technicians
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
GB	Great Britain
GI	Galvanised Iron pipes
GoJ	Government of Japan
GPS	Geographical Positioning System
GRZ	Government of the Republic of Zambia
HDI	Human Development Index
IBM	International Business Machines Corporation
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency

JMP	Joint Monitoring Programme
K	Kwacha
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
Km	Kilometres
L	Litres
LA	Local Authority
l/c/d	litres per capita per day
m^3/sec	cubic metres per second
MDGs	Millennium Development Goals
MLGH	Ministry of Local Government and Housing
MoAIWD	Ministry of Agriculture, Irrigation and Water Development (Malawi)
MoH	Ministry of Health
MWDSEP	Ministry of Water Supply, Sanitation and Environmental Supply
N	North
NAC	National Action Committee
NGOs	Non-Governmental Organisations
NKJV	New King James Version
NRWSSP	National Rural Water Supply and Sanitation Programme
NRWSSP	National Rural Water Supply and Sanitation Programme
NWASCO	National Water Supply and Sanitation Council
O&M	Operation and Maintenance
pH	potential of Hydrogen
PPP	Public Private Partnership
PST	Programme Support Team
RHC	Rural Health Centre
RWS	Rural Water Supply
RWSN	Rural Water Supply Network
RWSS	Rural Water Supply and Sanitation
S	South
SADC	Southern Africa Development Community

SCM	Supply Chain Management
SDG	Sustainable Development Goal
SI	Statutory Instrument
SNDP	Seventh National Development Plan
SOMAP	Sustainable Operation and Maintenance Project
SPSS	Statistical Package for the Social Sciences
ToT	Trainer of Trainers
UN	United Nations
UNICEF	United Nations Children's Education Fund
uPVC	unPlasticised Polyvinyl Chloride
USAID	United States Agency for International Development
USD	United States Dollars
V-WASHE	Village Water and Sanitation Health Education
WARMA	Water Resources Management Authority
WASH	Water Sanitation and Hygiene
WDC	Ward Development Committee.
WHO	World Health Organisation
WRM	Water Resources Management Act
WSP	Water and Sanitation Program
WSPS	Water Sector Programme Support
WV	World Vision
ZNS	Zambia National Service

LIST OF DEFINITIONS OF TERMS

Accessibility - is having a functioning and reliable water supply facility without any barriers within a radius of 500 metres.

Adequate Water - is the quantity of water required to meet the minimum demand per capita per day. The minimum water requirement is 25 litre per capita per day (l/c/d). This amount is enough to take care of basic hygiene needs and basic food hygiene

Community - refers to people living in a designated area who share residential and developmental challenges and benefits. It may also refer to all people sharing such challenges and benefits regardless of geographical or social boundaries.

Community-based Management - is a form of community participation in which the community takes the final decision on all aspects of planning, implantation, management, monitoring, evaluation, operation and maintenance (O&M) of the water supply facility.

Coverage - is the percentage of people with access to safe, adequate and reliable water supply.

Downtime - is the period between the time the hand pump breaks down and the time when it would be repaired and operational again.

Effectiveness – is the degree to which objectives are achieved and the extent to which targeted problems are solved. Effectiveness is determined without reference to costs.

Evaluation - is the periodic and systematic review and analysis of a practice to determine the relevance, effectiveness, efficiency and impact of programmes/projects compared to set objectives.

Maintenance - refers to the activities required to sustain the water supply facilities in a proper working condition. It includes preventive maintenance, corrective maintenance and crisis maintenance.

Model – refers to a simplified description of a system or process, to assist predictions or a thing used as an example to follow or imitate

Monitoring - is the regular and continuous checking of whether plans; activities and situations are being implemented as planned, and includes the provision of feedback to facilitate the taking of corrective measures by relevant stakeholders.

Operation - refers to the daily running and handling of water supply facilities in a manner that optimises their use and contributes to a reduction in breakdown and maintenance needs.

Preventive Maintenance - refers to an activity that includes checking the status of hand pump components at regular fixed time intervals.

Rehabilitation – is the correction of major defects and the replacement of equipment to enable a facility to function as originally intended.

Reliable Water Supply - is the supply of water on a continuous basis meeting the minimum demand per capita per day

Repair - is the restoration of a defective component to return the facility to acceptable working condition. The cost of repair should be up to K500.00 and should be borne by the community. Repair works beyond K500.00 should be considered as rehabilitation.

Rural areas – are areas of population outside urban or peri-urban using point or surface water sources for which the community is responsible for the operation and routine maintenance. In addition, low population densities characterise rural areas (usually less than 20 persons per square kilometre), with small houses isolated from each other.

Safe Water - is water that is free from chemical substances, parasites, bacteria or other biological substances that negatively human health.

Seed money –is the initial sum of money disbursed to an organisation in order to create / start a revolving fund for undertaking a designated programme.

Sustainable Supply Chain - is a system of procuring and supplying spare parts that guarantees a continuous supply of spare parts.

Sustainability – (context of rural water sector) is the maintenance of the perceived benefit of investment projects (including convenience, time -savings, livelihoods or health improvements) after the end of the active period of implementation.

V-WASHE (Water Point Committee) – is a committee of representatives from a number of Water Point Committee of the same village. Sometimes V-WASHE committee may refer to two or more village representatives benefitting from a water point.

ABSTRACT

This study was to explore the effectiveness of the strategy adopted by the Government of Republic of Zambia to sustain rural water sources of boreholes fitted with hand pumps, using a case of Chongwe District. The Government of the Republic of Zambia adopted a strategy to reduce the rate of non-functional hand pumps for sustaining rural water supply under the National Rural Water Supply and Sanitation Programme (NRWSSP). Under the NRWSSP, the Sustainable Operation and Maintenance Project (SOMAP) was piloted as a model for sustaining rural water supply. At the end of the pilot project, the results showed a reduction in the non-functional rate and the down time of hand pumps in the project area.

The main theory for the study adopted is Expanded Community-based Management Model (Mandara 2013), based on community based management model (Harvey and Reed 2004). Convenient sampling technique was used to sample 47 water points at villages, schools and rural health centres for the study. The data collection tool used was a semi-structured questionnaire, administered at water points. The data was analysed for frequencies using the IBM statistical package for the social sciences (SPSS) version 23.

The key findings of the study were that the communities do not regularly contribute towards operation and maintenance of hand pumps. The spare parts outlet does not have spare parts available all the time. There are no sub-district structures under the District Council to monitor rural water supply in the communities. Some communities are experiencing problems with inappropriate hand pumps installed. Common problems were difficult to pump hand pumps in hilly terrains due to low water level in the boreholes and rusty water resulting from corroded galvanised iron pipes used. Most communities do not practice preventive maintenance such as greasing of the chains on the hand pumps.

In light of these findings, the conclusion is that the SOMAP model is not effective to sustain rural water supply in Chongwe. Recommendations have been set in three categories: short term, medium term and long term. The short-term recommendations include: to increase staff in the Rural Water Supply and Sanitation Unit (RWSSU), to reorganise the RWSSU to be responsive to make rural water supply to be sustainable; to provide additional resources to increase the visibility RWS in the rural communities. Reorganise the operation of the hand pump spares shop to be more responsive to the market forces.

Key words: Community-Based Management, Downtime, Effectiveness, Rural Water Supply, Safe Water, Supply Chain, Sustainability, Model and; Operation and Maintenance

CHAPTER ONE

Introduction and Background

1.1 Introduction

This study is on the effectiveness of the SOMAP Model to sustain rural water supply. This is about boreholes fitted with hand pumps in Zambia. The study area was Chongwe District.

According to the statistics, improved water sources in rural Zambia is at 47%. Boreholes fitted with hand pumps account for 33% of improved water sources in rural areas (CSO 2015. p. 16 *Zambia Demographic and Health Survey*). This shows that boreholes with hand pumps are the highest improved water sources of safe drinking water in the rural areas.

The principal justification for water supply projects has been to improve health, and the link between water and health has long been understood (UNICEF 1999, p. 5). When the project sponsors undertake a Rural Water Supply (RWS) Project, the objective is to provide safe and clean water supply to the rural communities. The RWS Projects reduces infant mortality and morbidity from diarrhoea diseases; it reduces walking distance to water points – thus increasing time for other economic activities in rural areas. Hand pumps are sources of safe and clean water in most rural areas such as Kapulanga village of Chongwe shown in Picture 1 below.

Picture 1: Hand pump in use at Kapulanga village, Kapete Ward, Chongwe

Picture taken by Javan Nkhosi - December 2017.

Hand pump breakdown reverses the safe and water coverage, the public health benefits and economic benefits. Literature reviews shows that in Sub-Sahara Africa, on average there are 30 – 50% of water points that are non-functional at any given time (Harvey and Reed 2004; RWSN 2009). The non-functional rates in the different countries from different studies show the following rates. In Ethiopia the non-functional hand pumps is at 33% (Migbar 2013) and in Tanzania is at 46% (Taylor 2009). In the Southern Africa sub-region, the non-functional rate in Malawi is at 31% (Baumann and Dabert, 2008); while in Zimbabwe, it is over 40% (Ahmad, Kinyanjui, Jonga, and Mashingaidze 2016).

In Zambia, the rate of non-functional hand pumps estimated to be more than 50% (Chitembo, 2015; Kambole, 2016). In order to bring the non-functional rate of hand pumps lower than it is, the Zambian Government started a programme called the National Rural Water Supply and Sanitation Programme. One of the components in this programme is for the operation and maintenance of hand pumps. Under this component there was a project called the Sustainable Operation and Maintenance Project (SOMAP) (GRZ, 2007) to pilot and explore how to improve the sustainability of rural water supply.

The SOMAP piloted in two rural districts of Mumbwa and Monze from 2005 to 2007. The project trained the Local Authorities (LAs) staff and rural communities in stock management and financial management for hand pumps. The project also established spares parts shops in the districts, trained the area pump minders (APMs) to repair hand pumps, and trained the environmental health technicians (EHTs) to manage toolkits at rural health centres (RHCs). The rural communities made aware to make monetary contributions towards operation and maintenance of their hand pumps.

The pilot project proved very successful, extended for another three years (2007 – 2010), and covered four additional districts – Chibombo, Kapiri Mposhi, Mkushi and Serenje in Central Province (SOMAP2, 2010).

The success results from the SOMAP 1 and 2 Pilot Projects showed: reduced down time, sustainable hand pump spare parts available in the district and community members contributed towards cost of operation and maintenance. The other successful results showed capacity of rural community members built to maintain the hand pumps and standard hand pumps used in the community meeting hydrogeological conditions. The non-functional hand pump rate results from *the pilot project* districts under SOMAP1 and SOMAP2 was 12.4%.

(SOMAP2, 2010). Based on successful SOMAP results, the Government adopted the SOMAP model as the *model of practice* for sustaining rural water supply.

Today in the Rural Water sector, SOMAP is the recognised name for the national approach to establish and implement Operation and Maintenance (O&M) mechanisms at district and sub-district level under the O&M component of NRWSSP. (GRZ/JICA, 2010). The **SOMAP model** of practice for O&M of hand pumps based on the five practices.

i. 100% Cost contribution by communities;
ii. Sustainable supply chain of spare parts;
iii. Monitoring and maintenance mechanisms (EHTs; Toolkits (RHCs), APMs)
iv. Adopt available (standard) hand pumps in the district and
v. Capacity building (Trainings and orientations) (RWSS, 2010. p. 22)

From the literature reviews, there has not any research on the Zambia SOMAP model to sustain rural water supply. This research undertaken to fill up the gap noted from the literature review. This research seeks to establish the effectiveness of the SOMAP model that was been rolled out to sustain rural water supply in Zambia, using Chongwe district as the study area.

This study targets the stakeholders (government ministries, the local authorities, NGOs working in the rural water supply sector) in the rural water supply sector on how the SOMAP model practices are being implemented to have the hand pumps to be operational every time.

The main question was to establish the effectiveness of the SOMAP model in sustaining rural water supply in Zambia, using Chongwe as the study area. The more specific questions covered each of the five principles of the SOMAP model; what is the level of communities' cost contributions towards maintenance of hand pumps in Chongwe? How sustainable is the supply chain of spare parts of hand pumps? The other questions - what are the monitoring and management mechanisms set up to oversee the hand pumps in the communities. What are the adopted standard hand pump types in Chongwe and what SOMAP trainings and orientations done to the stakeholders?

The study findings highlights to stakeholders in the rural water supply sector challenges in implementing the five principles of the SOMAP model to ensure the sustainability of rural water supply in Zambia. The recommendations for the stakeholders in the rural water supply sub-sector seek to improve the sustainability of rural water supply, so that the public health and economic benefits to the rural communities to be maintained for a long time.

1.2. Background to the Study

Rural water supply projects seek to provide safe drinking water to the rural communities in a sustainable way, thereby reducing morbidity and mortality from diarrhoeal diseases. Upon successful completion of borehole projects, the community rejoices for safe water source.

With the presence of a new safe water source in the rural community, this brings with it a reduction in the incidences of diarrhoea diseases, a reduction of walking distance to the water point. This results in women walking a shorted distance to fetch water resulting in time saving. With the available time available, the women can be involved in other economic activities such as farming and other income generating activities or look after their families.

Unfortunately, due to hand pumps that breakdown or get abandoned, these public health and economic benefits do not last long, the community trek back to the old and unsafe water sources. This reverses the public health and economic benefits to the communities.

1.2.1 Model to Sustain Rural Water Supply

The term *model* in the Oxford English Dictionary means any one of these five descriptions:

i. a three-dimensional representation of a person or thing or a proposed structure , typically on a smaller scale than the original – *'a model of St Paul's Cathedral'*,
ii. a thing used as an example to follow or imitate – *the project became a model for other schemes'*
iii. *a simplified description*, especially a mathematical one, *of a system or process, to assist* calculations and *predictions* or
iv. a person employed to display clothes by wearing them. *'a well-known fashion model';*
v. a particular design or version of a product – *'the company revealed their latest model at motor show'*.(ed. Stevenson 2010)

In the context of the research topic, the SOMAP model is what is implied in (iii) above - *A simplified description of a system or process, to assist predictions.* Simply put the SOMAP model is the simplified description of the operation and maintenance of hand pumps in rural areas leading to predictable sustainability.

The objective of the SOMAP Model is to reduce the down time of the hand pumps. Down time is the time between the time that the hand pump is broken down to the time it would be

repaired and usable. The lessons learnt and experienced gained from SOMAP2 are documented in the RWSS O&M Implementation Manual and User Guide (RWSS 2010).

1.2.2 Organisation Structure of the SOMAP Model

The organisation structure of the SOMAP Model arranged in a three-tier operation and maintenance system to ensure that hand pumps are operational over time. The three-tier system is the operation and maintenance of rural water at three levels - district level, sub-district level and community level is given in the organizational structure of a sustainable O&M system at district level in diagram below:

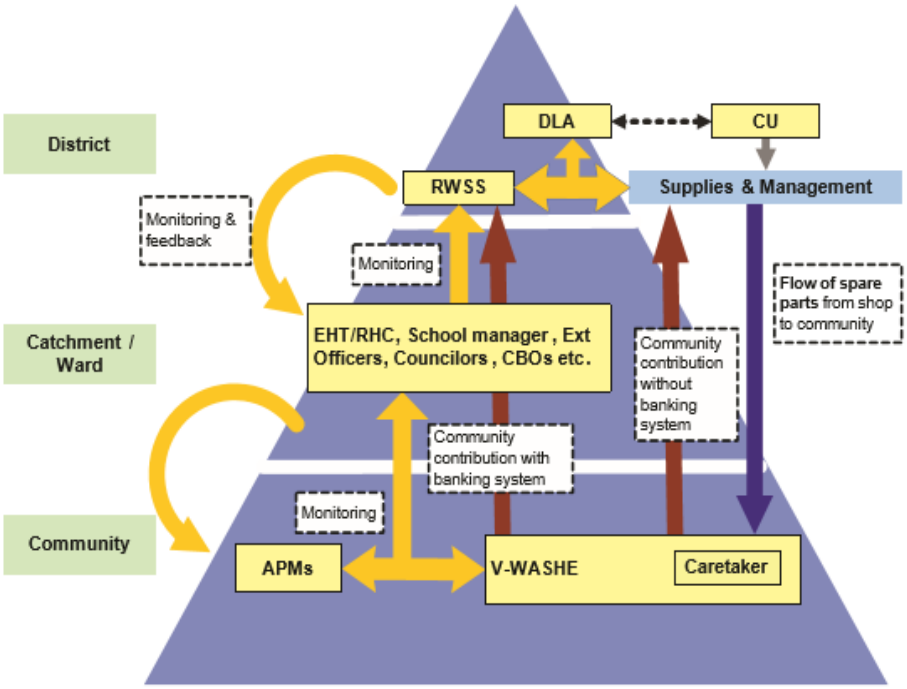


Figure 1: Organisation structure of a sustainable O&M system at district level

(Source:RWSS O&M Implementation Manual and User Guide, 2010, pp 23).

The Organizational structure of a sustainable operation and maintenance system at district illustrated, by a triangle in three segments divided as district level, sub-district or ward or catchment level and the community level.

District Level - The head of the District Council administration is either the Town Clerk or Council Secretary who oversees the operation and maintenance through the WASH Coordinator. The National Rural Water Supply and Sanitation Programme (NRWSS) established hand pump spares shop to stock up spare parts at the district.

Sub-District / Ward / Catchment Level- the catchment areas or the wards. Chongwe District has one constituency with nine wards or catchment areas as stipulated for the 2016 General Elections (ECZ 2016). An example for sub-district structures in the Ministry of Health (MoH) below the District Hospital are the Rural Health Centre (RHCs) covering the Catchment area, then Health Posts then the community. Below the Health Posts spread out equitably in the catchment area to service the rural communities (MoH 2012).

For the SOMAP model sub-district structure is the Environmental Health Technicians (EHT) from the Ministry of Health at the Rural Health Centres (RHCs) who oversees the operation and maintenance of the hand pumps in the sub-district with the help of the Area Pump Minders (APMs).

Community Level. At community level, there are Area Pump Minders (APM) that maintain and repair hand pumps in the communities. The Water Committees also called Village Water Sanitation Health and Education (V-WASHE) organised at each water points (MLGH 2007). Each hand pump services a community or a village. Every water point has an elected water committee to oversee the operation and maintenance. In the water committee apart from the usual officers, there is a caretaker who overs sees the daily operation of the hand pump. If there is a fault, the caretaker reports to the area pump minder at sub-district level. In the committee is also the treasurer that collects user fees and pays for the spare parts and the APM for the repair works (RWSS 2010).

1.2.3 Economic Benefit of the SOMAP Model on the Rural Communities

The major economic benefit of the SOMAP Model on the rural communities is in public health – reduction in disease burden of infant morbidity and mortality that come about due to diarrhoea diseases resulting from drinking unsafe water. Water and Sanitation Program (WSP) stated that about 6,600 children in Zambia under 5, die each year from diarrhoea – nearly 90% of which is directly attributed to poor water, sanitation and hygiene (WASH).(WSP 2012).

Therefore, effective SOMAP Model practice has a direct bearing on good health and reduced infant morbidity and mortality in rural areas.

This research responds to the Seventh National Development Plan (SNDP) in enhancing human development with regard to improve access to water supply and sanitation (SNDP 2017).

In the second strategy of the enhancing human development, the SNDP talks about improved availability of water and sanitation infrastructure. The SNDP advocates prioritising infrastructure development in rural areas to improve the livelihoods of the rural population. One of the programmes to be undertaken in this SNDP programme activity is the sustainable operation and maintenance improvement. The SNDP programme activity sits well with this research topic of effective sustainability of rural water supply infrastructure.

1.2.4 Regulation of Rural Water Supply

With regard to regulation of water supply and sanitation, the Water and Sanitation Act No. 28 of 1997 established the National Water Supply and Sanitation Council (NWASCO) (WSS Act 1997, p. 244), state that only Local Authorities (LA) or utility companies formed by the LA are to provide water supply and sanitation services within their areas of jurisdiction.

NWASCO give licenses utility companies and develop sector guidelines for the provision of water supply and sanitation. NWASCO advises government on water supply and sanitation matters; sets tariffs for the provision of water and sanitation services; and enforces standards for water supply and sanitation services.

Presently NWASCO regulates seventeen-licensed water supply and sanitation providers for which are eleven Commercial Water Utilities and six Private Schemes to provide water supply and sanitation services to urban and peri-urban areas (NWASCO 2017, p. 20). There is no water utility company to provide rural water supply and sanitation services, therefore NWASCO does not regulate or oversee rural water supply.

There is a gap to regulate and enforce standards for water supply and sanitation in rural areas. NWASCO regulates and enforce standards for water supply and sanitation in the urban and peri-urban areas only.

According to the Water Resources Management Act 2011, there is no permit required for the use of water, from any water resource for domestic and non-commercial purposes and the development or use of ground water for domestic and non-commercial purposes (WRM 2011, Clause 70 (a and b) p. 320). In the context of water for the rural communities, rural water can be considered as water for domestic and non-commercial use. The WRM Act (2011) defines domestic or non-commercial purposes as what the household uses of water for the following:

a. drinking, cooking, washing, bathing or sanitation;
b. subsistence gardening and support of livestock not being commercial livestock husbandry;

c. subsistence fishing;
d. the making of bricks for the private use of the occupier;
e. the dipping of livestock not being commercial livestock husbandry.

However, borehole development for groundwater for use for commercial purposes requires a permit from WARMA. For rural water supply, the requirement and submissions to WARMA are the notice for construction works, construction record and registration of the completed boreholes.

According to the Environmental Management No. 12 of 2011, there is institution that can grant a permit for execution of a project unless the Zambia Environmental Management Agency (ZEMA) grants an approval for the project. (EMA 2011, Clause 29).The project execution permit is granted after approval of an environmental impact assessment or an environmental project brief has been satisfactorily been carried out. The ZEMA decides whether the developer of the project to submit a project brief or environmental impact assessment according to the regulations in the statutory instrument (SI) issued.

According to the Second Schedule (regulation 7(2) of the Statutory Instrument (SI) No. 28 of 1997 of the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulation. Rural water supply boreholes are not included under the list of the second schedule for projects that require an environmental impact assessment (Republic of Zambia Government Gazette 1997, *Statutory Instrument No. 28 of 1997).*

The boreholes that would require an environmental impact assessment are the commercial boreholes that would have '*water extracted to be more than two million cumecs (m^3/sec)'* (Ibid, p. 111). The boreholes fitted with hand pumps discharge about 0.3 litres per second (Adekile 2012). From this comparison, we can see that rural water supply boreholes impact on the environment is negligible.

1.2.5 Rural Water Supply in the Millennium Development Goals

The United Nations global leaders came up with the Millennium Declaration in September 2000 termed the Millennium Development Goals (MDGs). The MDGs goals and targets were signed by 189 countries including 147 Heads of States in September 2000. The MDGs represent a partnership between the developed and developing countries to create a conducive environment to development and elimination of poverty.

The MDGs cover rural water supply and sanitation under Goal 7: ‘ensure environmental sustainability’. Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation (United Nations 2015).

The indicator to monitor the progress for the water supply is the population with sustainable access to an improved water source – in urban and rural areas. The proportion of the population with access to safe drinking water is an indicator expressed as the percentage of people using improved drinking water sources or delivery points. Therefore, improved water technologies are more likely to provide safe drinking water.

Improved drinking water sources include the following: piped water in dwelling, plot or yard; public tap or stand pipe; tube well or borehole; protected dug well; protected spring and rainfall collection (WHO and UNICEF 2006).

The Regional and Global Costs of attaining the MDG targets for water supply and sanitation was estimated at 42 billion United States Dollars (USD) for water supply and 142 billion USD for sanitation. (Hutton and Bartram 2008) as shown in Table 1. .

Table 1. Estimated spending required to meet the water MDG target

WHO sub region	Water			Sanitation		
	Total (USD million)	%	Per capita (USD)	Total (USD million)	%	Per capita (USD)
Africa (D)	5,952	14	18	15,544	11	48
Africa (E)	5,724	14	15	18,335	13	48
America (B)	1,537	4	4	6,351	4	15
America (D)	786	2	10	2,082	1	28
Eastern Mediterranean Region (B)	292	1	3	119	0	1
Eastern Mediterranean Region (D)	2,324	6	6	7,125	5	19
Europe (B)	680	2	5	1,398	1	10
Europe (C)	406	1	3	2,239	2	14
South East Asia (B)	2,080	5	9	4,270	3	18
South East Asia (D)	1,446	3	1	41,980	30	32
West Pacific Region (B)	20,634	49	13	42,494	30	27
All	**41,862**	**100**	**8**	**141,937**	**100**	**28**

(Source: Hutton and Bartram 2008, p. 9 *Regional and Global Costs of Attaining the Water Supply and Sanitation Target (Target 10) of the Millennium Development Goal*, Public Health and the Environment Assessing & Managing Environmental Risks to Health, World Health Organisation, WHO Press, Geneva, Switzerland)

The Table 1, above indicate that the developing countries in the WHO Western Pacific Region would need 49% of the global resources to increase coverage to meet MDG target for water, followed by 28% for the WHO Africa region (strata D plus E).

With the period for the implementation being over, the 2015 update and the MDG assessment show, that the global MDG target for drinking water was met in 2010. Meeting the MDG target for water has resulted in 91% of the global population using improved drinking water sources. (UNICEF and WHO 2015). Five developing regions met the MDG drinking water target, but the Caucasus, Central Asia and Sub-Sahara Africa have not.

Reviewing the progress of meeting the MDG target for water within the countries in the Southern Africa Development Community (SADC), it is only South Africa, Botswana and Namibia that met the target. Malawi have made good progress. Zambia, Mozambique and Madagascar have made moderate progress. The Democratic Republic of Congo, Tanzania, Angola and Zimbabwe have made limited or no progress (UNICEF and WHO 2015)

Research evidence show that in Sub-Sahara Africa, on average there are 30 – 50% of water points that are non-functional at any given time (Harvey and Reed, 2004; WSP, 2006, RWSN

2009). The term Sub-Sahara Africa is refers Africa with the exception of the North African countries of Algeria, Egypt, Libya, Morocco, Sudan, Tunisia and Western Sahara (IMF 2015).

These problems are most common to Sub-Sahara Africa as seen on the Human Development Index (HDI) scale of 2016. Most of the Sub-Sahara Africa countries are below Namibia at 125 rank of HDI to 188 rank of HDI. (HDI 2016). The top three highly ranked countries on the HDI in Africa are Algeria (83), Tunisia (97) and Libya (102). Zambia is at 139 rank of the HDI.

In the Southern Africa sub-region, evidence shows that in Malawi, the non-functional hand pumps rate is 31% (Baumann and Dabert, 2008); while in Zimbabwe, it is over 40% (Ahmad, Kinyanjui, Jonga, and Mashingaidze 2016). In Ethiopia the non-functional hand pumps is at 33% (Migbar 2013) and in Tanzania is at 46% (Taylor 2009).

The most recent data on non-functional hand pumps from different countries is from Rural Water Supply Network (RWSN) and presented in Table 2 below.

Table 2. Rate of Non-functional hand pumps

No	Country	Percentage of non-functional hand pumps (%)	No	Country	Percentage of non-functional hand pumps (%)
1	Tanzania	44	7	Malawi	21
2	Afghanistan	30	8	Burkina Faso	20
3	Liberia	26	9	Kenya	14
4	Sierra Leone	23	10	Nicaragua	12
5	Uganda	22	11	Ethiopia	11
6	South Sudan	21			

(Source: Rural Water Supply Network, 2016, poster)

This data is the non-functional rates in countries that submitted information to RWSN, in 2016 to update the data of the 2009 on hand pump functionality. This data is available from countries with significant data available through the Water Point Data Exchange. (RWSN 2016) (www.WaterPointData.org). Data is from few countries because of the strict criteria of inclusion used, that is, to have more data through the Water Point Data Exchange. Comparing with the 2009 data, there is a trend of reduction in the rate of non-functional hand pumps in most countries.

1.2.6 Rural Water Supply Projects

In Zambia for the rural water supply projects undertaken in Central Province (2000 – 2007) and Luapula / Northern Provinces (2010 – 2015), the number of non-functional water points is *high at* 56% (Kambole 2016). Though Zambia has put in a place an initiative of sustaining the rural water supply – the SOMAP Model there seem to be some disconnect such that the rate of non-functional rate is still exceptionally too high.

The end term evaluation report for the National Rural Water Supply and Sanitation Programme (2006 – 2015) conducted in September 2015 came up with anecdotal data that indicated that the non-functionality rate of hand pumps nationally is more than 50%. (Chitembo 2015). These findings from Chitembo (2015) and Kambole (2016) on Zambia's rural water supply are similar and it indicates that the SOMAP Model may not be effective. To the rural communities the implication of this are that the challenge of sustainability is still high. Unless something is done to address the challenge of rural water sustainability, provision of safe water supply is still precarious in the rural areas. This means that mortality and morbidity associated with unsafe water supply still abounds.

To the project sponsors it means there is no value for the investments put in to alleviate the problem of unsafe water supply. Although the number of boreholes with hand pumps have increased, yet the coverage of safe water supply has not, due to broken down hand pumps. The project sponsors of the National Rural Water Supply and Sanitation Programme (NRWSSP), the programme for rural water supply boreholes with hand pumps are the Co-operating Partners (CPs) and international Non-Governmental Organisations (NGOs). The list of project sponsors and the planned supported to the NRWSSP in 2012 – 2015 are given.

The table shows the funds pledged in United States Dollars (USD) and the percentage of the table amounts are given in Table 3 below.

Table 3. Planned Support for 2012 – 2015 to NRWSSP

Item	Co-operating Partners / Non-Governmental Organisations	Amount (United States Dollars)	Percentage (%) of Budget
1	United Nations Children's Fund (UNICEF)	73,700,000	53
2	Kreditanstalt für Wiederaufbau (German Development Bank) (KfW)	22,666,667	16
3	African Development Bank (AfDB)	14,400,000	10
4	Danish International Development Assistance (Danida)	9,880,000	7
5	WaterAid	8,831,040	6
6	Japan International Cooperation Agency (JICA)	6,980,000	5
7	United States Agency for International Development (USAID)	2,448,959	2
8	German Agency for International Cooperation (GIZ)	800,000	1

(Source: JICA, Survey of NRWSSP Components, 2012 p. 21)

Understanding the effectiveness of the SOMAP model shall help the communities have a reliable source of safe drinking. For the project sponsor a reliable source of safe drinking water increases the coverage of safe drinking water.

According to the *National Guidelines of Sustainable Operation and Maintenance of Hand Pumps in Rural Areas* (GRZ/MLGH 2007), the replacement of hand pump spares, begin after 2 years of operation. The parts that wear out quickly is the piston seals. The recommendation from the National Guideline, after the first 5 years, the whole hand pump need to be overhauled to replace some worn out parts.

To address the problem of broken down hand pumps in rural areas, the Government of the Republic of Zambia in 2005 came up with initiative project called the Sustainable Operation and Maintenance Project (SOMAP) (GRZ/MLGH 2007).

SOMAP model successfully piloted in Mumbwa and Monze Districts. After the successful piloting, SOMAP model was rolled out to four districts – Chibombo, Kapiri Mposhi, Mkushi and Serenje in Central Province. SOMAP model has now been rolled out to all the districts in Zambia for sustaining rural water supply. The principles and practices of the SOMAP model is the mode of operation for all rural water supply projects in Zambia to ensure sustainability of hand pumps.

The districts where SOMAP Model is effectively utilised, the rate of non-functional hand pumps is reduced to the minimum and the community has sustainable safe water supply. The examples of districts where SOMAP Model was effectively used resulting in reduced rate of non-functional hand pumps are Mumbwa, Chibombo, Kapiri Mposhi, Mkushi and Serenje. The non-functional rate results from the five of the six districts under SOMAP1 and SOMAP2 was 12.4%. (SOMAP2 2010).

In this research, the researcher seeks to establish the effectiveness of the SOMAP Model to sustain rural water supply Zambia, using Chongwe district as the study area. The findings and lessons learnt shall inform changes that can be replicated to other districts in Zambia.

1.3 Statement of the Problem

After the successful completion of rural water supply projects, the major apprehension to the project sponsors is how long the constructed water facility that has been installed would operate before it breaks down. The objectives for the implementation of rural water supply projects is to increase the safe water coverage, thereby improve public health due to morbidity and mortality resulting from diarrheal diseases resulting from drinking unsafe water. Broken and non-functional hand pumps reverses safe water coverage, the public health and economic benefits to the rural communities.

Literature review shows that in Sub-Sahara Africa, on average there are 30 – 50% of water points that are non-functional at any given time (Harvey and Reed 2004; RWSN 2009).

To address the problem of broken and non-functional hand pumps in the rural communities, the Government of the Republic of Zambia came up with a strategy to sustain rural water supply called the Sustainable Operation and Maintenance Project (SOMAP) Model (RWSS 2010). All local authorities in Zambia by default implement the SOMAP Model to sustain the rural water supply in the jurisdiction areas falling under them (GRZ/MLGH 2007).

The effectiveness of the SOMAP Model to sustain rural water supply in each district is unknown.

In this research, we seek to establish the effectiveness of SOMAP Model to sustain rural water supply in Zambia using Chongwe district as the study area.

1.4. The Research Objectives and Research Questions

The SOMAP model has five principles to ensure sustainability of rural water supply. These five principles came about from the pilot studies over five years in six rural districts in

Zambia. To understand the effectiveness of the SOMAP model, these five principles are interrogated to verify the effectiveness of the model in sustaining rural water supply. The specific objectives and specific questions are formulated based on each of the five SOMAP model principles of the study.

1.4.1 Main Objective

The main objective of the research is to establish the effectiveness of the SOMAP model to sustain rural water supply as it is applicable to Chongwe district.

1.4.2 Specific Objectives

The specific objectives of the research in line with the principles of the SOMAP model are:

i. To assess the communities' cost contributions towards maintenance of hand pumps.
ii. To verify the sustainability of the supply chain of spare parts of hand pumps in Chongwe district.
iii. To establish the monitoring and management mechanism of SOMAP in Chongwe district at district, sub-district and community levels.
iv. To scrutinise adopted standard of hand pump types in Chongwe district.
v. To ascertain the SOMAP trainings and orientations of stakeholders in Chongwe district.

1.4.3 General Research Question

How effective is the SOMAP model in sustaining rural water supply in Zambia, using Chongwe as the study area

1.4.4 Research Questions

i. What is the communities' cost contribution towards maintenance of hand pumps?
ii. How sustainable is the supply chain of spare parts of hand pumps in Chongwe district?
iii. What is the monitoring and management mechanism of SOMAP in Chongwe district at district, sub-district and community levels?
iv. What is the adopted standard of hand pump types in Chongwe district?
v. What SOMAP trainings and orientations of stakeholders were conducted in Chongwe district?

1.5 The Scope of the Study

The study focused on the effectiveness of the SOMAP model to sustain rural water supply in Zambia using Chongwe District as the study area.

This study targets the stakeholders (government ministries, the local authorities, NGOs working in the rural water supply sector) in the rural water supply sector on how the SOMAP model practices are working out to have the hand pumps to be operational every time.

The main question was to establish the effectiveness of the SOMAP model in sustaining rural water supply in Zambia, using Chongwe as the study area. The more specific questions covered the five principles of the SOMAP model; what the communities' contributions towards maintenance of hand pumps in Chongwe were. How sustainable the supply chain of spare parts of hand pumps was. The other questions were: what the monitoring and management mechanisms were set up to oversee the hand pumps in the communities; what were the adopted standard hand pump types in Chongwe and what SOMAP trainings and orientations were done to the of stakeholders.

The study interviewed the rural water supply staff, the operation of the established hand pump spares shop and the staff working for non-governmental organisation working in the rural water supply sector at district level.

The study used semi-structured questionnaires to gather information from the rural community members that use the hand pumps to draw water. The informants at community level included the ordinary community members, the water committee members that oversee the hand pumps, teachers at schools and the area pump minders that repair hand pumps. The hand pumps in the community were inspected for functionality and maintenance.

The study findings highlights to stakeholders in the rural water supply sector challenges in implementing the five principles of the SOMAP model to ensure the sustainability of rural water supply in Zambia.

The recommendations for the stakeholders in the rural water supply sub-sector seek to improve the sustainability of rural water supply, so that the public health and economic benefits to the rural communities are maintained for a long time.

The study was conducted during the semester from August 2017 to December 2017.

1.6 The Purpose of the Study

The author's work experience in rural water supply (RWS) that spanned more than 15 years has seen the challenges of the lack of safe water in rural areas and its devastating effect on the local communities.

The problems on the hand pumps at times would be something minor. However, since the community may not have the technical knowledge or lack funds for spare parts and repair cost, the community needlessly lose lives resulting from diarrhoea diseases or from reptiles when searching for water.

There seem to be a tendency of leaving RWS to its own with little attention from both local and central government to ensure sustainability. The budgetary allocation for sustaining RWS from both local and national governments is minimal or at times missing, but assisted from the donor community to help in financing RWS. RWS seem not to provide ready returns to the government, as it is a service to the poor communities in rural communities located in far-flung rural areas.

Sustainability of RWS is an area of study that lacks critical investigation and would need urgent research on. This study shall add value to the rural areas as the rural community population constitutes about 60.5% of the population of Zambia (CSO 2012, p. 5). The quality of water in some rural communities' poor - rusty and smells due to corrosion with galvanised iron pipes and unpalatable, but community have to subsist, as there is no substitute for water.

Out of author's volition, concern, and moved to assist, the study shall bring the topic of the sustainability of RWS to the national developmental agenda. Currently the National Water Supply and Sanitation Council (NWASCO) regulates water to the urban and peri-urban areas, RWS is not yet regulated to improve water supply to the rural communities (NWASCO, 2017 p. 20).

The SOMAP model during the pilot phase improved the sustainability of RWS in the rural areas by reducing down time and helped the rural community have a safe water for a long time. The challenges experienced in the sustainability of RWS makes good results of the SOMAP model seem as *'cover up'* of non-operational RWS. In districts where SOMAP model has rolled out to, with the establishment rural water supply units at local authorities and set-up of spares parts shops may seem as though the RWS is sustained.

In this study, the author seeks study what seem as *'cover-up'* of SOMAP model, to verify the effectiveness of the SOMAP model in sustaining the hand pumps in the rural areas, to ensure

that the rural water supply in the rural is given the needed attention, and improve the livelihoods of the communities' in rural areas.

1.7 The Significance of the Study

This study is significant to many stakeholders in Rural Water Sub-sector. The stakeholders are Government Ministries - Ministry of Water Development, Sanitation and Environmental Protection (MWDSEP) and Ministry of Local Government (MLG). To the ministries the study shall provide what is happening on the ground in the communities.

The other stakeholders are the Local Authorities (District Councils) and Rural Communities – this study shall point out some weaknesses in the implementation of sustain rural water in the communities. To the Non-Governmental Organisations (NGOs), both local and international – the study shall highlight areas that need to be strengthened to ensure that the facilities installed are sustained in improving health in the rural areas. To the other scholars in the rural water supply sector, this study brings out what is pertaining in sustaining rural water supply from a Zambian perspective.

The study shall also influence of the Rural Water Supply sector by improving the sustainability of rural water supply. Discussing rural water supply in this study shall be the discussions of rural water supply on the developmental agenda, which on many occasions tend to be eclipsed as more attention given to urban and peri-urban water supply.

The study is significant to the rural communities, as it ensures the public health benefits to the rural communities are maintained for a very long time. The public health benefits are the reduction in mortality and morbidity due to diarrhoea diseases.

To the Government of Zambia, this study is significant, as it shall contribute to the reduction to the disease burden due to diarrhoea resulting from people drinking unsafe water. In addition, when the rural water supply is sustained, the safe and clean water coverage in the rural areas is increased, but when hand pumps breakdown, safe and clean water coverage is reduced. When safe and clean water coverage is reduced, it means the government shall spend a lot more money in providing for the rural communities.

When hand pumps are sustained in operation, this indirectly is a response to the Seventh National Development Plan for improved access to water supply (SNDP 2017, p. 102), which is the first strategy to enhance effective and sustainable management of clean, safe water to improve health for all.

This study shall also contribute to scholarly work, as it shall provide researched data on the challenges of sustainability of rural water supply in Zambia. The study shall provide evidence based information to the scholarly body of knowledge to ensure sustainability of rural water.

To the researcher, this is his contribution to the body of knowledge of the sustainability of water supply in rural areas, which is also a partial fulfilment of the requirement towards the attainment of a Master of Science Degree in Project Management.

1.8 Delimitation of the Study

The physical boundary of the study area is restricted to rural part of Chongwe district. Chongwe district encompasses only one constituency – Chongwe constituency as from November 2013 when Rufunsa District was created as a separate district from Chongwe.

The western part of Chongwe district is Lusaka City Council. Lusaka is the Capital City of Zambia; the communities that border with Chongwe are mostly urban areas, commercial farms, agro-based industries and upmarket settlements. Due to the urban influences, the communities in the west bordering with Lusaka City Council were excluded in the study.

The rural part of Chongwe District included in the study is the area that meet following criterion: rural communities that **use communal and not private** hand pumps to draw water and communities beyond 10 kilometre (km) radius from centre of Chongwe District.

1.9 Limitation of the Study

The study was conducted in the fourth semester from August to December 2017. The limitations of the study were beyond the capacity of the researcher, but did not impede the success of the study to collect the vital information for the study.

i. The study area is a rural area and the respondents who are local communities mostly subsistence farmers involved in farming. The period for data collection coincided with the planting period and most of the respondent were busy with farming activities.
ii. Decentralisation is to do with devolution of some functions from the district to the sub-district level. According to Government policy pronouncement, decentralisation is adopted, but this has not been effected and implemented. The study could not extend to Rural Health Centres to interview the Environmental Health Technicians (EHTs) at the sub-district level. The EHTs are answerable to the Ministry of Health and not Ministry of Local Government, even when permission was granted from the Local Authority.

