CONSTRAINTS AND OPPORTUNITIES TO THE SUSTAINABILITY OF RURAL WATER SUPPLY SERVICES IN TANZANIA

A CASE STUDY OF BUNDA DISTRICT

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Master (Integrated Water Resources Management)
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By

Tanu Ibrahim Deule

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master in Integrated Water Resources Management of the University of Dar es Salaam

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by the University of Dar es Salaam a dissertation entitled: **Constraints and Opportunities to the Sustainability of Rural Water Supply Services in Tanzania: A case study of Bunda District** in partial fulfilment of the requirements for the Award of Degree of Master in Integrated Water Resources Management of the University of Dar es Salaam**.**

…….

Dr. Richard Kimwaga

(Supervisor)

Date: ----------

Dr. Nobert Joel

(Supervisor)

Date: ----------

DECLARATION

AND

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I**, Tanu Ibrahim Deule**, declare that this dissertation is my own original work and that it has not been presented and will not be presented by me to any other University for a similar or any other degree award.

Signature ----------

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DEDICATION

To my father Ibrahim and my late mother Paulina Mwagala for laying education foundation in my life. My beloved wife Herieth for her moral support that contributed much in making this study successful. Also my son and daughter Ibrahim and Laura for their love and endurance. God bless them!

ABSTRACT

This study aimed to characterize water supply services, investigate on the constraints to the sustainability of rural water supply services, and determine Sustainability Index of rural water supply services in the study area. The study involved collection, processing and analysis of data for the four dimensions namely; applied technology, socio-environment, institutional arrangement and financial dimension. Tools administered, included questionnaires, interviews, literature review and physical observations. Identified Sustainability constraints were analyzed using Microsoft Excel Spreadsheet and Statistical Package for Social Sciences (SPSS) version 11.5 and the weighted table method of Mult-Criteria Analysis was deployed to assess Sustainability Index by making use of Analytical Hierarchy Process Framework.

Identified constraints include; slack institutional arrangements, inadequate funding, poverty level of communities affecting willingness and ability to pay for improved water services. The traditional behaviour of ignoring routine maintenance of water-works, compounded with lack of spareparts, lack of repair kits, lack of maintenance manuals, the obsolete water systems, constrained technological options and inadequate expertise. Remote water points endangered to vandalism and theft. Inadequate water and environmental management entities at community level to deal with encroachers of water sources areas and environmental polluters and destructors. Sustainability index of water supply services in the study area attained 58% meaning ***not sustainable***. Critical dimension was social-environment scoring less than half its weight. The study corroborate a four way partnership between Central Government, LGA/District Council, User Communities and Private Sector in operating and managing rural water facilities as the antidote for sustainability.

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ABBREVIATIONS AND ACRONYMS

AWEC	Annual Water Experts Conference
BH	Bore Hole
BWO	Basin Water Officer
CBO	Community Based Organization
CMT	Council Management Team
COM	Community Ownership and Management
DC	District Council/District Commissioner
DDH	District Designated Hospital
DED	District Executive Director
Dev	Development
DP	Draw Point or Domestic Point
DRA	Demand Responsive Approach
DV	Development Vision
DWE	District Water Engineer
DWST	District Water and Sanitation Team
ESA	External Support Agencies
EWURA	Energy and Water Utilities Regulatory Authority
FC	Fecal Coliforms
FGD	Focus Group Discussion
FTC	Full Technician Certificate
GIS	Geographical Information System
HESAWA	Health and Sanitation through Water

HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
HP	Hand Pump
ICT4RD	Information and communication Technology for Rural Development
IRC	Institute for Resource Centre
IWRM	Integrated Water Resources Management
IUCN	International Union for Conservation of Nature
KASHUWASA	Kahama - Shinyanga Urban Water Supply Authority
KI	Key Interview
KIBWUA	Kibara-Busambara Water User Association
MNWUA	Makongoro Nyamuswa Water User Association
LAAC	Local Authority Accounting Committee
LGRP	Local Government Reform Programme
LVBWB	Lake Victoria Basin Water Board
LVBWO	Lake Victoria Basin Water Office
LVEMP	Lake Victoria Environnemental Management Project
MARAFIP	Mara Farmers Initiative Programme
MDG	Millennium Development Goals
MIS	Management Information System
MKUKUTA	Mkakati Kukuza Uchumi na Kupunguza Umasikini Tanzania (NGPRS in English)
MoWI	Ministry of Water and Irrigation
MPA	Method for Participatory Assessment

NAWAPO	National Water Policy
NETWAS	Network for Water and Sanitation
NGO	Non Governmental Organization
NRWSSP	National Rural Water Supply and Sanitation Programme
NSGRP	National Strategy for Growth of Economy & Reduction of Poverty
O & M	Operations and Maintenance and OC is other charges
pH	the potential of electric for positive Hydrogen ions
POM	Program Operation Manual
PRS	Poverty Reduction Strategy
PS	Permanent Secretary
PSP	Private Sector Partnership
QARQC	Quantity Access Reliability Quality and Cost
QTY	Quantity
RWA	Regional Water Advisor
RWSN	Rural Water Supply and Sanitation Network
SI	Sustainability Index
SPSS	Statistical Package for the Social Science
SWOT	Strength Weaknesses Opportunities and Threats
TAEEs	Tanzania Association for Environmental Engineers
TASAF	Tanzania Social Action Fund
TC	Total Coliforms
TOR	Terms of Reference
UDSM	University of Dar es salaam

UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children Education Fund
URT	United Republic of Tanzania
VEO	Village Executive Officer
VG	Village Government
WATSAN	Water and Sanitation
WEDC	Water and Environment Development Committee
WDMI	Water Development and Management Institute
WEO	Ward Executive Officer
WHO	Word Health Organization
WSDP	Water Sector Development Programme
WS & S	Water Supply and Sanitation
RWS	Rural Water Supply
WSS	Water Supply and Sanitation
WUE	Water User Entity
WWW	World Wildlife Fund

STRUCTURE OF THE STUDY

Chapter One – Introduction; gives the general overview of the water sector in global context, in Africa as a continent and Tanzania in particular.

Chapter Two - Literature Review; presents experiences in the country pertaining to sustainability crisis, ways used in the past to overcome it and intricacies that jeopardizes.

Chapter Three - Research and Methodology; discusses approaches that were used to accomplish the study, detailing on methods, tools, and aids that were deployed to collect data, process and analyze them.

Chapter Four - Results and Discussion; covers the findings of the study

Chapter Five - Conclusions and Recommendations; describes about suggestive ways to solve the problem of poor sustainability in rural water supply sub sector.

Appendices: Here are about eight appendices entailing organization structures, sustainability index analytical framework, sustainability checklist, list of functioning and non functioning water points according to water point mapping conducted by WaterAid Tanzania in 2008. District water supply coverage and the questionnaires are included.

CHAPTER ONE

INTRODUCTION

1.1 General Introduction

1.1.1 Water Supply in a Global Context

Out of the estimated global rural population of 3.2 billion in the year 2000 approximately 2.3 billion had access to water supply representing 71% of the world's rural population. This mean were still about 1 billion people without safe drinking water inspite the growing levels of investment and considerable progress made in the water supply sector all over the world in the past four decades (UNICEF & WORLDBANK, 2004). Although water is no doubt a precious commodity, you would wonder to see it is perhaps one of the most mismanaged resources globally.

Worldwide the conviction is growing that the availability of sufficient quantities of clean, potable water should be considered one of the basic human rights. As a result many governments and international organizations facilitate implementation and expansion of water supply systems. Most government, however, focus on water supply to urban population, arguing that, lack of water in these densely populated areas may result into serious unhygienic, unsanitary conditions leading to epidemic breakout of water borne and water related diseases.

Consequently, little attention is paid to water supply in rural areas where the vast majority live. This is particularly so in developing countries. Improvement in water supply water supply services is core element in most of the well designed strategies for poverty alleviation. In this study, sustainability of the drinking water supply service is viewed as amalgam of technical, financial, social/environmental, and institutional dimensions.

1.1.2 Water supply in African Context

MDG targets for water and sanitation in Africa can only be reached by making good progress in rural water supply. Unfortunately, this is where progress is most difficult. Across Africa, rural households lag well behind urban ones in coverage and quality of water services and the situation for remote and poorest communities is even worse.

Gaps are seen everywhere in a struggle to achieve MDG goal of halving people without sustainable access to clean water by 2015. Although, several sub-Saharan countries are making progress over historically low rates of access to clean water, and rapidly growing population the aim to halve from the 1990 figure the population without access to water and sanitation by 2015 for adequate and affordable safe drinking water and sanitation, will be hard to achieve in Africa due to low levels of existing coverage, and will become almost impossible if sustainability levels cannot be improved (Harvey & Reed, 2007).

In spite of decades of government and donor-supported investments in water supply, many African countries have been unable to fully meet the demand for water supply

services. One of the resulting effects of the poor service is that Africa has the lowest water supply and sanitation coverage in the world. According to Mwanza (2001), more than 1 in 3 Africans do not have access to improved water supply facilities. Current coverage level stands at 62% for water supply. This level of coverage includes urban areas where coverage is higher. The reality is that the absolute number of people without access to water services is increasing and between now and the year 2020 the number will increase from 300 million to 400 million, majority being in rural areas.

In the report prepared by UNDP & UNICEF (2002) for Africa showed access to improved water in urban areas slightly declined during the 1990s, as the urban population increased faster than the expansion of safe water supply systems, especially in marginal and Peri-urban areas. Although the trend has been more positive in rural areas, the pace of progress there has been slow. The report further noted that with regard to observed rate of increase, and then the goal of reducing by half the proportion of people without access to improved water will not be achieved until 2050s. The figure below shows the status quo in Africa and the pace that is supposed to be in order to achieve the MDG goal of halving 1990 un-served population by the year 2015