1.10 The Organization of the rest of the report

The study report is arranged in six chapters. Chapter One - sets the introduction to the research, the background of the research, statement of the problem, the research objectives and research questions, the scope of the study; the purpose of the study; the significance of the study and the delimitation and the limitations of the study.

Chapter Two; is the literature review. In this chapter, the author highlights scholarly literature on sustainability of rural water supply that others scholars have researched and written about within and outside Zambia. The researcher brings out sustainability issues of rural water supply in other countries with similar social economic conditions as Zambia.

Chapter Three, the author highlights the theoretical and conceptual frameworks for the study. The theoretical framework adopted is the expanded community-based management model. The developing of the conceptual framework of the SOMAP model was from the WaterAid sustainability framework (2011). In this Chapter, the author also describes the historical development of the Zambia SOMAP model concept.

Chapter Four- is the methodology of the study. The author highlights the research design of the study, location of the study, data collection; data analysis; validity and reliability test and the ethic consideration.

Chapter Five – is in three sections – data analysis, results and discussion of the findings. Data analysis begins with background to the research area and then the status of the community hand pumps surveyed. There after the author analyses the study questions grouped in the five principles of the SOMAP model - communities cost contributions towards maintenance of hand pumps; supply chain of spare parts of hand pumps; monitoring and management mechanism at district, sub-district and community levels. (APMs and EHTs); adopted hand pump type used in Chongwe district and trainings and orientations of rural water supply stakeholders.

The second section is on the results of the study on the SOMAP model principles in Chongwe. The last section is the discussion is on the SOMAP model principles in Chongwe.

Chapter Six is the last chapter where we bring out the conclusion that answers to the main objective of the study based on the findings of the study and recommendations to make the SOMAP model effective.

CHAPTER TWO

Literature Review

2.1 Introduction

In this section of literature review, empirical studies in line with the specific objectives set out in Chapter 1 are reviewed. The literature review start with the definition of sustainability in the context of rural water supply. Two examples of projects, which are running successfully with viable sustainable evidence, are cited here from Malawi and Zimbabwe.

The examples are followed by a brief historical development of SOMAP and the concept of SOMAP model for rural water supply.

The rest of the material in this chapter is devoted to the five research specific objects summarised below in statement form:

i. Communities' cost contributions towards maintenance of hand pumps.
ii. Sustainability of the supply chain of spare parts of hand pumps.
iii. Monitoring and management mechanism
iv. Adopted standard of hand pump type
v. SOMAP model capacity building

The literature reviews highlight what other scholars have written about the research. The author tries to pick up some knowledge gaps that the research shall seek to address in the research.

2.2 Definition of sustainability

Different practitioners of development define sustainability differently.

Len Abrams (1997) defines sustainability as something that continues to work over time. In case of a water supply system, this would mean that water continues to be available for the duration for which it was designed for, in the same quantity and quality as the day it was commissioned (ibid). This pre-supposes that somewhere in the long period there could have been some rehabilitation works.

If water continues to flow, then it means that all the different aspects required for the system to be operational are working. Using the case of rural water supply that follows the SOMAP model principles, as an example, it would mean that the hand pump continues to operate as it was supposed to be. This means that the community is well organised, where the community-based management is operational to collect user fees. The community members are

contributing funds towards operation and maintenance of the hand pump. There is an area pump minder nearby to repair hand pumps in the community; the supply chain for spare parts is operational and the spare parts are available close to the community. (RWSS, 2010).

Sustainability involves that all the different facets associated with rural water supply are all operational – the technical, social, financial issues, natural environment and institutional arrangements (ibid).

WaterAid Sustainability Framework paper (2011) provides another definition of sustainability. Sustainability is about whether or not WASH services and good hygiene practices continue to work and deliver benefits over time. No time limit is set on those continued services, behaviour changes and outcomes. In other words, sustainability is about lasting benefits achieved through the continued enjoyment of water supply and sanitation services and hygiene practices (ibid p 11). Lockwood and Smits (2011, p. 24) defines sustainability in the context of rural water sector as - the maintenance of the perceived benefit of investment projects (including convenience, time savings, livelihoods or health improvements) after the end of the active period of implementation (ibid).

This means that a sustainable hand pump is one that continues to supply water to the community long after the project implementation period is past or the benefit of the water facility continues to accrue to the community long after the project implementation period. A hand pump that fails even before the project implementation period is over is not sustainable.

Sustainability of the service is affected by many factors. These factors include not only the technical or physical attributes of the system, but also the financial, organisational (support functions) and managerial capacities of the service provider, which indicate the likelihood of the service continuing to be provided over time. Sustainability as defined above has inherit and interrelated challenges. The three reasons why sustainability is a challenge in the WASH sector (WaterAid 2011) are

i. Limited capacity with regard to knowledge skills and material resources of communities and local government to manage systems.
ii. inadequate financial revenue to cover full cost recovery of capital cost and full operation and maintenance and
iii. The historical approach to service delivery of different actors in wash sector

According to the WaterAid sustainability framework, the most important prerequisite for a rural water supply to be sustained is that there must be real need and demand for the changed

practices to be sustained (WaterAid 2011, Jansz 2011). If within proximity to a communal hand pump is an alternative water source, the community tend not sustain one, the water source that would require investment.

Other rural water supply scholars (Harvey and Reed 2004) have defined a sustainable water source as one if the water sources are not over-exploited but naturally replenished. The facilities are maintained in a condition, which ensures a reliable, adequate water supply, the benefits of the supply continue to be realized by all users indefinitely, and the service delivery process demonstrates a cost-effective use of resources that can be replicated. (ibid).

2.3 Examples with viable sustainable evidence

Two successful projects are cited from Malawi and Zimbabwe as examples with viable sustainable evidence.

InterAide is working on a project to support operation and maintenance of rural water supplies in three districts in Malawi - Mchinji, Dowa and Salima. InterAide is a French field-oriented Non-Governmental Organisation (NGO), implementing development projects in Malawi, (Méloir 2009).

The main improved rural water supply source in Malawi are boreholes equipped with Afridev hand pumps with coverage of 71%, which was the highest in the region i.e. Tanzania 46%, Mozambique 26%, Zambia 41% (WHO/UNICEF 2006,JMP Data).With this high coverage, it was imperative to maintain it..

The Government of Malawi recognised the need to harmonise wide range of approaches to operation and maintenance of rural water supply to improve access to spare parts by water users. Other concerns were the untrained water point committees, poor quality maintenance services and lack of spare parts, inadequate financing mechanisms, lack of capacity to manage and undertake repairs, which are beyond the capacity of local communities.

To sustain the gains in coverage in rural water, InterAide started the operation and maintenance project in the three districts in Malawi - Mchinji, Dowa and Salima. InterAide identified two key areas for sustainability of rural water supply – lack of knowledge in the water committees to maintain and repair hand pumps and lack availability of spare parts close to the users.

The project components were to ensure spare parts were available through existing local shops; to train and equip the local area mechanics to provide repairs and maintenance services to the communities. The third project component was follow up in a cost effective manner.

The project established the selling of spare parts through the local Chipiku chain store and some independent shops that were identified in new locations. The spare part dealers were trained in stock management and supplied with spare parts. The spare parts were within 10km radius from each other for easy supply of spare parts. The cost of spare parts were on equal price policy and the shops were supplied with spare parts. These shops were on supply contract for 2 years. InterAide provided initial stock of spare parts, display shelves and advertising posters and fliers.

For the area mechanics this was open to those who already live in rural areas, these were identified, trained to work as private sector mechanics. Each mechanics was responsible for fifty hand pumps and these to be paid by the communities. The cost of repairs was not a fixed price but had to be negotiated with the community. InterAide provided bicycle, special tool kit for Afridev pumps and documentation. The duties of the area mechanics were cover their areas regularly, attend monthly meetings, and undertake a minimum of 12 repairs per year.

By close of 2008, the project had trained 67 area mechanics, opened 14 independent spares shops in addition to the 11 existing Chipiku Stores. The summary of the project data is shown in Table 4 below.

Table 4. Summary of Data for the Project Districts of Mchinji, Dowa and Salima

Description	Mchinji	Dowa	Salima
Population	440,162	511,448	342,979
Area (km2)	3,356 km2	3,041 km2	2, 196 km2
No of Pumps			
Afridev	865	1101	850
Malda	5	224	125
Hand pump spare part suppliers			
Start selling spares	May 2008	November 2008	October 2008
Number of independent shops	6	4	4
Number of Chipiku Stores	4	6	1
Number of area mechanics	19	21	27
No of Contracts between area mechanics and communities	191	84	n/a

Source: Méloir 2009, *InterAide Support to Operation and Maintenance of Rural Water Supplies in Malawi in 2008,* Rural Water Supply Network, Member Experiences No. 1

By 2016 InterAide project had spread to 11 districts in Malawi. There are now 388 area mechanics and 150 shops that are providing maintenance services to rural water in Malawi (InterAide 2016). (http://www.interaide.org/watsan/malawi/ accessed on 20 November 2017).

Zimbabwe has another success story in sustaining rural water supply with viable sustainable evidence. In 2012, the Rural WASH Project was implemented covering thirty-three (33) of sixty-(60) rural districts aiming at improving access to WASH services for the most vulnerable and disadvantaged people (Ahmad et al, 2016).

Under the project, the public private partnership (PPP) models were tested leading to repair and rehabilitation of 10,361 boreholes equipped with hand pumps and the development of WASH PPP National strategic framework for operation and maintenance of rural water supply. The process included huge capacity building of the 33 districts and 5 provinces national structures on various aspect of WASH and community structures of operation and maintenance of water points.

The WASH sector in Zimbabwe degenerated to very low levels as a result of the economic downturn of 2000 – 2009 from the international sanctions after the land reforms. This led to 98,592 cholera outbreaks cases and 4,282 deaths. In response to the cholera outbreaks, the donor community invested in the sector for rehabilitation and provision of WASH services.

In 2012, the Government of Zimbabwe with the support from UNICEF and other donors initiated a four (4) year Rural WASH Project covering 33 of 60 rural districts. The selection of the districts was based set criteria that included level of access to WASH services and prevalence of WASH related disease (cholera).

The project activities included the rehabilitation and construction of new WASH infrastructure, building of sustainable community based operation and maintenance system of hand pumps on public private partnership and WASH governance.

The Water Policy had a paradigm shift that stated that public and development partners finance for rural WASH to focus on capital development and behavioural change whilst user finance to cover operation and maintenance costs. This addressed the operational challenges of high hand pump breakdowns leading to longer down time, institutional weakness to handle operation and maintenance spare part supply chain and the weak three tier maintenance system.

The higher strategic level rural WASH subsector objective were;

i. to unlock a range of private sector skills;
ii. applying the "allocating risks to the party best able to manage them" PPP principle – the assumption that community based private partners have the right skills to manage,
iii. operate and maintain water supplies on a more sustainable basis and
iv. promote sustained community based demand and ability to pay for operation and maintenance.

The Zimbabwe Rural WASH subsector identified spelt out public and private partners at different levels as shown in Table 5 below

Table 5. Zimbabwe Rural WASH Sub-Sector Public Private Partnership

Governance level	Public Sector Partners	Private Sector Partners
National Level	National Action Committee is constituted by the Government Ministries and Departments	Suppliers and manufacturers of WASH inputs and commodities.
		Distributors of WASH inputs and commodities
Sub-National Level	Provincial Water and Sanitation Committees	WASH inputs wholesalers, manufacturers and distributors
	District Water and sanitation Committees	
	Rural District Councils	
Community / Local Level	Village and Ward WASH structures	Retailers – Individual and business enterprises
	Village Development Committees	Village Pump Mechanics
	Water Point Committees	Latrine builders
	Government and Local Authority Extension Staff	

Source: NAC/WASH 2015, p. 7, *Zimbabwe Rural WASH Sub-Sector Public Private Partnership (PPP) Framework*, Government of Zimbabwe, Harare.

Through implementation of the Rural WASH Project, Zimbabwe moved from a heavily subsidised repair and maintenance system that failed to a community-based operation and maintenance system.

Overall, the Rural WASH Project has achieved a great success with reaching over 3 million people with access to improved sources to improved sources of drinking water mainly through repair and rehabilitation of non-functional water points (Ahmad et al, 2016)

2.4 Historical Development of the SOMAP

The title "SOMAP" started as the name attached to the specific project support for rural water supply from Japan International Corporation Agency (JICA) to Ministry of Local Government and Housing (MLGH) under the operation and maintenance component of National Rural Water Supply and Sanitation Programme (NRWSSP). SOMAP model is nowadays, it is recognised as the name for the national approach to establish and implement O&M

mechanisms at district and sub-district level under the O&M component of NRWSSP. (GRZ/JICA 2010).

The historical development of the SOMAP for rural water supply can be traced back to the drought stress calls of the 1980s and 1990s to the international communities.

In 1981, Southern Province experienced a drought when wells and streams dried up in the rural areas. The Government Republic of the Zambia (GRZ) requested for the construction of 222 new boreholes and rehabilitation of 100 boreholes to the Government of Japan (GoJ). This was implemented as the Groundwater Development Project in Southern Province Phase I and Phase II in 1985 and 1988 (JICA 2004).

Another severe drought again was experienced in five provinces – Southern, Western, Eastern, Lusaka and Central in 1991 and 1992. In 1995, the Government of Zambia requested for grant aid assistance from the Government of Japan to construct 500 boreholes with hand pumps in Southern Province. This grant aid was extended to spare parts, consumables to maintain and rehabilitate the drilling equipment under the previous Japanese project.

A further request was made for an additional 77 boreholes in 1996. Due to the delay in the implementation, some Non-Governmental Organisation (NGOs) came in and drilled some in that number, due to the dire need in the communities. The final number of boreholes that was drilled by the Japanese Government increased to 104 boreholes.

In 2004, the Government of Japan carried out the Follow-up Study on the Groundwater Development and Rural Water Supply projects in the four provinces on the constructed boreholes, to check on the condition of the boreholes with hand pumps and the sustainability of the boreholes. The projects that were in the Follow-up Study and the number of boreholes involved were:

i. Groundwater Development Phase I (1985 – 1987) with 36 new boreholes.
ii. Groundwater Development Project (Phase II) in Southern Province (1985 – 1990) for 26 new boreholes
iii. Project for Rural Water Supply Development (Phase III) in 1991 – 1996 for 220 new boreholes and 160 rehabilitations.
iv. Southern Province Water Supply Project in 1997 – 1999 for 220 new boreholes. (JICA, 2005)

The findings from the Follow up Study on the condition of the water supply facilities; accessibility to the improved water supply; operation and maintenance; and sustainability were:

i. Communities supported by external support agencies such as local authorities, donors, and NGOs in capacity building on management of water facility were managing the water points in more sustainable manner than those without support services.
ii. Lack of supply chain of spare parts of hand pumps was the common problem in the operation and maintenance of boreholes with hand pumps.
iii. There was insufficient institutional arrangement to monitor and attend preventive maintenance of water facilities and this affected period of down time of the facilities.
iv. It was necessary to officially standardise the hand pump in Zambia and improve the spare parts supply system.

These findings formed the basis for actualising the concept for the Sustainable Operation and Maintenance Project to ensure continuous operation of the hand pumps in the communities. The Ministry of Local Government and Housing with support from the Japan International Cooperation Agency (JICA) initiated the Sustainable Operation and Maintenance Project. The SOMAP 1 ((Sept 2005 – Aug 2007) implemented the findings from the Follow up Study by establishing a sustainable operation and maintenance system at district level, sub-district and community level in Monze and Mumbwa.

From the lessons learnt from the pilot study, SOMAP 2 (2007 – 2010) was implemented in further four districts (Chibombo, Kapiri Mposhi, Mkushi and Serenje) of Central Province. The SOMAP 3 (2010 – 2015) was extended to Luapula Province. SOMAP model was later rolled out to rest of Zambia. (RWSS 2010)

2.5 Rationale of the SOMAP model to sustain rural water supply

From the above definitions, for a rural water supply to be sustainable, it means it shall depend on many factors. Different scholars and institutions have come up many pre-requirements to be in place for a water supply system to be sustained.

It is important to differentiate between sustainability of a single hand pump and sustainability of many hand pumps installed on a project or programme. With regard to the rural water supply sustainability, the researcher is concerned about factors influencing many hand pumps on a project or programme. Here the author is concerned with factors that affect the

sustainable operation of a large number of pumps, rather than micro-issues affecting the function of a particular pump (Harvey and Reed 2004).

According to Haysom (2006), there are seven pre-requisites for a rural water supply to be sustainable. The pre-requirements factors include management at village level, community management of water schemes, availability of spare parts and expertise; capability of technology and service e level with the capacity of the beneficiary. Haysom (2006) say that if these pre-requirements were met in good proportion, the rural water would be sustainable.

The WaterAid sustainability framework (2011) describes other aspects to program design and implementation to be fundamental to the achievement of effective and sustainable community based operation and maintenance. The sustainability framework identified these aspects – full user participation, capital contribution by users, high quality of implementation, appropriate tariff structure, environmental aspect properly addressed and a monitoring system in place. These programme design aspects are supposed to be supported by external support from the national and local governments support. The external support to the community management system should be in form of management and monitoring system, technical assistance to the water user committees, recurrent cost sharing, support to supply chain and service providers (WaterAid 2011 p. 12).

In the Zambian context, the sustainability initiative has five sustainability factors termed as the SOMAP model. The term SOMAP is an acronym for Sustainable Operation and Maintenance Project. This project was designed to explore how to improve the sustainability of hand pumps by reducing the downtime (RWSS, 2010). Down time is the period between the time the hand pump breaks down and the time when it would be repaired and operational again.

The SOMAP project was piloted in two districts (SOMAP1) for two years and thereafter, the project (SOMAP2) was extended to four other districts. In the five SOMAP project districts the rate of non-functional hand pumps was reduced to the minimum and the community had sustainable safe water supply. The non-functional rate results from the five districts under SOMAP1 and SOMAP2 was 12.4%. (SOMAP2 2010).

The project was a model because it stands out as good practical example of having the five aspects work together for hand pump sustainability, to have the project hand pumps to be operational for a long time. The SOMAP model is Zambia's initiative to in response to sustain

hand pump projects in rural areas. The five SOMAP model principles are: one hundred percent cost sharing of operation and maintenance by communities; sustainable supply chain; operation and maintenance mechanisms; choice of appropriate technology and capacity building (MLGH 2007).

2.6 Communities' cost contributions towards maintenance of hand pumps.

The community cost contributions is a system established so that the beneficiary community contributes towards the sustainability of water supply system. Under the National Rural Water Supply and Sanitation Programme (NRWSSP), communities are expected to cover one hundred percent of the operation and maintenance costs (RWSS 2010. p. 26).

The community contributions or the saved funds shall be utilised for the purchase of spare parts as well as payment for the area pump minders' services when hand pump breaks down. The contributed funds may be used in some income generating activities to increase the revenue base of the community for repairs of the hand pump in the community.

Some experiences from rural water supply projects on community contributions towards maintenance of rural water Supply project (RWS).

In Tanzania, WaterAid (Haysom 2006) commissioned a study to explore the reasons for non-functional water points in Central Tanzania and how to restore them. Sustainability ultimately depend upon community taking financial responsibility for their water points. The Tanzania Water Policy has provided for communities to provide full cost recovery for operation and maintenance as prerequisite for sustainable rural water supply. The study came up with three groups of findings – water points that had never broken down; water points that had broken down and not rehabilitated and those water points that broke down and had been repaired.

The features of findings in the second category of water points that had broken down and not rehabilitated showed that none of the villages had bank accounts, some had savings but not in an account but with some village leaders, other villages had account but not known to other members. This shows that having a water committee and funds raised does not guarantee sustainability of water point.

In the same category, some villages had poor management where village government resigned with the water committee, in other villages the water committee is in total inactive and have never met within agreed period. This showed low commitment to the water committee.

Within the same category of findings, community members were not willing to pay due to due to mismanagement. This showed that financial management stand out as one of the principal cause of persistent non-functionality of water point in this category.

The experiences for those water points that had broken down and repaired showed that they had bank account, used all the savings for repairs and have not collected any more since. The other village had bank account but village government repaired the repair of the hand pump. This showed the ability to pay for repairs enabled villages to repair broken down hand pumps.

For the hand pump to be sustainable there is need to have funds at community level to pay for the spare parts and for payment for repair of the hand pump. These are findings on the hand pumps that had broken down and rehabilitated.

In Swaziland, Baraki and Brent (2012) conducted a study on the technology transfer of hand pumps in rural communities, where more than 40% of the hand pumps are abandoned and in some dry and remote areas, the failure rate rose to 80% (Fairwater Foundation 2010).

The hand pump failures were attributed to two broad aspects – the technical and community management aspects. The technical aspects were due to faulty borehole design and construction; faulty type and procedure of pump selection and lack of spare parts. The community management aspects: the poor community management included poor financial management training, operational and inefficient support system.

With regard to operation and maintenance community structures, despite the presence of community based management structures, hand pump failure rate in Swaziland is high with longer down time. Project implementers did not train the village water committees to maintain and operate the hand pumps. There were no maintenance tool kits provided and communities had no plans to replace the hand pumps when these broke down. The communities were not trained the importance of collecting funds for payment for the repair of hand pumps (Baraki and Brent 2012)

The hand pumps failed due to lack of commitment from the communities to collect funds for payment for the repair of hand pumps. Due to lack of training to set aside funds for the repairs, the community was not able to repair the broken hand pumps.

In Zimbabwe, there are new experiences issues on sustainability of the community-based management of rural water supply a case of Gwanda District (Dube 2012). In this paper, Dube

(2012) examined how the community-based management strategy was operationalised in Gwanda district.

The findings showed high non-functional rates of 60 - 70% of water points in most wards of Gwanda district. Several system weaknesses were noted such as depletion of committee members, inadequate community resources and limited agency and government support.

The community-based management faced many sustainability challenges. Most rural communities in Gwanda live under the poverty datum line as such maintaining a borehole was a challenge with regard to the community contributions required. Those households that failed to contribute towards the repair of the community hand pumps were prohibited from using the repaired water point, and were forced to use unsafe and further off water sources. This exposed them to water borne diseases.

Poverty was having adverse effect on the sustainable operationalisation of the community-based management of rural water supply. Dube (2012) proposes to adopt a flexible and integrated approach where cost sharing between communities and supporting agencies. For other new projects, these should operate with income generating side projects that should raise funds for maintenance of water infrastructure.

Poverty is real in some rural communities such that cost contributions by the communities is a real and practical challenge to sustain rural water supply.

In Mozambique, WaterAid undertook a study into Rural water supply sustainability in Niassa Province in 2010 (Jansz 2011). The study compares factors that affect sustainability with the Mozambique water policy. We review the study in the light of community contributions for operation and maintenance of rural water supply.

The findings show that community contributions have compromised the sustainability of rural water supply, as majority of the communities did not have any savings. The communities did not carry out monthly contributions for operation and maintenance. Most communities engage in reactive financing (Harvey and Reed 2004, p. 109) where the community contributed when hand pump breaks down.

In the study, the lack of monthly savings was related to mistrust between community members and water committees. Few communities collected contributions on regular basis, though this was done on an annual basis. There was confusion on the differences between the capital

contribution done at commencement of the construction of the water project and the need for community contribution for operation and maintenance fees. The community did not fully appreciate the difference between contribution towards the capital cost and contribution towards the operation and maintenance of the hand pumps. The lack of understanding the difference affected their willingness to pay.

In Rwanda, the government with support from the Netherlands and UNICEF implemented the Rwanda Water, Sanitation and Hygiene (WASH) Project during 2009-2014 (Murtaza et al, 2016). The paper describes the findings of the assessment of WASH interventions under the Rwanda WASH project. The project undertook annual sustainability assessment of the project against 22 indicators grouped under five categories - institutional, social, financial, technical, and sanitation and hygiene. The assessment was at three intervals in 2011, 2013 and 2014 in 4 districts.

The overall sustainability in the four districts increased from an average sustainability score of 70% in 2011 to 75% in 2013 and finally at 87% in 2014. The findings in the social and financial sustainability indicators showed improvements on annual basis.

Social sustainability was attributed to high awareness of community, regarding where to report breakage or non-functional hand pumps, high degree of community awareness of the disease that can be prevented by hand washing (hygiene practices), inclusion of all community members in project activities.

Financial sustainability was attributed to the management capability of the private water operators for each districts and effective systems for collection and management of funds, high cost recovery and financial capacity of districts of districts to undertake major repairs.

The sustainability assessment reports had twofold uses: to prepare for further action for implementation to address issues affecting sustainability; and to develop national action plans for enhancing sustainability of RWS systems.

Experiences of Rwanda WASH project demonstrate that regular sustainability assessment contribute considerable improvement in the sustainability of WASH interventions through timely identification of sustainability bottlenecks and necessary follow up action to addressing the same (Murtaza 2016).

In Malawi, Dr Ellie Chowns (2016) reviewed whether community management in Malawi rural water supply is part of the sustainability problem and not the solution. The paper reports on a study of sustainability of rural and small town water supplies in 2010 – 2012.

This study critically examined the way community management works in practice. The findings in the light of community cost contributions showed that community management does not work as it is supposed. Preventive maintenance is almost never done. Repairs are often slow and at times sub-standard, committees were unable to collect funds, and committees are generally dormant or defunct and often have to be reconstituted when a breakdown occurs (Chowns 2016).

The paper describe that the challenge of sustainability can be reduced to two elements – technical and financial. The financial factors compromises the technical sustainability and therefore community management is part of the problem and not the solution.

For rural water supply to be sustainable, Chown (2016) contend that it does not so much lie in community cost contribution but rather it requires ongoing public investment in recurrent cost.

In the light of the literature reviews from the six scholars above, the cost contributions towards maintenance of hand pumps as a means to sustain rural water supply still remains a thorny issue in addressing sustainability. It is important that the community contributes towards operation and maintenance to ensure sustainability of rural water yet there are practical challenges faced on the ground. Every is differently, the difficult situation in Zimbabwe cannot be compared with the Rwanda success experience. Each case should be dealt with differently, to identify the challenges to achieve sustainability of rural water supply.

2.7 Sustainable Supply Chain of Hand Pumps

The goal of a sustainable supply chain of hand pumps is to have a system that supports hand pump repair and maintenance beyond installation has much attention. According to the RWSS O&M Implementation manual and user, guide (RWSS, 2010) sustainable supply chain is defined as a system of procuring and supplying spare parts that guarantees a continuous supply of spare parts.

The second principle for the SOMAP model is a sustainable supply chain. The details for this are that spare parts should be available at outlets at all times, spare parts should be affordable;

and that an appropriate mechanisms should be set up for a sustainable supply chain (RWSS 2010, p. 21).

Spare parts supply for pumps (specifically hand pumps) in rural water supply is one of the weak links in the quest for sustainability. This problem has been widely recognized for several year. This has led to a number of key developments to promote sustainable supply chains for rural water supplies (Harvey and Reed 2004). Success supply chain need to go beyond end of water projects and requires a national perspective so that hand pumps do not fail and fall into disuse due to lack of spare parts.

According to Oyo (2006), the key factors that contribute towards successful supply chain of hand pumps are three: the supply chain management; technology choice and supply chain types (Oyo 2006).

1. **Supply chain management:** This is the overall supply chain management, which is very critical to the success of the supply chain. Supply chain management is divided into critical action points - market assessment, identify opportunities for supply chain new business, communicate between links, cost effective chain, price setting in the chain and quality control.

   Large international companies devote significant resources to manage supply chains. Donors and governments through project implementation predominately provide supply chain management. One such example is in Ethiopia as reported in the Region Specific Supply Chains for Hand pumps and Spare Parts in Ethiopia with support from the World Bank (Abdi and Baumann 2010).
2. **Technology Choice**. Choice of technology has impact on the ability of a supply chain to support spare parts and repair needs.

   There are two technology types of pumps – low cost technology pumps are pumps produced locally and their supply chain are short and uncomplicated. For example: the rope pump manufactured locally and supply chain short as it involves a local manufacturer and customers only.

   High cost technology pumps are foreign pumps as the India Mark II or the Afridev. The supply chain for the high cost is long and complicated.

   Standardisation of hand pump as a national policy to limit number of types of pumps permitted in new installations leads to standardised spare parts of the selected hand pumps. This creates a higher demand for generic group of spare parts. This inevitably increases the chances of sustainability of hand pumps.

3. **Type of supply chain** - there are three types of supply chains: private sector supply chain, public sector supply and the mix supply chain or the private/public sector supply chain.

   For the private sector supply chain to be sustainable, the key driver is adequate demand and depend on population density and a high spare part replacement rate, which leads to profit. The unit cost of hand pump supply reduces with increase in volume of parts. The point beyond where the two curves intersect is where the private sector supply is profitable as shown in Figure 2.

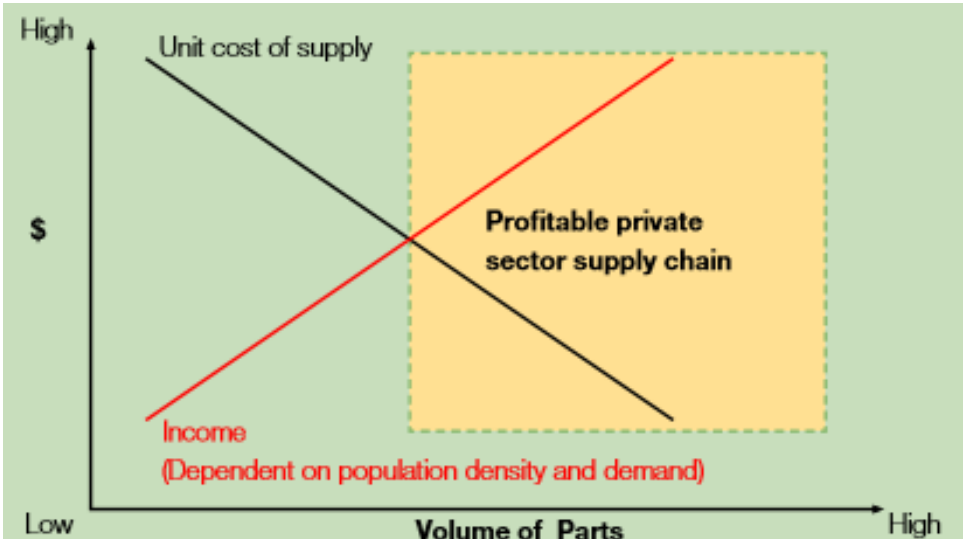


Figure 2: Profitability of the private sector supply chain

Source: Oyo 2006, *Spare Part Supplies for Handpumps in Africa*, Field Note, RWSN

Public sector supply chain is a long-term commitment to support spares provision. Typically, funds come from donors through the government, and water agencies and Non-Governmental Organisation operate the supply chain.

The private / public sector supply chain is a combination of the two characteristics of the private sector and public sector supply chain system.

Harvey (2011) linked the low levels of sustainability to supply chains do not deliver spare parts close to the customers at affordable cost (Harvey 2011, p. 2). Harvey explains that though the source of hand pumps and spare parts (mainly from India for the India Mark II hand pump for the African market), yet the routes by which these reach the ultimate user, the rural community are different and the costs are different.

Hand pumps come from India through governments, donors and Non-Governmental Organisations, but spares parts are purchased from overseas manufacturer by an agent.

Reasonable profits are made on pumps but small margins on spares are negligible as a result there is no incentive for local businesses to stock spare parts.

Based on the study by Harvey and Reed (2004, p. 197), to gauge the commercial viability of a standalone supply for spare parts, a density breakpoint methodology was used to determine density of hand pumps required for a standalone private sector spare parts supply chain. The study finding in Ghana was that it would require 200 hand pumps within a 20km radius for a private standalone supply chain to be viable, this even in a populous area is not attainable. This is the reason why standalone spare parts supply chain are not commercially viable in the vast majority of Sub-Sahara Africa (Harvey 2011, p. 6)

Sustainable supply chain for hand pumps has remained a difficult problem to address in sustainability of rural water. Different countries are at different level of progress with regard developing hand pump supply chains; this is due to various reasons.

In Sierra Leone, Oxfam GB undertook a study; the study showed that there were no spares for all pump types available (Magrath 2006, p. 13).

In Ethiopia, the country has made headway in setting up sustainable supply chain in the country. In December 2008, with the support of the World Bank, the Ethiopian government commissioned a study to set up supply chain model for hand pumps. This was termed as region specific supply chain for hand pumps and spare parts (Abdi G. and Baumann E, 2010). The study resulted in the rolling out pilot project for supply chain management throughout Ethiopia from 2011 to 2014.

In the sub-region, various measures of progress have been recorded in some countries while in other countries little progress has been made.

In Swaziland, Baraki and Brent (2012) conducted a study on technology transfer of hand pumps in rural communities, towards sustainable project life cycle management. In Swaziland, more than 3,500 hand pumps were installed, according the UNICEF data, it showed that 40% of the hand pumps were abandoned.

The hand pump failures were attributed to two broad aspects – the technical and community management aspects. The technical aspects were due to faulty borehole design and construction; faulty type and procedure of pump selection and lack of spare parts.

Despite the presence of community based management structures, hand pump failure rate in Swaziland was high with longer down time.

In Mozambique, WaterAid carried out a study in rural water supply sustainability in Niassa Province; the report states that spare parts are not easily available at district level. It further highlighted that spare parts were not adequately addressed in project frameworks (Jansz 2011, p. 34)

In Malawi, a study was carried out in December 2008 on the operation and maintenance of rural water supplies in Malawi, (Baumann E. and Danert K, 2008), the study findings were that spare parts for Afridev were available in most parts districts through the Chipiku Stores – a chain store in Malawi. However, as for the Malda hand pumps, a standard hand pump for shallow wells is manufactured locally, but there were no spare parts available. It seems that the implementing Non-Governmental Organisation (NGO) that installed the Malda pumps never bothered to set up the supply chain.

For the spare parts for the Afridev pumps in Malawi, the spare part dealers are not keen at stocking them. They perceive stocking of spares parts as a social than a commercial activity (Baumann and Danert 2008, p. 34).

Since there was no supply chain for the Afridev pump that covers the whole of Malawi, the Government of Malawi for sustainability of rural water supply facilities, the government established a supply chain, so that spare parts are readily available and reasonably priced (MoAIWD 2015).

In Zambia, the literature shows that government has responded to the need to have the RWS facilities to be sustainable through the provision of spare parts through an established sustainable supply chain. The Zambian government developed guidelines for setting up the supply chains - the National Guidelines for Sustainable Operation and Maintenance of Hand Pumps in Rural Areas, First Edition (GRZ/MLGH 2007) and Supply Chain Management Manual, Second Edition (GRZ/MLGH 2012). These guidelines were to guide all stakeholders on how to establish supply chains to sustain operation and maintenance of rural water supply.

In the past when a project for RWS constructed boreholes and equipped with hand pumps, the implementing agent provided 1 – 2 years spare parts. When these spare parts run out hand pumps were left and abandoned. Now the MLGH disseminates the Supply Chain Management (SCM) Manual to guide district stakeholders, such as local authorities / district councils, commercial water utilities and other relevant parties concerned, to introduce revolving Supply Chain of spare parts for hand pumps to enhance sustainability of rural water supply facilities. (GRZ/MLGH 2012, p. v).

All district councils, who are mandated by law to provide water supply, are expected to apply the methodologies in the SCM manual to establish and manage the supply chain of hand pumps and spare parts (RWSS 2010, p. 23). In the supply chain management, the roles of the different actors are given:

i. Ministry of Water Development, Sanitation and Environmental Protection are to provide the initial "seed stock" of spare parts.
ii. The District Council are to procure and manage the spare parts, reorder and replenish spare parts stock and sale the spare parts to the communities.
iii. The community are to buy the spare parts from the established spare parts shops.
iv. In this thesis, the researcher in the second specific objective is to verify the sustainability of the supply chain of spare parts of hand pumps that was established in Chongwe district.

2.8 Monitoring and Management Mechanism

Monitoring seems to be what makes or breaks sustainability of rural water supply. In this section of the literature review, we obtain the bulk of the discussion from the RWSS Operation and Maintenance Implementation Manual and User Guide, 2010 (RWSS 2010 p. 64 - 68)

The challenges in monitoring the rural water supply is demonstrated the example drawn the region on the experience from Malawi on how the system is working of the local government approaches to improving WASH service delivery in Malawi by Byrns and Hughes (2016)

The definition for monitoring in the context of Rural Water Supply (RWS) is the regular continuous checking on whether plans, activities and situation are being implemented as planned, and includes the provision of feedback to facilitate the taking of corrective measures by relevant stakeholders (RWSS 2010, p. 5).

The problem with monitoring in rural water supply has been the lack of appropriate monitoring tools, inadequate funding to the District Councils to carryout monitoring activities and the inadequate institutional framework to define its roles and responsibilities. The issues around operation and maintenance process revolve around the status of the hand pump:

1. Whether the users contribute agreed amounts towards operation and maintenance of the hand pumps.
2. Whether there are spare parts and tools for repairing hand pumps readily available at designated spares shop and tools kept near to the installed communal hand pump.

3. Presence of operation and maintenance records – that includes area pump minders records of repaired works; caretaker's maintenance record; treasurer record of income and expenditure for the water point and the water committees minutes of meetings.
4. Availability of skills for all components to manage finances; technical solutions to hand pumps and effective carryout operation and maintenance activities.

Under the National Rural Water and Sanitation Programme (NRWSSP), the monitoring of the operation and maintenance is monitored at three levels – the District Council or Local Authority level, the sub-district / ward / Area Development Committee (ADC) level and the community / water point level.

In the monitoring system, the ADC level plays a very pivotal position in the monitoring structure as it bridges between users - communities and the District Councils. The monitoring structure under the NRWSSP in Figure 3 below.

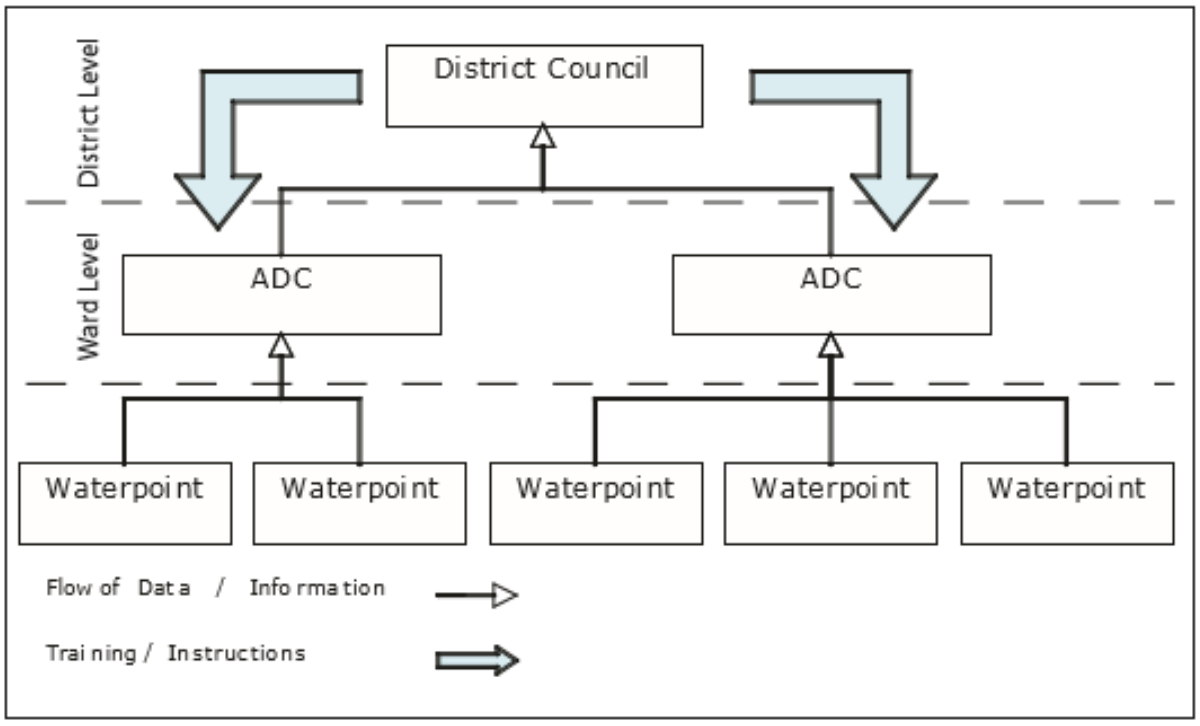


Figure 3. Monitoring Structure under NRWSSP

Source: GRZ/MLGH, *RWSS O&M Implementation Manual and User Guide*, 2010 p. 66.

The Area Development Committees (ADCs) is an institution created at Sub-District Level. The ADCs is supposed to establish in all districts under the decentralisation policy. (Decentralisation 2009, p. 31). The roles of the ADCs is expected to involve resource mobilization, revenue collection, community sensitisation, and prioritisation of projects for inclusion into the district strategic development plans.

The monitoring mechanism includes the ADCs as an existing institution because of the decentralisation policy is expected to have taken effect in most districts. Decentralisation involve the transfer of responsibilities, authority, functions as well as power and appropriate resources from the central government to provincial, district and sub-district levels.

Decentralisation has already started, but not fully developed as some of the key functions in the process have been implemented such as the approval of the Decentralisation Implementation Plan 2009 – 2013 (Decentralisation 2009).