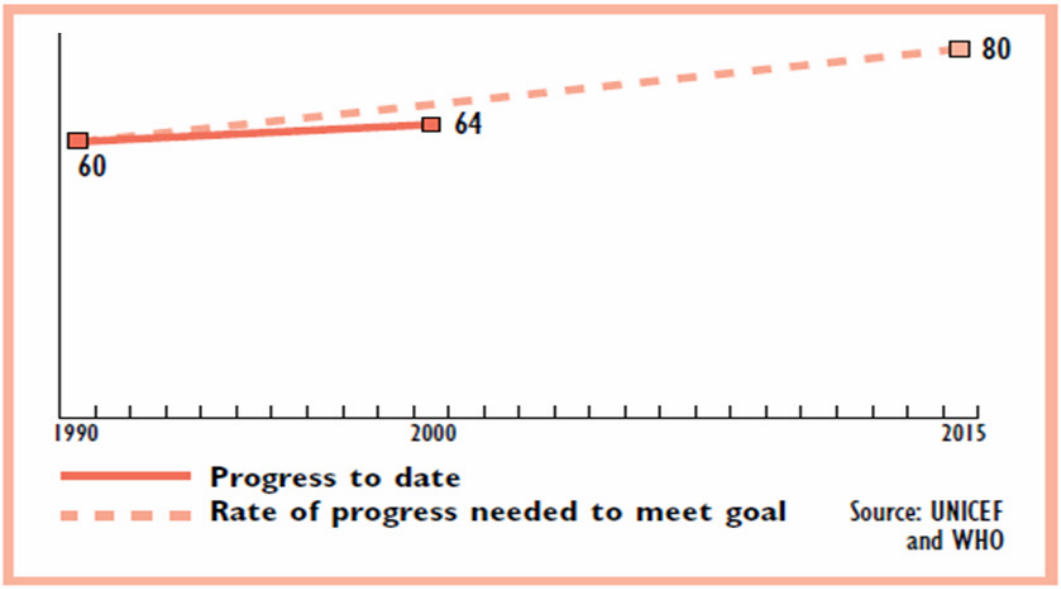


Figure 1-1: Access to improved water Supply Services in Africa

1.1.3 Water supply Sector in Tanzania

Over the last four decades there have been many initiatives by the government in various regions of Tanzania to improve water supply service coverage, both using own funds and with assistance of External Support Agencies (ESAs). Despite all these efforts the water supply coverage in Tanzania has remained low and only about half of the population has access to safe, adequate and reliable water supply service. In essence, 58% of rural population were recorded in the year 2008 to have access to improved water supply services. MKUKUTA target is to increase proportion of rural population with access to clean and safe water from 53% in 2003 to 65% in 2010(Water sector status report, 2009).

1.1.3.1 Rural Water Supply in Tanzania

Rural water supply sector in Tanzania has for long time been supported through traditional approach of building water systems. Government has been paying more attention to building new facilities than ensuring the existing ones are functioning. This approach focused on designing and constructing systems based on perceived needs and which were usually linked to perceived health improvements. Little consideration was given to community demand which is key factor in sustainability of services. As a result RWS has frequently resulted into services that have not been sustained. The Roles for project planning, implementation, cost recovery, operations and maintenance (O&M), and facility ownership have also been poorly defined and communicated. Although communities have usually been expected to provide cash or in-kind contribution, it has often been unclear how the level of contribution has been determined or how the level relates to demand. Decentralization by devolution in the country has brought governance of water service to local government authorities (LGAs) who are handicapped by lack of adequate technical and financial support. LGAs where these water systems are built have been assumed to "manage" their facilities, but the capacity is questionable. Shortages of funds is common in Bunda and in other cases capacity building funds are lately disbursed when training period has passed and sometimes capacity building funds are reallocated for infrastructure development.

For a long time, the government has been the owner and operator of rural water supply systems. This has led to lack of commitment by communities to sustain their facilities and has also led to overlapping of roles and inadequate coordination. Many

existing water supply systems are unable to meet the demands of a growing population.

Projects and programmes have typically been implemented by a variety of government agencies and non-governmental organisations using inconsistent approaches which have not always included the participation and system ownership by the beneficiaries. Overlaps of responsibilities and interventions have also meant inefficient application of resources across the sub-sector. Often, user charges are not sufficient to adequately cover operation and maintenance (O&M) costs. For large schemes, government subsidy still flow to offset electricity bills, chemicals and salaries. The availability of spare parts at the district level is often problematic, contributing to O&M problems (MoWI, 2007). Below is a map showing percentages of rural communities with access to improved water supply services

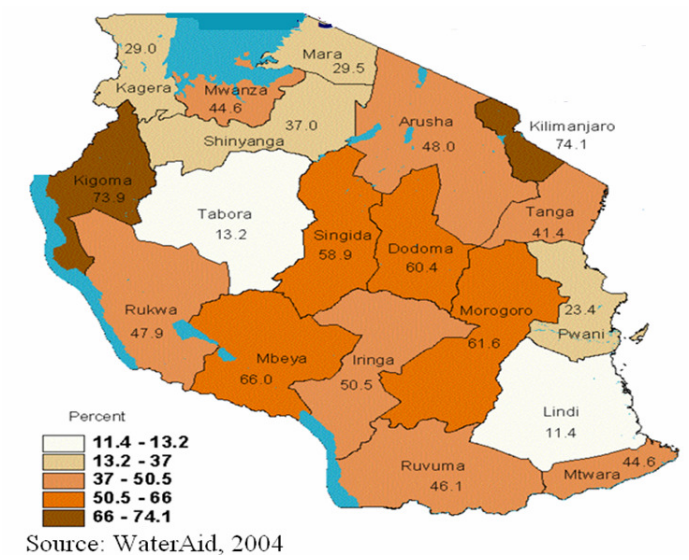
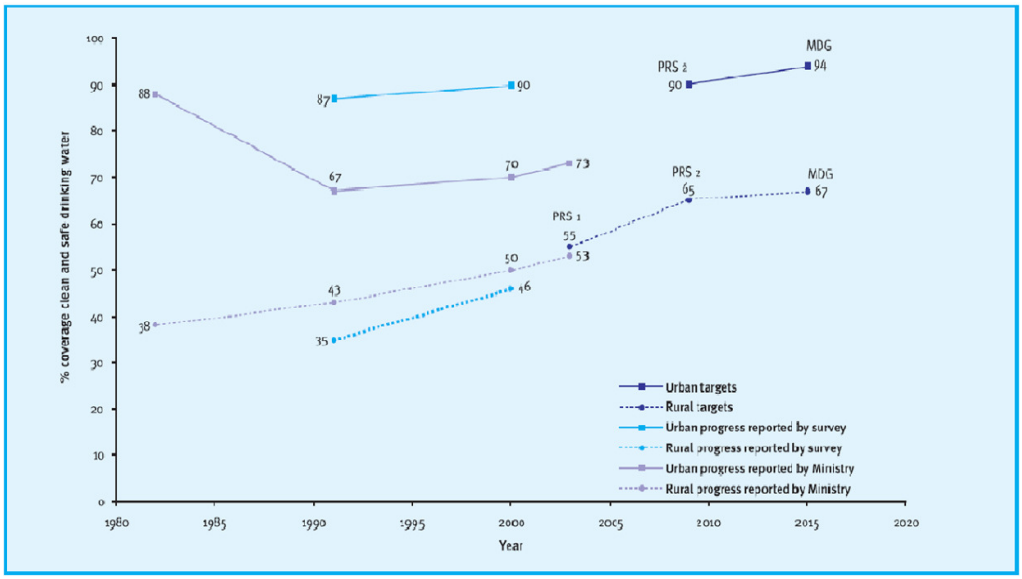


Figure 1-2: Percentage of households using improved Water sources

In the figure above, Dar es salaam region is not shown because it was the only city at that time and so was assumed to have little majority in rural settlements. But, Mara region where Bunda is one of its 5 districts had only 29.5% population with access to improved water supply services. Mara is ranked next to the least served regions of Lindi and Tabora.

Integrated approach to the management of water resource is still new approach and has not been applied to good extend (Sokile et al, 2005). Haysom (2006) reported that improving the sustainability of rural water supplies has a number of consequences. Invariably sustainability of water supply schemes depends upon communities taking financial responsibility for their schemes, which if achieved will help the schemes to serve longer and hence relieve the government from the burden of O & M.

Recently the GoT launched a 20years water sector development programme (WSDP), which is however facing a number of constraints in expediting its implementation to meet its set out water supply targets. Water supply targets are those of National Strategy for Growth and Reduction of Poverty (NSGRP) which in Swahili is known as "Mkakati wa Kukuza Uchumi na Kupunguza Umasikini Tanzania- MKUKUTA" of 65% water supply coverage by 2010, Millennium Development Goal (MDG) of 74% water supply coverage by mid 2015 and Development Vision (DV) of 90% water supply coverage by 2025 (URT-MDG Progress Report, 2008:). Figure below shows progress towards the set targets.



Source: WaterAid, 2004

Figure 1-3: Urban & Rural Water Supply Targets' Progress in Tanzania

1.1.3.2 National Water Policy of Tanzania

1.1.3.3 Tanzania National water policy of 2002 states clearly four principles of Social, Economic, Environment and Sustainability and this study covers the principle of sustainability. Sustainable development and delivery of rural water supply services depend on clear definition of the roles and responsibilities of the various actors and stakeholders. The policy recognises the following pre-requisites for the sustainable rural water supply service as;

(i) Adopting the principle of managing water schemes at the lowest appropriate level,

(ii) The beneficiaries themselves establishing, owning and managing their water schemes,

(iii) Ensuring full cost-recovery for operation and maintenance, and replacement,

(iv) Facilitating availability of spare parts and know how for timely repair and maintenance of the schemes through standardization of equipment and promotion of private sector involvement,

(v) Protection of water sources areas,

(vi) Reconciling the choice of technology and the level of service with the economic capacity of the user groups, and

(vii) Recognizing women as being among the principal actors in the provision of rural water supply services

Further, the water policy advocates that Water is considered as a basic need. The policy goal is to ensure universal access to clean safe water supply by 2025 within 30min return journey or in a radius not exceeding 400m from one's home. And the principles governing sustainability while implementing the project being demand-responsive approach to selecting communities and autonomy of service providers

The policy further define that sustainability is not just reaching the design life of a technology, but is about the ongoing availability of clean, affordable and accessible water. The Policy further reports that approximately 80% of Tanzania's population lives in rural areas.