The Local Authority cannot always-carryout physical visits to the community water points in the district, as this would not be cost effective; more especially that most local authorities budget from the central government is low. A bottom up information flow was established so that the Local Authority will collect RWSS information from the ADC who in-turn collect information periodically from the water points in the community.

The stakeholders in the operation and maintenance of hand pumps from the Ministry down to the users at community level are the Ministry of Water Development, Sanitation and Environmental Protection (MWDSEP), the District Council / Local Authority, the Area Development Committees (ADCs), Area Pump Minders (APM), the Water Committee / Caretaker and then the Users.

The stakeholders' actions to be undertaken and their specific tools to use in the monitoring process are summarised in Table 6, below. .

Table 6. Stakeholders' Roles, actions undertaken, and tools for monitoring

Actors	Roles/ action to be taken	Tools or forms to be used
MWDSEP	Receives IMS and M&E reports from DLAs Carries out data analyses & overall planning, revision of RWSS indicators Prepare & review of manuals for districts Implementation & monitoring support to DLAs Resource mobilization	IMS and M&E systems Databases RWSS implementation reports
DLA	Receives monitoring reports from ADC Analyses report and provides feedback/ action Prepares O&M report to MLGH	DLA monitoring check list Sales reports Bank account statements
ADC	Collects RWSS data in community, and submits questionnaires to DLA Keep records of tool kits & management Inspects water points Prepares & submits quarterly monitoring report to DLA Receives APM repair work report and submits to DLA	Water point questionnaire* Village settlement questionnaire* Tool kit usage movement form ADC Monitoring form ADC Activity Plan
APM	Prepares APM repair work form and submits to ADC Monitor water points	APM repair work form
V-WASHE (Caretaker)	Prepares & keeps register for hand pump users Collects O&M funds and records details in register/cash book. Write minutes of meetings held Prepares daily maintenance sheet	Caretaker logbook Household register Register for O&M collections/Cash book Minutes of meetings held Sweeping roster Rules and regulations
Users	Make verbal or written reports to caretaker on hand pump faults	Reports

Source: GRZ/MLGH, *RWSS O&M Implementation Manual and User Guide*, 2010 p. 67.

One example from the region is used to illustrate the use of the Area Development Committee (ADCs) in the monitoring of rural water supply between the users and the local authority.

Malawi is making systems work of local government approaches to improving WASH service delivery in Malawi (Byrns and Hughes 2016). In this paper, the authors show how District government water offices in Malawi face significant financial barriers to delivering WASH services at scale.

The background is from a decentralised policy, where the responsibility for ensuring rural water points are maintained by government water offices. The current average monthly budget

of district government water office is about USD 400 *or equivalent to Zambia Kwacha K4, 000.00 (current exchange rate of 1 USD to K10.00)* that can hardly cover office rentals, utilities, vehicle maintenance, but is expected to provide for fuel and other costs. Community based management approach was adopted to mitigate resource challenges by government in rural areas (Bryrn 2016 p. 1).

Lack of resources is a major restricting factor in the level of service that government offices able to provide is commonly used scapegoat for not making concerted effort to improve WASH service delivery.

The paper describe approaches taken by government offices to address systemic challenges to improve WASH service delivery in Malawi such as:

i. Designing system within district government resources constraint. The many districts came up with approaches to budget for alternative lower cost materials and methods. For example instead of 8 field trips in a month to visit 40 area pump minders, they opted calling the area pump minders in groups and use of public transport than buy fuel for the field trips.
ii. Supporting community structures in management roles. The use of the Area Development Committees (ADCs) to visit water points monthly, mediate water point issues, facilitate water points repairs. The district water offices stay in contact with the ADCs and provide technical support as needed.
iii. Build strong district teams. The district water office staff share common vision and support each other in achieving individual outcomes, build technical capacities of permanent stakeholders, contract out technical jobs to avoid addressing the management and operation skills and ensure NGOs are aligned with each other and with government.

Innovation was the result of concerted effort by district staff to understand implication of their office's roles in sustaining rural water supply service by taking steps and make operations more efficient.

With non-financial support WASH Catalyst Malawi, collaborate with government water offices by offering thought partnership and change management practices support. Districts in Malawi think critically about how their offices can manage WASH service delivery within existing meagre resources (Byrns and Hughes 2016, p. 4).

The concerted efforts in the face of meagre resources, with the help of the local sub-district ADCs institutions, the government water staff were able to manage WASH service delivery.

An effective and operational ADC institution at sub-district level is critical to the sustainability of rural water supply in a resources strained economy like Zambia. The number of staff at District Council is small to visit the communities in the district, with the help of the ADCs; this would assist in visit the water points in the communities. The lack of operational institution of ADCs poses a challenge to effective monitoring mechanism for rural water supply under the SOMAP model. The research shall seek to establish the monitoring and management mechanism that is working in Chongwe district.

2.9 Adopted Standard Hand Pump Type

Hand pump standardisation is defined as formal or informal mechanism that governs the types of community hand pumps used within a particular country (MacArthur 2015, p. 2). This means to have restricted number of hand pump types to use in a particular country. For example, Zimbabwe has restricted the number of hand pumps to be used to one, the Bush pump. This pump is in the specification in the law of the land. (MacArthur 2015, p. 6).

Hand pump standardisation is used in two different ways; it could mean either, as a policy that limits the range of hand pumps that can be used within a particular country or as the development of fixed standards and specification for public domain pumps (Harvey and Reed 2004, pp. 24).

When a country standardises the hand pump, it should guard against stifling local competition but allow for flexibility, innovation and manufacturing. Local innovation in manufacturing should be encouraged instead of depend on importation of hand pumps and spare parts.

According to Harvey and Reed, (2004, p. 24) the advantages for standardising hand pumps are:

i. The number of hand pumps models requiring specialist spares and skills are reduced.
ii. Quality of pumps and components can be readily be assured since there is a standard against which they can be tested.
iii. Opportunities are created for local enterprise where standardised pumps and spares are manufacturer.

The disadvantages of standardization include:

i. Lack of competition among manufacturers to improve the quality of products;
ii. Lack of incentives for local innovators and entrepreneurs; and
iii. Inflexible attitudes to alternative technologies.

Many of the pumps that are standardised are those that are in the public domain such as India Mark II, India Mark III and Afridev hand pumps. Public domain hand pumps are pumps for which the designs are available to the public. (Harvey and Reed 2004, p. 145). For a public domain, hand pump means that any company or individual can choose to manufacture it, as there is not patent restrictions. This is to encourage local in-country manufacturers to manufacture high quality pumps and to promote competition between international manufacturers and local manufacturers.

Although there is a push towards standardising of hand pumps, field research has shown that countries, which do not have, pump standardisation policies (such as Kenya and South Africa) do not demonstrate lower levels of hand pump sustainability than those that do – such as Ghana and Zambia. The primary difference is that those countries without standardisation (Kenya and South Africa) policies have large range of pumps without available spare parts but there is a great level of local innovation. (Harvey and Reed 2004, p. 145)

The push towards standardisation of hand pumps has two reasons – to develop a single specific hand pump standard design and to development national policy of standardisation. For the single specific hand pump, standardisation is based on success on the single successful hand pump for example in India and Zimbabwe. In India, the single hand pump is the India Mark II hand pump whereas in Zimbabwe, the single hand pump design is the Bush Pump. It was believed that if one pump were regulated, governments would be more capable of managing the infrastructure handed over from the donors and training of local area pump minders (MacArthur 2015, p. 5).

According to MacArthur (2015), standardisation of hand pumps as a government policies are categorised either as formal or informal standardisation. Formal government standardisation policy are categorisation as either regulation or endorsement.

i. Regulation are the oldest and most formal type of standard in Sub-Sahara Africa. In this case, regulations exist as a published list of hand pumps in the national laws or statutes. Example of countries of standard regulation of hand pumps are in Ghana, Guinea, Nigeria, Tanzania and Uganda.

ii. Endorsement refers to a published list of hand pumps for use within the country that have endorsed by the government through the national government ministry responsible of water or rural water supply. Countries with endorsed standardisation are Angola, Madagascar and Mozambique.

The informal standardisation are categorised as recommendations or a de-facto.

i. Recommendations are a written list of hand pumps with no official backing. The recommendations are held by project implementing agencies.
ii. De-facto standardisation refers to countries where a shift to a single pump variety has occurred without government interventions though economical forces. For example, South Africa has a de facto hand pump, which is the mono pump

Today many countries in the sub-Saharan Africa have experienced hand pump standardisation in one form or another, either formally or informally. This is manifest in the limited varieties of hand pumps installed.

A brief of the standardisation type and type of hand pumps standardised in Africa is given in Table 7 below:

Table 7. Standardisation types and types of standardisation pump varieties

Item	Country	Standardisation types	Types of standardisation pump varieties
1	Angola	Endorsement	Vergnet, Afridev, Volanta
2	Benin	Endorsement	India mark II, Afridev, Vergnet
3	Ghana	Regulation	Ghana Modified India mark II, Afridev, Nira, Vergnet
4	Guinea	Regulation	Kardia, Vergnet
5	Madagascar	Endorsement	Tany, Vergnet India Mark II Canzee
6	Malawi	Endorsement	Afridev, Malda
7	Mali	Regulation	Afridev, India mark II, Duba
8	Mozambique	Endorsement	Afridev, Volanta, Rope pump
9	Nigeria	Regulation	India Mark II, Afridev
10	South Sudan	Endorsement	India Mark II, Afridev, Nira, Duba
11	South Africa	De facto	
12	Tanzania	Regulation	Nira, Walami
13	Uganda	Regulation	India Mark II, India Mark III and Uganda Modified II
14	Zambia	Recommendation	
15	Zimbabwe	Regulation	Bush Pump

Source: Mac Arthur J. 2015 p. 7, *Hand pump Standardisation in Sub-Saharan Africa*, Rural Water Supply Network, St Gallen, Switzerland

Other literature support the idea of standardised hand pumps as it has effect on sustainability to keep functionality at high level. For example in the operation and maintenance of rural water supplies in Malawi (Baumann and Darnet 2008) report, the findings showed the connection of high functionality level to standardisation of hand pumps The standard pumps in Malawi are two - Afridev and Malda for boreholes and hand dug wells respectively.

On the other hand, due to lack of standardised hand pumps in Swaziland, where suppliers imported hand pumps of their choice, as there is no legal requirement to meet minimum performance or quality standard of hand pumps. There is a challenge when it comes to availability of spare parts. This has partly led to hand pumps not being sustainable (Baraki and Brent 2012).

With regard to standardisation of hand pumps in Zambia, this has been termed as illussive on the ground and with implementing organisations It has not been categorically put that Zambia

has standadised hand pumps, although in the official documents, there are two public domain hand pumps that are mentioned together – India Mark II and Afridev, (MacArthur 2015 p. 10). Harvey and Skinner (2002) highlighted the importance of handpump standardisation with a possibility of adoption of the Afridev as a second standardised pump in Zambia after the India Mark II.

Public domain hand pumps are defined as those hand pump designs that are not protected by patents or royalty rights. Anyone can copy or manufacture the product, for example the India Mark II and Afridev. The private domain hand pump designs are those hand pump designs held by a private manufacturer protected by patents and/or royalty rights, for example Kardia and Vergnet hand pumps. (MacArthur 2015 p. 2)

The National Guidelines for Sustainable Operation and Maintenance of Hand Pumps in Rural Areas (GRZ 2007), has a list of proposed water lifting devices for standardisation. The list include the India Mark II and Afridev pumps for high lift pumps, The low lift pumps and that could be used on the hand dug wells areTara, Malda and Rope pump.

The Operation and Maintenance Implementation Manual and User Guide (RWSS 2010), focuses on the India Mark II, the most popular hand pump in Zambia and the Afridev (which is slowly gaining popularity and is being encouraged as the alternative pump (RWSS 2010 p.72).

Afridev pumps is used in areas with a pH less than 7 or a depth less than 30 meters and the India Mark II in all other installations (Yokogi 2013)

While standardisation may have never officially occurred in Zambia, the historical use of strictly the India Mark II is changing with or without an official policy. (MacArthur 2015).

2.10 SOMAP Model Capacity Building

The fifth principle of the SOMAP model is capacity building of all the stakeholders in the operation and maintenance of rural water supply. The stakeholders in the operation and maintenance of rural water supply are from the National lever all the way down to the community level of the users. The stakeholders at the national level are Ministry of Water Development, Sanitation and Environmental Protection (MWDSEP), the Department of Water Supply and Sanitation and these focus on the District Councils.

At provincial level, the stakeholders are the Provincial Department of Housing and Infrastructure Department (DHID) and the Programme Support Team (PST) that focus on the District Councils.

At District level, the stakeholders are the District Council that focuses on the Rural Water Supply and Sanitation Unit (RWSS Unit). The RWSS Unit also focuses on the Area Development Committees (ADCs), the Area Pump Minders and Water Point Committees.

At the sub-district level are the ADCs and APMs that focuses on the Village Water and Sanitation and Health Education committees (V-WASHES).

Finally at the Community or Village level is the Water Point Committee or the V-WASHE that focuses on water point and the individual households.

Unless all the stakeholders are trained in their various roles and responsibilities, the expected activity may not be undertaken and this renders sustainability of the operation and maintenance ineffective.

The building of capacity is cross cutting to all the stakeholders involved in the operation and maintenance of rural water supply as provided in the SOMAP model.

According to the NRWSSP, the implementation of the operation and maintenance of rural water supply activities shall be carried out through partnership with various stakeholders.

The summary of stakeholders from the National level to the Community level in the operation and maintenance their roles and responsibilities are given in Table 8 below:

Table 8. Stakeholders from National level to Community level

Level	Players	Focusing on	Roles
Central Government	MWDSEP / DWSS	Councils (LAs)	Providing policy direction and sourcing funds for capacity building, strategy formulation, Supporting districts in Programming (new / rehabilitation of water supply and sanitation facilities).
Provincial	Provincial DHID and PST.	Councils	Backstopping in the supply of spares (spare parts), especially for hand dug wells. Technical Support and Monitoring.
District	Council	RWSS Unit	Backstopping in the supply of spare parts; Accounting, Planning, Storing of spares
	RWSS Unit	ADCs, APMs, WPCs	Implementing Training, Monitoring, Supervision, Reporting & Recommending
	ADCs and APMs	V-WASHEs	Community Sensitization, Repairing & Monitoring
Community	WPC's (V-WASHE)	Water point And individual households	Owners of the water points. Managing & Budgeting of various activities at the water point including organising meeting, training of community members, arranging for repairs, and scheduling for preventive maintenance

Source: GRZ/MLGH, *RWSS O&M Implementation Manual and User Guide*, 2010 p. 31

According to the NRWSSP, the capacity building training sequence of activities for the operation and maintenance stakeholders from district level to community level, for the sustainability and improvement of the community-based management of hand pumps follows the flow chart in Figure 4 below.

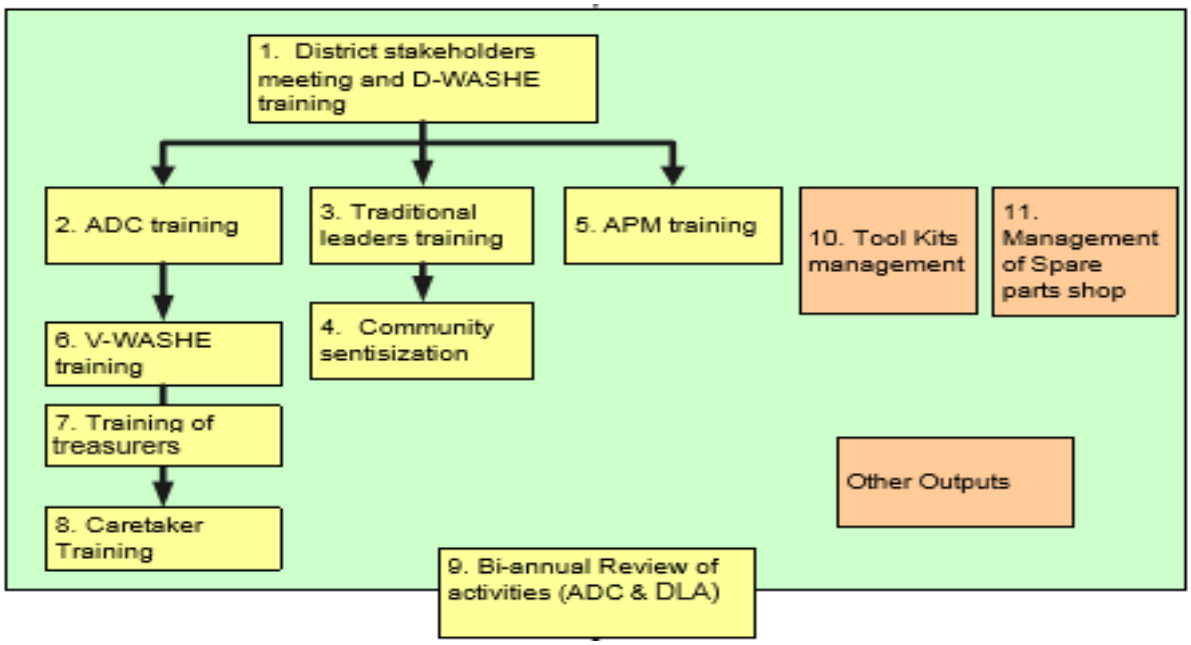


Figure 4: Capacity building training sequence of activities

Source: RWSS operation and maintenance implementation manual and user guide (2010),

The sequence and the details of the training are the following:

1. District stakeholders meeting and D-WASHE training. This is the initial training and orientation of the stakeholders and D-WASHE members at district level. These are given the overview of the SOMAP model for sustainability of rural water and attendant roles and responsibilities that different stakeholders play.
2. ADC training – It is assumed that all districts have ADCs that have been elected to these positions. This is where the pivotal roles of the ADCs are explained and what roles they are to play in the operation and maintenance of the hand pumps in the communities. The position of the ADCs is created under the decentralised policy.
3. Traditional leaders training – The traditional leader are part of the institution in the community and where these are not oriented tend to be a stumbling block is the sustainability of rural water supply. The traditional leaders need to know and understand that sustainability of the hand pumps and the community's responsibility in the cost contribution towards the operation and maintenance of the hand pump.

4. Community sensitisation – The community needs to understand their role in the cost contribution in the operation and maintenance of the hand pumps. The community need to understand also their roles sustain rural water supply in their communities. The Senior Chief in the area should be invited to attend.
5. Area Pump Minder Training – this is an important training as the rural water supply depends upon them. The training should be practical and with hands on experience, to be skilled in repairing and maintaining the hand pumps.
6. V-WASHE Training – The V-WASHE is the committee at the village level and these should know their responsibilities and should meet regularly. These should not only meet when the hand pumps are broken, reactional maintenance.
7. Training of Treasurers – the treasurers are the ones that collect and keep the village cost contributions. The treasurers should be trained in bookkeeping, lack of transparency and record keeping tend to discourage the community from making further contributions.
8. Caretaker Training – the caretaker training is for the day-to-day preventive maintenance of the hand pumps at the community. The caretaker should regularly carryout hand pump inspection and report any faults to the area pump minder so that the hand pump does not break down. The caretakers to be trained by the ADCs and the APMs.
9. Bi-annual Review of activities (ADC and DLA) – these are important review meetings between the APMs and ADCs. At the district level, there should be review meetings between the ADCs and the Local Authority and also between the LA and the Programme Support Team (PSTs)
10. Toolkit Management – The toolkits are the tools for repairing hand pumps, which should be kept within the ward. Since in a ward there may be more than one APM, the tools for the ward should be kept at some central location at a government institution. The training should to include the agreed practices of managing the toolkit so that the tools should be ready for use any time the APM needs to use the.
11. Management of Spare parts shop – the spare parts shop is to be located at the district centre under the responsibility of the Local Authority. The staff should be trained in basic bookkeeping and stock management to attend to the APMs and community members that come for the spare parts. The spare parts should be re-stocked every so often so that at all time, there should be spare parts stocked to ensure that the community find spare parts whenever they come for them.

Other literature reviewed with regard to the importance of capacity building to sustain rural water supply.

Making rural water supply from a Global Study (Katz and Sara 1997). The RWS Global study aim was to clarify what is mean by 'demand responsiveness' in theory and practice and to measure and quantify the impact of demand responsiveness on the sustainability of the rural water systems.

The Global study was for projects in six countries – Benin, Bolivia, Honduras, Indonesia, Pakistan and Uganda. The project was undertaken with support from the World Bank and the Water and Sanitation Program.

The study finding showed that a demand responsive approach at community level significantly increases the likelihood of water system sustainability. To be effective a demand responsive approach should include procedures for adequate flow of information to households, provisions for capacity building at all levels and a re-orientation of supply agencies. A positive correlation was found between water system sustainability and water committee training in operation and maintenance (Katz and Sara 1997).

This goes to say that where a water committee was trained or whose capacity with regard to operation and maintenance was built, there is a more likelihood that the hand pumps or water system under such trained water committee is more likely to succeed and sustainable.

Tanzania experience on capacity building of community management and sustainability of rural water supply facilities (Mandara, Butijn and Niehof, 2013).

This paper addressed the question whether community management in service delivery affect sustainability of rural water facilities at village level, in terms of technical and managerial aspects and; what role capacity building of users and providers play in the process. This research was conducted in nine villages in the district of Kondoa and Mpwapwa in Dodoma Region of Tanzania.

The findings revealed that sustainability of rural water facility is in jeopardy and villages far from the District Council headquarters experienced numerous technical and managerial problems. With regard to capacity building, the villages studied had no local technicians trained in basic operation and maintenance. The study recommended capacity-building workshops for clusters of villages to repair breakdown and coordinate spare parts.

Sustainability does not come up without capacity building to the communities such as repairing of the hand pumps even over a short workshop.

WaterAid Mozambique study in rural water supply sustainability in Niassa Province, (Jansz 2011). WaterAid chose the project site of Niassa Province because of 15 years' experience in the province.

. The findings from the study with particular reference to capacity were that to make water policy operational, it is imperative that all stakeholders on rural water supply programme to have sufficient capacity to act to the best of their ability.

Improved capacity of government at appropriate levels - knowledge, understanding and practice of government are critical issues for improving government capacity to achieve sustainability.

There is need to improve partner's capacity in the local NGOs for them to have sufficient skills, knowledge and capacity to maintain services on time. Improved community education work is also dependent on effective partner capacity.

From the study, it can be deduced that capacity building is imperative for the success and sustainability of a rural water supply project, especially where a project has to rely on other partners to compliment the work.

The evaluation of the United Nation Children Fund (UNICEF) water and sanitation programme in Malawi from 2007 – 2013 (Rijsdijk and Mkwambisi 2016).

The evaluation objective with regard to capacity building was to assess the extent to which the programme focused on the deprived and vulnerable and on systems and capacity development in the sector; and to build capacity of partner for effective, efficient and accountable implementation of water and sanitation.

The evaluation findings with regard to capacity building at different levels were:

1. At National level, the programme facilitated development and approval of the sanitation policy, which call for sanitation issues to be recognised at district level.
2. At district level, capacity was built through the provision of computers, vehicle and motor bikes. The programme also developed capacity of district coordination Teams by periodic briefings.

3. At community level, the programme built local capacity where the communities were involved in the installation of water points where they received the training. The communities where the NGOs worked, there was no capacity built as the community were not trained.
4. The other capacity built at community level is the training of the area pump minders trained in technical skills to carryout major repairs on hand pumps
5. The programme was core facilitator in bringing officers from other sectors such as water, community development and health together for the first time at country level.
6. Most other development partners are using structures that were developed and put up by UNICEF funded WASH programme.

The UNICEF example of capacity building encompassed a wide scope of what needs to be included in capacity building of an integrated sustainable rural water supply projects.

2.11 Conclusion

The principles and practices of the SOMAP Model for operation and maintenance of the rural water supply is the mode of operation and practice adopted for all districts in Zambia for sustaining all rural water facilities (RWSS 2010). The objective of the SOMAP model is to reduce the down time of the hand pumps. The objective of the research is to verify the effectiveness of the SOMAP model in reducing the downtime in Chongwe District.

The literature review has brought out experiences from various scholars of the aspects of the SOMAP model to sustain rural water supply and in this research, we explore each of the aspects to see how ultimately effective the SOMAP model is in Chongwe district.

1. Literature review has shown that financial management standout as principal cause of persistent non-functionality of hand pumps (Haysom 2006). The lack of financial management training for community (Baraki and Brent 2012) is one of the causes for community failing to contribute towards repairing of hand pumps. High poverty levels in the communities affect community's capacity to make financial contributions (Dube 2012). Community contribution is beyond the scope that community-based management can cope with (Chowns 2016). The research shall bring out the main challenges to community cost contributions as prevailing in Chongwe district.
2. Literature seem to suggest a correlation an established hand pump supply chain to low non-functional hand pumps rate. Ethiopia set up regional supply chain (Abdi G. and Baumann E, 2010) and the Malawi government established supply chain to make spare

parts readily available (MoAIWD 2015). Both Malawi and Ethiopia reduced the non-functional hand pump rates and countries attained the Millennium Development Goals (MDGs) with regard to Goal 7 to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation (WHO and UNICEF 2015 p 63, 67). The research shall verify the sustainability of the supply chain of spare parts of hand pumps in Chongwe district.

3. On the third criteria of the SOMAP model the research seek to establish the monitoring and management mechanism that is operational in Chongwe at the three levels of operation - at district, sub-district and community levels. Literature from the Malawi shows the effectiveness of the institution of ADCs between the District and community levels, this link is missing from the Zambian context due to lack of a fully-fledged decentralisation. The research shall seek to establish an effective monitoring and management mechanism that shall ensure that rural water supply is sustained.
4. Following the argument for the need for having a standardised hand pump policy, to improve on the sustainability of rural water, the research shall scrutinise the adopted standard of hand pump type used in Chongwe district, whether it is the India Mark II or the Afridev hand pump.
5. Rural water supply has many stakeholders from the national level down through the district to the community levels. From the literature review, it has been noted that for rural water supply projects to be successful it needs that the stakeholders capacities at different levels to be built to sustained rural water supply. Capacity building even over short duration would make all the difference to wards sustainability of rural water supply.

Hence, this research intends to look at the effectiveness of the SOMAP model to sustain rural water supply in Zambia, using Chongwe District as a case.

CHAPTER THREE

Theoretical and Conceptual Framework

3.0 Introduction

In this chapter, the theoretical and conceptual frameworks are discussed. The theoretical framework undergirds and supports the research on the sustainability of rural water supply project. The definition adopted for sustainability to guide the selection of the theoretical framework is

Sustainability is about whether or not WASH services and good hygiene practices continue to work and deliver benefits over time. No time limit is set on those continued services, behaviour changes and outcomes. In other words, sustainability is about permanent beneficial change in WASH services and hygiene practices. (WaterAid 2011)

The two theoretical frameworks selected for sustainability of rural water supply are expanded community based management model (Mandara et al (2013).

The Mandara et al (2013) expanded community based management model theoretical framework is based on the Harvey and Reed (2004) model that relies on voluntary water committees to carryout basic day-to-day operation and maintenance tasks to keep the systems going and address minor repairs on hand pumps.

Conceptual framework for the SOMAP model is discussed from the perspective of the conceptual framework developed by WaterAid. WaterAid has done a lot of work in the sustainability of rural water supply.

The chapter closes with the research questions and a conclusion.

3.1 Theoretical Framework

This section presents the theoretical framework that guide the understanding of sustainable rural water supply. The theoretical framework that selected is the expanded community based management model theory based on the Community-based Management Model theory developed by Harvey and Reed (2004). The Community-based Management Model Theory is briefly discussed below before discussing the study Expanded Community based Management Theory.

3.1.1 Community-based Management Model Theory

The Community Based Management (CBM) has its roots in the International Decade for Drinking Water and Sanitation of the 1980s, which ushered in a new wave of donor and NGO programmes, largely bypassing government structures in favour of communities and grassroots organisation (Lockwood and Smits 2011 p. 75). In simple form, CBM relies on voluntary water committees to carryout basic day-to-day operation and maintenance tasks to keep the systems going and address minor repairs on hand pumps.

The community management model sometimes known as Village Level Operation and Maintenance (VLOM) is by far the most common partnership approach adopted in sub-Sahara Africa is sustaining rural water supply (Harvey and Reed 2004 p. 16 and 41) as illustrated in Figure 5 below.

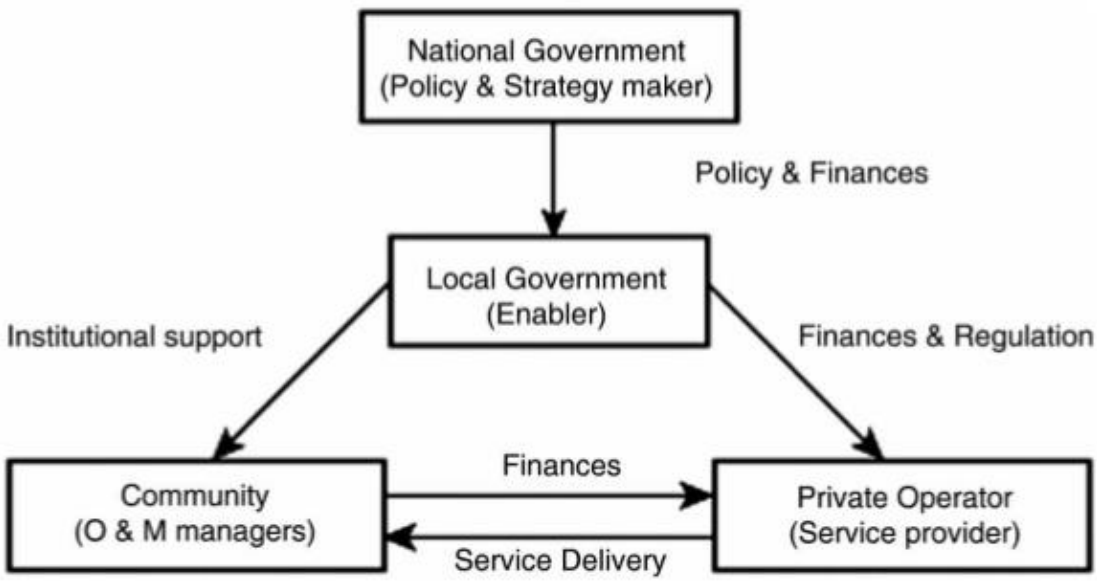


Figure 5: Community Based Management model

Source: Adapted from Harvey and Reed 2004 p. 41 *Rural Water Supply in Africa, Building Blocks for Hand Pump Sustainability*, Water, Engineering and Development Centre (WEDC), Loughborough University, UK

In the Harvey and Reed framework, the CBM the National Government is the policy and strategy maker and provides the finances.

The Local Government at the district is the enabler; this means that the Local Authority is responsible for regulation, facilitation and monitoring of sector stakeholders. Facilitation by the local authority involve information provision, follow-up training and technical support.

The local authority provide institutional support to the communities, provide finances, and regulate the operation of the private operators that provide services to the communities.

The community based management in the form advanced by Harvey and Reed (2004) proved insufficient to address the problem of sustainability as communities had no legal ownership and ill prepared to take on management responsibilities, this developed toward a Demand-Responsive Approach (DRA) and community participation. (Lockwood and Smits 2011 p. 75).

This new approach differed from the VLOM approach as it had a stronger emphasis given to communities demand for services expressed through community contribution towards capital investment and cost contribution towards the operation and maintenance. Greater attention paid to preparing community to take on management tasks. CBM has brought many benefits and recent studies indicate that this approach has improved the performance of water supply systems (Bakalian and Wakeman 2009)

Over the last two decades, CBM model has emerged as paradigm for providing water to rural communities (Lockwood and Smits 2011 p. 76).

CBM model has been expanded in the sustainability of rural water supply at village level in terms of their technical and managerial aspects and role played by capacity building of users and providers. Mandara et al (2013) carried out a study on community management and sustainability of rural water facilities in Tanzania.

This study has expanded the Harvey and Reed framework by expanding the community box that comprised the O&M managers to have them within the village structures. Appropriate capacity development for all stakeholders at all levels from the National level all the way down to community level as illustrated in Figure 6. This theoretical framework has been adapted for this study.

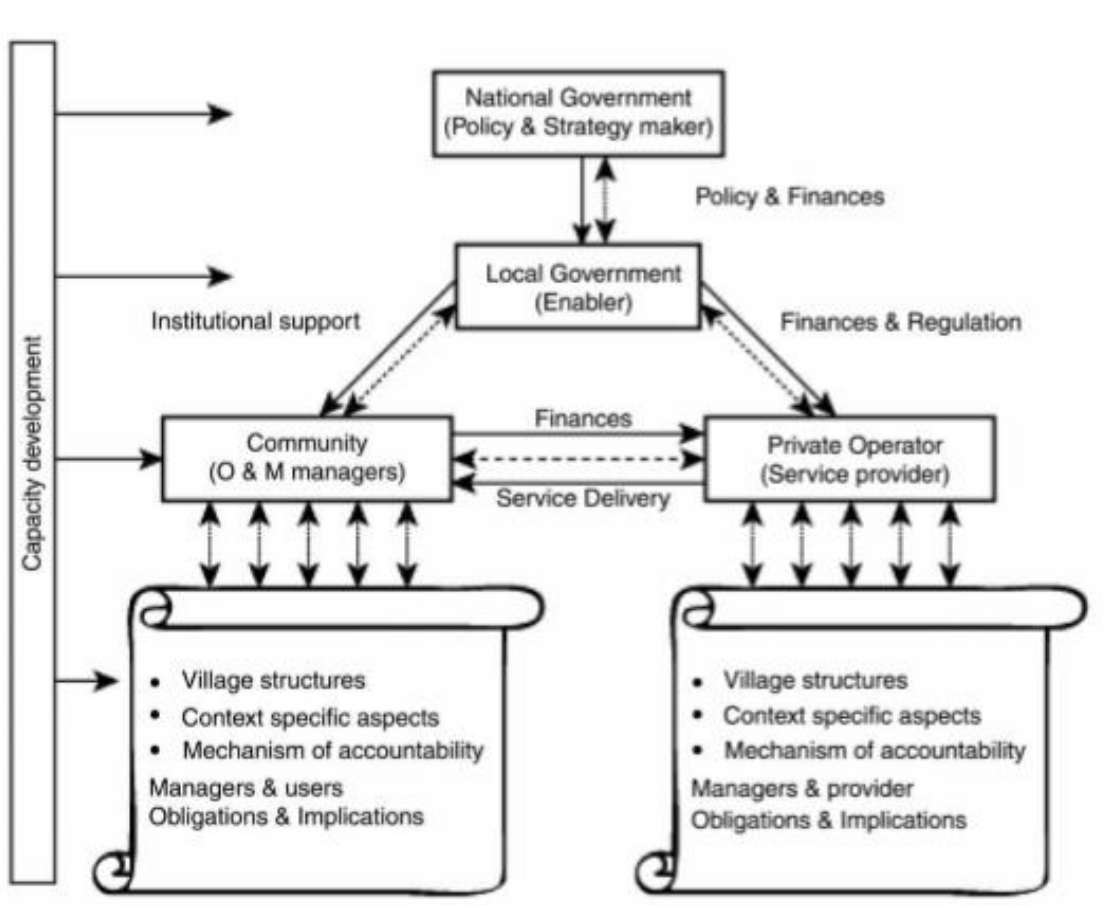


Figure 6: Expanded Community Based Management model

Source: Mandara et al 2013, *Community Management and Sustainability of Rural Water Facilities in Tanzania*, Water Policy 15 p. 79–100, Wageningen University, Wageningen, Netherlands, IWA Publishing.

The expanded Mandara (2013) CBM model is the same as the Harvey and Reed (2004), except for contextualisation and the introduction of capacity building at all levels of the sector, inclusion of village structures in both the community and private operators and inclusion of line of feedback mechanism through all sector stakeholders. There should be special emphasis in the capacity building for villages to include maintenance, record keeping and financial management.

The emphasis on building capacity of the villages will address concerns expressed against CBM as expressed in Chowns (2015) study on whether community management is an effective model for public service delivery using lessons from rural water supply sector in Malawi.

3.2 WaterAid Conceptual Framework

The WaterAid Conceptual Framework is described as basis for the conceptual framework for the SOMAP model.

According to Carter, Casey, and Harvey, (2011) in the WaterAid framework paper, sustainability of community-based services depends on the four major broad components real need and demand driven service, fundamental aspects of design and implementation of the programme; functional community-based management system and external support, (WaterAid 2011).

These four sustainability pillars can be explained in the following way. .

1. *Real need and demand driven service*. Without this prerequisite for a service of WASH, there will be little prospect of sustainability. There will be no need to sustain a service if there is an alternative to the failed service.
2. *Fundamental aspects of design and implementation of the programme*. The programme should be undertaken according to the requirements of the programme if it is to be sustained by the community –based operation and maintenance.
3. The fundamental aspects include full user participation; technology fit for purpose and chosen by users; capital contribution by users; high quality of implementation; appropriate tariff structure; environmental aspects properly addressed; and monitoring system in place
4. *Functional community-based management system*. This is key to sustainability of the WASH sector at community level. The evidence of a functioning community based management system are: Water User Committee (WUC) should be functional that is, revenues are collected and recorded; upkeep and maintenance tasks being undertaken; strong links between user community and support; strong links between user community and support organisation in place and environmental monitoring
5. *External Support*. The external support is support that comes to the community from the National and local government support and support from the private suppliers of goods (of spare parts), and services (repairs). There should also be an external enabling environment of national policies and budget lines for external support, and a regulatory framework surrounding private providers.

After this WaterAid framework (2011), we develop the SOMAP model conceptual framework based upon the five principles of sustainability of rural water supply.

3.3 SOMAP Model Conceptual Framework

For the hand pumps at the community level to be sustained to be operational every time, there are operation and maintenance structural systems that need to be established and conducted by various stakeholders to maintain hand pumps in a sustainable way. These structural operational and maintenance systems are the independent variables that need to be fulfilled to sustain hand pumps and reducing downtime.

The independent variables are the five principles of the SOMAP model are necessary for the hand pump to be sustainable at any time. The variables in the five principles of SOMAP model are summarised as follows:

1. *Community Cost Contributions* The community need to contribute one hundred percent (100%) cost contribution towards the operation and maintenance of hand pumps. Apart from this, to demonstrate their sense of commitment to the installed hand pump, the community is requested to contribute K1, 500.00 toward capital cost for borehole with hand pump. For major rehabilitation works, the Local Authority is to facilitate the assistance to the rehabilitate works that would cost more than K500.00

2. *Sustainable Supply Chain of Spare Parts* - Sustainable supply chain of spare parts should be available at outlets at all times. The spare parts should be affordable, so that the communities could afford them. An appropriate sustainable supply chain should be set up, in the district within proximity to the rural communities. To ensure ease of repair by the Area Pump Minders toolkit should be made available in the communities. The toolkit can be stored at a government institution like a rural health centre. A toolkit management mechanism should be established to ensure tools are available any time in working condition when the need arises to use them.
3. *Monitoring and Management Mechanism. There should be a* monitoring and management mechanism. The monitoring and management should devolve from the district level down, the ward or catchment level down to community level. At catchment, level the Environmental Health Technician (EHTs) to oversee the APMs and tool kits at Rural Health Centres (RHCs). The APMs to oversee RWS at community level and report to the EHT at catchment level. The EHT to oversee the management of the toolkit at RHC so that tools are ready for use. The RWS at community level to be managed by a gender balanced Village Water Committee.

4. *Adopted Standardised Hand pumps*. The local authority to adopt available hand pumps in the district that have proved over time. The hand pump satisfy hydro-geological conditions, with regard to aggressive and corrosive groundwater, such as the use of polyvinyl chloride (PVC) pipes of Afridev hand pumps. The use of standardised public domain hand pumps are encouraged. The standardised hand pumps include India Mark II, Afridev and Modified India Mark II. The hand pumps should be affordable from the capital and recurrent costs consideration. The standardisation should come from the process of research and development.
5. *Capacity Building.* There shall be a supportive regulatory framework provided policies provided. Capacity building include physical, material resources along with knowledge, understanding and skills from national down to the community. At community level, there shall be awareness campaigns and public participation created. Management, financial and technical skills development shall be imparted for effective operation and maintenance.

The conceptual framework of the SOMAP model shows that the five independent variables are linked to ensure that the hand pump is sustainable. When all the five operation and maintenance practices are equally practiced, then the sustainability of the rural water at the water point in the community is assured.