1.1.4 Rationale of the Study Area

According to the study conducted in 2005 by the Research and Analysis Technical Working Group of the MKUKUTA monitoring System in the Ministry of Planning, Economy and empowerment of Tanzania, reported Bunda the poorest district in Tanzania with majority of households ***living below basic needs poverty line***. And the

researcher wanted to explore in the area of basic human services, specifically water supply services in rural areas. The aim being to investigate how communities manage to sustain their water supply services notwithstanding their poverty status. In spite of Bunda having abundant surface water from Lake Victoria and the existence of several water supply options ranging from gravity schemes, groundwater, diesel and electrically pumped schemes, shallow wells for hand pumps, Bunda still has water supply coverage of 47.43% well below the national average. This phenomenon also instigated the need for a study in the area.

1.1.5 Description of study area

1.1.5.1 General Background

Bunda is one of the 6 local government authorities of Mara Region in the northern part of Tanzania. It is bordering Musoma (Rural) District in the North, Serengeti District in the East, Serengeti national park in east-south, Magu and Bariadi Districts in the South and Ukerewe district in the West. Bariadi district is in Shinyanga region, Magu and Ukerewe are districts of Mwanza region. Administratively, Bunda is divided into 4 divisions, 20 wards, 86 villages, 470 hamlets and there are 14 sub villages forming Bunda Township.

The district is located south of Mara region at longitude $0^0$30’30” and $0^0$35’ 15’’ east of Greenwich and is between Latitude $0^0$1’30’’ and $0^0$2’45’’ south of equator. Headquarters of Bunda district is located in Bunda town and is 68 kilometers to Musoma Municipality, the regional headquarters. Annual rainfall in the district ranges between 900- 1300mm and the district covers an area of 3,088 km^2 of which

2,888 is dry land and 200 km^2 is occupied by Lake Victoria. 480km^2 of the dry land is occupied by Serengeti National Park and the remaining 2,408 km^2 of dry land is constituted of forest, hills reserve, farming, grazing, road networks and human settlements.

Population in the district is 258,930 people of which 123,978 are men and 134,952 women (2002 Census) and main occupations include agriculture, livestock and fishing. The annual population growth rate of the district stands at 1.8% and the average population density is 90 people/ km^2. There are 42,605 households with an average size of 6.1 people per household. The district is divided mainly into two zones; the middle zone has altitude 1,219-1524M AMSL and lower zone has altitude ranges 1,120-1300M AMSL. Middle zone has an estimated area of 1,570 and receives average annual rainfall of 900-1,250mm p.a. In this zone you find Chamriho, Balili and Changuge hills and the temperature in this zone during June to October is around 18^0C and on January to March is 33^0C on average.

The lower zone has an estimated area of 1,318km^2 and mainly around lake Victoria. Rain in this area is below 900mm p.a and the heat during June to October is 30^0C and January to March is 35^0C on average. Mainly this zone is flat with low hills namely Ragata, Iramba and Mumagunga in Kenkombyo division. Others are Kurwirwi, Makala and Nambubi in Nansimo division. UN-HABITAT (2008) and Bunda DC LAAC Report (2006).

1.1.5.2 Socio-Economic and related particulars

Like any other district, Bunda depend mainly on agricultural activities however other sectors are fisheries & livestock keeping. These three sectors employ about 81% of the rural population see table below.

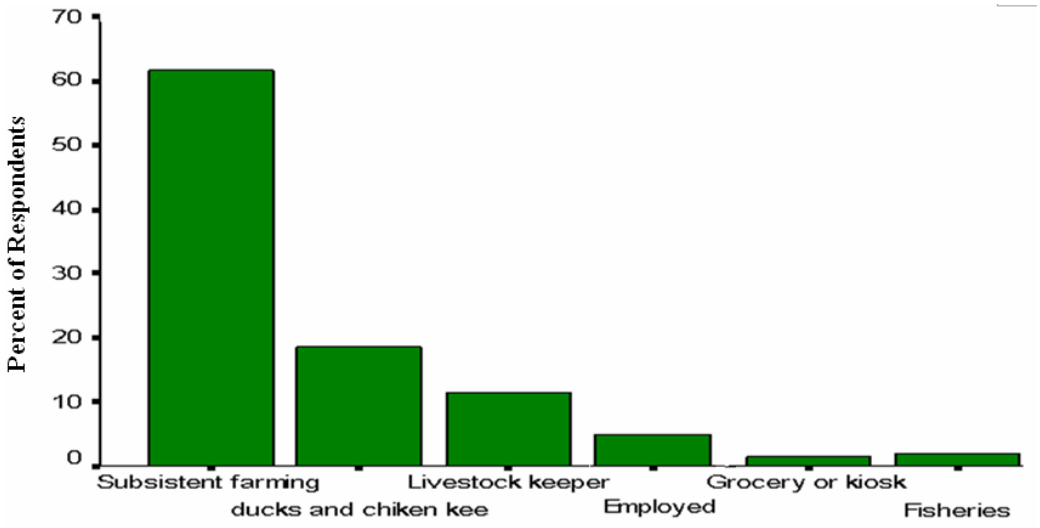
Table 1-1: Sectoral Contributions to GDP in 2007

No.	Sector	Contribution to District GDP	Percentage
1	Agriculture	14,343,400,000	38.0
2	Livestock	10,678,341,000	28.2
3	Fisheries	5,570,813,000	14.7
4	Forestry	57,905,500	0.2
5	Industries	4,250,875,000	11.2
6	Employment	1,915,800,000	5.1
7	Others	972,000,000	2.6
	Total	**37,789,134,500**	**100.0**

Source: Bunda DC Reports, 2008

The district per capita income per annum in 2007 was Tsh. 125,343 below the national average of Tsh.253,000. Electric power supply is through national grid of which apart from lighting of Bunda town lights other villages like Guta, Kibara, Nyamuswa, Mugeta and Kisorya are also connected.

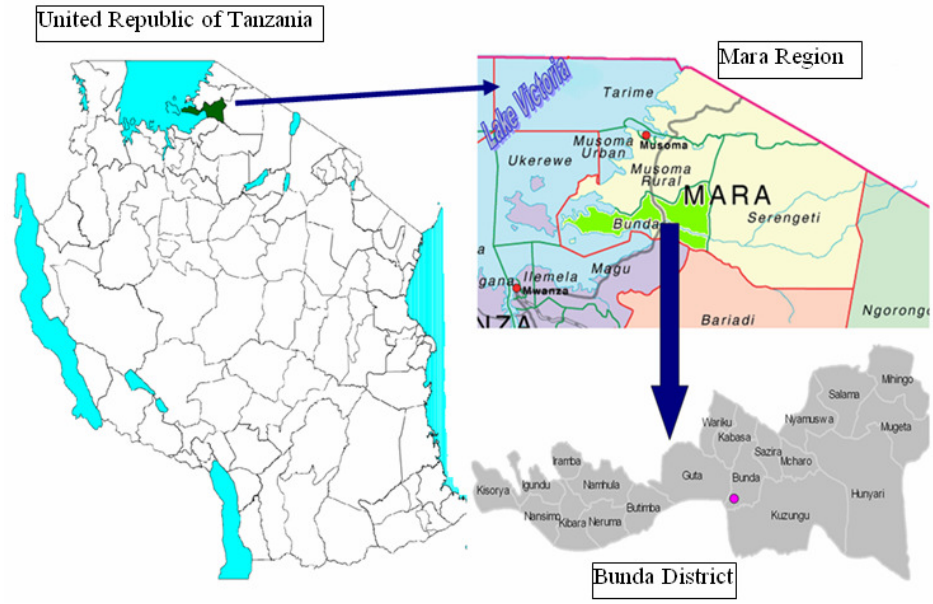
Dominant ethnic groups are; Kurya, Guta, Kizu, Shashi and Kerewe. Majority population of Bunda grows cotton as cash crop and food crops such as maize, cassava and millets. There is also cattle and goats grazing in the area. Residents on the shoreline of Lake Victoria depend mainly on the lake and their counterparts on the mainland depend on improved traditional wells and drilled shallow, medium and deep boreholes as source of water. See figure below for socio-economic activities of respondents:



Source: This Study
Figure 1-4: Socio-Economic activities of respondents

1.1.5.3 Location Map for Study Area

The location of Bunda district and its bordering districts are shown in figure below.



Source: Bunda District Council –Water department, 2008
Figure 1-5:Map Showing the Study Area

1.1.6 Bunda District Water Supply Service Coverage

1.1.6.1 Background

The rural population of Bunda has limited access to safe water and hygienic sanitation, resulting in poor health, lost productive time due to sickness, missed schooling opportunities for children, and increased medical expenditures. Worst affected are women and girls, who bear the primary responsibility for collecting and storing water. According to Bunda District Executive Director in 2008, only 42% of the rural population had access to improved water supply while in Bunda township was 22%. The district water supply coverage has increased to 47.43% for urban and rural in 2009.

1.1.6.2 Rural Water supply In Bunda District

Bunda has serious water problems in rural areas leave alone the town. This is aggravated by mismatching growing population versus district capacity to develop and maintain water infrastructure. These water problems have different facets extending from obsolete water schemes built in 1970s lacking spare parts and complicating the operations and maintenance, vandalism, drought and limited funding are also major challenges in the district. The pace for development of new water infrastructure in Bunda is affected adversely with the level of poverty such that the communities fail to produce upfront capital contribution on time and thus delaying implementation. Upfront capital contribution in cash or in kind is often set at 2.5% or 5% of the project investment cost, depending on the type of technology selected. Generally, community participation in water projects is low in rural and is exacerbated by low literacy. Also the dependency syndrome and fragmented

institutional arrangements, to mention but a few factor are affecting the sustainability of a number of water supply schemes in rural areas (MOWI, 2005).