Any weak variable in the link leads to the hand pump not being sustainable but break down. The SOMAP Model sustainability conceptual framework is illustrated in Figure 7 below:

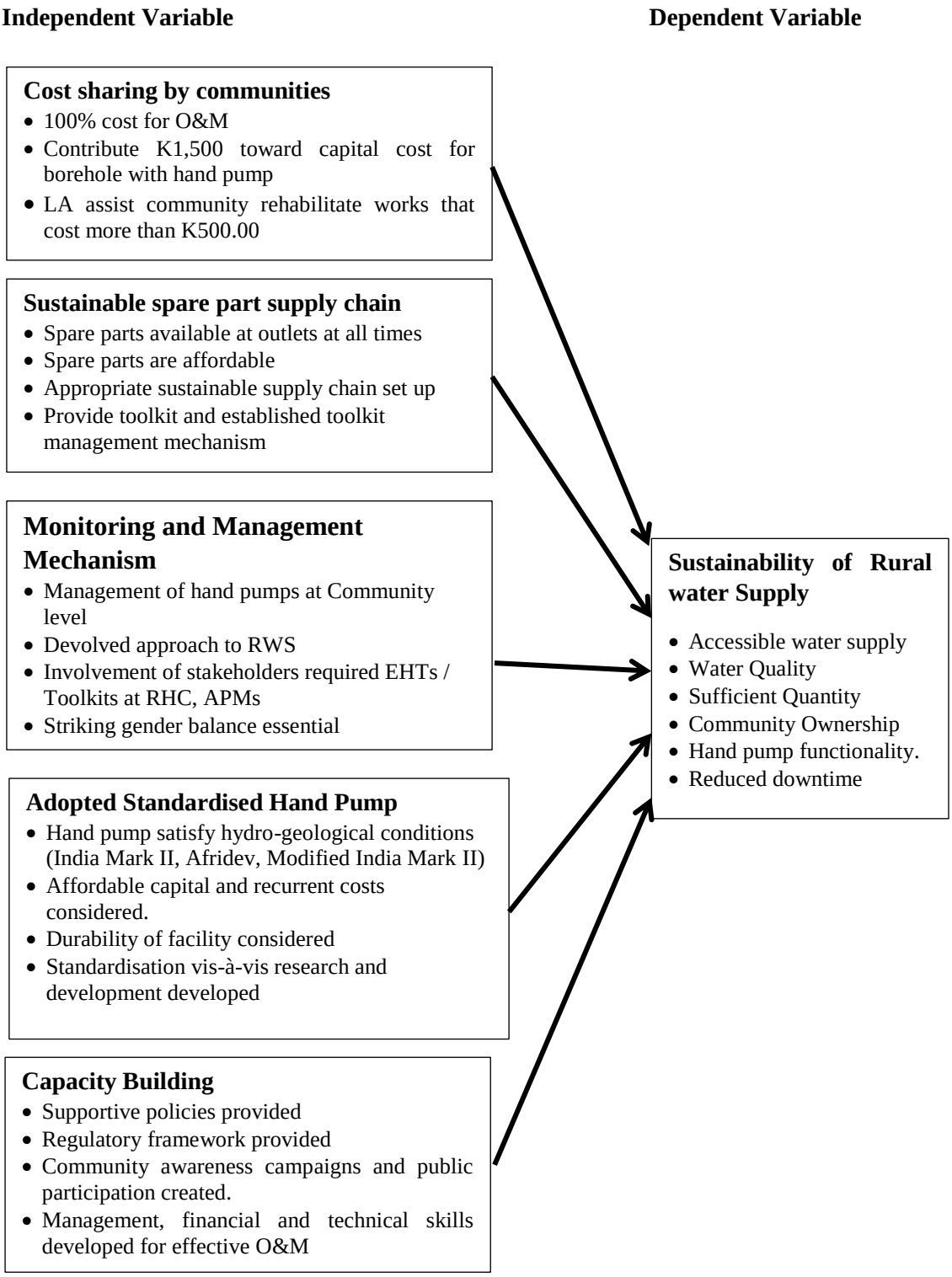


Figure 7: Conceptual Framework SOMAP Model

Source: Author

The conceptual framework for the SOMAP model for the sustainability of the rural water supply is based on the five general practices of the sustainability of rural water supply. (GRZ/JICA 2010 p. 22).

3.4 Conclusion

Sustainability of rural water supply is about whether or not the WASH services, in the case of the operation and maintenance of hand pumps, it is to continue to the provision of permanent benefits of flowing safe drinking water to the communities. Water supply at the water point is sustained using the community-based management system where the community oversees the operation and maintenance of the hand pump in the community.

A functional community-based management is supposed to be supported on one hand, by external support of the national government, local government and the private sector and on the other hand, the water facilities should be according to the fundamental aspects of the design and implementation of the rural water programme.

The capacity of all the rural water supply sector players from the national level, through the local government down to the communities should be built to function and support rural water supply facilities. The rural communities should be organised such that sustainability of hand pumps is a day-to-day activity as way of life.

The five principles of SOMAP model are the independent variables that ensures the sustainability of rural water, a failure in one lead to the failure to sustain rural water supply.

CHAPTER FOUR

Research Methodology

4.0 Introduction

This chapter of research methodology begin with the research design and research approach that has been selected for the study. These two are followed with the description of the location of the study. Although Chongwe Municipal Council is described as a rural municipal council, its proximity to Lusaka makes it not a typical rural district.

Because of the district not being a typical rural district, the population that has been selected to be included in the research are those wards that are further from Lusaka that have been loosely classified as rural areas.

The data collection tools and procedure for gathering data semi-structured questionnaires and personal interviews to collect primary data and documentary data from the files and project reports to collect secondary data.

The study population is restricted to rural section of Chongwe district. The sampling technique for the communities shall be purposively to ensure adequate geographical coverage.

The last section before the conclusion are the ethical considerations for the research.

4.1 Research Approach

Research approach can be divided into three types:

1. Deductive research approach
2. Inductive research approach
3. Abductive research approach

The relevance of hypotheses to the study is the main distinctive point between deductive and inductive approaches. Deductive approach tests the validity of assumptions (or theories/hypotheses) in hand, whereas inductive approach contributes to the emergence of new theories and generalizations. Abductive research on the other hand, starts with ‘surprising facts’ or ‘puzzles’ and the research process is devoted to their explanation (Bryman and Bell 2015 p. 27)

According to Dudovskiy (2017) makes the distinction between the three research approaches in the following way.

Deductive Research Approach - If you have formulated a set of hypotheses for your dissertation that need to be confirmed or rejected during the research process you would be following a deductive approach.

Dissertations with deductive approach follow the following path of theory, hypothesis, observation and end with confirmation or rejecting the theory.

Inductive Research Approach. Inductive approach does not involve formulation of hypotheses. It starts with research questions, aims, and objectives that need to be achieved during the research process.

Inductive studies follow the route: Observation / tests, pattern and then end up with a theory

Abductive Research Approach. In abductive approach, the research process is devoted to explanation of 'incomplete observations', 'surprising facts' or 'puzzles' specified at the beginning of the study.

In this research, the selected research approach is the deductive research approach. The research study has hypothesis that follows the theoretical frameworks, then the observations shall follow. The conclusion shall confirm or reject the hypothesis.

4.2 Research Design

The research design adopted for this study is quantitative research. The research problem is the non-functional and broken down hand pumps that lead to unsustainable water supply in rural areas. The problem calls for understanding the different aspects of the SOMAP Model to best predict the outcomes. The background of the researcher is from a civil engineering field with wide experience in the rural water supply sector. The audience for the study are the stakeholders in the rural water supply sector, which include government staff, the local authorities, the non-governmental organisations (national and international) and scholars working in the rural water supply sector.

4.2.1 Philosophical Assumptions of Quantitative Research

The philosophical worldview espoused is the post-positivist worldview. This worldview also called the scientific method or doing science research. This involves developing numeric measures of observations and studying the behaviours of individuals is paramount for post-positivist.

4.2.2 Quantitative Research Strategy

The quantitative research strategy is the survey research that shall provide numeric descriptions of trends of a population by studying a sample of the population. The researcher shall use semi-structured questionnaires at community level data and personal interviews at district level for data collection. The sample results shall be generalised to make claims about the population.

4.2.3 Data Collection Procedures

The survey is the preferred type of data collection procedure because it is economical and quick turnaround in data collection. The survey was cross-sectional data - data was collected at one point in time. The researcher shall use three types of data collection forms – interviews; structured record reviews (to pick information from official records) and structured observations at water points in the communities.

4.2.4 Population and Sample

The characteristic of the population of the study area are the three borehole construction interventions in Chongwe before 2009, the Water Sector Programme Support (WSPS) Phase I (2009 – 2011), WSPS Phase II (2012 – 2013). Rationale for selecting this population of boreholes are: age of use more than four years; community served were trained in the SOMAP model of sustaining the hand pumps; V-WASHE committees and caretakers were provided with tool kits.

4.2.5 Sampling Frame

The Sample frame is the updated list of boreholes kept at Chongwe Municipal Council. The selection of the samples convenience sampling (also known as haphazard sampling or accidental sampling) is a type of nonprobability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time (Dörnyei 2007). This provided the ability to generalise to a population

4.3 Location of Study

The location of the study is Chongwe District in Lusaka Province. Chongwe District is one of the eight districts in Lusaka Province. Chongwe District centre is located about 45km East of Lusaka, the Capital City of Zambia, on the Great East Road. The location coordinates for Chongwe Civic centre is S15.32629, E28.67894.

According to the 2010 Census of Population, the population of Chongwe was estimated at 141,301 people of which 129, 141 was rural population and 12,160 was urban population (CSO 2012). The target population for the study is the rural population of Chongwe District, which is about 129,141 people, which constitutes 91.4% of the district population.

Chongwe District is on the fringe of Lusaka, because of that it has a high population growth rate of 3.4% per annum (CSO 2012), predominately in the wards that border with Lusaka on the west end of the district. The location of Chongwe district is shown on the map of Zambia in Figure 8 below.

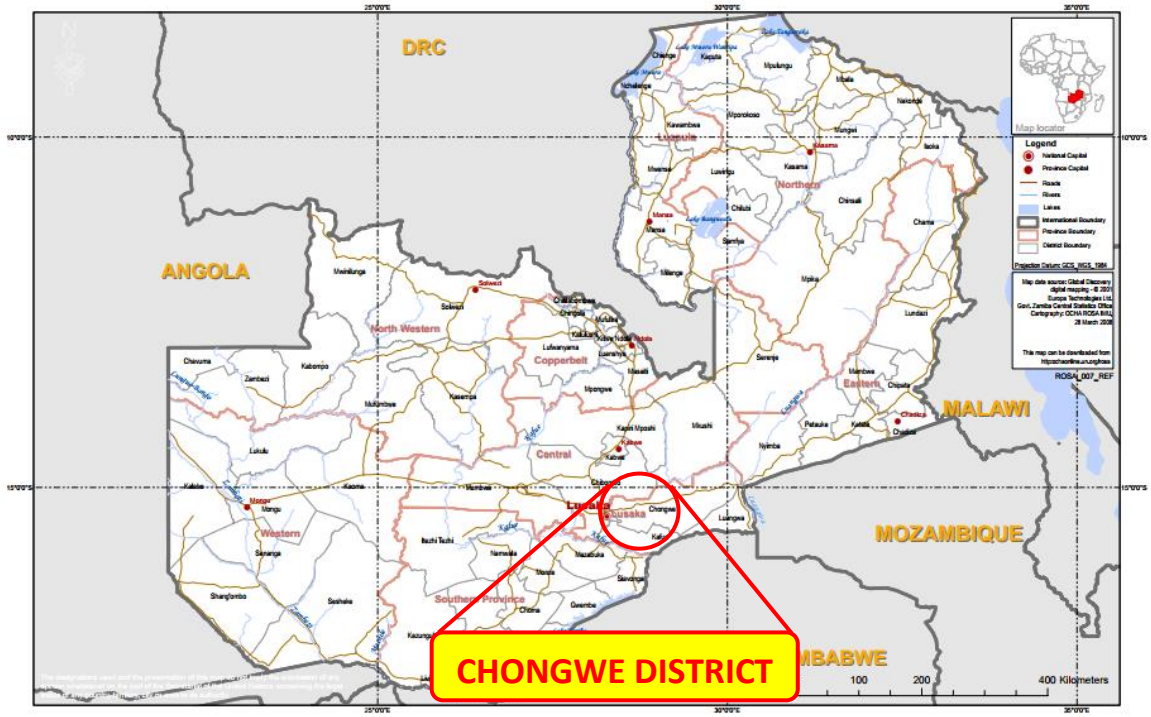


Figure 8: Site Location for Chongwe District on Map of Zambia

Map data source: Global Discovery digital mapping - © 2001 Europa Technologies Ltd. Govt. Zambia Central Statistics Office Cartography: OCHA ROSA IMU, 28 March 2008. This map was downloaded from http:ochaonline.un.org/rosa on 9 November 2017

4.4 Data Collection, Tools and Procedure

The data collection tools used in the research are semi-structure survey / questionnaires, personal interviews and document reviews. This study used the semi-structured questionnaires and interviews to collect primary data and documentary data from the files and project reports to collect secondary data.

The semi-structured questionnaires were drafted to respond to the specific objectives of the study, there after these were piloted in Chongwe, to see how these the community are able to respond and to see whether the required data is being captured. The pilot was used to estimate the amount of time to complete the interview. Two questionnaires were prepared to collect data at District level and the community level.

4.4.1 Questionnaires

The questionnaires were semi-structured such that the responses to the questions could either be ticked or circled. The description of the information obtained in each of the questionnaires is as given below.

District survey questionnaire. In this questionnaire, the stakeholder was the RWSS Co-ordinator. The questionnaire was semi-structured and addressed the five study specific objectives. The responses from the questionnaire have been included as report as research findings.

Community survey questionnaire. The community questionnaire was the main tool for capturing the research data. The front page of the community questionnaire had an introductory letter addressed to the respondent. The original plan collecting data was to have the questionnaire be self-administered. This idea was later changed and not used. The questionnaire was administering to a group of respondents at a water point.

The rest of the community questionnaire hand seven sections.

1. Section A in the community survey questionnaire was on the identity of the respondent and site identification. The details that were captured were date of the interview, the gender of the respondents as a total number present. The site name, ward name and the name of the chief's area. Additional information of the identity of the area were the nearest rural health centres and the schools that children attended. The last detail that was captured was the unique location on the globe, using the hand held Geographical Position System (GPS) location tool – the GPS locator. The hand held GPS tool used is the Garmin, etrex 10 model.
2. Section B of the community survey questionnaire was gathering information on the status of the hand pump in the community. The information captured included when the hand pump was constructed. Whether hand pump has ever broken down and how long was the hand pump down before it was repaired – length of the downtime. The

other information gather under this section was the hand pump functionality, which included number of strokes to fill a 5-litre container, checking whether the hand pump had grease on the chain, water availability from the hand pump for the community. Information on quality of water and EHT's visit to the water point.

3. Section C was about the community's contributions towards operation and maintenance of the hand pump. This addressed the first specific objective of the study and the first principle of the SOMAP model.
4. Section D of the questionnaire was about the spare part supply chain. How much the community appreciated the established spare part shop at Chongwe? This addressed the second specific objective of the study and second principle of the SOMAP model.
5. Section E of the questionnaire was on the monitoring and management mechanism of rural water. This reviewed the presence of the water committee, the area pump minders and management of the toolkits. This addressed the third specific objective of the study and the third principle of the SOMAP model.
6. Section F of the questionnaire was on the type of hand pump installed at the borehole in the community. This also asked on the challenges that the community experienced with the hand pump. This section addressed the type of the standard hand pump used the fourth specific study objective and fourth principle of the SOMAP model.
7. Section G is the last section and was about the capacity building of the community to sustain rural water in the community. This addressed who was sensitised and by who and when this was done. This section addressed the fifth study specific objective and the fifth principle of the SOMAP model. For the full community questionnaire (S*ee Attachment in Appendix 5)*

The responses from the semi-structured questions were analysed for frequencies using computer software – IBM statistical package for the social sciences (SPSS) version 23. (*See Photo shots in Attachment in Appendix 1*)

4.4.2 Interviews

The interviews were conducted with the district key informants and the spare parts shop assistant. Apart from the RWSS Coordinator the other key district informant were NGOs working in Chongwe in the rural water supply sector.

After the interview with the spare parts shop assistant, a visit to the spares shop container was undertaken to have an insight of the operation of the spare parts shop.

The questions for the interview with the SOMAP spare part shop assistant were based on the best practices as described in the *Supply Chain Management Manual*, second edition. (MLGH/GRZ 2012). The questions were targeted at the four stages to establish and maintain the supply chain for hand pump spare parts, which are the organisational set up; preparation of spare parts shop; daily shop operation and management and the replenishment and price revision.

The responses from the interview are incorporated in the findings section of this report.

4.4.3 Document Reviews

The rural water supply project has generated many reports over time. For more technical information from management, the contractors and end of project reports, documents reviewed.

4.5 Study Population

Chongwe has an estimated population of 141,301 people with 129, 141 (or 91.4%) people being rural population and 12,160 (or 8.6%) people being rural population (CSO 2012). The target population for the study is the rural population of Chongwe District, which is about 129,141 people, which constitutes 91.4% of the district population.

Chongwe is a district with one constituency – Chongwe Constituency. There are ten wards in Chongwe District namely, Chinkuli, Chalimbana, Lukoshi, Kanakantapa, Kapwayambale Manyika, Nthandabale, Lwimba, Nakatindi, and Chongwe.

Chongwe District Council was upgraded to a Municipal Council on 27 February 2017. The justification for the upgrade was due to massive development in form of infrastructure to the West of the district that borders with Lusaka.

Although Chongwe Municipal Council population is 91.4% classified as rural, this is not synonymous to settlement in villages. The population in Chongwe is a mixture of settlements that are commercial units along the Great East Road, smallholder farms, low-density housing complexes and peri-urban areas of Lusaka.

Because Lusaka is an urban area, the wards of Chongwe Municipal Council that share boundary with Lusaka were not included in the research, as these were not typical rural areas - where the community members draw water from communal hand pumps and live in villages.

4.5.1 Sampling Techniques

The study used convenient sampling. Convenience sampling is a non-probability sampling techniques that a researcher uses to choose a sample of subjects / units from a population. Although, convenience sampling can be used in both qualitative and quantitative study, but it is frequently used in quantitative study while purposive sampling is typically used in qualitative study (Ilker 2016).

Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of nonprobability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study (Dörnyei 2007). .

4.6 Calculation of Sample Size

Chongwe has an estimated population of 141,301 people with 129, 141 people being rural population and 12,160 people being rural population (CSO 2012). The target population for the study is the rural population of Chongwe District, which is about 129,141 people.

The rural population included in the research were drawn from Lukoshi, Manyika, Lwimba, Chinkuli and Kanakantapa Wards, which have rural area characteristics of sharing a common water point and living in villages.

Using the population from the 2010 population figures for the population and number of the households, the population used are provided in Table 9 below

Table 9. Population in Wards included in the research

Item	Ward	Population	No. of Households
1	Chinkuli	22,662	4,397
2	Kanakantapa	14,017	2,619
3	Lukoshi	8,738	1,511
4	Manyika	10,617	1,842
5	Lwimba	5,129	812
	Total	**61,163**	**11,181**

Source: 2010 Census Population and Housing, *Population Summary Report*, Central Statistics, 2012.

The number of households in the population sampled is 11, 181 households that represented a population of 61, 163 people.

Using **Yamane formula** (1967:886), simplified formula to calculate sample sizes. At 95% confidence level and the desired level of precision (P) of 95%, P = 0.5

$$n = \frac{N}{1 + N(e)^2}$$

Where *n* is the sample size, *N* is the population size, and *e* is the level of precision.

Using the rural population in terms of households of 11, 181 households, as the sample size calculated, using the formula above, gives the sample size of **400 people** to be interviewed.

4.7 Data Analysis, Tool and Techniques

A quantitative data analysis software was used for analysis of the research data from the community questionnaire. A systematic process was followed of editing all the data obtained from the field.to check and ensure it was complete and correctly filled. The variables were coded to allow for analysis.

The community questionnaires had 110 variables to be analysed for frequency. These had to be analysed using the IBM statistical package for the social sciences (SPSS) version 23.

The district questionnaire data gave the status and perspective of the SOMAP model from district staff standpoint, whereas the Community Questionnaire gave the SOMAP model from the community's perspective.

The sum of the two perspectives is the perspective of the effectiveness of the SOMAP model is sustaining rural water supply in the district.

4.7 Validity and Reliability Test

The community questionnaire tool was pre-tested for validity to the extent that the concepts covered by the variable under consideration is accurately measured and provides valid response. The reliability test was to verify whether the responses were reliable – that is giving accurate and consistent results if used in same situation on repeated occasions (Heale and Twycross 2015).

The community questionnaire was checked for validity and reliability by conducting pre-test runs in the communities before the full survey was conducted. The pre-test runs were conducted at four borehole sites. The changes were made to the questionnaire after the pre-

test run to ensure the flow of the questionnaire was consistent, there were no repetitions and the responses were consistent and reliable.

4.9 Ethical Considerations

Ethics is the study of moral obligations involving the distinction between right and wrong (Kreitner 2009 p. 127). This has to do with making decisions from personal convictions between what is right and wrong. The ethical considerations for the research on the sustainability of rural water supply shall include the following considerations.

Prior to the commencement of the research in the district, permission was sought with the head of the institution that oversees rural water supply in the district that is the Town Clerk of Chongwe Municipal Council with official introductory letter from the University of Lusaka. (*See Attachment in Appendix 3*). The researcher was asked to pay to the Chongwe Municipal Council a fee for carrying out research in Chongwe District (*See Attachment in Appendix 4*)

At community level, permission was sought from the village head person in the local community. The research targeted rural water projects. The objective for sustainable rural water supply is to improve the supply of safe water where the hand pumps are functional. The research data protected the identities of the respondents in the communities.

The study did not interview vulnerable persons and under-age persons as research subjects. The researcher's personal skill and competence was biased towards technical field. Academic research has to be conducted within specified period, which would result being in a rush. Rushing respondent is disrespectful in Zambian culture. The research shall devote sufficient time for the study and treat respondents with respect and courtesy.

This is an academic research and has not been funded; therefore, most of the work shall be borne by the researcher, as there is no money to pay any community volunteers, who may seek for compensation in monetary terms, for whatever assistance they may seek to offer, so that there is no misunderstanding at the end of the study. Prior to the commencement of the research, the research topic was cleared and defended before research examiners of the University of Lusaka.

4.9 Conclusion

The research design adopted for the research for the effectiveness of the SOMAP model for rural water supply in Zambia using Chongwe District as the study area is the quantitative research using the deductive research approach.

The study location is Chongwe district. Although 91.4% of the population of Chongwe district is classified as rural, it is not synonymous as settlement in villages. Chongwe district boundary on the West is Lusaka, which is an urban settlement. The wards that share the boundary with affluent Lusaka were not be included in the research, as these are not typical rural areas that drawing water from hand pumps and living in villages. The wards that were included in the research were those, which had characteristics of rural areas of sharing a common water point and living in villages.

The data collection tools used in the research are semi-structure survey / questionnaires, personal interviews and document reviews. This study used the semi-structured questionnaires and interviews to collect primary data and documentary data from the files and project reports to collect secondary data. The two data collection questionnaires were used at district and community level. The district level questionnaire targeted rural water sector staff at district centre while the community level questionnaire targeted the stakeholders at sub-district and community level.

The sampling technique that was selected is the convenience sampling method. Convenience sampling is a nonprobability sampling techniques that a researcher uses to choose a sample of subjects/units from a population, frequently used in quantitative study. The collected data shall be analysed for frequencies using the IBM statistical package for the social sciences (SPSS) version 23.

CHAPTER FIVE

Data Analysis, Results and Discussion

5.0 Introduction

This chapter is in three major sections: data analysis, the results and the discussion. Each section begins with a brief introduction highlighting the issues raised in the section under review.

At the end of the third section is a conclusion of the chapter.

5.1 Data Analysis

The section that follows was after the data entry in the Statistical Package for the Social Sciences (SPSS) programme of the collected data from the field. The output from the analysis is here described to make meaning from the frequency tables that were developed from the data entry.

The analysis begin with the background of the research area, and then followed by the location map of the water points surveyed. Each water point had geographical position point taken to identify for each location. The other information that has been analysed is the status of the water points surveyed. The bulk of the status section shows how the water points have been sustained from the community members. This includes the capital contributions, the repair works undertaken of the hand pumps under the study; the experienced down time and the hand pump functionality. The other issues reviewed are the practice of preventive maintenance, water availability and usage; alternative sources of water and the water quality at the present water point.

After analysis of the status of the hand pumps the next analysis moves to the five SOMAP model principles.

5.1.1 Background to research area

The number of the group respondents in the study was 282 segregated as 114 men and 168 women. In percentage terms as 40.40% and 59.60% as men and women respectively. This represents 70.5% of the response from the target sample size of 400 respondents

The number of water points visited was 47 sites these included rural health centres, basic school, villages. Chongwe Districts has only two Chiefs – Chieftainess Nkomeshya Mukamambo II and Chief Bunda Bunda. There is a natural boundary between these two chief's areas. The Chongwe River divides these. The area around Chongwe town before the

Chongwe River is under Chieftaines Nkomenshya and the land across the river is under Chief Bunda Bunda.

Picture 2: Researcher administering questionnaire at Water Point at Nkomeshya Village.

The communities surveyed were 55%from Chieftainess Nkomenshya's area and 45% from Chief Bunda Bunda's area as shown in Figure 9 below.

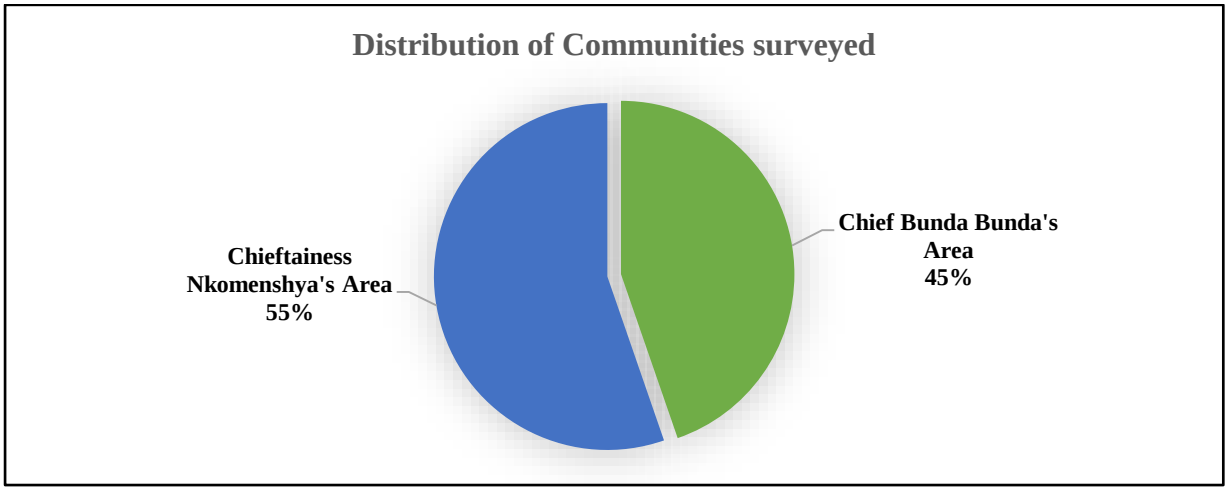


Figure 9: Distribution of Communities surveyed

According to the wards, the communities that were included in the research came from the following wards in proportions given in Figure 10 below.

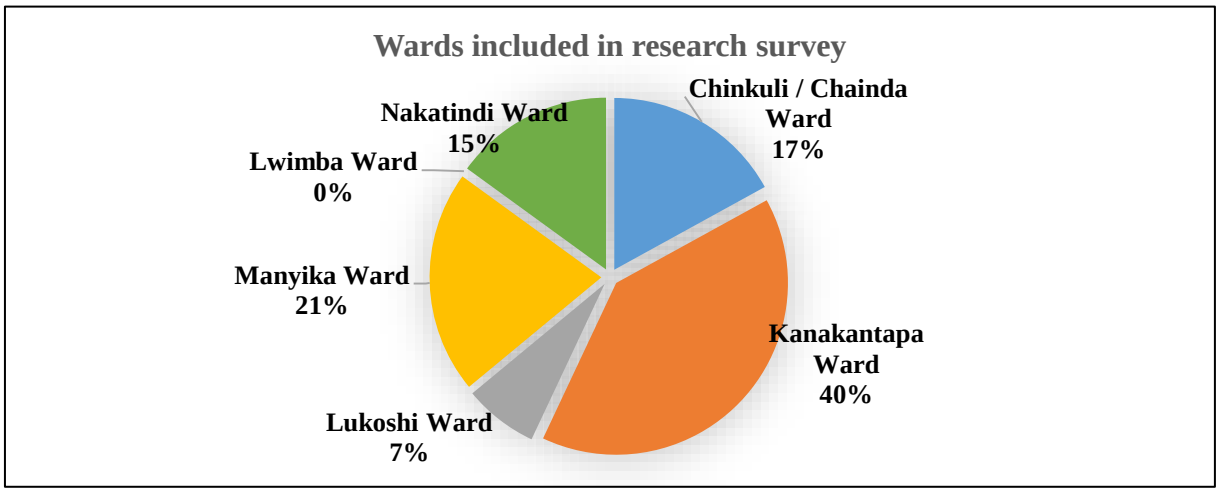


Figure 10: Wards included in research survey

The communities can also be identified through the rural health centres nearest to the villages or where the community members go to for medical attention. The names and the nearest RHCs that the communities went to are given in the Figure 11 below.

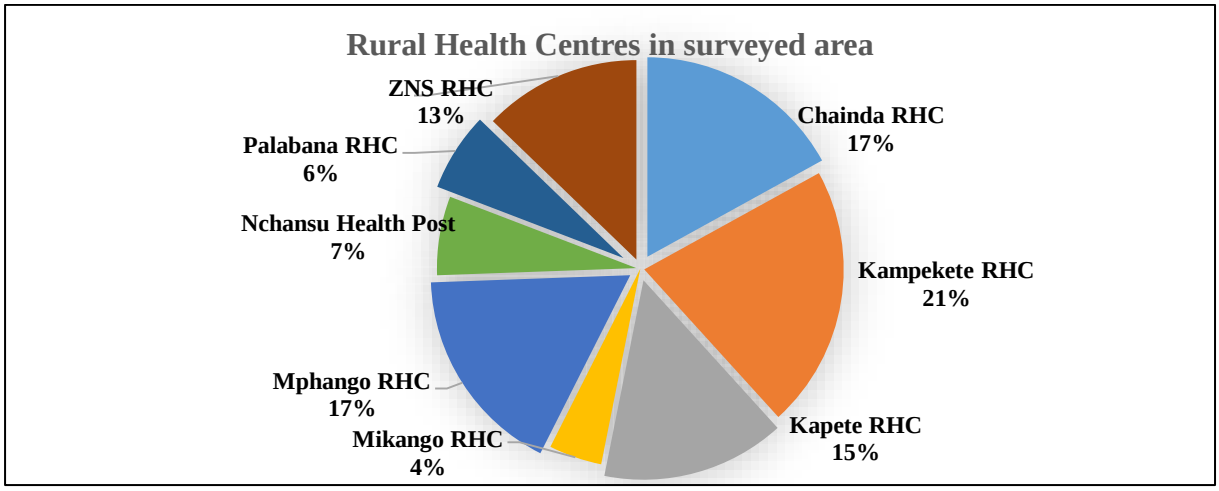


Figure 11: Rural Health Centres in surveyed area

The concentration of the study was in the rural areas around five rural health centres of Kampekete, Chainda Mphango Kapete and Zambia National Service respectively.

The communities can also be identified by the nearest primary schools that are used. The schools that were identified by the community as used in the vicinity are ten and the frequency that they were identified is given in Figure 12 below. The communities identified Mulola, Kampekete, Chainda, Mphango and Kapete in descending order as the most used primary schools in the area surveyed.

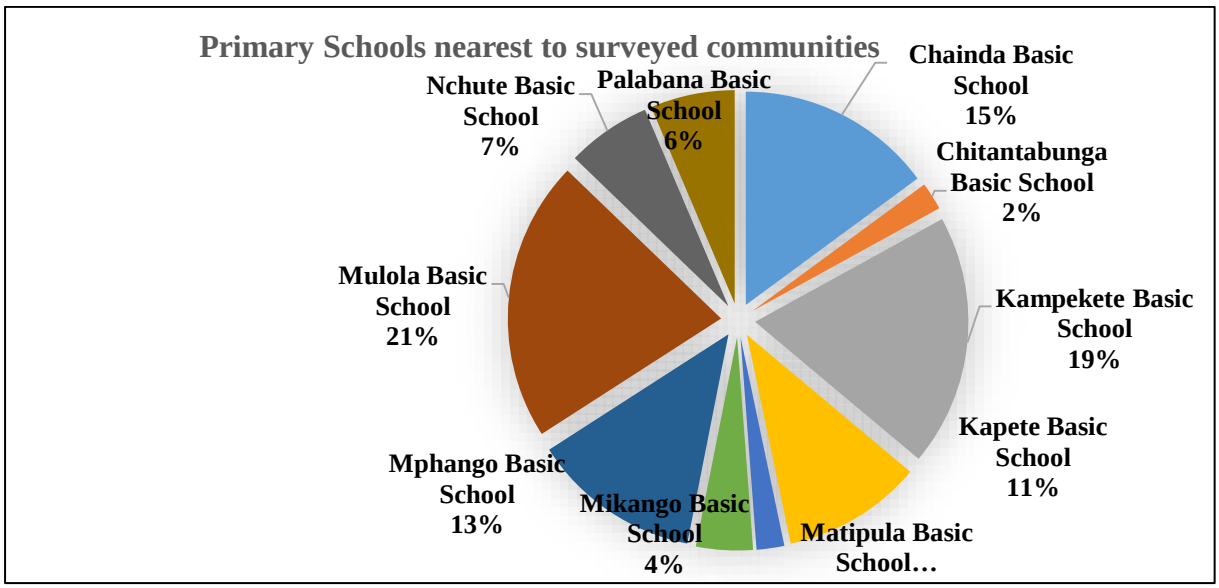


Figure 12: Primary Schools nearest to surveyed communities

The location of the surveyed water points were identified using the hand-held Geographical Positioning System (GPS) unit. The GPS model used was the Garmin ® etrex 10 model. The map datum used for the GPS is the World Geodetic System 1984 (WGS 84).

The latitude and longitude coordinates for each point were expressed in decimal degrees (DD). The location for each point are plotted on a base map to show the location of the surveyed water points. The location map of the water points surveyed is shown in Figure 13 below.

The names and coordinates of the 47 water points have been appended in **Appendix 2 - List of Water Points and Communities Visited.**

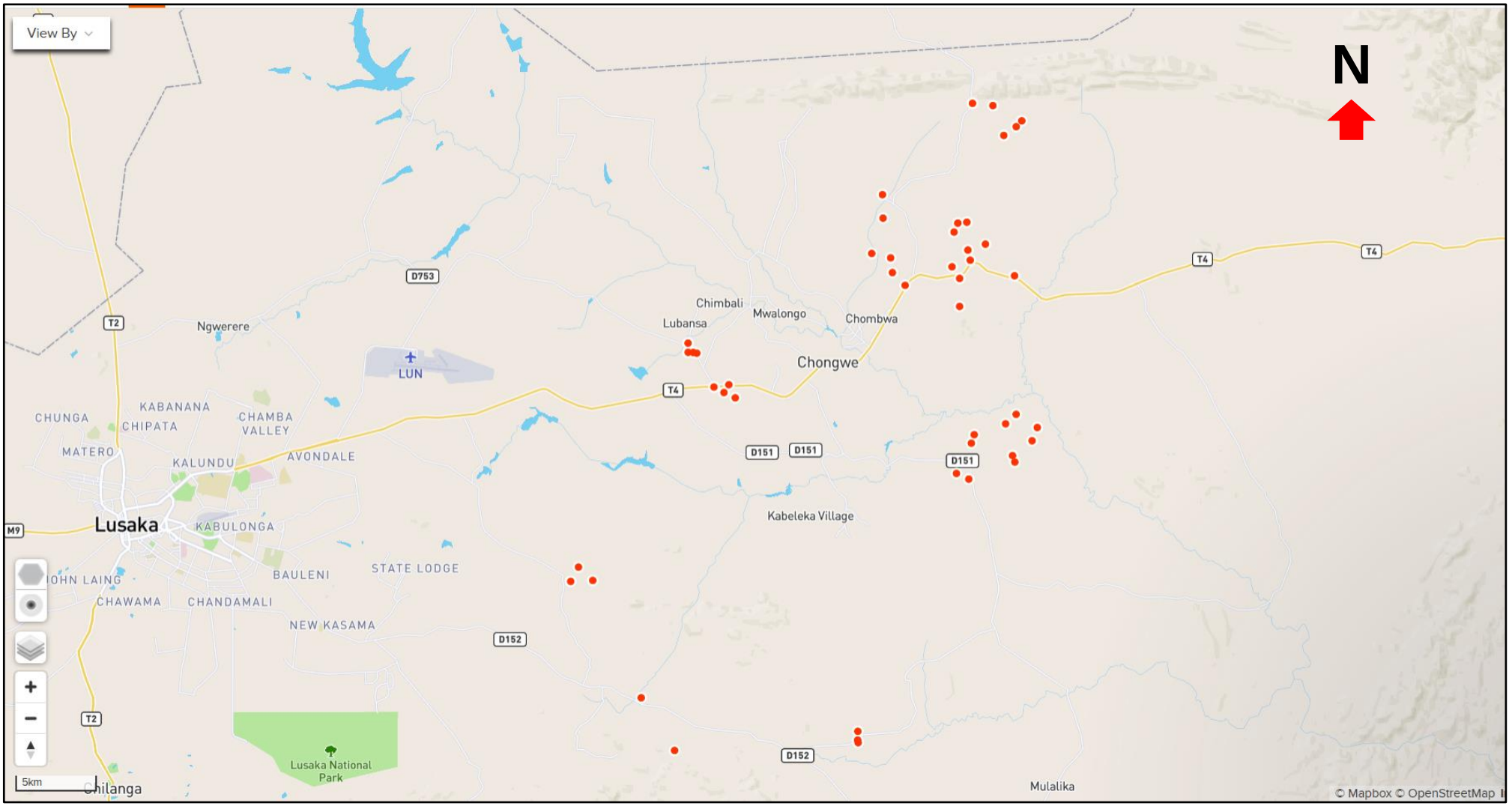


Figure 13: Map of Chongwe – Showing surveyed water points.

5.1.2 Status of the community hand pumps surveyed

The hand pumps that were surveyed communal hand pumps that were installed more than two years old. The findings showed that 36% of the boreholes were constructed before 2009, 30% were constructed between 2009 and 2012; and 32% were constructed between 2013 and 2015 as shown in Figure 14 below.

These findings show that 98% communities serviced by the boreholes installed in the rural areas that was surveyed should have been sensitised to sustain rural water using the principles of the SOMAP model.

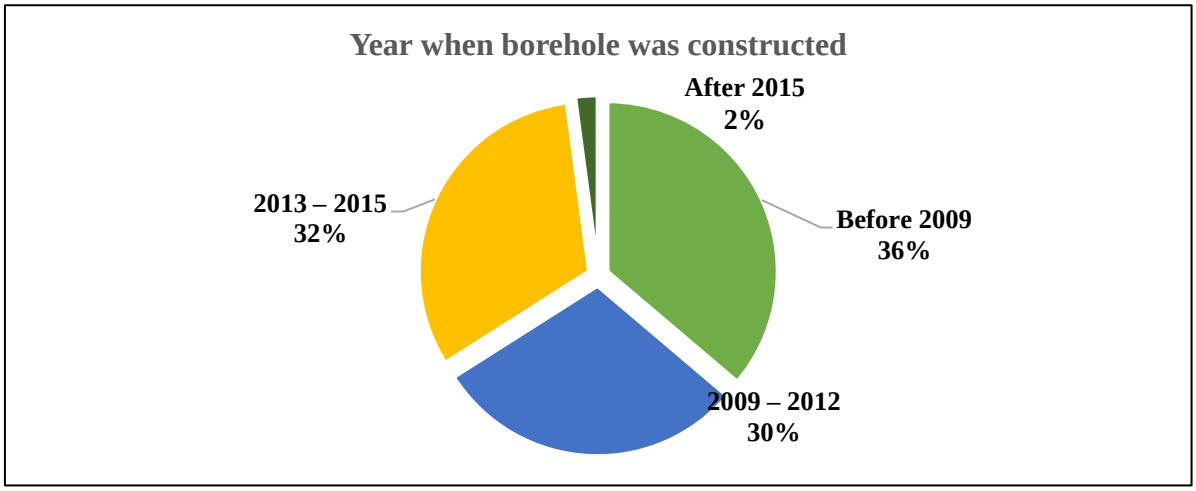


Figure 14: Year when borehole was constructed

Since these hand pumps are more than two years old, some have been rehabilitated to continue being operational and providing water supply to the communities.

The definition of rehabilitation according to rural water supply literature (RWSS, 2010 p. 5) is the correction of major defects and replacement of equipment to enable the facility to function as originally intended. Repair is the restoration of a defective component to return the facility to acceptable working condition. The cost of the repair should be up to K500.00 and should be borne by the community.

Rehabilitation involves works on the hand pump that would amount to more than K500.00.

The findings on number of hand pumps rehabilitated was 30% of the boreholes installed in the survey area were rehabilitated as shown in Table 10 below.

Table 10. Rehabilitated hand pumps on site

Description	Frequency	Percent	Cumulative Percent
Rehabilitated hand pumps	14	29.8	30.4
Hand pumps NOT rehabilitated	32	68.1	100.0
Total	46	97.9	
Missing from System	1	2.1	
Total	**47**	**100.0**	

The rehabilitated works were conducted over a period. The findings showed that 15% in the surveyed hand pumps were rehabilitated in the period from 2013 to 2015. The other findings are shown in Figure 15 below.