Currently, a dam is under construction at Nyamuswa for people and livestock with total volume of water 210,000cum and one completed Chaco dam at Kinyambwiga village mainly for cattle with volume size 143,000cum.

1.2 Problem Statement

Various efforts have been made by the government of Tanzania to sustain rural water services with little achievements. A number of approaches have been developed and policy changed several times to speed up the process and now there is a sign of introducing IWRM policies. Despite all these initiatives the sustainability is still a daydream. It is estimated that 30% of rural water supply systems in the country are not properly functioning and even those which are classified a functioning are questionable (URT-NAWAPO, 2002). Handpumps that carter for nearly half of rural population with protected water has an estimated functionality rate of 66% (http://www.rwsn.ch).

In Bunda 22% uses handpumps and there are 419 hand pumps of which only 195 (46%) are properly functioning, 34 hand pumps are seating on drywells, 190 (40%) entangled with various problems including theft and lack of spareparts (Bunda DC, 2006). Motorised pumps are on and off with frequent breakdowns. Constraints to the sustainability of these systems has not been clearly ascertained and hence. This study will try to find out why?

1.3 Research Objectives

1.3.1 Main Objective

The overall objective of this study is to determine constraints and potential opportunities to the sustainability of rural water supply service

1.3.2 Specific Objectives

The specific objectives of this study include the following:

i. To characterize water supply services in the study area

ii. To investigate the constraints and opportunities to the sustainability of water supply services

iii. To determine the sustainability index for water supply service in the district

1.4 Potential Hypotheses

The primary hypothesis of this study is that the sustainability of water system is indirectly linked with poverty level and directly connected to how best the system responds to beneficiaries water demand backed-up with beneficiaries' willingness and awareness

1.5 Scope of Study

The study researches on four items of sustainability namely; Institutional arrangements, applied technology, financing of operation and maintenance, and the protection of water sources areas.

It is restricted to water supply in rural settlements of Bunda district and the township is not part of the study. Characterization of water supply service included the identification of water sources, applied technology for abstraction, service coverage.

Limitations to sustainability and sustainability index are also included. The research was carried out form March through June 2010, and it aimed to determine Constraints and potential Opportunities to the Sustainability of Rural water Supply Service in Tanzania.

1.6 Significance of the Study

Bunda water supply service, like many other local government authorities in Tanzania is challenged with National Strategy for Growth and Reduction of Poverty (NSGRP)-MKUKUTA targets, MDG goals, and consequently the national development vision of increasing sustainable rural water supply service coverage to 90% by 2025. Hence the output of this study will be to identify weaknesses in managing operating and maintaining water services and will come out with some recommendations pertaining to appropriate technologies, proper water management level, spareparts supply chain, technical know how, good environmental conservation practices of water sources areas and finance management. This in particular aims at making the water supply services sustainable today and in the future. Institutional arrangements will also be studied to explore existing inadequacies. Outputs of this research are expected to be of interest water sector stakeholders at all stages of policy formulation, planning and implementation.

People and staff of Bunda district in particular will know the status of their WS and act accordingly, and the results will help Bunda District Council Management Team (CMT) in formulating realistic and effective strategies with regards to Strength, Weakness, Opportunity and Threat (SWOT) analyzed from this study with the light

of improving sustainability principle of water services. In addition, the output will be input to the Ministry of Water and Irrigation (MoWI) in taking appropriate measures for rural sub-sector and most importantly dealing with constraints highlighted to the sustainability of water systems installed in rural and probably revert to paying attention in reflection to principles articulated in NAWAPO of 2002.

Water Quality in the study area: Table below shows incidences of water borne and water related diseases in the study area which gives an indication to the quality of water. In rural part of Bunda at Kibara village, cholera broke out in January 2010.

Table 1-2: **Incidences of Water Borne Diseases in Bunda district**

S/N	Description of Diseases	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Average
1	Diarrhoea	19,902	22,715	20,097	24,915	26,384	22,802.6
2	Eye infections	2,779	6,656	4,433	6,570	7,707	5,629
3	Skin infections	3,284	7,145	7,661	8,402	7, 411	6,780.6
4	Dysentery	379	555	422	465	366	437.4
5	Typhoid	0	0	0	0	0	0
6	Intestinal worms	4,499	9,079	10,953	14,259	13,116	10,381.2
7	Cholera	0	0	0	65	118	36.6
TOTAL		30,843	46,150	43,566	54,676	55,102	46,067.4
Population		274,339	279,277	311,087	322,963	335,356	304, 604.4
W (patients/1000 people)		112	165	140	169	164	151

Source: District Health Department Report, Bunda district Council, 2009

CHAPTER TWO

LITERATURE REVIEW

2.1 Availability of fresh water resources for human Consumption

A table below shows some calculations done by Shiklomanov in 1993. From the table, it is clear that the globe population approaching 6 billion people (2010) is unleashed to only **1.715%** of the total water resource on earth which keeps on diminishing due to a number of factors. This minute proportionate now calls for attention to sustainable use of fresh water resources and facilities to abstract, treat, convey and distribute fresh water to human beings and associated beneficiaries.