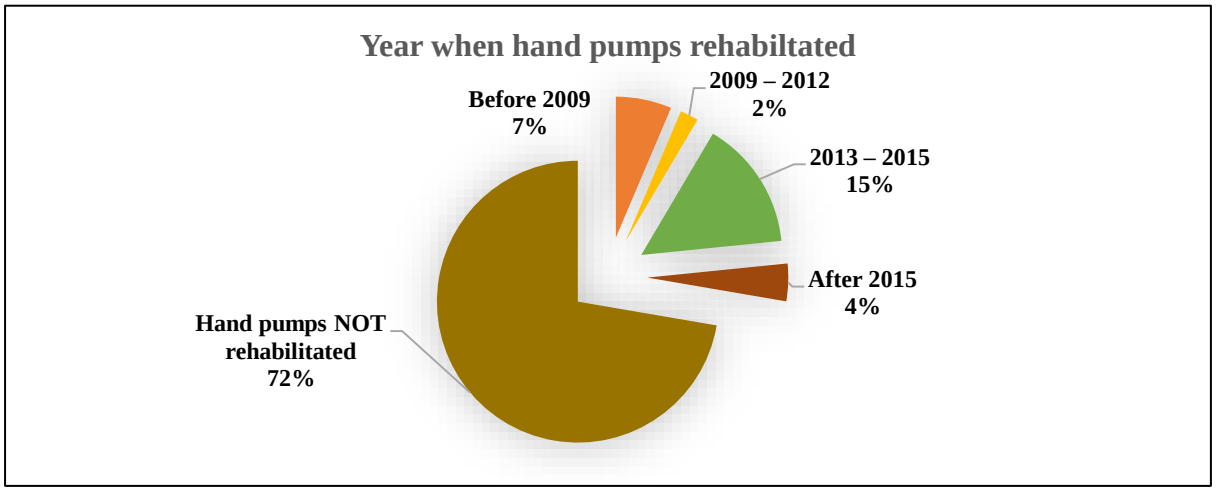


Figure 15: Year when hand pumps rehabilitated

Most of the hand pumps were rehabilitated through the RWSS projects undertaken by the government through the Local Authority. The other organisations that have been involved in the rehabilitation of hand pumps are World Vision, DAPP / HITACHI, Child Fund and some individuals.

5.1.2.1 Community capital cost contributions

Community capital cost contribution of the construction of the boreholes is not a well-rooted practice of construction of hand pumps in the communities. This is a called demand driven project where the community expresses their desire for the project. For boreholes equipped with hand pumps, the community members are required to pay K1, 500.00 as cost contribution towards the capital cost of the hand pump. During the survey, the communities that contributed

towards the capital cost of the borehole were easily identified. Without indicating the amount to be contributed, the community without asking the amounts required, the amount of K1, 500.00 was spontaneously, mention.

The findings showed that 43.5% of the water points surveyed made community capital cost contributions towards the construction of the boreholes while 56.5% of the water points did not have capital cost contributions as shown in Table 11 below.

Table 11. Community capital contribution towards construction of hand pumps

Description	Frequency	Percent	Valid Percent	Cumulative Percent
Community paid capital cost contribution	20	42.6	43.5	43.5
Community NOT paid capital cost contribution	26	55.3	56.5	100.0
Total	46	97.9	100.0	
System	1	2.1		
Total	47	100.0		

5.1.2.2 Repair works of the hand pumps

After the hand pump is installed, with passage of time, the hand pump need to be repaired. The repairing may not be necessary where the facility is serviced regularly. The findings with regard to repair works of the hand pumps showed that 80% of the surveyed boreholes were repaired whereas 20% have not been repaired at all as shown in Table 12 below:

Table 12. Hand pump repairs

Description		Frequency	Percent	Valid Percent	Cumulative Percent
Hand pump repaired before		36	76.6	80.0	80.0
Hand pump NOT repaired before		9	19.1	20.0	100.0
Total		45	95.7	100.0	
Missing	System	2	4.3		
Total		47	100.0		

For the repairs undertaken on the hand pumps, the findings showed that 56% were repaired in 2017, 22% were repaired in 2016 and the other 22% were repaired in 2015 as shown in Figure 16 below.

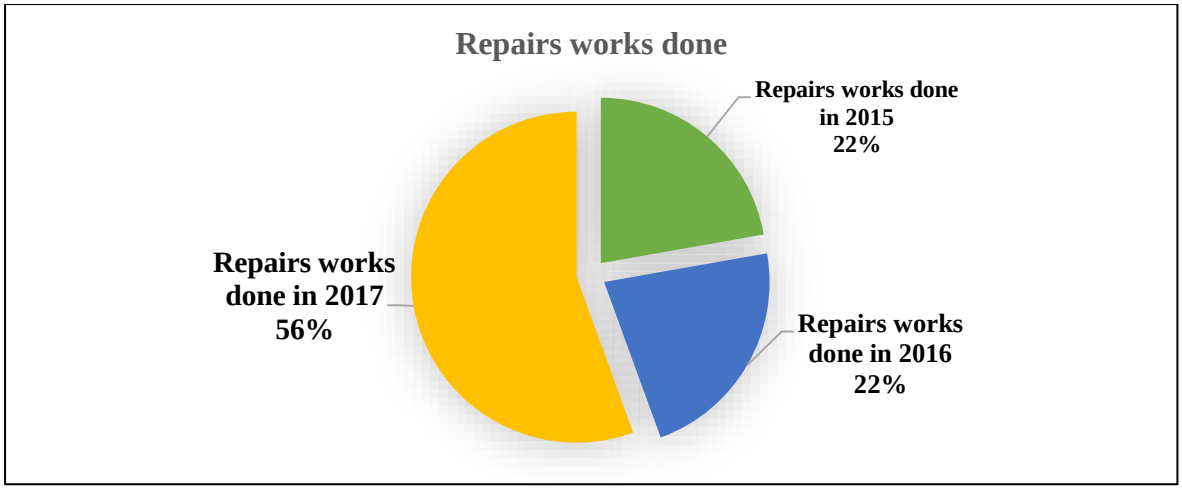


Figure 16: Repairs works done

The most common repair works on the hand pumps involved the pipes and rubbers in the cylinders. The least part on the hand pump to be replaced are the bearings and chains.

5.1.2.3 Complete breakdown of hand pump before repair

The hand pumps tend to breakdown every so often and have to be repaired. When there is regular servicing of the hand pumps it is possible to notice the hand pump about to break before it completely breaks down. During the study if was found that 57% of the hand pumps surveyed completely broke down before they were repaired. The other 26% of the hand pumps did not completely breakdown before they were repaired. These hand pumps were repaired before they broke down and stopped working as shown in Table 13 below.

Table 13. Hand pump completely stop working before the repair

Description		Frequency	Percent	Valid Percent	Cumulative Percent
Hand pump completely stop working		27	57.4	69.2	69.2
Hand pump NOT completely stop working		12	25.5	30.8	100.0
Total		39	83.0	100.0	
Missing	System	8	17.0		
Total		47	100.0		

For the hand pumps that broke down, 25% of the hand pumps had less than one week of down time. 36% had down time of between two weeks and four weeks and 39% take more than four weeks down time as shown in Figure 17 below.

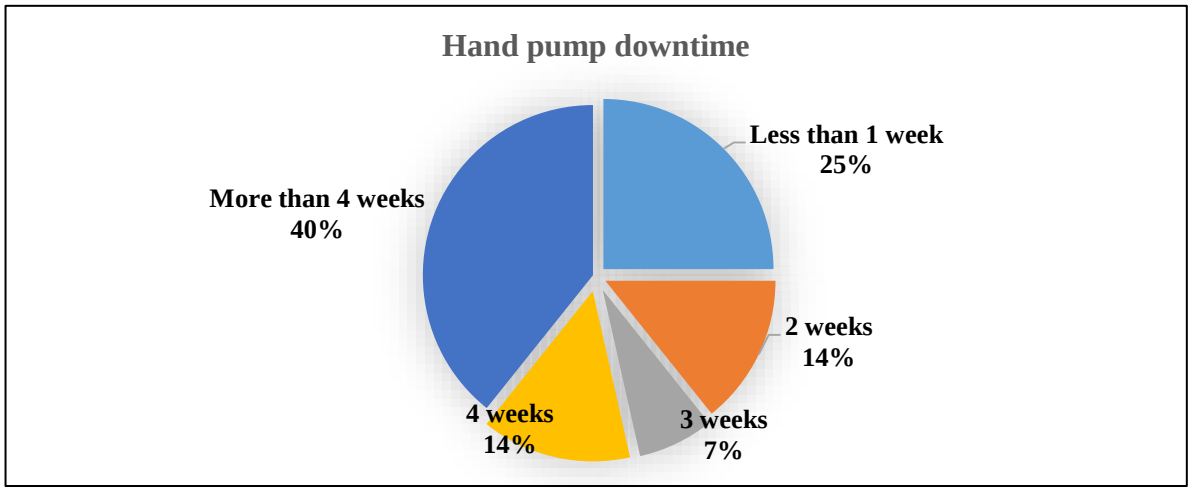


Figure 17: Hand pumps downtime

5.1.2.4 Hand pump Functionality

The survey looked at the functionality of the hand pumps at the time of the survey. Almost all the hand pumps surveyed were working; the finding was 94% that were operational and 6% were not operational. This is not the rate of non-functional hand pumps in the district as the objective of this research was not to come with the rate of non-functional hand pumps. Part of the objective of the survey was to see how the community are sustaining the hand pumps that is to keep the pumps operational. The findings of the operational hand pumps on site are shown in Table 14 below.

Table 14. Operational hand pumps on site

Description	Frequency	Percent	Valid Percent	Cumulative Percent
Operational hand pumps on site	44	93.6	93.6	93.6
NOT operational hand pumps on site	3	6.4	6.4	100.0
Total	47	100.0	100.0	

To check the functionality of the hand pumps, the research verified on how soon the water re-starts pouring out after a pose of 10 minutes on the hand pumps that were functioning.

Of the hand pumps that were operational, 56% of the hand pumps water flowed at the first stroke of resumed pumping of the hand pump. This means that the water line of the rising pipe was water tight and not leaking. On the other extreme, 28% of the hand pumps, though are

mentioned to be operational it took more than 11 strokes of pump before water commenced flowing out of the hand pump. This indicated that water was leaking out of the rising pipe through the foot valve or leaking pipes. The rest of the findings are shown in the Figure 18 below.

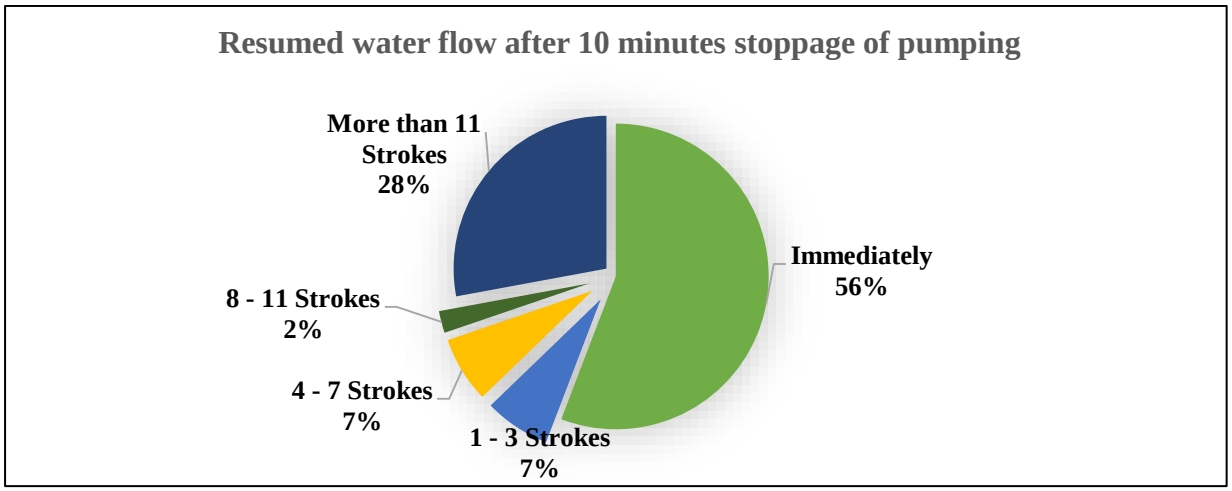


Figure 18: Resumed water flow after 10 minutes stoppage of pumping

With this demonstration, functional hand pumps are those that are operational with watertight line of the rising main pipe.

5.1.2.5 Application of Grease on the hand pumps

Although the hand pumps were functional, it was mentioned that these were also being serviced. The researcher used the presence of greasing of the chain on the hand pump as indicator of the hand pump being serviced.

The finding of the grease on the hand pump chain was found out through the inspection of the chain after opening the hand pump cover. 85% of all the hand pumps were surveyed and inspected were never greased. This shows that there is no servicing of the hand pumps in the communities. Only 15% of the hand pumps had grease applied to the chain. This finding is shown in Figure 19 below.

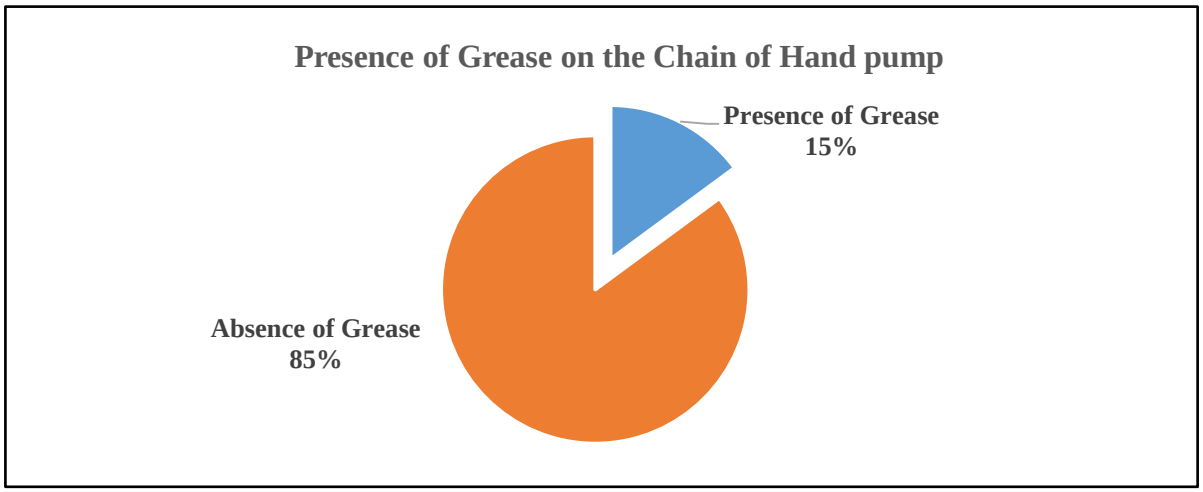


Figure 19: Presence of Grease on the Chain of Hand pump

Picture 3: Applying grease to chain on hand pump at Nkomeshya Village, Chongwe

Picture taken by Javan Nkhosi. Dec 2017

5.1.2.6 Water Availability and Usage

The survey reviewed the availability of water from the hand pumps with regard to reliability of the water supply throughout the year. The research finding on this was that 89% of the boreholes were reliable as the water was available throughout the year, in both the dry and rainy season and 11% was unreliable due to low water table in the dry season.

The findings of the availability of water from the borehole in a year is shown in Figure 20 below.

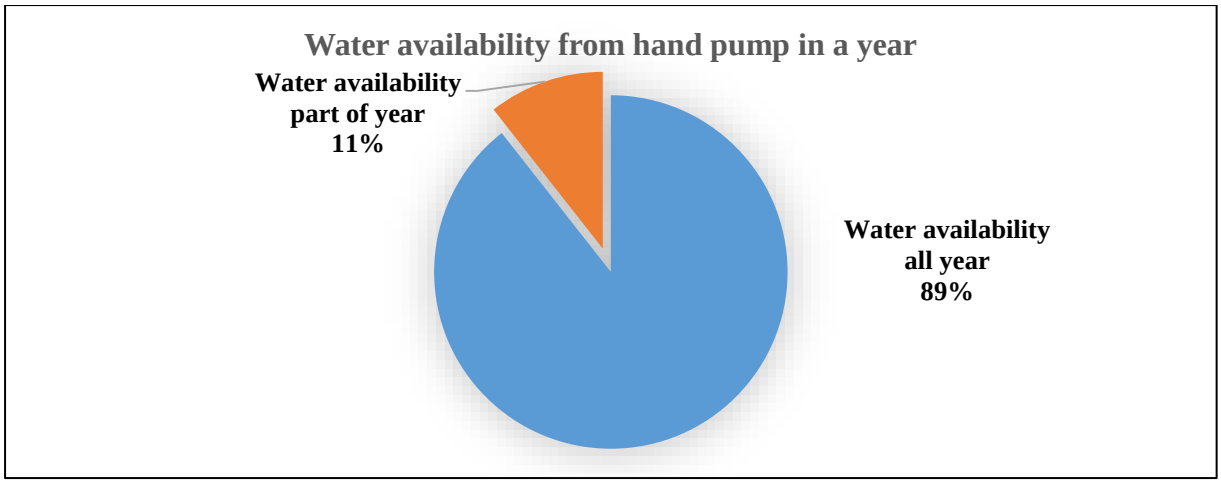


Figure 20: Water availability from hand pump in a year

The available water supply also met the water demand in the serviced communities around the borehole throughout the year. The water from the hand pump is primarily used for household daily chores of drinking, cooking, washing and bathing in the households.

The finding of 94% of the communities indicated that water from the boreholes are used for the daily chores. Where the borehole water is not used for the daily household chores, it indicates that the borehole could have been disused for a long time and would require to be flushed and disinfected and re-commissioned for use. The findings are shown in Table 15 below.

Table 15. Water use from the water from borehole

Use of borehole water	Frequency	Percent	Valid Percent	Cumulative Percent
Drinking, cooking, washing and bathing	44	93.6	93.6	93.6
Other	3	6.4	6.4	100.0
Total	47	100.0	100.0	

5.1.2.7 Alternative sources of water supply in communities

On the alternative sources of water supply apart from the hand pumps described in the target communities. More than 77% of the boreholes described had other substitute water sources. 23% of the hand pumps did not have other water sources within vicinity.

The challenge with the single water sources in case of hand pump failure is that the community is in dire water stress; on the other hand, the lack of alternative water source is a catalyst that gives the impetus on the community to sustain the only available water point in the community. The findings on the alternative water supply sources given in Table 16 below.

Table 16. Alternative source for water supply

Water Sources		Frequency	Percent	Valid Percent	Cumulative Percent
Presence of other water sources		34	72.3	77.3	77.3
Lack of other water sources		10	21.3	22.7	100.0
Total		44	93.6	100.0	
Missing	System	3	6.4		
Total		47	100.0		

5.1.2.8 Water Quality from Hand pump

The research also surveyed the community's perception of the quality of water from the hand pumps. The findings showed that 66% of the water from the hand pumps was good and were happy with it. From 34% of the hand pumps, people felt that the water quality was not good as shown in Figure 21 below.

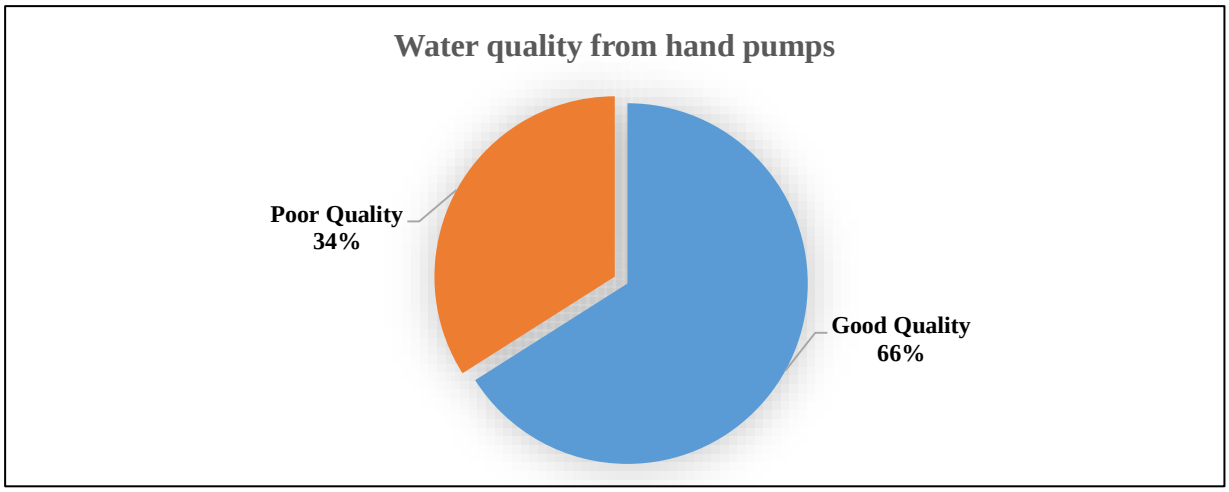


Figure 21: Water quality from hand pumps

The reasons given by the community as possible reason for the water from the 34% of the hand pumps surveyed as not being good was primarily the issue of rusty smell from the water. IN the mornings when one is first early in the morning to draw water, the water is of brownish colour. One has to pump continuously until the water clears off to draw clear water.

The other problem from the rusty water is that it discolours the inside of the water container with a reddish-brown colour. When cooking *nsima*, the staple food made from white mealie meal turns to light brown after cooking and served at table, it makes it less palatable. The white clothes are dis-coloured after using water from the hand pump with high iron content in the water. One of the visual indicators on the hand pumps with high iron content water is the

discolouring of the hand pump pedestal and the concrete apron with a reddish-brown stain. As shown in Picture 4 below

Picture 4: Rust stained pedestal and concrete apron at Shanyanga Village, Chongwe
Picture taken by Javan Nkhosi. December 2017

The main problem with rural water is the rust or the amount of iron content in the water, which is identified as rust among the rural community.

The communities complained of poor quality water, the findings showed that 32% pointed out-rightly that the problem was rust in the water, the other 8.5% said it was rust but with other problems. The findings are shown in Figure 22 below.

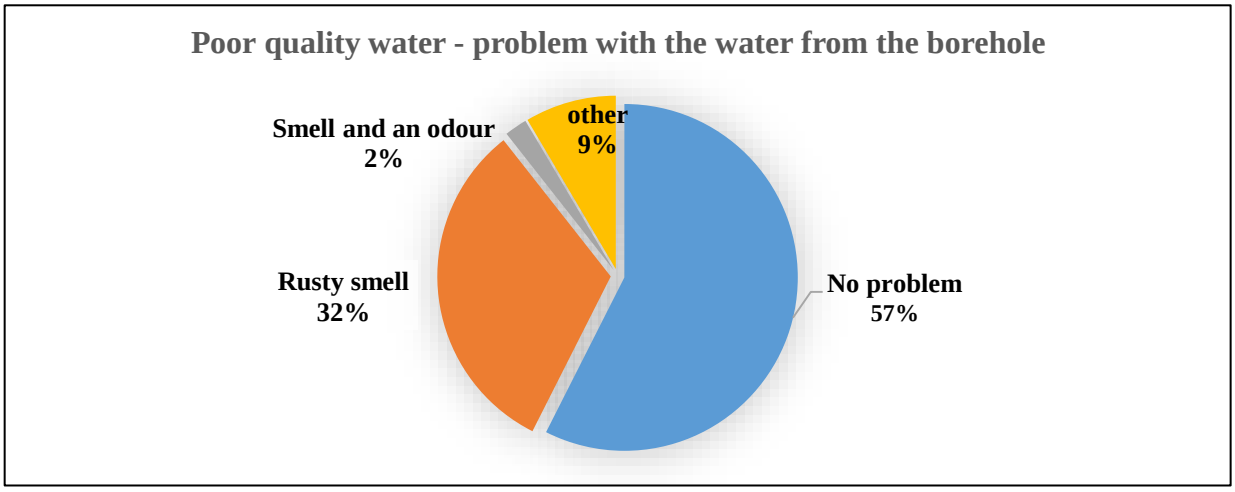


Figure 22: Poor quality water - problem with the water from the borehole

The link between the Ministry of Health and the Ministry of Water Development, Sanitation and Environmental Protection as regards to rural water supply at community level is the work of the Environmental Health Technicians (EHTs) based at Rural Health Centres in the community who oversees water supply and sanitation. The research found out the frequency that the EHTs visit the communal water points in the catchment areas was erratic or rare.

A research question was posed on whether the EHTs visit the community water points and collect water samples from the hand pumps in the catchment areas for analysis. The research findings were that in 28% cases, the EHTs visit the hand pumps to collect water samples in the communities for analysis.

The water points visited were mostly the high population areas such as the primary schools or markets and these were sites nearest to the Rural Health Centres. In 72%, incidences showed that the EHTs do not visit the water points in the rural communities not collect water samples as shown in Figure 23 below

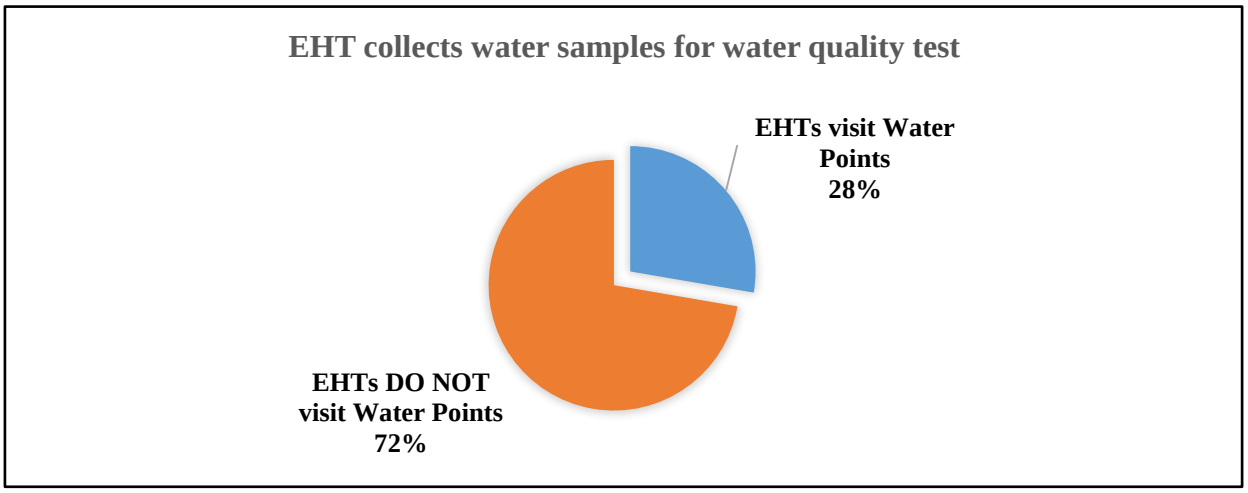


Figure 23: EHT collects water samples for water quality test

The frequency of the EHTs visits to the sites that indicated EHT's visit to collect water samples for analysis, the findings showed that 58% are visited once and 42% are visited twice in a year.

5.1.3 Communities' contributions towards operation and maintenance

According to the first principle of the SOMAP model for sustaining rural water supply, the community are required to contribute 100% towards operation and maintenance of the hand pumps that they use in the communities. The research question was to find out whether the communities contribute towards operation and maintenance of the hand pumps on site in full.

The findings were that 64% contributed for the one-off contribution when the hand pump had broken down needed to be repaired. This contribution was a one off contribution and not on a regular basis to sustain the hand pump on site. The community contribute as a crisis management measures to have the water point operational due to the water stress in the community.

With regard to regular cost contributions towards operation and maintenance, to set aside funds at community level, only 28% made regular payments. These findings were mostly common for the communities at primary schools and in some incidences the communities supported by World Vision. Otherwise, the rest of 72% of the communities did not make regular contributions towards the operation and maintenance of hand pumps on site as can be seen from Figure 24 below.

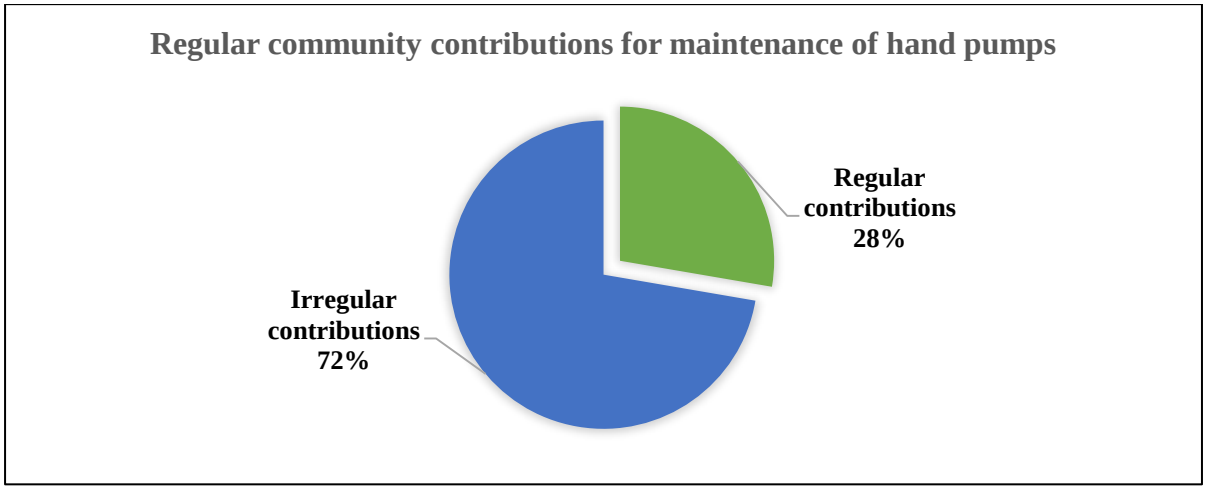


Figure 24: Regular community contributions for maintenance of hand pumps

For the communities that regularly make contributions towards the cost of operation and maintenance of hand pumps 40% indicated that the treasurer of the water committee collects the community contributions and is kept at community level in the house of the treasurer.

In few instances of 4% of the communities indicate that the money is taken to the Bank for safekeeping. These instances were from the schools where the community have school bank accounts to keep the money safe.

There is a high sense of accountability for the funds collected from the community members as 89% of the findings showed that the communities that regularly contribute towards operation and maintenance of the hand pump recorded the received the money received in a notebook.

With regard to the approximate amount of money that the community had raised towards operation and maintenance, the findings showed that 40% of the communities had raised less than K100.00 towards operation and maintenance and 20% had raised more than K500.00 towards operation and maintenance of hand pumps. The rest of the findings are shown in Figure 25 below

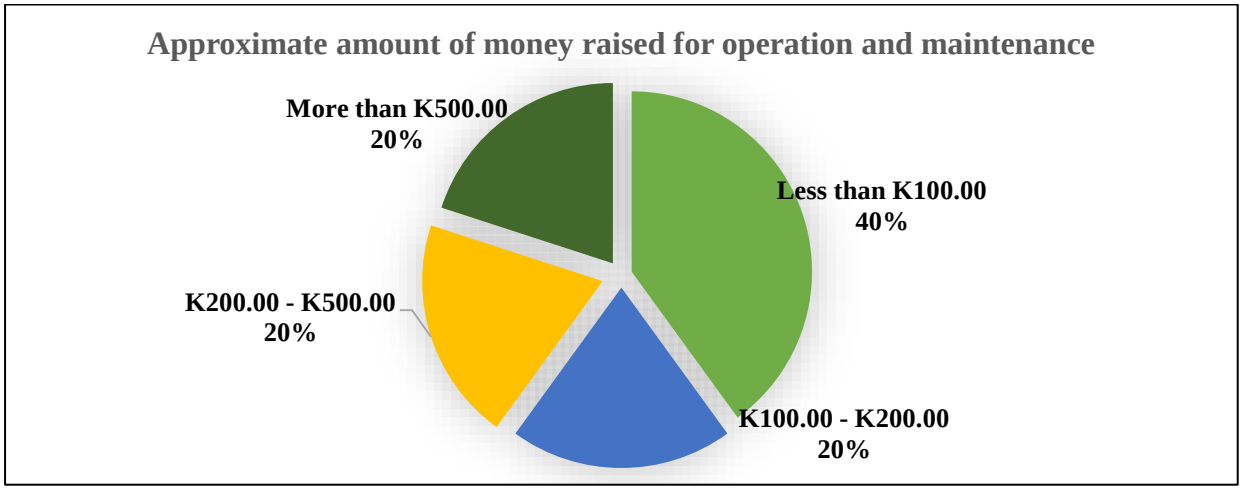


Figure 25: Approximate amount of money raised for operation and maintenance

The money collected is used mostly for payment for transport, labour charge for the APMs and for buying spare parts for the hand pumps.

The most common amount of money as monthly contributions per household in the rural communities is K5.00. This accounts only for 25% of the communities surveyed as shown in Figure 26 below.

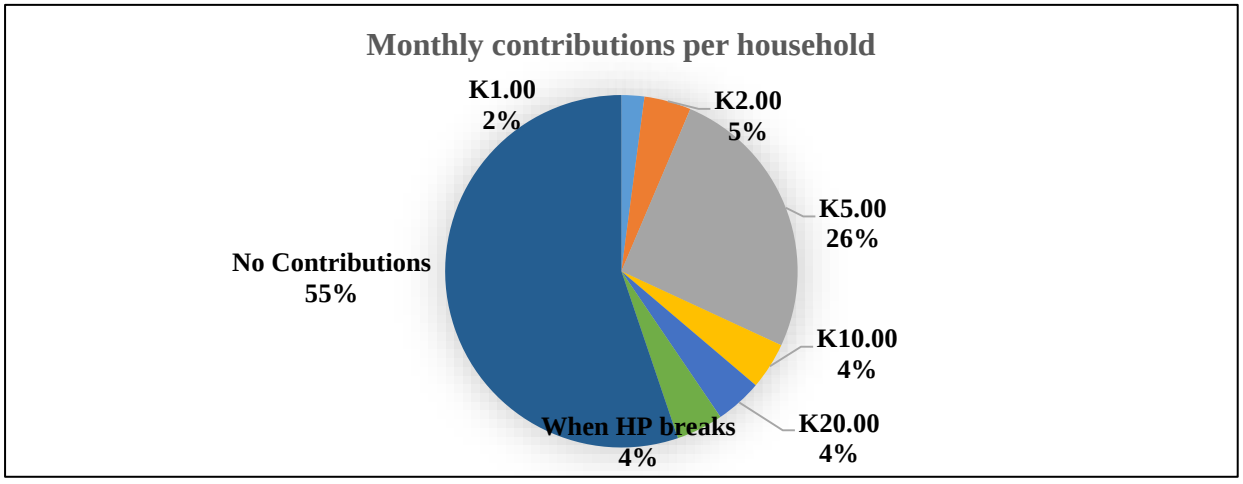


Figure 26: Monthly contributions per household

The findings also showed that those that paid a monthly payment of K5.00 per household accounted for less than 9% of the population surveyed.

The communities in the rural areas are generally peasant farmers and may not regularly have cash on them. A research question was whether the communities could allow payment in kind and not cash towards operation and maintenance of hand pumps. The findings were that 74% do not allow payment in kind and 26% allowed payment in kind instead of cash payment.

On the research question of engaging in income generating activities to raise money for operation and maintenance, the finding were that 95% of the respondents did not engage income generating activities to raise money for operation and maintenance of hand pumps.

5.1.4 Sustainable spare parts supply chain

Chongwe Municipal Council established a spares shop in a container to stock up hand pump spare parts in September 2014 with support from the Ministry of Local Government and Housing then, but now Ministry of Water Development, Sanitation and Environmental Protection. The purpose of the spares container was to reduce the down time of the hand pumps in the communities there by sustaining rural water supply in the communities.

Under the SOMAP model, in order to sustain rural water supply, the Local Authority shall establish a spares shop and stock with seed stock. The stock shall be sold out as a revolving fund to re-order fresh stock when it is depleted.

As the SOMAP spares shop has been operational now for three years and the hand pumps surveyed would have required maintenance, the research inquired on the community's response to the spares shop. The research question was on whether the community knew about the hand pumps spares container at Chongwe Municipal Council and what benefit there has been from the operation of the spares shop in the district.

The findings on the community's knowledge of the SOMAP hand pump spares shop was at 51% of the community knows about it. The finding are shown in Figure 27 below.

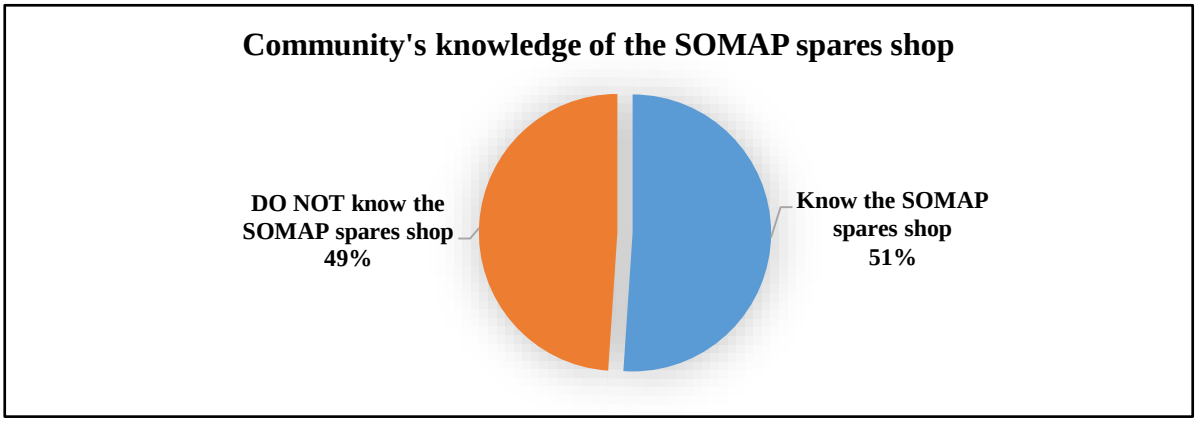


Figure 27: Community's knowledge of the SOMAP spares shop

The findings show that nearly half (49%) of the population in the rural area of Chongwe do not know about the existence of the SOMAP spares shop.

The rural community came know about the SOMAP spare shop through the work of the area pump minders that repair the hand pumps. The findings showed that 26% of community members knew about the SOMAP spares shop through the area pump minders, 2% knew about the SOMAP spares shop over Chongwe Community radio and another 2% knew the SOMAP shop through the Councillors.

The last 11% of the communities knew about the SOMAP spares shop through the Water committee Chairperson, Chongwe RWSS staff, during the WASHE training at Chainda, World Vision staff and others have actually seen the SOMAP container in Chongwe.

On the research question of whether this is the source of spare parts, for the repair of the hand pumps. The findings showed that 15% acknowledged to having obtained spare parts from the SOMAP spares shop. 38% responded that they did not obtain spare parts from the SOMAP shop. 45% did not know where the spare parts used on the hand pump were obtained.

Of the 15% that obtained spare parts from the spares shop, only 6% said they found spare parts each time they went to the spares shop for spare parts. The frequencies of communities obtaining spare parts from the spares shop reduced – those who obtained spare parts one time was at 6%, for two times was at 4%, three times was at 4% and more than three times was at 2%.

Since there was little interaction between the SOMAP spares shop and the community, many other research questions were not answered. The research questions that were left out include the operations of the SOMAP shop and the frequency of replenishment of the spare parts stock in the container.

5.1.5 Monitoring and management mechanism

In order to ensure sustainability of the hand pumps, a community-based management should be established for every installed hand pump. The community-based management system ensures that the community contributes funds to pay for the repair of hand pump and to ensure timely repair of the hand pump by calling the area pump minders to come and repair the hand pump.

The research question posed on whether there was a water committee that was formed to oversee the operation and maintenance of the hand pump in the community after the construction of the water point. The findings to this question were that in 85% of all the water points had a water committee elected after construction of the water point as shown in Figure 28 below.

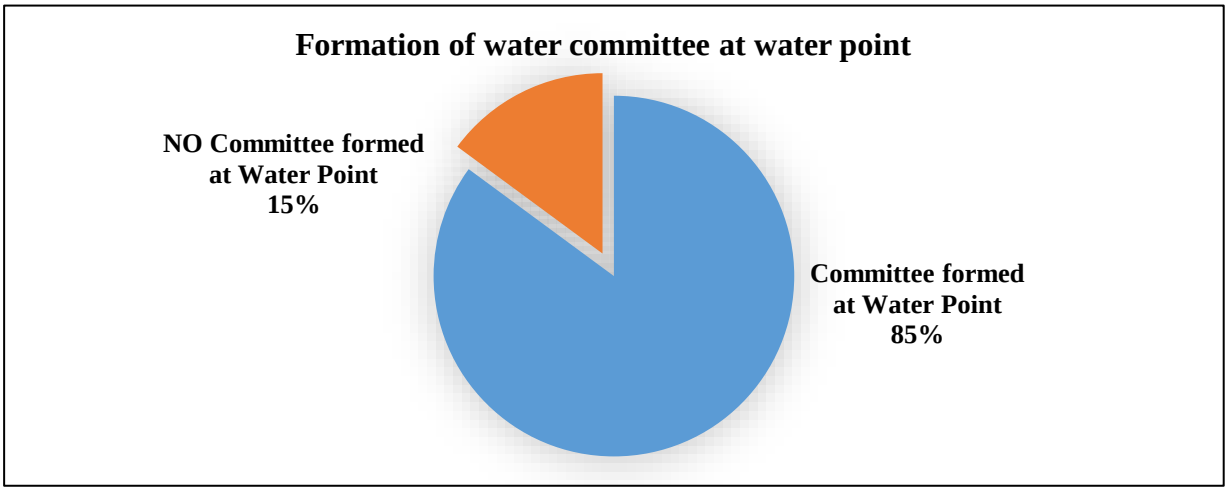


Figure 28: Formation of water committee at water point

After the initial constitution of the water committee on the water point, the water committees lasted only for a short time. The research questions further probed whether the water committees was still active after present time at the water points. The findings showed that 74% of the responses indicated that the water committees were not active, only 26% were active.

The water committee members were selected through an election that was conducted after calling for a public meeting in the villages.

5.1.5.1 V-WASHE Committee Membership

According to the RWSS O&M Implementation Manual and User Guide, the Village WASHE committees is to have a membership of ten (10) committee members (RWSS, 2010, p. 35) with a gender balance is recommended. The research questions reviewed whether the water committees were established according to the recommendations of the RWSS O&M Implementation Manual and User guide.

The findings in the constitution of the V-WASHE committee membership in the communities surveyed were that 57% had committee's membership of 10 members, and 24% had committees of membership of five members as shown in Figure 29 below.

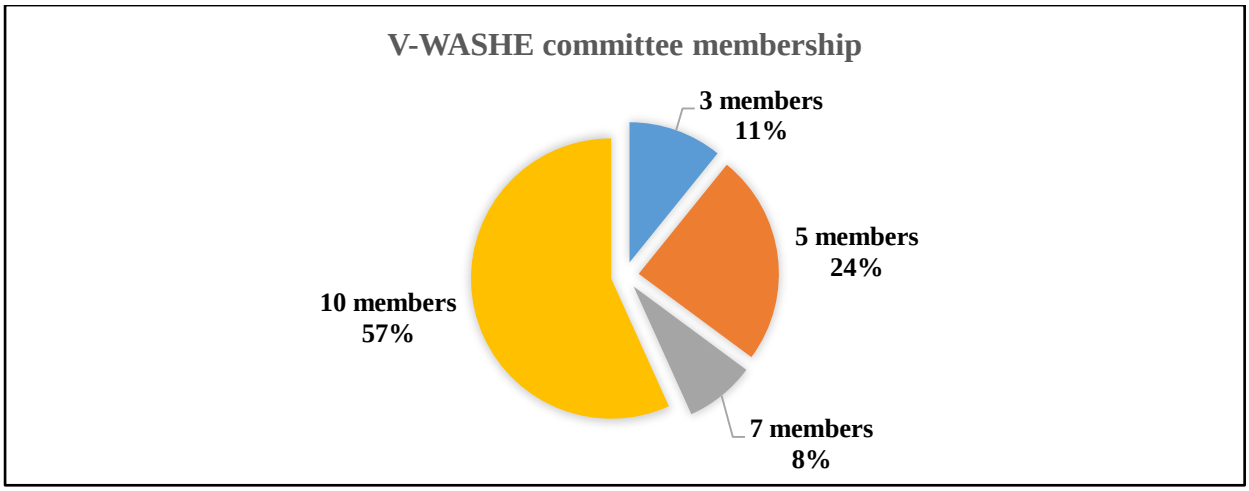


Figure 29: V-WASHE committee membership

The finding on the gender balance of women in the V-WASHE committee membership was 62% of the committees had five women in the V-WASHE committee, and 33% of the V-WASHE committee had three members and less the number of women in the committees.

In the V-WASHE committee at community level, one of the most important committee member is the caretaker who is supposed to regularly check on the operation of the hand pump, undertakes periodic maintenance on the hand pump and to reports any faults found to the rest of the V-WASHE committee members and to report to the area pump minder. The caretaker is a very important person as he or she ensures the sustainability of the hand pump. The research question enquired whether there was a caretaker in the V-WASHE committee at the surveyed water point.

The findings on caretakers were that 48% of the water committees had caretakers and 52% of the V-WASHE committees did not have caretakers.

5.1.5.2 Area Pump Minders within vicinity of villages

The area pump minders (APMs) are the key cadres in sustainability of rural water supply. The Ministry of Water Development, Sanitation and Environmental Protection trained APMs to repair hand pumps in the villages. The trained APMs were not provided with toolkits for repairing the hand pumps. The Ministry provided the toolkits in the Wards and not to each individual water point. The strategy was to store the toolkits at a Government institution – at either a Rural Health Centre or the Government School that is centrally located within the Ward.

When the caretaker from the V-WASHE committee approaches an area pump minder for a repair service, the area pump minder would go to the RHC or the School to pick the toolkit to

use. Upon completion the repair works, the APM would return the toolkit back to where he or she collected the toolkit.

The findings on the availability of the APMs within vicinity of the villages to repair the hand pumps was 89%. In less than 11% of the communities, there were no APMs. The findings are shown in Figure 30 below.

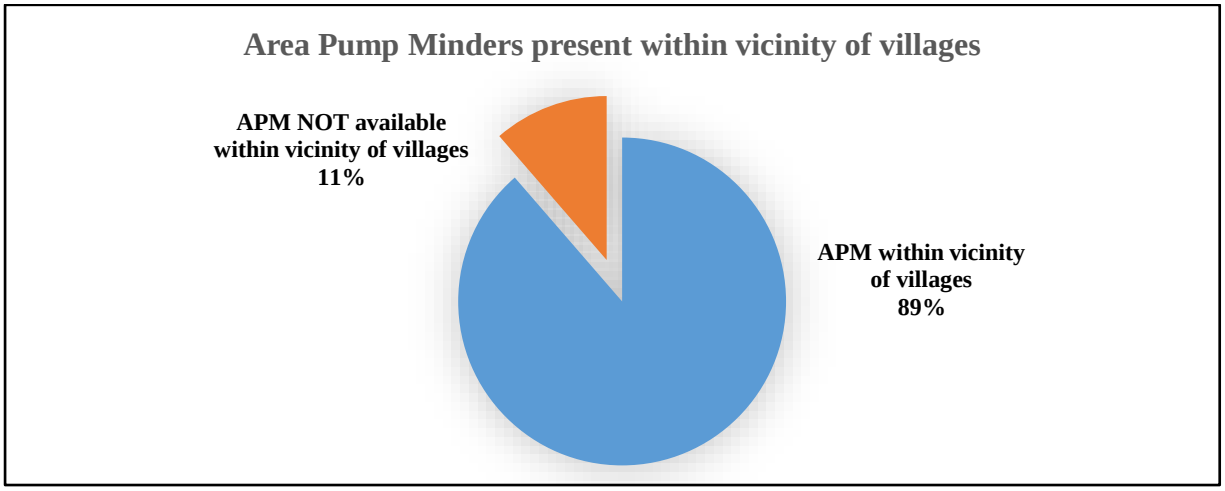


Figure 30: Area Pump Minder present within vicinity of villages

The findings on the research question of APMs owning toolkits were 33% of the APMs owned toolkits and 62% of the APMs did not own the toolkits. Therefore those that did not own toolkits, they got these toolkits either from the RHCs or Schools. In the extreme cases where neither the RHCs nor Schools had, the toolkits the APM would go to the RWSS unit at Chongwe.

The findings on where the APMs collected the toolkits from, 59% collected from the RHCs, 27% from the RWSS unit at Chongwe and 14% from the Schools.

There are two sets of toolkits used for the repair of hand pumps. The two set of toolkits are the standard toolkit and special toolkits. The two toolkits are shown in Figure 31 below.

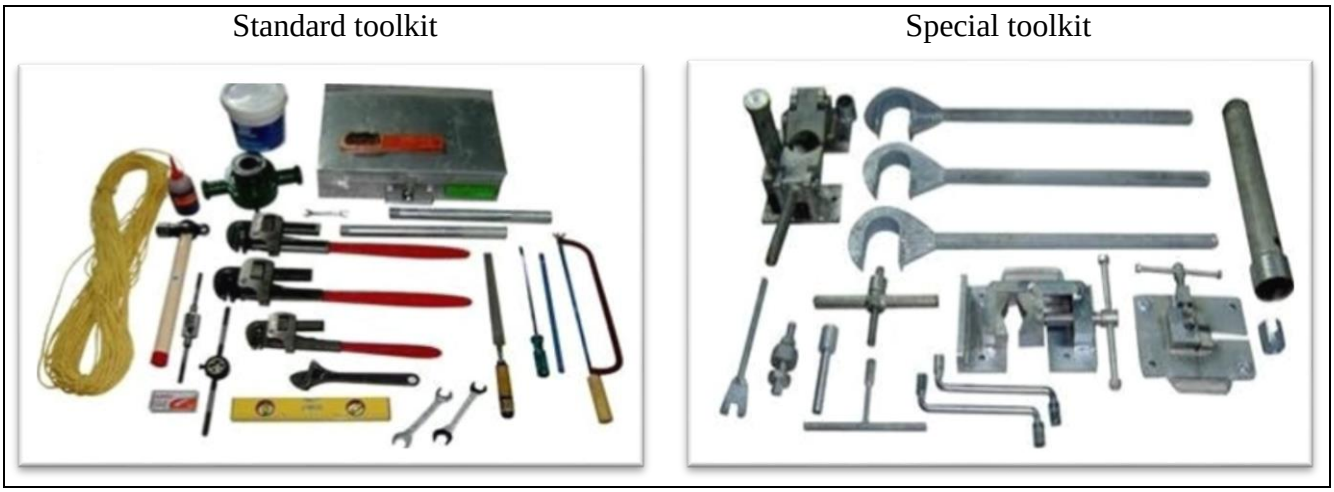


Figure 31: India Mark II toolkits

Source: RWSS O&M Implementation Manual and User Guide, 2010 p. 78

The standard toolkit is used to repair the upper parts of the hand pumps and the initial installation of the hand pump. The special toolkit is used to remove the below components of the hand pump such as the pipes, rods and cylinder.

The APMs that repair hand pumps in the communities. For those that repair hand pumps where they also drink from and live in same village, the repair was done as a community service. However, in situations where the APM had to go out of his or her village to repair the hand pump, the APMs were allowed to charge a small fee for the service that they render to the communities in repairing the hand pumps.

Different members view the APMs differently. A research question was posed on how the communities viewed the APMs.

The findings showed that 46% of the communities viewed the APMs as private business individuals, because they charge for the services, 36% view the APMs as community workers and 18% viewed the APMs as volunteers.

The APM minders are be freelance individuals and a question posed on what the community regarded as to whom the APMs were answerable. The findings were diverse. More than 57% did not know to whom the APM were answerable; other respondent said the organisation that trained them for example World Vision was 10.6% or the Headperson in the village 10.6% and RWSS Coordinator at Chongwe 8.5%. The findings are highlighted in Figure 32 below.

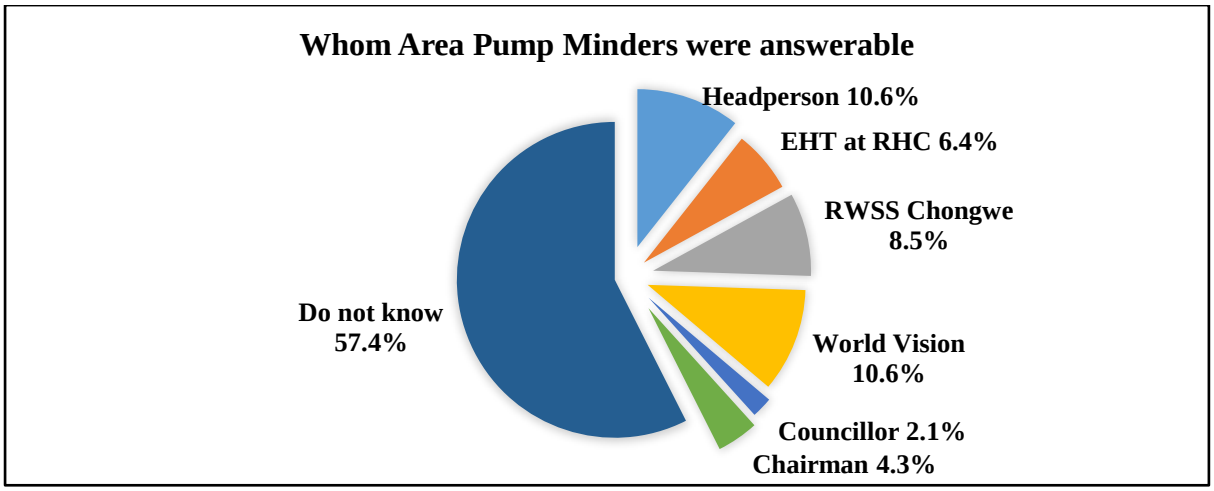


Figure 32: Whom Area Pump Minders were answerable

5.1.6 Adopted Standard Hand Pump

The fourth principle of operation for the SOMAP model is to have a hand pump in the district that have proved itself as one that suits and satisfies the hydro-geological conditions, affordable for capital and recurrent costs, durable and one that is a standardised hand pump through research and development.

This research did not review all the available hand pumps used in Chongwe district, but the hand pumps that were reviewed are those in common use. The district has spares parts in the SOMAP spares shop for those hand pumps that are in common use. The district also trained the area pump minders to repair the most common hand pumps used in the district and for which the community are happy with to use.

The findings on the type of hand pumps used in Chongwe in the surveyed areas were two hand pump types, 85% were the India Mark II hand pumps that uses galvanised iron riser pipes and 15% were the Ghana Modified India Mark II, that uses stainless steel riser pipes as shown in Figure 33 below.

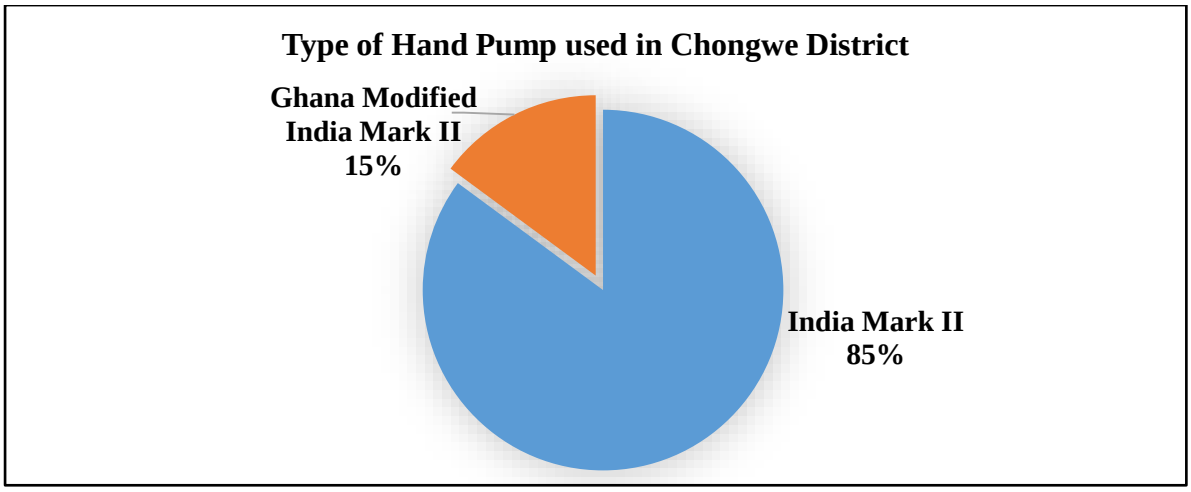


Figure 33: Type of Hand Pump used in Chongwe District

For the two types of hand pumps that are in common use in Chongwe, the SOMAP spares shop stocks the spare parts.

For the India Mark II hand pumps, Chongwe Municipal Council can re-order the spares parts from suppliers that import from the manufacturers. There are many suppliers India Mark II hand pumps in Lusaka. Some of the India Mark II hand pumps may be agents for the manufacturers from India.

For the Ghana Modified India Mark II hand pumps that uses the stainless steel riser pipes, may not have ready suppliers of the spare parts from Lusaka. New arrangements would need to be made with possible suppliers to import into the country the stainless steel pipes and other spare parts from the manufacturers to sustain the Ghana Modified India Mark II hand pumps.

The hand pumps types tend to be used over time as long as there are spare parts available for maintaining and repairing the hand pumps. In a situation where there are no available spare parts for the particular hand pump or if the hand pump type becomes obsolete or where the hand pump spare parts cannot be sourced locally, the community tend to the hand pump to one for which the spare parts can be easily be sourced.

A research question was asked on whether there has been some hand pump type that had been replaced for possible reason of the pump either being obsolete and could not find spare parts locally in Lusaka. This informs the background that the research question.

The findings on the originality of the hand pump on the borehole site was 91% to be the original type of hand pumps on the sites. In 8% of the cases, the hand pumps had been changed from the original type to the current hand pump on site. The reason for changing the pump type is due to lack of spare parts. The old type of pumps that were obsolete on some borehole sites

were the bellow pumps. Bellow hand pumps are no longer being manufactured and as such, these could not have spare parts locally.

The local area pump minders can repair all the type of hand pumps used in Chongwe District. The trained area pump minders can repair the adopted hand pumps of India Mark II and the Ghana Modified India Mark II. The challenge that has been identified with the Ghana Modified India Mark II hand pump is the thin wall of the stainless steel pipe, which easily are deformed when lifted out of the borehole using the pipe lifters that come with the India Mark II toolkits.

The Ghana Modified India Mark II has good positive characteristics observed during the survey.

Picture 5: Ghana Modified India Mark II hand pump, Chongwe

Picture taken by Javan Nkhosi, December 2017

The positive characteristics that noted during the fieldwork regarding the Ghana Modified India Mark II hand pump were that since most of them were installed in 2012 under the Danish International Development Agency (Danida) Supported Project – Water Sector Programme Support (WSPS) Phase 1 of the National Rural Water Supply and Sanitation Programme (NRWSSP).

The quality of water from the Ghana Modified India Mark II hand pumps had not deteriorated or produced rusty water. The other factor is that the Ghana Modified hand pumps that were installed five years ago, have not been opened or developed any faults, except in some instances that the bearings are slowly giving way. The Ghana Modified India Mark II hand pump in that regard can be described as being very robust hand pump in the rural communities, except for the weak wall stainless steel pipes.

Although there are two types of hand pumps that can be regarded as adopted standard hand pump have been adopted, yet India Mark II hand pump is facing some challenges, as it produces water that is not palatable to communities.

India Mark II hand pumps with galvanised iron pipes tend to produce rusty water, the communities complained of rusty water when the water was left over night or when one is first in the morning to draw water from the hand pump.

Ghana Modified India Mark II hand pumps with stainless steel pipes do not produce rusty water.

The findings of the hand pumps with challenges to the communities was 38% and those hand pumps without community complaints against the hand pumps was 62% as shown in Figure 34 below.

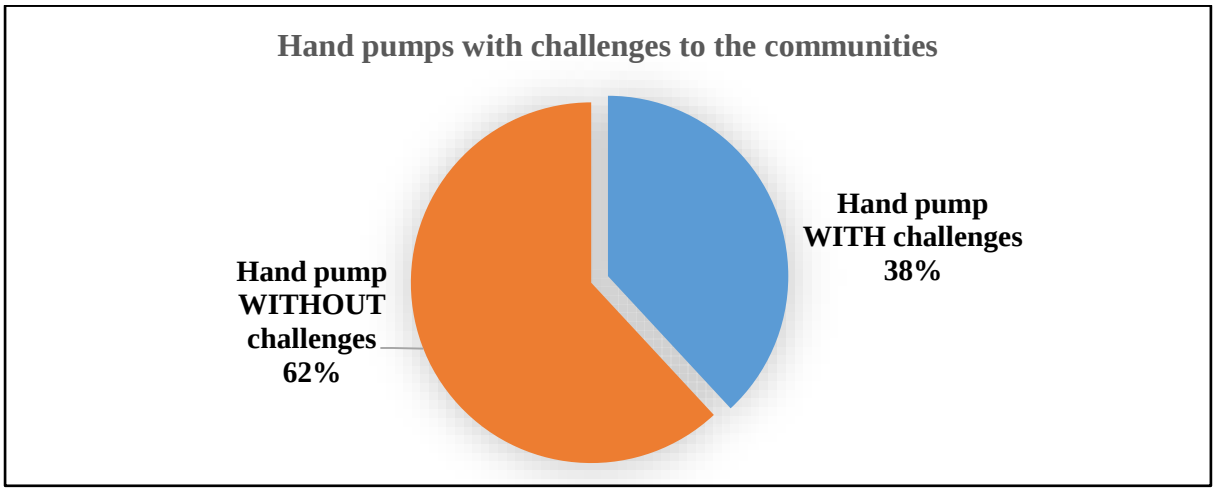


Figure 34: Hand pumps with challenges to the communities

The challenges that the communities complained about rusty water (23%) and the hand pump being too hard (2%) when pumping the water. The borehole that was drilled in a hilly terrain had the water table was very low and it was difficult to pump water. Other community members (2%) complained of the hand pumps that easily breakdown.

The other boreholes (2%) were drilled in a stream channel. During the rainy season, the borehole sites were flooded. The hand pump had a raised and narrow apron for one to stand on.

5.1.7 Capacity Building

In order to ensure that the community-based management know how to sustain the operation and maintenance of hand pumps, there is need to build capacity of the community members on what needs to be done. Generally, there is a tendency to enjoy the benefits of a nicely operating

hand pump without realising that there is wear and tear on the hand pump. If the community do not maintain the hand pumps, as it soon becomes difficult to draw water from the hand pump.

Some faults are not noticed from outside the hand pump such as the rising main that has developed holes and water leaks and flows back into the borehole. This is only noticed when one has to pump many strokes before water commences to flow out of the pump.

In order to ensure sustainability, the community as well as the V-WASHE committees need to be sensitised to put some money to aside for the operation and maintenance of hand pumps, to cleaning the hand pump surrounding and to regularly carrying out preventive maintenance on the hand pump in the community.

The findings on community sensitisation for sustaining hand pump showed that 72% of the communities were sensitised to sustain the hand pumps, while 26% of the communities were not, as shown in Figure 35 below.

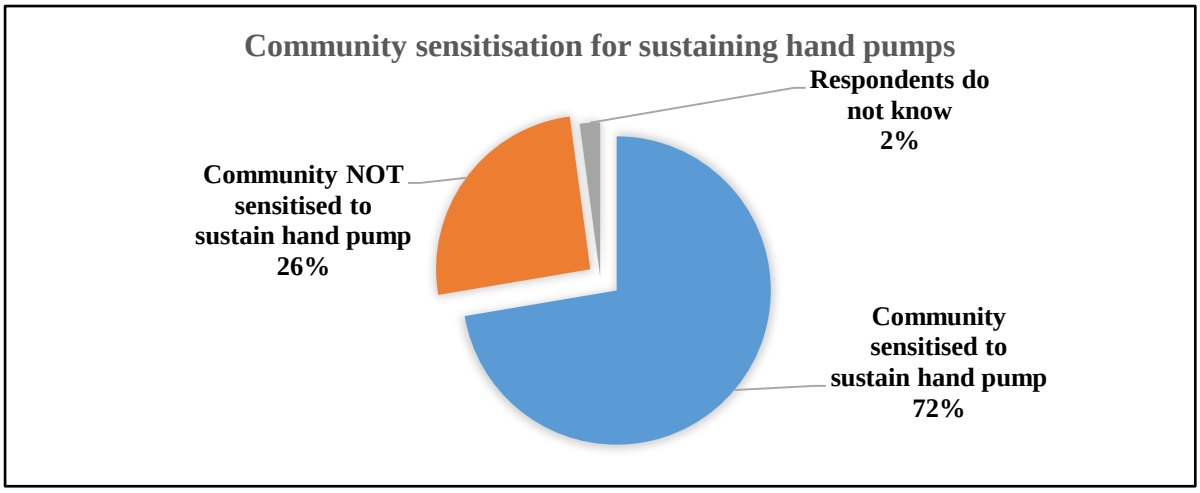


Figure 35: Community sensitisation for sustaining hand pumps

The research question was further asked as to when the communities were sensitised on maintaining the hand pumps. The findings show 32% of the communities were sensitised in 2013 – 2015, another 27% of the communities were sensitised in both 2010 to 2012 and in 2016. In the period before 2009, only 15% were sensitised. These findings are shown in Figure 36 below.

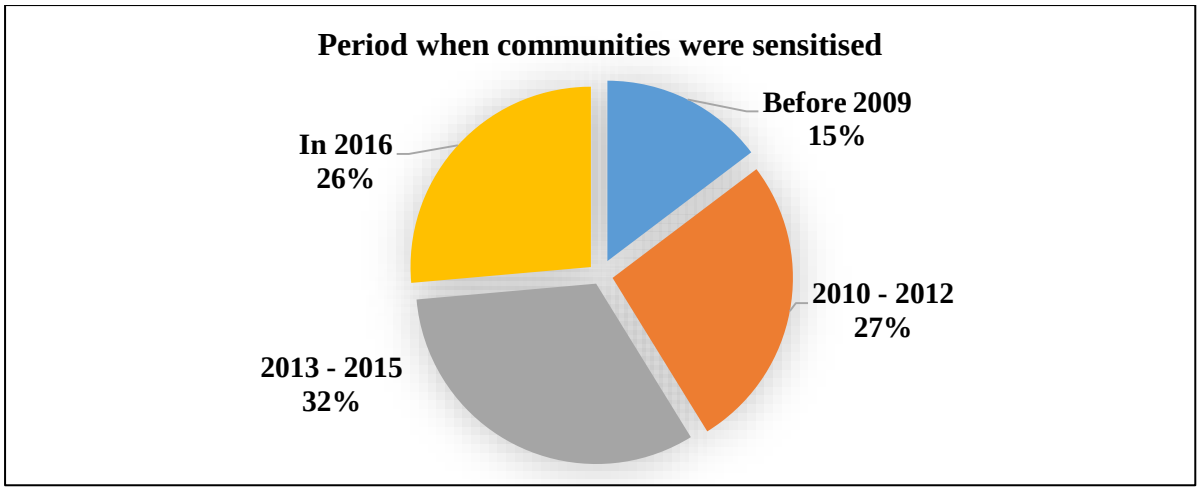


Figure 36: Period when communities were sensitised

The sensitisation was done mainly through public meetings, where the community members were called to a meeting and the project team members would explain on how the hand pumps would be sustained. The findings show that 57% were sensitised through the public meetings, 2% were sensitised through a drama group and 2% are school pupils instructed regularly during school assembly.

The findings also that the people that were involved in sensitising the communities were 30% were the Chongwe RWSS team, 15% were the World Vision team and 30% constituted other groups of people such as the EHTs from the rural health Centres and Chairpersons for the V-WASHE committees.

To verify whether the lessons were well assimilated, the research questions were rephrased for the community members for them to highlight some of the activities that the communities should engage in to sustain the hand pumps in their communities, what they could remember from the lessons.

The findings showed 32% of the community members pointed on the need to contribute towards the cost of repair of hand pumps; 17% pointed out the need to keep the hand pump surroundings clean and 21% gave the response in combination of both cost contribution and cleanliness at the water point.

5.1.7.1 V- WASHE Trainings

The V-WASHE committee is the committee that leads the community-based management as the village level. This committee is composed of ten (10) committee members with different roles and responsibilities. The committee responsibilities include that of the Chairperson, to provide leadership at the water point, the secretary that takes minutes whenever there are

meetings and communicates with other people with regard to the activities of the V-WASHE committee. There is the treasurer that collects, keeps and dispenses community contributions and the caretaker who is the technical hand and oversee the regular preventive maintenance of the hand pump in the community.

Apart from the community sensitisation, the study checked whether the focal group of the community-based management had additional training to oversee the sustainability of the hand pump on site.

The findings showed that 64% of the surveyed communities indicated that the V-WASHE committees were trained, 23% of the V-WASHE committees were not trained and 13% did not know whether the V-WASHE committees were trained. The findings are shown in Figure 37 below.

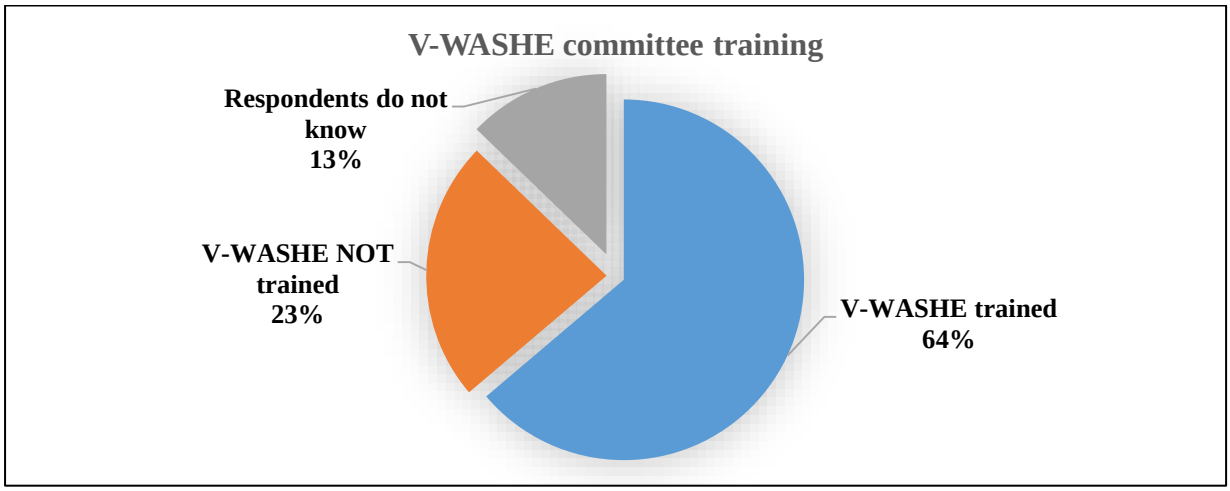


Figure 37: V-WASHE committee training

The research question findings showed that Chongwe RWSS team trained 36% of the V-WASHE committees; World Vision trained the other 15% of the V-WASHE committees and other group of people trained less than 19% while the other 8.5% did not identify the group that trained them.

With regard to providing leadership at the water point, the findings showed that 65% of the respondents indicated that there was someone trained to provide leadership at the water point.

With regard to collection, keeping and disbursing community contributions, the findings showed that 53.5% of the respondents said there were treasurers that were trained.

With regard to technical requirement of preventive maintenance of the hand pumps, the findings showed that 42% of the V-WASHEs had caretakers who were trained as caretakers at the water points.

5.2 Results

The next section after the analysis are the results based on the analysis described earlier in this chapter. The results begin with the established SOMAP hand pump spares shop then followed by the activities of the Area Pump Minders that repair the hand pumps. This information was gather through personal interviews from the district staff and the area pump minders.

Thereafter the section deals with results from the five SOMAP model principles.

5.2.1 SOMAP Hand Pump Spares Shop

The SOMAP hand pump spare part shop was established on 30 September 2014. This was one of the project deliverables of the Danish International Development Agency (Danida) Supported Project – Water Sector Programme Support (WSPS) Phase 2 under the National Rural Water Supply and Sanitation Programme (NRWSSP).

Four members of staff from Chongwe Municipal Council were trained in the daily operation of the SOMAP spare part shop. The training was for three days in shop operation, procurement and replenishment of spare parts. Those trained were the stores assistant, RWSS Coordinator, Director Finance and the cashier.

Of the staff that were originally trained at the inception, two of the staff have been transferred – Director Finance and the Cashier. The staff that work for the SOMAP hand pump spare parts shop have other responsibilities at the council.

The RWSS Coordinator oversees the operation of the spare parts shop and controls the inventory. With the assistance of the Director Finance, the RWSS Coordinator undertakes stocktaking and signs for replenishment of stock in the container.

When the SOMAP spare shop was established, a separate bank account was opened, with independent signatories to the account.

The SOMAP spare parts shop is a twenty feet (20') steel container that has been refurbishes with shelves with a galvanised iron roof to reduce the high temperature.

The SOMAP spare parts container 'shop' is near the Great East Road, with a billboard on the main road pointing to the container. The container is not far from the Council offices, it is easily accessible to both the community members and the Council staff.

5.2.1.1 Operation of SOMAP hand pump spare part shop

When a customer comes for the hand pump spare part, they are first taken to the spare parts container to check the availability and identify the spare part required. Upon verifying the availability of the spare part and the price, the customer goes to pay to the Council cashier and is issued with receipt. The customer goes back to the stores assistant who issues a delivery note and is taken to the container to collect the spare part.

At the time of the survey, the fast moving spares and galvanised iron pipes were exhausted. People do not find the spare parts that they are looking for, especially galvanised iron pipes and rubbers. Since the spare shop started operating, the spare parts stock there has been no replenishment (October 2017).

When the SOMAP hand pump spares shop was established and commenced its operation, it was advertised using fliers, posters and over the radio. These fliers and posters were distributed to the rural communities through the area councillors, the headpersons and the Rural Health Centres.

Picture 6: Chongwe Municipal Council SOMAP spare parts container shop
Picture taken by Javan Nkhosi, Sept. 2017.

5.2.1.2 Spare parts prices

The price list for the spare parts stocked at the container were given to the Area Pump Minders and there is a copy the price list in the container. The community is expected to check the price of the spare parts from the local area pump minders before coming to the District Centre.

The prices on the list are of September 2014. There has not been any price adjustment of the spare parts since the establishment of the spare parts shop. The spares shop has kept the same price for the spare parts for the last three years!

5.2.1.3 Spare parts shop stock

The spare parts shop stocks the spare parts for India Mark II and Ghana Modified India Mark II hand pumps. The initial seed stock in the container came from the WSPS - Danida Supported Programme in 2014. The stock of pipes for the Ghana Modified India Mark II hand pump. The pipes for the Ghana Modified India Mark II are the stainless steel pipes.

The area pump minders complaint against the stainless steel pipes is that the stainless steel pipes have a thin wall and easily deform when lifted using the pipe lifters used for lifting the galvanised iron pipes used on India Mark II hand pumps. The stainless steel pipes are not strong to withstand the sharpness of the pipe lifters.

The initial seed stock of galvanised iron pipes have been exhausted, except for a the stainless steel pipes which seem not to be selling due to these not being strong enough to be lifted with pipe lifters.

As the existing stock has not been replenished before, the SOMAP shop has not established a supply chain with local importers of India Mark II hand pumps, except there are plans for stock taking to replenish the stock.

5.2.1.4 Replenishment of spare stock

The original idea for operating the SOMAP hand pump spare parts shop was to have it run as a revolving fund in using the initial seed stock. The funds raised from the sales of the spare parts were to be used to re-order and replenish more stock. The Local Authority were to order from the open market from the local hand pump suppliers that import India Mark II hand pumps. There were no previous quotations from the suppliers, as the Local Authority had not yet approached any company to supply spare parts for re-sale in the spares shop.

There were no reports or minutes on the activities carried out on the operation of the SOMAP spare parts shop at Chongwe Municipal Council.

5.2.2 Area Pump Minders

The District Water Supply Sanitation Hygiene (D-WASHE) together with the Non-Governmental organisation such as World Vision and Child Fund trained area pump minders in Chongwe District since 2009. There have been some repeated trainings for APMs in the district in the basic repairs of hand pumps. In most cases, the NGO trained APMs worked in the NGO operational areas.

The duration of the trainings was mostly run for five days, with three days devoted to the theory and the other two days being devoted to practical trainings. The size of the group of APMs at a single training session an average of 25 trainees.

During the practical training sessions, the Area Pump Minders (APMs) repaired two or three broken hand pumps. There has been no advanced APM training that has been given to the current APMs in the district. After the training the APMs were given training hand outs

5.2.2.1 APM Operation Activities

After the training, some APMs are very busy, while a large group of them are moderately active in the catchment areas in repairing hand pumps. On average, the very active APMs are called to repair than 20 broken hand pumps per year, whereas those who are less active are called to repair less than 10 hand pumps per year. Most repairs are done in the dry season because the water levels in the boreholes is the lowest.

Those APMs that are less active do not consider their work as APM as a livelihood. The APMs perceive their work as voluntary or as community worker and not as a private businessperson. Most APM do not own any toolkits to repair hand pumps in the communities.

The APMs in the communities said that they are answerable to either the Environmental Health Technicians at the RHCs or the RWSS Coordinator at the District Council offices at Chongwe or to World Vision, who trained them.

The APM that do not own toolkits find tools for repairing hand pumps from the RHCs or schools where the communal toolkits are stored.

5.2.2.2 Common hand pump problems

The most common hand pump problems that the APMs encounter in their operation are rod and pipe disconnections, worn out handles, broken bearings and worn out rubbers in the cylinders.

5.2.2.3 Future APM training topics

If the APMs were given an opportunity to undertake a refresher course, some of the topics that they would like to be incorporated in the curriculum included fishing out hand pumps, making fishing tools, setting the pedestal, construction of concrete aprons and get new technologies on other hand pumps that they have not been trained on.

The other topics to be included were on how to deal with rusty water in boreholes and installation of submersible pumps

5.2.2.4 APM Monitoring and Management

In the wards that have provided with toolkits, the toolkits are kept at the RHC or primary schools. There is no clear policy to make payment for the use of the tools from the tool kit in the communities. For the tools that are kept at the RHCs, the EHTs are the ones that are in-charge of the toolkits.

The APMs have on average less than 10 hand pumps in their catchment areas, but those APMs near Chongwe District Centre have more hand pumps in their catchment areas. The average distance to the furthest water point in the catchment areas is about 10km.

5.2.3 District Level SOMAP Activities

Rural water supply programmes in the district are organised from the office of the Town Clerk. The staff that directly oversees the activities is the RWSS coordinator. In order to understand what is carried out in the district, the Researcher made an appointment with RWSS coordinator with a questionnaire. The RWSS unit is a new establishment with one staff – the RWSS coordinator assisted by a district plumber and area pump minders not on the Council establishment.

The rest of this section is the summary of the responses to the questionnaire and findings.

5.2.4 Community cost contributions

The community pays the full cost towards the operation and maintenance of hand pumps in the communities. The funds are from the sale of crops and livestock that the community raises. There are no programmes from the government specifically institutes to help the communities to raise funds towards operation and maintenance.

The main challenge faced by the communities to raise funds in the catchment areas is poor attitude and the need to have free things that have been

5.2.5 Supply chain of spare parts

The communities in Chongwe mostly obtain hand pump spare parts from the newly established SOMAP spares container, which is reliable. The presence of the spares shop in Chongwe has improved the sustainability of rural water supply. The prices of the spare parts are displayed in the container where the spare parts are stored.

The SOMAP spares shop does not supply all the required spare parts in the District regularly. To improve the operation of there is need to have a larger structure, to conduct a market survey and to sell the spare parts in the catchment areas.

5.2.6 Monitoring and management mechanisms

The government structure that oversees the RWSS in the rural communities is the Rural Health Centre from the Ministry of Health. This responsibility falls under the Environmental Health Technician at the RHCs.

The RWSS office supervises area pump minders at the district level. The RWSS office provides toolkits in the communities for repairing pumps by the APMs. The toolkits provided are both the special and standard tools. The toolkits are stored in the communities at the government schools or rural health centres.

In order to reduce the incidences of the toolkits from missing or breaking the APMs pay maintenance fees every time the y collect tools from schools or RHCs.

Apart from toolkits provided at the RHCs or schools, there are no other resources or equipment provided for the work of the APMs in the communities. The tools were not distributed to all areas of the district; this is a challenge in some cases. To mitigate this challenge, Chongwe Municipal Council has kept a set of spare toolkits at the office of the RWSS coordinator to be utilised by the APMs in areas where there are no toolkits.

The number of trained APMs has reduced. Some APMs have moved on to do other things in life, others have changed villages and a few have since passed on. In order to improve the operation of the APMs, there is need to retrain some and distribute more toolkits to cover those areas without toolkits and those toolkits with missing components.

The staff from the District Council regularly monitors the RWSS activities of the EHTs, APMs and toolkits in the communities four times in a year.

5.2.7 Adopted standardised hand pump type in Chongwe District

Three standard hand pumps types adopted in Chongwe District. The three-hand pump types are Afridev, India Mark II and Ghana Modified India Mark II hand pumps. The most common of these hand pumps is the India Mark II.

The SOMAP spares shop does not stock up spare parts for all the three types of hand pumps in the district. The challenges of hand pumps in the district is the problem of corrosion of pipes in some parts of the District.

5.2.8 Capacity building in District

There has been training and orientation on the sustainability of rural water supply in the district. The capacity building orientation conducted was the SOMAP orientation workshop. This orientation was conducted in 2013. The SOMAP team based at the Ministry of Water Development, Sanitation and Environmental Protection conducted the SOMAP orientation. Within the District, there are Trainers of Trainers (ToTs). Currently the level of training for the team leader for the SOMAP at the District is a Diploma in Water Engineering.

Within the Council establishment, the staff responsible for training and orientation on SOMAP in Chongwe is the RWSS Coordinator.

The private sector should be involved to train and orient the rural communities on SOMAP.

5.3 Discussion

In this third section of the Chapter, the author discuss the research findings in the light of the five research specific objectives and that was set out to enquire on summarised in statement form as:

i. Communities' cost contributions towards maintenance of hand pumps.
ii. Sustainability of the supply chain of spare parts of hand pumps.
iii. Monitoring and management mechanism
iv. Adopted standard of hand pump type
v. SOMAP model capacity building

5.3.1 Communities' cost contributions towards maintenance of hand pumps

In order to achieve sustainability of rural water supply the SOMAP model espouses that the community should contribute towards maintenance of hand pumps by providing one hundred percent cost contribution for operation and maintenance of the hand pumps. There are three

variables that need to be qualified if the community are sustain the hand pump under this principle.

5.3.1.1One hundred percent cost for operation and maintenance

In the findings, the communities contributed towards the repair of the hand pumps in a crisis on a one off basis. Most of the communities failed to make regular contributions towards operation and maintenance of hand pumps. The few that is 28% of the communities, which manage to contribute on a regular basis, the funds that they have managed to raise are not adequate to sustain the hand pumps on a longer basis.

The communities that raised the funds towards operation and maintenance, only 20% of them more than K500.00 for repairing hand pumps. According to the price list of hand pump spares kept at the Chongwe SOMAP spare part shop, the unit cost of galvanised iron pipe is K206.77 and a pipe rod is K108.73.

Looking at a hypothetical example for a community needing to replace 2 pipes and two rods, the community would need at least K631.00, without repair fee for the area pump minder and transport to Chongwe. Even those communities that have raised more than K500.00 who are 20% of the communities would need an additional K131.00 and a further amount for paying the area pump minder and transport to Chongwe.

The communities have not developed an initiative to encourage payment in kind towards, as more than 74% did not allow contribution in kind. More than 95% of the communities do not engage in income generating activities to raise money for operation and maintenance of hand pumps.

Looking at the trend - the cost of spare parts, (though the present prices of hand pumps were set in September 2014 with no adjustment since then) being not cost reflective of actual present cost. The failure to regularly contribute for operation and maintenance and lack of initiative by the communities to raise money, it was be difficult to contribute one hundred percent towards operation and maintenance of hand pumps.

5.3.1.2 Contribute K1, 500.00 toward capital cost

The government policy is that the community contribute K1, 500.00 toward capital cost for borehole with hand pumps. The findings showed that 43.5% of the hand pumps installed, the community paid capital contributions, and a larger proportion of the 56.5% did not contribute towards capital contribution for the construction of borehole with hand pumps. Among those boreholes where there were no capital contributions of K1, 500.00 are those constructed by World Vision and Constituency Development Fund.

Those organisations that do not encourage the government laid policy tend to distort the message towards sustainability of rural water supply, as the community do not source for funds to sustain the facilities.

5.3.1.3 Local Authority rehabilitate works that cost more than K500.00

According to the SOMAP model, the community is expected to contribute one hundred percent towards the operation and maintenance of hand pump for repair. The repairs are those works that would cost less than K500.00. For costs, more than K500.00 are defined as rehabilitation works (RWSS, 2010 p. 5). The Local Authorities are to assist the communities to rehabilitate the hand pumps. According to the findings, Chongwe Municipal Council carried out rehabilitation works in 15% of the hand pumps surveyed in the period from 2013 to 2015. These works were under the Danish International Development Agency (Danida) Supported Project – Water Sector Programme Support (WSPS) Phase 2 of the National Rural Water Supply and Sanitation Programme (NRWSSP).

5.3.2 Sustainability of the supply chain of spare parts of hand pumps.

The second principle to have rural water supply to be sustainable under the SOMAP model is the sustainability of the supply chain of spare parts of hand pumps with four variables to be satisfied. The four variables of sustainable supply chain of hand pumps are that:

i. Spare parts available at outlets at all times
ii. Spare parts are affordable
iii. Appropriate sustainable supply chain set up
iv. Provide toolkit and established toolkit management mechanism

In each of the four variables, the findings are discussed in the following.

5.3.2.1 Spare parts available at outlets at all times.

The Local Authority established a spare shop at Chongwe Municipal Council for the sale of hand pump spares. The spares shop was established in September 2014. For the spares parts to be available all the time means that as the stock of spare parts is depleted through sales, it need to be replenished by bring in new stock regularly. The findings showed that for three years, there was no stocktaking undertaken to determine available stock and to estimate what stock of the spare parts needed re-ordering.

The community members complained of not finding spare parts after the first time. Only 15% obtained spare parts from the spare parts shop. Of the 15% that obtained spare parts from the spares shop, only 6% said they found spare parts each time they went to the spares shop for spare parts. The frequencies of communities obtaining spare parts from the spares shop reduced

– those who obtained spare parts one time was at 6%, for two times was at 4%, three times was at 4% and more than three times was at 2%.

The knowledge about the presence of the hand pump spare parts outlet need to be known by the rural community. The findings showed that only 51% knew about the presence of the spares shop established in Chongwe.

With the failure to restock the spare parts, the lack of advertisement for the rural community to know the presence of the spare parts shop in Chongwe, it shows that the spare parts are not available at all times. The spare part shop is not a reliable source of spare parts in the district.

5.3.2.2 Spare parts are affordable.

The pricelist is available in the spare part container shop. The container is only opened when the stores assistant goes to open to verify the availability of the spare parts to a potential customer. The Ministry determined the price of the spare parts at the time of establishment of the spare parts shop and the prices have not been adjusted for three years. Because the prices are centrally controlled, from the Ministry, market forces do not determine prices of hand pump spares, they are kept to the lowest making the prices to be affordable.

If the prices of the hand pumps were displayed in public places in the rural communities, for example the Coca Cola recommended retail prices for all to see, the community would plan and raise funds to match with the recommended prices of the spare parts. As it is presently, the community raise their funds without knowing the cost of the spare parts.

The prices are affordable as they are centrally determined as are pro-poor, except the knowledge of the prices is not public – there is need to display the recommended prices in public places in the rural communities.

5.3.2.3 Appropriate sustainable supply chain set up.

There are three public domain standard hand pumps in use in Chongwe District, India Mark II, the Ghana Modified India Mark II and the Afridev. In the district with more than 500 hand pumps in use, the number of Afridev pumps is only three. The findings from the survey was 85% were India Mark II and 15% were Ghana Modified India Mark II hand pumps. Therefore, it can be safely be stated that there are only two adopted standard hand pumps in Chongwe – the India Mark II and Ghana Modified India Mark II.

The India Mark II hand pump is the most common used hand pump in Chongwe. There are many local suppliers in Lusaka but would need to be selective to obtain quality spare parts. As the scripture, say '*in multitude of words sin is not lacking …' (Prov. 10v19a, NKJV),* similarly with so many supplier of hand pumps, there are definitely those that would supply defective

and of poor quality spare parts. . It is easier to set up a sustainable supply chain for India Mark II with the suppliers based in Lusaka - credible suppliers that provides good quality spare parts. The Ghana Modified India Mark II is relatively new on the Zambian market, but is a robust hand pump as observed in the rural areas where it has been installed. The Ghana Modified India Mark II hand pump seem to do well in an area with corrosive groundwater as observed in the two villages of Shanyama Village with Ghana Modified India Mark II without rust compared with Shanyama "C" village with India Mark II, which had rusty water.

For the sustainability of the Ghana Modified India Mark II, there is need to have appropriate sustainable supply chain set up. The complaint concerning the thin wall of the stainless steel pipe shall need to be addressed.

There is no appropriate supply chain that has been set up for Ghana Modified India Mark II hand pump.

5.3.2.4 Provide toolkit and established toolkit management mechanism

To repair the India Mark II hand pump there are two sets of toolkits called the standard toolkit and the special toolkits. The standard toolkit is used to repair the upper parts of the hand pumps and the initial installation of the hand pump, while the special toolkit is used to remove the below components of the hand pump such as the pipes, rods and the cylinder.

The toolkits are to be provided within reach for the area pump minders to repair the hand pumps there by sustain the operation of the hand pump. The toolkits are composed of many different components which break or wearout with usage. In order to have the tools ready for use and as a complete set, these are kept at rural health centre or school in the Ward.

There is supposed to be an established way of managing the toolkits in such a way when the APM collects, there should be a small fee paid for use of the tool. The fee is to be used for replacing tools that wearout or as surety to replace missing tools.

The findings showed that 62% of the APMs did not own the toolkits and as such obtained tools from either the schools or from the RHCs. The most common places that kept the toolkits are the RHCs, where 59% of the APMs obtained tools from.

There are other communities where the APMs would not find the toolkits from the RHCs and would have to obtain the toolkits from the RWSS office at Chongwe. The findings showed that in 27% instances, the APMs would find the toolkits from RWSS office. The toolkits have not been provided to all RHCs in the district.

There is only one type of toolkit available for use in the communities – that is the India Mark II hand pump, this is the same one used for Ghana Modified India Mark II hand pump. The challenge on the India Mark II special toolkit has been the pipe lifters which are not suitable for the thin wall stainless steel pipes.

There is no clear policy for payment of a fee for use of the toolkits from the RHCs are learnt from the practices from the APMs.

The total weight of the pieces in the special toolkit is more than 25kg, and this weight too heavy to be carried to the average furthest water point of 10 km on a bicycle as the APMs are not provided with any means to transport the toolkits.

The toolkits have not been sufficiently distributed to all the RHCs and there is no clear policy on the management of the toolkits are not sufficient

5.3.3 Monitoring and management mechanism

The third principle for the SOMAP model is the monitoring and management mechanisms that involves the management system of the water supply system right down to the community level, the devolved approach to rural water supply, involvement of stakeholders of EHTs and striking a gender balance.

5.3.3.1 Management of hand pumps at Community level.

In order to sustain a hand pump at a community level there is supposed to have a leadership in place to manage the hand pump. This management can take the form of a Village Water and Sanitation and Hygiene Education (V-WASHE) committee to oversee the operation and maintenance of the hand pump. The findings showed that in 85% of the water points had a water committee of some kind to ensure direction and coordination of activities at the water point.
Where there is an effective water committee, it is most also likely that the water point shall be operational, conversely it is also true that where there is no water committee, the hand pipe would work up to the point where the hand pump breaks down with no sense of it being to be repaired. One example that could be cited is the hand pump at Njolwe (S15.51177, E28.57495)

Picture 7: Community members at broken down hand pump at Njolwe, Chongwe

Picture taken in December 2017

The community is willing to walk more than five hundred meters to a private water point than attend to the communal water point. The community around are vegetable farmers that send vegetables to Lusaka markets.

Inactive water committees is a common feature in the rural communities, 74% of the communities indicated lack of active water committees. Most water committees are mobilised when the hand pump has broken down to raise funds to repair the hand pumps. One indicator that showed lack of management at community level was the lack of grease on the chain, which was used as an indicator of lack of maintenance of the hand pump. The findings showed that in more than 85% of the hand pumps had no grease on the chains.

This lack of cohesion of the community management at community level is a sign of lack of sustainability of the hand pumps in the communities.

5.3.3.2 Devolved approach to Rural Water Supply

According to the National Decentralisation Policy, that was approved in 2013 (Decentralisation 2013 p. 2), there shall be transfer of responsibilities, authority, functions, as well as power and appropriate resources, to provincial, district and sub-district levels. At sub-district level, Ward Development Committees (WDCs) shall be established in each Ward. The nature of WDCs may vary between urban and rural districts.

At community level, the rural water supply is to be organised through the Village Council, which is represented in the WDC. As there are no WDCs in existence yet, rural water supply has not been devolved and shall affect the sustainability of the hand pumps.

5.3.3.3 Involvement of other stakeholders required

Chongwe Municipal Council has a skeleton staff at the RWSS unit. The strategy is to work through trained staff at sub-district level that works through the APMs, who in turn would work with the community members. The staff at the sub-district level that are involved in RWSS are the Environmental Health Technicians (EHTs) who fall under the Ministry of Health.

According to the National Health Policy, the EHTs work in the community to promote hygiene, universal access to safe water, acceptable sanitation and food safety in order to reduce the incidence of environmentally related diseases, to reduce mortality and morbidity. The EHTS are primarily at RHCs to improve environmental health services (MoH 2012, p. 27) in the catchment areas that they work in.

This means that the EHTs work in RWSS is only to do with meeting the MoH's objective and not the objective of the Ministry of Water Development, Sanitation and Environmental Protection. The MoH have given resources for the EHTs to carry out their work and not meeting the objective of MWDSEP.

This is evidenced when the research question was asked on whether the EHTs visit the community's RWS, 72% of the communities responded that the EHTs do not visit the communities. The 28% of the communities that were visited were mostly the high-density places such as the schools and market places and not how the hand pumps were operating in the communities. The presence and management of the toolkits at the RHC is for convenience, but not the prime reason for the work of the EHTs at the RHC.

There is need to streamline the work of the RWSS unit at the sub-district level with staff from the Council and answerable to RWSS unit of similar calibre to the EHTs than relying on the APMs.

The APMs are community members that have been trained to help repair hand pumps in the communities. Their position in the community is not well defined as to what their roles are. The findings showed that 46% of the communities viewed the APMs as private business individuals, because they charge for the services, 36% view the APMs as community workers and 18% viewed the APMs as volunteers.

A definite position should be defined so that the APMs work as private sector entrepreneurs working in the communities. The APMs need to have someone to whom they are answerable to than the present state where 57% of the communities do not know.

Unsupervised work of the APMs is prone to the hand pump not well attended to leading to the hand pumps not sustainable. Most of the APMs do not have the common tools and the specialised fishing tools such that when the cylinder and pipes fall into the borehole, either such boreholes are abandoned or another pump is fitted into the same hole.

The reorganised and streamlined operation APMs would result in increased level of sustainability of hand pumps.

5.3.3.4 Striking gender balance essential

Different genders play different roles in the community. This is the same thing with regard to rural water supply. According to the Zambian culture, the women usually draw water from the hand pumps. There are issues that are peculiar to each of the different genders and are better addressed that particular gender.

In order to balance the aspirations at the water point, it is important to have a water committee to have a balanced gender representation. In a water committee skewed towards one gender, the other tend not to address the aspirations or concerns of one gender.

For example, taking the problem where there is a leakage in the rising main, where it takes more than five strokes before water starts coming out of the hand pump after stopping pump water after ten minutes. The women easily notice this that the hand pump is faulty; the men may only take note of this when the problem worsens. This discrepancy affects the sustainability of the hand pump at the water point.

The findings in the membership of the V-WASHE committee in the communities surveyed were that 45% had committee's membership of 10 members. The gender balance of women in the V-WASHE committee membership was 30% of the committees had five women in the V-WASHE committee.

This goes to show that, of the committees with membership of ten V-WASHE committees two thirds had gender balance of women. There is still the thirty percent that still outstand that is not gender balanced that may affect the sustainability of hand pumps.

5.3.4 Adopted standard of hand pump type

The research findings showed that the hand pumps installed on the sites were, 85% of the hand pumps were India Mark II and 15% were Ghana Modified India Mark II. On checking records from Chongwe Municipal Council, it is evident that there is also a small number of Afridev hand pumps. Three Afridev hand pumps have been installed in Chongwe.

There are three adopted standard hand pumps in Chongwe District – India Mark II, Ghana Modified India Mark II and Afridev. The most common hand pump of these is the India Mark II, followed by the Ghana Modified India Mark II. The adopted standard of hand pump is one that stratifies the following four variables of

i. Hand pump satisfy hydro-geological conditions
ii. Affordable capital and recurrent costs considered.
iii. Durability of facility considered
iv. Standardisation vis-à-vis research and development developed

5.3.4.1 Hand pump satisfy hydro-geological conditions

The hydrogeological conditions that are critical for the rural water supply include the depth at which the static water level is found in the boreholes and aggressive or corrosive water. 38% of the communities surveyed raised concerns and challenges with the hand pumps installed in their communities. Prominent amongst the challenges raised at 23 % was rusty water from the hand pumps and 2% was the difficult in pumping water from the boreholes.

5.3.4.2 Hand pump for extra deep borehole conditions

The borehole at Pada (S15.44002, E28.53918), a community near the Palabana Market in Palabana Ward is constructed in a hilly terrain. The water level is very low in the borehole. To pump water up, it would require exerting a lot more power on the hand pump handle. It is this extra exertion that is required that makes it difficult to pump water out of the hand pump.

The community explained that 12 pipes (36m) were fitted on the rising pipes. To help in reducing the exertion on the hand pump handle, it would the use of a heavy-duty India Mark II hand pump. The heavy-duty India Mark II hand pump has a thicker handle and an extra deep India Mark II cylinder.

The extra deep well hand pump has these characteristics

i. Special cylinder with two layers of rubber cups,
ii. The head assembly is slightly different, with a thicker handle. The handle is made of 40 mm square rod instead of the usual 32 mm square of India Mark II.
iii. The extra deep well hand pump handle may also have counter weights attached to the handle to assist in the movement of the handle since the water is lifted from very a great depth (up to 90 meters). The number of counter weights depends upon the exact depth at which cylinder is placed.

Picture 8: Extra deep India Mark II hand pump with counter weight

Source: RWSN http://www.rural-water-supply.net/en/implementation/handpump-overview/148 -india-mark-ii-extra-deep-well-pump. Accessed on 19 December 2017

5.3.4.3 Hand pump for corrosive borehole conditions

For the areas with corrosive water that corrode the galvanised iron pipes is to replace the galvanised pipes with either PVC pipes or stainless steel pipes. Research has shown (Casey et al 2016, Yokogi 2013) that the use of PVC pipes that is non-corrosive pipe addresses the problem of rust in the hand pump water.

One such hand pump that could be used in place of India Mark II is the Afridev hand pump. The Afridev hand pump is suitable due to some of its salient features such as:

i. unPlasticised Polyvinyl Chloride (uPVC) pipe, which is non-corrosive.
ii. The pump rods may be made from stainless steel or from galvanised iron rod.
iii. Bearing bushes are made from special plastics and the pump is hot dip galvanized.
iv. Variable handle settings are possible to meet changes in water levels at different times.

v. The Afridev hand pump can pump water from up to 45 – 60m below ground surface.

In the terrain which is hilly and with corrosive groundwater, the Afridev hand pump is suitable for its non-corrosive unPlasticised Polyvinyl Chloride (uPVC) pipes and variable handle settings that can be elongated to give a mechanical advantage to the handle.

In water that is corrosive, the downhole gun metal/mild steel/cast iron components constantly in contact with water tend to corrode very quickly. This concern is addressed by use of PVC riser pipes with stainless steel ends or use of stainless steel cylinder assembly with all stainless steel components inside.

5.3.4.4 Ghana Modified India Mark II hand pump

The Ghana modified India Mark II hand pump is another solution for both extra deep borehole and corrosive ground water. The Ghana Modified India Mark II hand pump was adopted from the India Mark II during a German funded project in Ghana in the 1990s. The problems that were encountered during the project led to the modifications (TREND, 2013). Some of the problems that were encountered were the issue of rust and bearings that easily broke down.

The modifications that were made on India Mark II hand pump now incorporated on the Ghana Modified India Mark II hand pump are;

i. The pump rod and rising mains are made of stainless steel rather than galvanised iron to reduce corrosion.
ii. Water tank was modified with a two-inch spout to prevent negative pressure and suction of water back into water tank.
iii. The bearings of the handle assembly replaced with heavy-duty flanged bearings instead of the ball bearings.
iv. The Ghana Modified India Mark II hand pump can pump water from a depth of 70m

5.3.4.5 Affordable capital and recurrent costs considered.

The capital cost of projects of borehole drilling and installation are expensive and not affordable for the community to bear that is why such projects are borne by the central government. The last estimation of the unit cost of a borehole with hand pump was K35, 000.00 per water point (MLGH / GRZ 2007 p. 46). This is ten years ago, the current price could be in the region of K45, 000.00 per water point. To make the prices to be cost effective, it is required that the installed water point to service at least 250 people. According to Baumann and Erpf (2005, p. 14) the population served using the India Mark II hand pump is 300 people.

The recurrent costs are the costs for the spare parts that need replacement. The findings showed that 72% of the rural communities do not regularly contribute towards operation and maintenance. Even those that contribute, the amount of funds contributed are not sufficient to meet the recurrent costs. Only 20% of the communities managed to raise more than K500.00 towards operation and maintenance. There is no initiative of raising funds such as income generating activities to raise funds for recurrent cost for repairing hand pumps.

The communities have a history of raising funds when there is a crisis to repair the hand pump, where the committee pass through the community to make a one off payment towards the repair of the hand pumps. The rate of downtime also point to the same unpreparedness as the community take long to repair the hand pumps as more than 50% of the hand pumps are repaired after three weeks.

With this kind of scenario of failing by the large population to raise recurrent cost of hand pumps, it is difficult for the communities to sustain rural water supply through their community contributions.

5.3.4.5 Durability of facility considered.

The hand pumps that have been installed in Chongwe are generally durable and of good quality as has been noted from the time that the hand pumps are first repaired. One such example are the Ghana Modified India Mark II hand pumps, some of the hand pumps have not been opened for repairs after operating for more than five years.

5.3.4.6 Standardisation vis-à-vis research and development developed

Standardisation of hand pumps should be as a response to the challenges that are faced by the communities. One study that has contributed to standardisation of hand pump through research and development is the use of PVC pipes in place of galvanised iron pipes that are prone to rust due to high iron content and low pH groundwater.

Although this knowledge is there after checking the pH values, to replace the galvanised iron pipes with PVC pipes, this is not always straightforward. Several constraints make selection of alternative materials difficult in some areas. The constraint may include limited supply chains, lack of local knowledge and competence in different installation and maintenance techniques, and availability of appropriate tools to work with these materials (Casey et al 2016, p. 72).

5.3.5 Capacity building

Under the SOMAP model, for rural water supply to be sustainable, there must be capacity built to the different stakeholders participating in the rural water supply sector. Sustainability of the rural water supply involves many activities that need to be undertaken by different actors in the sector. The use of hand pumps in most communities is a new thing and not part of the culture of the communities, therefore practices that relate to keeping the hand pumps working all the time is something that has to be taught to the stakeholders in the sector.

The different roles and responsibilities have to be explained to different stakeholders at all levels. From the National level, the staff at the RWSS department need to be trained in their roles and responsibilities to sustain hand pumps in rural area of Zambia. At Provincial level, the staff should be trained on their roles and responsibilities in the provinces to sustain rural water supply.

At District level too, the RWSS staff need to know their roles and responsibilities to ensure the adherence to the SOMAP model practices to sustain rural water supply. The SOMAP model activities shall include that communities contribute one hundred percent cost towards maintenance of hand pumps; sustain the supply chain of spare parts of hand pumps, manage the sub-district monitoring mechanism of rural water and to adopt standard of hand pump type in the district that satisfies hydro-geology in the district.

In order for the rural water supply to be sustained, there should be supportive government policies provided and regulatory framework provided. These two provisions from the government are assumed in this study and are not discussed in this section. The rest of the section discusses capacity building that was given to the community and management skills that were imparted to the communities to ensure sustainability of rural water supply.

5.3.5.1 Community awareness campaigns and public participation.

The construction of the rural water supply commences with the application a water supply facility to the Local Authority. The Local Authority carries out first the desk appraisal followed by the field appraisal to review the felt need for the water supply and the size of the population to be served by the hand pump. When the community has passed the two appraisals, the community are requested to pay up K1, 500.00 the community capital contribution towards the construction of a borehole with hand pump.

After the payment of the community capital contribution, the RWSS team goes to prepare the community for the drilling of the borehole. The RWSS team goes to training the community to come up with a V-WASHE committee, its composition, roles and responsibilities. The community are also sensitised through use of music, dance and drama plays to help sensitise the community to be aware of what is expected of them to sustain the hand pumps. The community are brought together at a public meeting to have democratic elections. All this is done through the local leadership of the head person or the Chief.

The Local Authority also requests the local community to select someone that is trust worthy in the community for training as an area pump minder.

For the constructed water facility to be sustained, the community need to make aware of their roles and responsibilities and the RWSS staff at the Local Authority need to be knowledgeable on the demands and practices of RWS. When these practices are overlooked or not done or partly done, in most cases such hand pumps are not sustainable, as the communities are not made aware on how to sustainably look after the hand pumps.

The findings on community sensitisation for sustaining hand pump showed that 72% of the communities were sensitised to sustain the hand pumps. The findings showed that 57% were sensitised through the public meetings and 2% were sensitised through a drama group.

The sensitisation was done mainly through public meetings, where the community members were called to a meeting and the project team members explained how to sustain the hand pumps.

The research question findings also showed that Chongwe RWSS team trained 36% of the V-WASHE committees; World Vision trained the other 15% of the V-WASHE committees and other group of people trained less than 19% while the other 8.5% did not identify the group that trained them.

The Local Authority does not sustain the training and sensitising the rural communities as the research finding of only 36% training by Chongwe RWSS team, this has an impact on the level of sustainability of rural water supply in Chongwe.

5.3.5.2 Management, financial and technical skills developed

For the V-WASHE to be effective there is need to have a committee that has had some basic training in some skill in management, financial and technical skills for effective operation and maintenance of the hand pumps in Chongwe.

The findings showed that 65% of the respondents indicated that there was someone trained to provide leadership at the water point. With regard to collection, keeping and disbursing community contributions, the findings showed that 53.5% of the respondents said there were treasurers that were trained. With regard to technical requirement of preventive maintenance of the hand pumps, the findings showed that 42% of the V-WASHEs had caretakers who were trained as caretakers at the water points.

Although the communities explained that there were some form of training, the overwhelming evidence of lapses such as lack of basic maintenance of greasing the hand pumps, where 85% of the inspected hand pumps which did not have grease on the hand pumps showing that the hand pumps were are not regularly maintained. The other lapse of more than 74% of inactive water committees on site. The other community lapses with regard to community contributions for operation and maintenance. The findings showed that 72% of the communities did not make regular contributions towards the operation and maintenance; 74% do not allow payment in kind where the community do not have cash payment and 95% of the respondents do not engage income-generating activities to raise money for operation and maintenance of hand pumps. In all this, the communities seem not to be committed to raising funds towards operation and maintenance.

With these community sustainability lapses with regard to financial management that have been highlighted above, the issue of hand pump sustainability is in precarious position.

The RWSS unit at Chongwe is the organisation that has the responsibility to build capacity of the rural communities to sustain rural water supply. The RWSS unit presently has one member of staff – the RWSS Coordinator with a Diploma in Water Engineering. Within the Chongwe Municipal Council establishment, the staff responsible for training and orientation on SOMAP in Chongwe is the RWSS Coordinator.

5.4 Conclusion

This conclusion in this section is restricted to the third section - the discussion in this chapter. The discussion is on the five SOMAP model principles of sustainability of rural water based on the data analysis and the results that came out is the discussion in brief form.

1. Community Cost contributions

The analysis show that communities in 20% cases may meet one hundred percent cost contributions to sustain hand pumps. The government policy of community capital cost

contribution towards is not fully complied with by some non-governmental organisations and government structures

In the variables, rural water is not sustainable in with regard to community contributions towards maintenance of hand pumps. SOMAP model need to re-emphasise to community to strive to raise funds to procure at the cost of the spare parts.

2. Sustainable supply chain

The spare part outlet was established in 2014 and by end of October 2017 there had not been any restocking done. The prices of the spare parts have been kept at the same price level for the last three years. This shows that the supply of spare parts the rural communities has not been reliable. There are two hand pumps that have been adopted for rural water supply in Chongwe District – India Mark II and the Ghana Modified India Mark II hand pumps.

The conclusion for the sustainability of supply chain of hand pumps in Chongwe show that the spare parts are not available at the outlet at all times

3. Monitoring and management mechanism

Where there is an inactive water committee, it is not likely to find a hand pump operational. As it was been noted that more than 74% of the water committees were not active, this meant the hand pumps could not be sustained.

The other variable for sustainability to have a devolution down to the RWS, but it has been noted that this has not yet been effected in the RWS, as WDCs are non-existent. With the lack of devolution also shows that the hand pump monitoring and management mechanism is not effective.

Involvement of stakeholders required EHTs toolkits at RHCs. EHTs are Ministry of Health staff, their allegiance is to MoH, and not Ministry of Local Government. Therefore, overdependence upon staff from another line ministry is not an effective way to sustain rural water supply. APMs are private individuals with no one to superintend over them, reliance over them cannot sustain oversight of the hand pumps. There is still gender in-balance against women that may affect sustainability at community level.

In the light of all these variables that are not satisfied, we can say the monitoring and management mechanism in the present state, cannot make rural water supply sustainable.

4. Standard hand pumps

There are three standard hand pumps in use in Chongwe – India Mark II, Ghana Modified India Mark II and the Afridev. These hand pumps in some places do not satisfy the hydro-geological conditions. In 38% of the hand pumps surveyed were identified not satisfy the hydrogeological conditions, for which the communities were not satisfied with the hand pumps installed such as in hilly terrain where the water table was too low and the community found the hand pumps not suitable to pump water.

The other hand pump challenge was high iron content, where the hand pumps produced rusty water that was not palatable to the community. The three standard adopted hand pumps are correct, except that the correct hand pumps have not been installed in the right communities, which may lead to the hand pumps installed not being sustainable.

5. Capacity building

In order to have the rural water supply sustainable, the different stakeholders from the National level all the down to the community level need to have their capacities built and trained in their roles and responsibilities.

The discussion of the findings in this section are from the District level, sub-district level and the community level stakeholders. The Local Authority does not sustain the training and sensitising the rural communities. This seem not to be a high priority by Chongwe RWSS team to train rural community to sustain hand pumps. There were lapses in the communities with regard to basic management, financial and technical skills developed in the communities.

With regard to involvement in income-generating activities for operation and maintenance, the community do not engage income-generating activities to raise money for operation and maintenance of hand pumps. In all this, the communities seem not to be committed to raising funds towards operation and maintenance.

With these, sustainability of rural water supply lapses with regard to capacity building in the communities, financial management and lack of basic technical skills, the issue of hand pump sustainability of rural water in Chongwe is in precarious position.

CHAPTER SIX

Conclusion and Recommendations

6.1 Introduction

In this chapter, the researcher discusses the research conclusion of the research question for the problem that was identified at the commencement of the study in the light of the five research specific objectives.

After the research conclusion, the hypothesis is tested to see whether the findings have changed the hypothesis that was set. The recommendations are primarily for the study, but also applicable for the wider audience of the rural water subsector. The immediate audience of the study is for the academic rigours but its application is to the wider rural water community out there, to increase water coverage in the rural areas and to sustain public health and economic benefits for a long time.

6.2 Conclusion

This study sought to establish the effectiveness of the SOMAP model to sustain RWS in Zambia, using Chongwe district as an example of the rural area. The SOMAP model is the Government of Zambia's initiative to sustain rural water supply.

The effectiveness of the SOMAP model is the degree to which rural water supply continues to flow long after the rural water supply implementation project is completed. The SOMAP model has five principles to show that the rural water supply is sustainable that is to show that the hand pump is operational all the time.

According to the SOMAP model, rural water supply shall be said to be sustainable when the five principles are satisfied in the following:

i. The communities contribute 100% cost of the operation and maintenance of hand pumps.
ii. There is a sustainable supply chain of spare parts of hand pumps.
iii. There is an active monitoring and management mechanism of hand pumps in the communities;
iv. There is an adopted standard hand pump in the district and
v. There is capacity building of the rural communities.

The research findings under each of the five specific research objectives are:

6.2.1 Cost Sharing by Communities

The hand pump to be sustainable, the community is supposed to contribute 100% cost of the operation and maintenance of hand pumps. The findings is show:

- 72% of the rural communities do not make regular contributions towards operation and maintenance of the hand pumps;
- 80% of the communities have raised less than K500.00 towards operation and maintenance when the cost of spare parts is higher than that.
- When hand pumps breakdown, only 25% of the communities are able to have their hand pumps repaired within one week and 40% have their hand pumps repaired after four weeks.

This shows that the communities cannot contribute one hundred percent cost for operation and maintenance of hand pumps.

6.2.2 Sustainable spare part supply chain.

Chongwe Municipal Council established a hand pumps spare parts shop with assistance from the Danida Supported Programme in September 2014. The established spare parts shop was to sell spare parts sustainably, when the stock was depleted, these were to be re-ordered and replenish the stock. The findings show that:

- For the last three years, there was no price change, and no stocktaking was ever taken, to check what stock needed to be replaced. The spare parts that had been sold had not been restocked.
- The quantities of the spare parts that were bought in 2014 at the beginning of the spares shop cannot be bought at same price.
- The present price is not reflective of the present cost of the re-ordering price; as such, the raised money may not be enough to re-order same quantity.

The supply chain established at Chongwe is not sustainable; therefore, rural water supply is not be sustained, due to lack of unsustainable spare part supply chain.

6.2.3 Monitoring and management mechanism

In order to ensure sustainability of rural water supply, the RWSS unit rely on the EHTs from the Ministry of Health based at Rural Health Centres in the catchment areas or Ward level at sub-district level to monitor rural water supply and there is supposed to be water committees at water points. The findings in the research showed that:

- 72% of the communities indicated that the EHTs do not visit the water points in the communities to collect water samples for water quality analysis.
- 74% of the communities indicated that the water committees were not active, this means there was no management system to oversee that hand pumps at community level.

This shows that rural water supply is not sustainable as there is not monitoring and management mechanism to oversee the rural water supply in the communities.

6.2.4 Adopted standardised hand pump

To ensure hand pump sustainability, there should be a standard hand pump that should be adopted for the district. The adopted standard hand pumps in the district that should satisfy the different hydro-geological conditions that prevail in the district, such as for the hilly terrain and those areas that are prone to aggressive groundwater.

The findings show that there are three adopted hand pumps – India Mark II, Ghana Modified India Mark II and Afridev. Of these three hand pumps, India Mark II (estimated at 85%) is the most common followed by Ghana Modified India Mark II (estimated at 15%) of the sample surveyed.

The findings showed that 38% of the hand pumps had challenges and unsuitable to supply water to the communities. The challenges were either difficult in pumping due to the low water table in the boreholes and rust in the water when the community members draw water from the hand pumps. This 38% of the hand pumps were not sustainable due to hydro-geological conditions.

This shows that 38% not suitable to the hydro-geological conditions is not be sustained in the long run.

6.2.5 Capacity building

The use of hand pump is not part of the rural community's original culture, therefore communities need to be sensitised and their capacity built in order to sustain the hand pumps. The research findings shows that:

- 72% of the communities indicated to have been sensitised on how to look after the hand pumps and that 57% were sensitised through a public meeting. Although the communities indicated to have been sensitised, yet their practices on sustaining the hand pumps show the opposite.
- 85% of the hand pumps were found to be without grease, most of them had the grease that came with the original hand pump installation and was dry.
- 69% of the hand pumps completely broke down before they could be repaired. This indicated the lack of preventive maintenance by the caretaker.

- Only 25% had a downtime less than one week and 40% of the hand pumps had a downtime of more than 4 weeks.

This shows that the capacities of the rural communities were not sufficiently built to sustain rural water supply.

In the light of the above findings in each of the five principles of the SOMAP model, we can therefore conclude that the SOMAP model in Chongwe district is not effective in sustaining rural water supply.

In the conceptual framework, the five factors of the SOMAP model work collectively together as the sum parts of one solution to rural water sustainability. The five factors shall ensure that the community has access water supply, the water is of good quality in sufficient quantity. There was a sense of community ownership of the water facility. The hand pump shall be functional such that after stopping pumping of the hand pump, the hand pump commenced pumping within the first three strokes.

The findings showed that although 94% of the hand pumps were working on the date of survey, yet only 51% of the hand pumps were functional as they pumped water immediately after stopping pumping for ten minutes. The functionality of the hand pump and reduced down time that are indicators of a sustainable rural water supply.

6.3 Recommendations

The primary objective of these recommendations are to the original recipients of the study report. These shall further be applied to Chongwe Municipal Council, where the research was undertaken, to improve the effectiveness of the SOMAP model in sustaining rural water supply. Ultimately, it is the Ministry of Water Development, Sanitation and Environmental Protection that has the mandate to oversee that rural water supply in Zambia is sustainable.

These recommendations grouped in three categories, by which these should be implemented. The short-term recommendation are for implementation in the within 6 months to two years.

The medium-term recommendation are for implementation from year three to five, and the long-term recommendations in the year after year five.

6.3.1 Short-term recommendations

i. Increase number of staff from one to three in next one year, and increase every year by one for next two years and reorganise the RWSS unit to be responsive so that the rural water supply responds to five factors of the SOMAP model.

ii. Increase funding to the RWSS unit with additional resources of equipment of motor bikes to increase RWSS visibility in the rural communities or set up a rural water supply company (private) with Chongwe Municipal Council having shares, similar to Lusaka Water and Sewerage Company

iii. Reorganise the operation of the hand pump spares shop to be more responsive to the market forces.

iv. Move the spare parts container to a more visible location to have the Great Road as the container frontage.

v. Advertise the operation of the spare parts shop on the Chongwe community radio station, to increase the visibility of the spare parts.

vi. Prepare fliers of the spares shop and larger colourful posters with prices of the spare parts that could be place at community public places e.g. at basic schools and rural health centres and Food Reserve Agency sheds.

vii. Adopt standard hand pump suitable to Chongwe District hydro-geological conditions, so that there are no communities with challenges of the hand pumps.

6.3.2 Medium-term recommendations

i. Prepare community to make payment for operation and maintenance through cooperatives or payment in kind, as the rural community get payment from the sale of farm produce.

ii. Establish a rural water supply maintenance unit to be flushing and rehabilitating boreholes in the rural communities of Chongwe.

iii. Raise the profile of the APMs to be private sector Area Pump Mechanics, to run their business profitably that could be contracted, using the example of InterAide in Malawi.

iv. Set up appropriate sustainable supply chain with suppliers for India Mark II and Ghana Modified India Mark II hand pumps based in Zambia, so that there is a ready supply of spare parts for both hand pumps in Chongwe District.

v. Now, there are no toolkits specifically for Ghana Modified India Mark II hand pumps in Chongwe. The National RWSS Department to identify and develop appropriate toolkits for Ghana Modified India Mark II hand pumps and the APM training manuals for Ghana Modified India Mark II.

6.3.3 Long-term recommendations

i. Increase the number of staff at RWSS unit at Chongwe Municipal Council, the head of unit to have a Master's Degree in relevant training rural water supply.

ii. (Use a deliberate policy to send existing staff for higher training so that in the next five years the staff with have a higher qualification to take on higher responsibilities at district, sub-district and community level)

iii. The MWDSEP to come up with sub-district staff, a cadre like the EHTs from the MoH at RHCs, or Extension Officers at an Agriculture Camp. This staff shall be known as RWS Extension.

iv. The RWS Extension would make RWS a lot visible and this staff could be provided with motorbike and be in charge of RWS in the Ward.

6.4 Further Research

1. Ghana Modified India Mark II is a robust pump; it was tried in Zambia for the first time in the 2012 under the Danida supported programme. It would be worthy to carry out an in-depth research on the effectiveness of the Ghana Modified India Mark II hand pump under the Zambian conditions. This study can also review the appropriate supply chain of spare parts for Ghana Modified India Mark II hand pump.
2. The other challenge experienced with India Mark II hand pumps is the issue of rust in the drinking water, where the water is corrosive. The solution prescribed is the use of unPlasticised Polyvinyl Chloride (uPVC) pipes. Though this is the solution that is prescribed, (Casey et al 2016, p 72 - 74) in the study identified two problems that have been encountered:
    - Limited supply chains, lack of local knowledge and competence in different installation and maintenance techniques, and availability of appropriate tools to work with these materials.
    - Little demand for alternatives, so galvanized iron rods and riser pipes dominate the market. Stainless steel and plastic materials are theoretically available, appearing in product catalogues but not stocked. Suppliers reluctant to carry large stocks because they do not sell as fast as Galvanised Iron (GI) pipes.

There is need to carry out two further research studies under Zambian conditions under this problem of rusty water.

i. Study on the supply chain for uPVC pipes for aggressive corrosive water, to increase local knowledge and competence in different installation and maintenance techniques, and availability of appropriate toolkits.
ii. Study to increase the demand for uPVC in place of galvanised iron rods and pipes that dominate the hand pump market.

Rust in groundwater in rural water is a major problem; it covers the rural communities in eight out of the ten provinces in Zambia.

REFERENCES

1. Abdi G., and Baumann, E., 2010, *Region Specific Supply Chains for Hand pumps and Spare Parts in Ethiopia*, Federal Democratic Republic of Ethiopia and World Bank, Addis Ababa
2. Abrams, L, Palmer, I, and Mart, T, 1997, *Sustainability Management Guidelines*, Department of Water Affairs and Forestry, South Africa
3. Adekile, D, 2012, *Supervising Water Well Drilling, A Gide for Supervisors*, Rural Water Supply Network, Field Note No. 2012 – 2, UNICEF Skat Foundation, (www.rural-water-supply.net) St.Gallen Switzerland
4. Ahmad,T., Kinyanjui, V., Jonga, M., and Mashingaidze, H. R., 2016, Public Private Partnership or Rural Water Supply: Experiences from Zimbabwe 7th RWSN Forum "Water for Everyone" 29 Nov - 02 Dec 2016, RWSN, Abidjan, Côte d'Ivoire
5. Bakalian, A and Wakeman, W, 2009, Post-Construction Support and Sustainability in Community-Managed Rural Water Supply, Case Studies in Peru, Bolivia, and Ghana, World Bank – Netherlands Water Partnership, The World Bank Washington, D.C. 20433 USA
6. Baraki, Y.A and Brent, A. C, 2012, Technology transfer of hand pumps in rural communities of Swaziland: Towards sustainable project life cycle management, Research paper, University of Pretoria, South Africa.
7. Baumann E., and Danert K., 2008, *Operation and Maintenance of Rural Water Supplies in Malawi - Study Findings,* Swiss Resource Centre and Consultancies for Development, Rural Water Supply Network and Water and Sanitation Program, St Gallen, Switzerland.
8. Baumann E. and Erpf K, 2005, *Rural Water Supply Technology Options, Hand pumps, Mechanised Pumps and Surface Water*, Rural Water Supply Network, SKAT Foundation, St Gallen, Switzerland.
9. Bryman A. and Bell, E. 2015 p. 27 *Business Research Methods* 4 edition, Oxford University Press, London
10. Byrns S., and Hughes G., 2016, Making systems work: Local government approaches to improving WASH service delivery in Malawi, 7th RWSN Forum "Water for Everyone", 29 Nov - 02 Dec 2016, Abidjan, Côte d'Ivoire.
11. Casey V et al, 2016, *The role of hand pump corrosion in the contamination and failure of rural water supplies*, Waterlines Vol. 35 No. 1 January 2016, Practical

Action Publishing, London.
http://www.developmentbookshelf.com/doi/pdf/10.3362/1756-3488.2016.006 - Accessed on December 18, 2017

12. Chitembo, 2015, *End of Term Evaluation of the National Rural Water Supply and Sanitation Programme (NRWSSP) 2006 – 2015*, Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ), Ministry of Local Government and Housing, Lusaka
13. Chowns E, (2015) *Water point sustainability and the unintended impacts of community management in Malawi*, 38 th WEDC International Conference, Loughborough University, Water, Sanitation and Hygiene Services beyond 2015: Improving access and Sustainability, Refereed Paper 2147, University of Birmingham, Birmingham. UK
14. Chowns, E., 2016, Community management in Malawi: part of the sustainability problem, not the solution, 7th RWSN Forum "Water for Everyone" 7ème Forum RWSN « L'eau pour tous » 29 Nov - 02 Dec 2016, Abidjan, Côte d'Ivoire
15. CSO, 2012, *Zambia, 2010 Census of Population and Housing, Population Summary Report*, Central Statistical Office, Lusaka, www.zamstats.gov.zm
16. CSO, 2015, *Zambia Demographic and Health Survey 2013 – 14*, Ministry of Health and ICH International, Central Statistical Office, Rockville, Maryland USA.
17. Decentralisation, 2009, *Decentralisation Implementation Plan 2009 – 2013*, Decentralisation Secretariat, Ministry of Local Government and Housing, Lusaka
18. Decentralisation, 2013, *The National Decentralisation Policy (Revised Edition, 2013)*, Government of the Republic of Zambia, Office of the President, Cabinet Office, Lusaka
19. Dörnyei, Z. (2007). *Research methods in applied linguistics*. New York: Oxford University Press. UK
20. Dube, T, 2012, *Emerging issues on the sustainability of the community based rural water resources management approach in Zimbabwe: A case study of Gwanda District, International Journal of Development and Sustainability*, Special Issue: Development and Sustainability in Africa – Part 1, Vol 1 No. 3 (2012): pp. 644- 655, www.isdsnet.com/ijds
21. Dudovskiy J. (2017) e-book, *The Ultimate Guide to Writing a Dissertation in Business Studies: a step-by-step assistance* (https://research-methodology.net/about-us/ebook/) accessed on 22 November 2017.

22. ECZ, 2016, *2016 General Elections – Schedule of New Wards,* Electoral Commission of Zambia, Lusaka
23. EMA, 2011, *The Environmental Management Act, 2011,* Government of Zambia, Parliament of Zambia, Government Printer, Lusaka
24. GRZ, 1997, *Statutory Instrument No 28 of 1997, Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations*, Government of Zambia, Parliament of Zambia, Government Printer, Lusaka
25. GRZ/JICA, 2010, *RWSS O&M Implementation Manual & User Guide*, 1 st edn, Republic of Zambia, Ministry of Local Government and Housing, Lusaka
26. GRZ/MLGH, 2007 *National Guidelines for Sustainable Operation and Maintenance of Hand Pumps in Rural Areas*, 1st edn., Republic of Zambia, Ministry of Local Government and Housing, Lusaka
27. GRZ/MLGH, 2012, *Supply Chain Management Manual,* 2nd edn., Ministry of Local Government and Housing, Lusaka
28. Harvey and Reed, 2004 p. 41 *Rural Water Supply in Africa, Building Blocks for Hand Pump Sustainability,* Water, Engineering and Development Centre (WEDC), Loughborough University, UK
29. Harvey and Skinner (2002), *Sustainable Hand pump Projects in Africa, Report on Fieldwork in Zambia April 18 - May 4 2002.* Water, Engineering and Development Centre, Loughborough University, Leicestershire, UK
30. Harvey, P and Reed, B, 2004, Rural Water Supply in Africa – Building Blocks for Hand pump Sustainability, Water, Engineering and Development Centre, Loughborough University, Leicestershire, UK
31. Harvey, P and Reed, B, 2007, *Community-managed water supplies in Africa: sustainable or dispensable?*, Oxford University and Community Development Journal, Vol. 42 July 2007 pp. 365 – 378,
32. Harvey, P., 2011, *Sustainable Supply Chains for Rural Water Services – Linking local procurement of hand pumps and spare parts supply*, Rural Water Supply Network and Water and Sanitation Program, Field Note No 2011-1., St Gallen, Switzerland
33. Haysom, A, 2006 A Study of the Factors Affecting Sustainability of Rural Water Supplies in Tanzania,, WaterAid Tanzania, Dar es Salaam
34. HDI, 2016, *Human Development Report 2016, Human Development for Everyone,* United Nations Development Programme, UN Plaza, New York,

35. Heale, R., and Twycross, A, 2015 *Validity and reliability in quantitative studies*, Research Made Simple, Cross Mark downloaded on 2 May 2018 from https://pdfs.semanticscholar.org
36. Hutton G and Bartram J, 2008, *Regional and Global Costs of Attaining the Water Supply and Sanitation Target (Target 10) of the Millennium Development Goal*, Public Health and the Environment Assessing & Managing Environmental Risks to Health, World Health Organisation, WHO Press, Geneva, Switzerland
37. Ilker Etikan, Sulaiman Abubakar Musa, Rukayya Sunusi Alkassim. *Comparison of Convenience Sampling and Purposive Sampling*. American Journal of Theoretical and Applied Statistics. Vol. 5, No. 1, 2016, pp. 1-4. doi: 10.11648/j.ajtas.20160501.11.
38. IMF, 2015, Sub-Saharan Africa Navigating Headwinds, The Regional Economic Outlook: Sub-Saharan Africa, International Monetary Fund, Publication Services Washington, DC
39. Jansz, S, 2011, A Study into Rural Water Supply Sustainability in Niassa Province, Mozambique, WaterAid, London.
40. JICA, 2012, *National Rural Water Supply and Sanitation Programme, Survey of NRWSSP Components*, Draft Final Report, Ministry of Local Government and Housing, Republic of Zambia, Lusaka
41. Kambole, S M, 2016, Towards Achieving A Sustainable Community-led Rural Water Supply Management Model in Zambia: Strides or Rhetoric? 7 th RWSN Forum "Water for Everyone", 29 Nov – 02 December 2016, RWSN, Abidjan, Côte d'Ivoire.
42. Katz T and Sara J, 1997, Making rural water supply, with recommendation from a Global Study
43. Kreitner R., 2009 p. 127, *Management*, Arizona State University, 11 th ed. Houghton Muffin Harcourt Publishing Company, New York
44. Lockwood, L and Smits, S, 2011, Supporting Rural Water Supply, Moving towards a Service Delivery Approach, Practical Action Publishing, Warwickshire, UK
45. MacArthur J., 2015, *Handpump Standardisation in Sub-Sahara Africa – Seeking a champion*, Rural Water Supply Network, Publication 2015-1 , St Gallen, Switzerland
46. Macharia E et al, 2015, *Assessing Sustainability of Rural Water Projects in Naivasha, Kenya, Case Study: Maraigushu Water Project*, European Journal of Business and Social Sciences, Vol. 4, No. 07, October 2015 p 52 – 83, Jomo Kenyatta University of Agriculture and Technology Kigali, Rwanda.

47. Mandara C G, et al 2013, *Community Management and Sustainability of Rural Water Facilities in Tanzania*, Water Policy 15 p. 79–100, Wageningen University, Wageningen, Netherlands, IWA Publishing.
48. Mandara CG, Butijn C and Nie.hof A, 2013, *Community management and sustainability of rural water supply facilities in Tanzania*, Wageningen University, Water Policy 15 (2013) p. 79 – 100, Wageningen, Netherlands
49. May C R, and Finch, T, 2009, *Development of a theory of implementation and integration: normalization process theory*. Implementation Science, University of Glasgow, Manchester.
50. Méloir, B de S, 2009, *InterAide Support to Operation and Maintenance of Rural Water Supplies in Malawi in 2008,* Rural Water Supply Network, Member Experiences No 1, St.Gallen Switzerland, Lilongwe 3, Malawi, http://www.rural-water-supply.net/en/
51. Migbar, A, 2013, *Strategies to reduce the non-functionality of water supply schemes in Kedida Gamella Woreda, Ethiopia*, 36 th WEDC International Conference, Nakuru, Kenya, Delivering Water, Sanitation and Hygiene Services in an uncertain Environment, Briefing Paper 1703, Hawassa University, Ethiopia.
52. MLGH / RWSS, 2010, RWSS O&M Implementation Manual and User Guide, Ministry of Local Government and Housing, Lusaka
53. MLGH, 2007, *National Rural Water Supply and Sanitation Programme 2006 – 2015*, Ministry of Local Government and Housing, Government of the Republic of Zambia, Lusaka
54. MLGH, 2007, National Rural Water Supply and Sanitation Programme, 1st edn,, Republic of Zambia, Ministry of Local Government and Housing, Lusaka
55. MLGH/GRZ, 2012, *RWSS O&M Component, Supply Chain Management Manual*, 2 nd edn, Republic of Zambia, Ministry of Local Government and Housing, Lusaka
56. MoAIWD, 2015, *Guide Manual for the Establishment of an Afridev Hand Pump Spare Parts Supply Chain,* Government of Malawi Rural Water Supply Operation and Maintenance Series, Ministry of Agriculture, Irrigation and Water Development, Lilongwe, Malawi.
57. MoH, 2012, *National Health Policy, A Nation of Healthy and Productive People*, Republic of Zambia, Lusaka
58. Murtaza, M., Karangwa, L., Muzola, A., Sano, J., Marie, J., Rutaganda, V., and Musabyimana, G, 2016, Assessment of Sustainability of Rural Water, Sanitation and

Hygiene Interventions in Rwanda, 7th RWSN Forum "Water for Everyone" PEER REVIEWED 29 Nov - 02 Dec 2016, Abidjan, Côte d'Ivoire.

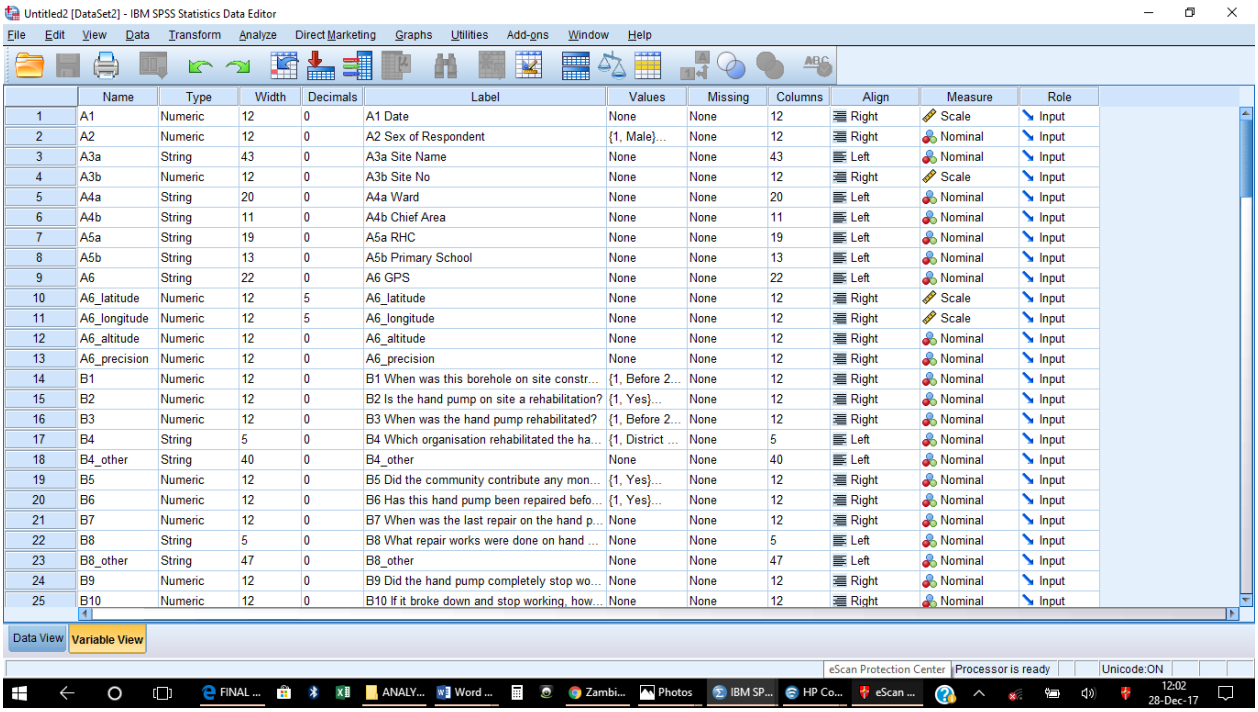
59. NDP, 2013, *The National Decentralisation Policy (Revised Edition, 2013),* Republic of Zambia, Office of the President, Lusaka
60. NWASCO, 2015, *Strategic Plan 2016 – 2020, Ensuring Better Services and Fair Value*, National Water and Sanitation Council, Lusaka
61. NWASCO, 2017, *Urban and Peri-Urban Water Supply and Sanitation Sector Report 2017*, p. 20National Water and Sanitation Council, Lusaka.
62. Oyo. A, 2006, *Spare Part Suppliers for Hand pumps in Africa – Success Factors for Sustainability, Field Note* Rural Water Supply Network and Water and Sanitation Program, St Gallen, Switzerland
63. Republic of Zambia Government Gazette 1997, p. 111, *Statutory Instrument No. 28 of 1997, The Environmental Protection and Pollution Control Regulations*, Government Printer, Lusaka
64. Rijsdijk A and Mkwambisi D, 2016, *UNICEF water and sanitation programme in Malawi from 2007 – 2013, Final Report,* UNICEF, Government of Malawi, Lilongwe
65. RWSN, 2009, Hand pump Data, Selected Countries in Sub-Saharan Africa, RWSN Poster, April 21, 2009, Rural Water Supply Network and Water and Sanitation Program, St Gallen, Switzerland
66. RWSS, 2010, *RWSS O&M Implementation Manual and User Guide*, 1 st edn, Republic of Zambia, Ministry of Local Government and Housing, , Lusaka
67. Shaw, D, 2012, *An Assessment of Rural Water Supply Sustainability in Monze District, Zambia*, WaterAid, University of Bristol, Bristol, UK
68. SNDP, 2017, *Seventh National Development Plan 2017 – 2021*, Ministry of National Development Planning, Republic of Zambia, Lusaka
69. SOMAP2, 2010, *Project Final Report, SOMAP Phase II Zambia*, Sustainable Operation and Maintenance Project for Rural Water Supply, Government of Zambia, Lusaka
70. SOMAP2, 2010, Project Final Report SOMAP Phase II Zambia, Sustainable Operations and Maintenance Project for Rural Eater Supply II, GRZ / JICA, Lusaka
71. Taylor, B, 2009, *Addressing the Sustainability Crisis, Lessons from research on managing rural water projects*, WaterAid Tanzania, Dar es Salaam
72. TREND, 2013, *Recommendations for the sustainability and scalability of the Ghana Modified India Mark II Handpump in Foase district, Ghana*, Recommendation Note,

WASHTech, London Accessed from WASHTech website at: http://wwwwashetechafrica.wordpress.com on December 18, 2017

73. UNICEF and WHO, 2015, *Progress on Drinking Water and Sanitation – 2015 update and MDG assessment.* World Health Organization WHO Press, Geneva, Switzerland
74. United Nations, 2015, *The Millennium Development Goals Report 2015*, United Nations, New York, Website at www.un.org/millenniumgoals Accessed on 27 Nov 2017.
75. WaterAid, 2011, *Sustainability Framework*, WaterAid, London
76. WHO and UNICEF, 2006, *Meeting the MDG drinking water and sanitation target : the urban and rural challenge of the decade*., World Health Organization, WHO Press, Geneva, Switzerland
77. World Bank, 2017, *Sustainability Assessment of Rural Water Service Delivery Models, Findings of a Multi-Country Review*, International Bank for Reconstruction and Development / The World Bank Washington, DC; Internet: www.worldbank.org
78. WRM, 2011, *The Water Resources Management Act*, 2011, Government of Zambia, Parliament of Zambia, Government Printer, Lusaka
79. WSP, 2012, , *Zambia loses ZMK946 billion annually due to poor sanitation*, Economic Impacts of Poor Sanitation in Africa, Water and Sanitation Program, The World Bank, New York. This document is available online at www.wsp.org
80. WSS Act 1997, *The Water Supply and Sanitation Act, No. 28 of 1997*, Government of Zambia, Parliament of Zambia, Government Printer, Lusaka
81. Yokogi, S., 2013, *Proposal on Standardisation of hand pump specifications in consideration of water quality*, Ministry of Local Government and Housing / Japan International Cooperation Agency, Lusaka

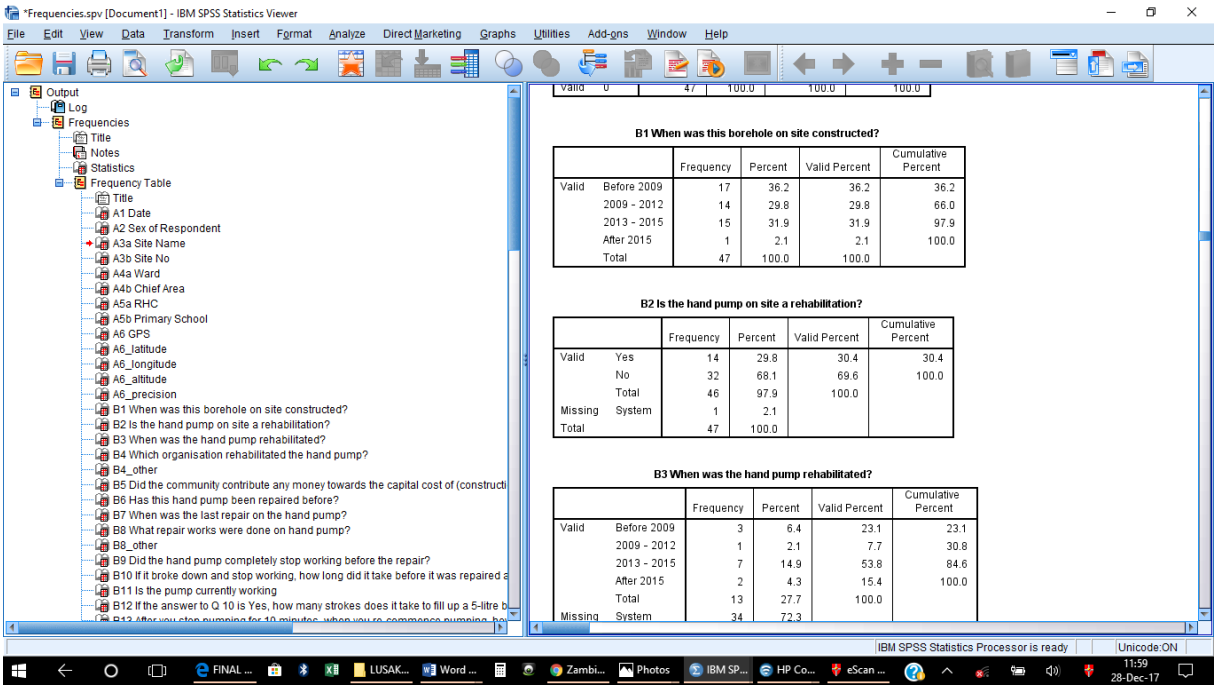
APPENDICES

Appendix 1 Screen shots of data analysis using SPSS



	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	A1	Numeric	12	0	A1 Date	None	None	12	Right	Scale	Input
2	A2	Numeric	12	0	A2 Sex of Respondent	{1, Male}...	None	12	Right	Nominal	Input
3	A3a	String	43	0	A3a Site Name	None	None	43	Left	Nominal	Input
4	A3b	Numeric	12	0	A3b Site No	None	None	12	Right	Scale	Input
5	A4a	String	20	0	A4a Ward	None	None	20	Left	Nominal	Input
6	A4b	String	11	0	A4b Chief Area	None	None	11	Left	Nominal	Input
7	A5a	String	19	0	A5a RHC	None	None	19	Left	Nominal	Input
8	A5b	String	13	0	A5b Primary School	None	None	13	Left	Nominal	Input
9	A6	String	22	0	A6 GPS	None	None	22	Left	Nominal	Input
10	A6_latitude	Numeric	12	5	A6_latitude	None	None	12	Right	Scale	Input
11	A6_longitude	Numeric	12	5	A6_longitude	None	None	12	Right	Scale	Input
12	A6_altitude	Numeric	12	0	A6_altitude	None	None	12	Right	Nominal	Input
13	A6_precision	Numeric	12	0	A6_precision	None	None	12	Right	Nominal	Input
14	B1	Numeric	12	0	B1 When was this borehole on site constr...	{1, Before 2...	None	12	Right	Nominal	Input
15	B2	Numeric	12	0	B2 Is the hand pump on site a rehabilitation?	{1, Yes}...	None	12	Right	Nominal	Input
16	B3	Numeric	12	0	B3 When was the hand pump rehabilitated?	{1, Before 2...	None	12	Right	Nominal	Input
17	B4	String	5	0	B4 Which organisation rehabilitated the ha...	{1, District ...	None	5	Left	Nominal	Input
18	B4_other	String	40	0	B4_other	None	None	40	Left	Nominal	Input
19	B5	Numeric	12	0	B5 Did the community contribute any mon...	{1, Yes}...	None	12	Right	Nominal	Input
20	B6	Numeric	12	0	B6 Has this hand pump been repaired befo...	{1, Yes}...	None	12	Right	Nominal	Input
21	B7	Numeric	12	0	B7 When was the last repair on the hand p...	None	None	12	Right	Nominal	Input
22	B8	String	5	0	B8 What repair works were done on hand ...	None	None	5	Left	Nominal	Input
23	B8_other	String	47	0	B8_other	None	None	47	Left	Nominal	Input
24	B9	Numeric	12	0	B9 Did the hand pump completely stop wo...	None	None	12	Right	Nominal	Input
25	B10	Numeric	12	0	B10 If it broke down and stop working, how...	None	None	12	Right	Nominal	Input

Screen Shot 1. Showing IBM SPSS Statistics Data Editor



B1 When was this borehole on site constructed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Before 2009	17	36.2	36.2	36.2
	2009 - 2012	14	29.8	29.8	66.0
	2013 - 2015	15	31.9	31.9	97.9
	After 2015	1	2.1	2.1	100.0
	Total	47	100.0	100.0	

B2 Is the hand pump on site a rehabilitation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	29.8	30.4	30.4
	No	32	68.1	69.6	100.0
	Total	46	97.9	100.0	
Missing	System	1	2.1		
Total		47	100.0		

B3 When was the hand pump rehabilitated?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Before 2009	3	6.4	23.1	23.1
	2009 - 2012	1	2.1	7.7	30.8
	2013 - 2015	7	14.9	53.8	84.6
	After 2015	2	4.3	15.4	100.0
	Total	13	27.7	100.0	
Missing	System	34	72.3		

Screen Shot 2. Showing IBM SPSS Statistics Viewer output generated

Appendix 2 List of Water Points and Communities Visited

No	GPS location	Water Point / Community Name	Ward	Name of Chief's Area
1	S15.28001, E28.78784	Ndubeni A	Kapete	Bunda Bunda
2	S15.26590, E28.76123	Mapulanga	Kapete	Bunda Bunda
3	S15.25106, E28.75545	Shanyama C	Kapete	Bunda Bunda
4	S15.18524, E28.76382	Njamu Village	Kapete	Bunda Bunda
5	S15.18647, E28.77547	Njamu Village	Kapete	Bunda Bunda
6	S15.19808, E28.78879	Chilikwela Village	Kapete	Bunda Bunda
7	S15.19484, E28.79195	Chilikwela B	Kapete	Bunda Bunda
8	S15.20285, E28.78167	Mwachilele Village	Kapete	Bunda Bunda
9	S15.34706, E28.62858	Chikonkoto Village S Jeke Section	Chainda	Nkomeshya
10	S15.33984, E28.62494	Mutanuka Village	Chainda	Nkomeshya
11	S15.34416, E28.62214	Mutanuka B	Chainda	Nkomeshya
12	S15.34114, E28.61642	Shiliya Market / Kanakantapa T/off	Chainda	Nkomenshya
13	S15.31701, E28.60166	Njobvu Village	Chainda	Nkomeshya
14	S15.32206, E28.60172	Njobvu Village (Shallow well with HP)	Chainda	Nkomeshya
15	S15.32213, E28.60463	Chainda Basic School	Chainda	Nkomeshya
16	S15.32251, E28.60662	Njobvu Village C	Chainda	Nkomeshya
17	S15.25055, E28.7606	Mapulanga Village 1	Kapete	Bunda Bunda
18	S15.25598, E28.75334	Shanyama Village 2	Kapete	Bunda Bunda
19	S15.26263, E28.77123	Kapulanga A	Kapete	Bunda Bunda
20	S15.27142, E28.76254	Mulola Basic School	Mulenje	Bunda Bunda
21	S15.28147, E28.75651	Kapini Mukopa	Mulenje	Bunda Bunda
22	S15.29686, E28.75651	Kapini Mukopa S Musonda	Kapete	Bunda Bunda
23	S15.27825, E28.71819	Nkondola	Kapete	Bunda Bunda
24	S15.27017, E28.71719	Nkondola A	Kapete	Bunda Bunda
25	S15.26774, E28.70637	Mwachikoka	Palabana / Tandabale	Nkomenshya
26	S15.44002, E28.53918	Pada	Palabana	Nkomeshya
27	S15.44789, E28.53475	Palabana Market	Mikango	Nkomeshya
28	S15.44736, E28.54732	Kilimanjaro	Lukoshi	Nkomenshya
29	S15.51177, E28.57495	Njolwe	Nchute	Nkomeshya
30	S15.54068, E28.59397	Muzembela Village	Manyika	Nkomenshya
31	S15.53497, E28.69835	Nchansu RHC	Manyika	Nkomenshya
32	S15.53640, E28.69865	Nchute Community BH	Manyika	Nkomenshya
33	S15.53017, E28.69846	Nchute Basic School	Tandabale	Nkomeshya
34	S15.38859, E28.7547	Nkomenshya Village	Nakatindi	NKomeshya
35	S15.3917, E28.76174	Kampekete	Nchute	Nkomenshya
36	S15.37195, E28.7632	Mali Village	Manyika	Nkomenshya
37	S15.36728, E28.76481	Mali B	Kapete	Bunda Bunda

No	GPS location	Water Point / Community Name	Ward	Name of Chief's Area
38	S15.38234, E28.78799	Kalulu	Manyika	Nkomenshya
39	S15.37879, E28.78668	Kalulu B	Manyika	Nkomenshya
40	S15.37066, E28.79783	Katalilo Village	Manyika	Nkomenshya
41	S15.36335, E28.8008	Katalilo A	Manyika	Nkomenshya
42	S15.35614, E28.78871	Kang'ombe 2	Manyika	Nkomenshya
43	S15.36133, E28.78272	Kang'ombe 1	Manyika	Nkomenshya
44	S15.27508, E28.75218	Mapulanga 1	Kapete	Bunda Bunda
45	S15.24835, E28.71285	Koto Village	Kapete	Bunda Bunda
46	S15.2354, E28.71251	Mushongo Farm	Kanakantapa	Bunda Bunda
47	S15.28526, E28.72541	Kapete Village	Kapete	Bunda Bunda

Appendix 3 University of Lusaka - Student Introductory Letter

UNIVERSITY
OF
LUSAKA

Plot No. 37413, Off Alick Nkhata Mass Media, P. O. Box 36711, Lusaka
Phone: +260 211 233407, 258409, Fax: +260 211 233409, E-mail: ictar@zamnet.zm, unilus@zamnet.zm

All correspondence should be addressed to the rector

5th September, 2017

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: DATA COLLECTION REQUEST- EFFECTIVENESS OF SOMAP MODEL TO SUSTAIN RURAL WATER SUPPLY IN ZAMBIA. A CASE OF CHONGWE DISTRICT.

This letter serves to introduce **JAVAN NKHOSI** Student Identity **MSCPM1613049** as a bona fide student of the University of Lusaka pursuing a Master of Science- Project Management.

JAVAN NKHOSI is required to submit a Dissertation as part of the requirements for the award of the degree and therefore seeks to collect data from your institution. His research title is stated above. The data will be used solely for Academic purposes and a copy of the final document can be availed to you upon request.

Any assistance given to him will be greatly appreciated.

UNIVERSITY OF LUSAKA
REGISTRAR POSTGRADUATE
05 SEP 2017
P.O. BOX 36711,
LUSAKA.

Sincerely,

pp
Mwamba Chanda (Mr.)

DEPUTY REGISTRAR

For responses or queries kindly contact the student on;

0966453646 OR
jnkhosi7@gmail.com

Passion for Quality Education! Our Driving Force

Appendix 4 Receipt for Conducting Research in Chongwe

CHONGWE DISTRICT COUNCIL
P.O. Box 1, Chongwe, Zambia
Tel: 211 620031

CDC/DC/90011 465898 12/09/17

Received from Mr. Kwacha Ngwee

the sum of Forty Kwacha only

in respect of Research fee

Sundry Debtors	Rates	Personal Levy	Sundries	Total
				K50

REPUBLIC OF ZAMBIA CHONGWE DISTRICT COUNCIL 12 SEP 2017 P.O. BOX 1 CHONGWE

District Treasurer

Printech Ltd

Appendix 5 Community Questionnaire

COMMUNITY QUESTIONAIRE

SECTION A RESPONDENT'S AND SITE IDENTIFICATION

1. Date: _____.
2. Sex of Respondent: Male [ ], Female [ ]
3. Site Name: _____ Site No._____
4. Ward: _____ Chief Area _____
5. RHC: _____ Primary School: _____
6. GPS: South _____ East: _____

SECTION B STATUS OF HANDPUMP IN COMMUNITY (OPTIONAL)

1. When was this borehole on site constructed?	1. Before 2009 2. 2009 – 2012 3. 2013 – 2015 4. After 2015	*Answer by number*
2. Is the hand pump on site a rehabilitation?	1. Yes 2. No 3. Unknown	*Answer by number*
If answer to Q above is Yes, go to Qs 3 - 5, otherwise skip to Q 6		
3. When was the hand pump rehabilitated? *Note: difference between repair(costs less than K500) and rehabilitation (costs more than K500)*	1. Before 2009 2. 2009 – 2012 3. 2013 – 2015 4. After 2015	*Answer by number*
4. Which organisation rehabilitated the hand pump?	1. District Council 2. NGO 3. Church Organisation 4. Other _____	*Answer by number*
5. Did the community contribute any money towards the capital cost of construction borehole or rehabilitation of hand pump?	1. Yes 2. No 3. Do not known	*Answer by number*
6. Has this hand pump been repaired before?	1. Yes. 2. No. 3. Do not know.	*Answer by number*
If answer to Q above is Yes, go to Qs 7.		
7. When was the last repair on the hand pump?	1. 2015 2. 2016 3. 2017	*Answer by number*
8. What repair works were done on the hand pump?	1. Replace the chain. 2. Replace worn out rubbers 3. Replace t bearings 4. Replace cracked pipe and rods 5. Other _____	*Multiple answer...*
9. Did the hand pump completely stop working before the repair?	1. Yes 2. No 3. Do not know	*Answer by number*

10. If it broke down and stop working, how long did it take before it was repaired and working again?	1. Less than 1 week 2. 2 weeks 3. 3 weeks 4. 4 weeks 5. More than a month	*Answer by number*
HANDPUMP FUNCTIONALITY		
11. Is the pump currently working	1. Yes 2. No	*Answer by number*
If answer to above Q is Yes, go to Q 12, otherwise skip to 13		
12. If the answer to Q 10 is yes, how many strokes does it take to fill up a 5-litre bucket?	1. 11 – 20 strokes 2. 21 – 30 strokes 3. 31 – 40 strokes 4. More than 40 strokes	*Answer by number*
13. After you stop pumping for 10 minutes, when you re-commence pumping, how many strokes do you pump before water starts flowing from hand pump?	1. Immediately 2. 1 - 3 strokes 3. 4 – 7 strokes 4. 7 – 10 strokes 5. More than 10 strokes	*Answer by number*
14. Open the hand pump cover and check the chain. Is there fresh grease on the chain?	1. Yes 2. No	*Answer by number*
WATER AVAILABILITY AND USAGE		
15. How available is the water from the borehole in a year?	1. Available all year round. 2. Available part of the year only	*Answer by number*
16. Is the quantity of water adequate for everyone in the community in dry season	1. Yes. 2. No	*Answer by number*
17. What is the water from borehole used for presently?	1. Drinking / cooking / Washing / bathing 2. Livestock watering / gardening only 3. Others _____	*Answer by number*
18. Are there other water sources in use in the community / Institution / village?	1. Yes 2. No 3.	*Answer by number*
WATER QUALITY		
19. Is the water from the borehole good?	1. Yes 2. No	*Answer by number*
If answer to above Q is Yes, Skip Q 20		
20. If the water is not good, what is the problem with the water from the borehole?	1. Salty 2. Muddy / milky 3. Rusty 4. With a smell / odour 5. Other _____	*Answer by number*
21. Does the EHT from the RHC come to collect water samples for water quality tests?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to above Q is Yes, go to Q 22.		

22. How many times has the EHT collected water samples from the hand pump this year?	1. Once a year 2. Two times 3. Three times 4. Four times	*Answer by number*

SECTION C COST CONTRIBUTION BY COMMUNITIES

1. Has the community contributed money towards the repair of the hand pump before? *(One off payment)*	1. Yes 2. No 3. Do not know	*Answer by number*
2. Do the community members *make regular* contributions towards the cost of maintenance of hand pump?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to above Q is Yes, go to Q 3, otherwise skip to 9		
3. Who collects the monetary contributions?	1. Care taker 2. APM 3. Treasurer of the V-WASHE 4. Others _____	*Answer by number*
4. How is the money kept safe at community level?	1. Taken to Bank 2. Kept in the house of treasurer. 3. Taken to District Council offices 4. Others _____	*Answer by number*
5. Is the received money recorded in a notebook?	1. Yes. 2. No. 3. Do not know	*Answer by number*
6. Approximately how much money has the community contributed so far?	1. Less than K100 2. K100 - K200 3. K200 - K500 4. More than K500	*Answer by number*
7. How is the collected money used?	1. Payment for transport, repairs and spare parts 2. Buy spare parts only 3. Pay APM to repair hand pump 4. Others _____	*Answer by number*
8. How much do they contribute as a household per month? (*Please estimate if this is done annually*)	1. 50 Ngwee 2. K1.00 3. K2.00 4. K5.00 5. Other _____	*Answer by number*
9. Does the community allow contributions in kind for those who cannot afford monetary contributions?	1. Yes. 2. No. 3. Do not know	*Answer by number*
10. Does the community engage in any income generating activities to raise money for hand pump repairs?	1. Yes. 2. No. 3. Do not know	*Answer by number*
If answer to above Q is Yes, go to Q 11		
11. If answer to Q above is yes, what income generating activities does the community engage in?	1. Raising livestock – goats, chickens, 2. Keeping bees. 3. Cash for work – piecework. 4. Small business venture (_____) 5. Other _____	*Answer by number*

SECTION D SPARE PARTS SUPPLY CHAIN

1. Do you know whether there is a SOMAP hand pump spares container at the Council, in Chongwe?	1. Yes. 2. No 3. Do not know	*Answer by number*
If answer to above Q is Yes, go to Q 2, otherwise skip to 4		
2. How did you know about it?	1. Advertised over the radio 2. Advertised on posters at the RHC 3. Councillor informed us 4. APM informed us 5. Other _____	*Answer by number*
3. Is this where you obtain spare parts for the hand pump?	1. Yes. 2. No 3. Do not know	*Answer by number*
If your answer to Q above is No, go to Q 4, otherwise skip to Q 5		
4. Then, where did you find spare parts for your hand pump?	1. In Lusaka 2. Do not know 3. Other _____	*Answer by number*
5. How many times have you obtained spare parts from the SOMAP spares container in Chongwe?	1. One time 2. Two times 3. Three times 4. More than three times	*Answer by number*
6. Did you find hand pump spares each time you went to the spares shop?	1. Yes. 2. No 3. Do not know	*Answer by number*
7. Did you ever find the spare parts you wanted out of stock at SOMAP shop?	1. Yes. 2. No	*Answer by number*
If your answer to above Q is Yes, go to Q 8, otherwise skip to Q 10		
8. How often has this occurred to you?	1. One time 2. Two times 3. Several times	*Answer by number*
9. What spare part did you fail to find in the SOMAP shop?	1. Pipes and rods 2. Rubbers 3. Chain 4. Other _____	*Answer by number*
10. Do you know the cost of spare parts from Chongwe SOMAP shop?	1. Yes. 2. No.	*Answer by number*
If the answer to above Q is Yes, go to Q 11, otherwise skip to Q 12		
11. If the answer to Q above is yes, how did you know them?	1. Spare parts prices are displayed. 2. Through the SOMAP shop fliers. 3. Cost is displayed at the RHC. 4. Through the APM 5. Other _____	*Answer by number*
12. Has the presence of the SOMAP spares shop in Chongwe helped to sustain the hand pump in the village?	1. Yes. 2. No. 3. Do not know	*Answer by number*

SECTION E MONITORING / MANAGEMENT MECHANISM

1. Was there a Water Committee / Village – WASHE Committee formed to oversee the operation and maintenance of the hand pump in the community?	1. Yes. 2. No 3. Do not know	*Answer by number*
If answer to above Q is Yes, go to Q 2, otherwise skip to 6		
2. Is the *Water Committee / Village – WASHE Committee* active since its formation?	1. Yes 2. No 3. Do not know	*Answer by number*
3. How were the water committee members selected?	1. Community elected them 2. Councillor selected them 3. Head person appointed them 4. Do not know	*Answer by number*
4. How many members are in the committee	1. 3 members 2. 5 members 3. 7 members 4. 10 members	*Answer by number*
5. How many women are the Water committee	1. 3 members 2. 5 members 3. 7 members	*Answer by number*
6. Is there a caretaker for this hand pump?	1. Yes 2. No 3. Do not know	*Answer by number*
7. Is there an APM in the village or other nearby villages to repair hand pump?	1. Yes 2. No 3. Do not know	*Answer by number*
8. Does the APM own a toolkit for repairing the hand pumps?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to above Q is No, go to Q 8, otherwise skip to Q 9		
9. If the APM does not own any toolkit, where does s/he get a toolkit?	1. Head person 2. RHC 3. School 4. RWSS Chongwe	*Answer by number*
10. How does the community view the APM, is s/he a private business individual or a community or volunteer worker?	1. Private business person 2. Community worker 3. Volunteer	*Answer by number*
11. Whom is the APM answerable to?	1. Village head person 2. EHT 3. RWSS Coordinator 4. No one 5. Other _____	*Answer by number*

SECTION F ADOPTED STANDARD FOR HAND PUMPS

1. What is the type of hand pump used on this borehole?	1. India Mark II 2. Afridev Hand pump 3. Modified India Mark II 4. Others _____	*Answer by number*
2. Are you able to find spare parts for the hand pump in the community in the Chongwe SOMAP spare parts shop?	1. Yes 2. No 3. Do not know	*Answer by number*
3. If answer to Q above is No, where can you buy the spare parts for your hand pumps?	1. Hardware shops in Chongwe 2. Hardware shops in Lusaka 3. Do not know 4. Others _____	*Answer by number*
4. Is this hand pump the original hand pump that was installed on the borehole?	1. Yes. 2. No 3. Do not know	*Answer by number*
If answer to above Q is No, go to Q 5 and 6, otherwise skip to Q 7		
5. If the answer to the above Q is No, what make of the hand pump was there before?	1. India Mark II 2. Afridev Hand pump 3. Modified India Mark II 4. Other _____	*Answer by number*
6. What could be the reason for the change of the hand pump in the community?	1. Lack of spare parts 2. Upgrade of the type of hand pump 3. Other _____	*Answer by number*
7. Is the local APM able to repair the type of hand pump in the Community?	1. Yes 2. No 3. Do not know	*Answer by number*
8. Are there challenge / weakness that you have observed with the current hand pump?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to Q above is Yes, then go to Q 9		
9. What are the challenges that you find on this hand pump?	1. Hand pumps produce rusty water. 2. Hand pump easily break down 3. Lack of spare parts in the district 4. Other _____	*Answer by number*

SECTION G CAPACITY BUILDING

1. As a member in this community have you been sensitised on the how to sustain the hand pump in the community?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to Q above is Yes, then go to Q 2, if the answer is No go to Q 7		
2. Which year were you sensitised / trained on the how to ensure the sustainability of the hand pump?	1. Before 2009 2. 2010 – 2012 3. 2013 – 2015 4. 2016	*Answer by number*

3. How were you sensitised on the how to ensure the sustainability of the hand pump?	1. Through a public meeting 2. RWSS Drama group 3. Project Team 4. The information from the Councillor 5. Other _____	*Answer by number*
4. Who sensitised/ oriented on the how to ensure the sustainability of the hand pump?	1. Chongwe RWSS Team 2. The Water Project 3. World Vision / Child Fund 4. Other _____	*Answer by number*
5. What are some of the activities you can be involved in to sustain the operation and maintenance of the hand pump in the community?	1. Contribute towards the cost of repair. 2. Keep surrounding of hand pump clean 3. Report broken pump to APM / EHT 4. Other _____	*Answer by number*
6. Was the *Water Committee / V-WASHE* committee been trained and oriented in SOMAP activities?	1. Yes 2. No 3. Do not know	*Answer by number*
If answer to Q above is Yes, then go to Q 7		
7. Who trained and oriented the V-WASHE committee in SOMAP activities?	1. PST / MWDSEP staff 2. District Council / D-WASHE 3. NGO / World Vision / Child Fund 4. Do not know 5. Other _____	*Answer by number*
8. In the Water Committee / V-WASHE, committee is there someone trained to oversee the management of the sustainability of the Water Point?	1. Yes 2. No 3. Do not know	*Answer by number*
9. In the Water Committee / V-WASHE, committee is there someone trained in Financial Management (Collect and Record Contributions) for the Water Point?	1. Yes 2. No 3. Do not know	*Answer by number*
10. In the Water Committee / V-WASHE, committee is there someone trained in Technical Management (Periodic Maintenance) for the Water Point?	1. Yes 2. No 3. Do not know	*Answer by number*

END OF QUESTIONNAIRE