Table 2-1: **Water resources Quantification on Earth**

Sea water	96.50%		Ground water	1.70%
Ice and snow	1.76%		Lakes	0.013%
Atmospheric water	0.001%		Rivers	0.002%
Total Non abstractive water	*98.261%*		***Freshwater Available***	***1.715%***
Grand Total water 98.26 + 1.7I5% = 99.976 approximately 100%				

Source: Shiklomanov, I. 1993

According to the definition provided in a joint monitoring programme by WHO and UNICEF, unimproved water supplies include; unprotected well, unprotected spring, vended water (bottled and bagged water), tanker/truck water, and all surface waters. And they also defined improved water supplies as; public standpipe, borehole (drilled well), protected dug well, protected spring, rainwater harvesting, household

connection which is outside the home and inside the home). Other pump power sources has following limitations, Diesel/Gasoline engines is required for high output pumps and it needs high maintenance requirement, high initial and operating cost. For electrically driven machines requires moderate maintenance requirements, suitable for high or low output wells however it has high initial cost and dependent on local power supply

2.2 General information

The term “Sustainability” is a well-liked term in modern development practices and discourses, and is understood in many ways according to the situation in which it is applied. It has become a complex term that can be applied to almost every system on earth. In fact, the earth’s resources are limited and all human activity should emphasize the sustainable use of it. According to IUCN, UNEP and WWF (IUCN et al., 1991), sustainability consists of "improving the quality of human life while living within the carrying capacity of supporting eco-systems. Literatures have advocated that "some developing countries become trapped in a civil infrastructure cost spiral, where they set aside the increasing amount of resources for building the infrastructure and devote less and less to maintenance and repair" (Takashi, 2004).

2.3 Sustainability concept

The general concept of sustainability was introduced for the first time to a larger political audience by the so-called Brundtland, the audience that was organised by the World Commission on Environment and Development in 1987. The Brundtland report coined the definition of sustainable development such that it is the most widely accepted definition todate; Sustainable development is the development that

meets needs of the present without compromising the ability of future generations to meet their needs" (United Nations 1987). This implies that whatever is done to take care of the present population then it will be in a manner that will not harm benefits of the coming generations. But the term sustainable is meaningless unless it is associated with a specific reference on quantity and it becomes meaningful only when it is related to a scale of values, for this reason this study research on sustainability index.

Sara and Katz, (1998) in their study of making rural water sustainable, they found sustainability was higher in communities where a demand-responsive approach was employed in the water supply services. Further their study found sustainability was marked higher in communities where household members made informed choices about whether to build a system, of what type and at which level of service they preferred, the relationship that proved statistically significant, even after controlling for the effects of independent factors such as poverty level and project related factors like training, technology type, and the per-capita cost of the system.

2.3.1 General understanding of Sustainability

Perhaps the most popular definition of sustainability is drawn from the 1987 report of the U.N. World Commission on Environment and Development (also known as the Bruntland Commission) which defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The concept of sustainability is used in many contexts and with widely different meanings. Some popular applications of the concept of sustainability can be witnessed on: Global

sustainability, Sustainability of the environment, Sustainable agriculture, Economic sustainability, Sustainable development, Sustainable benefits, Sustainability of water and sanitation project benefits.

However other scholars define "Sustainable" as to endure, to last, and to keep in being. Sustainable development is about marshalling resources to ensure that some measure of human well-being is sustained over time. According to Pearce and Atkinson (1993), the objective is to take actions which will not impair future generations from living at least as well as the present and hopefully better.

To do this, each generation must leave the next generation a stock of capital no smaller than the present one. Three forms of capital are; recognized-natural, infrastructure, and human. Natural capital includes natural resources such as water, soils, forests, wildlife, and oil.

Infrastructure includes machines, roads, dams, and cities. Human capital encompasses the stock of knowledge and skills exhibited by citizens. Together the various forms of capital comprise the aggregate capital stock of a nation. Water supply projects utilize all three form of capital. The role of the project is to: (1) utilize water (natural capital) for healthful purposes (and to avoid contamination of natural resources through sanitation initiatives); (2) build water supply facilities (infrastructure capital) which convey water to convenient locations for use; and (3) operate and maintain the facilities through skilful management of human and financial capital. Each form of capital must endure in order to achieve sustainability. The phrase sustainable development is typically applied in a project which was

designed to achieve a particular goal or set of objectives. Projects in the rural water supply sub sector are implemented by administrative entities serving a collection of village/hamlet sites with water supply systems. "Sustainability" of the "project" is dependent on the performance of institutions. Project sustainability is indicated by the ability to continue to meet objectives defined in term of benefit levels. Projects produce specific benefits for targeted beneficiaries which ideally should continue to increase after project completion. More narrowly, one can speak of sustaining or keeping in operation a particular WS facility, such as a handpump.

2.3.2 Rationale for Sustainability Assessment

The Water Supply Services planning, implementation, management and sustainability assessment process needs to address social justice, economic equity environmental and financial sustainability issues with appropriate technology. Additionally, people-focused WATSAN systems may face different, conflicting factors, because they need to satisfy different categories of stakeholders (communities including women, children and other water-users with diverse, ethnic, economic, educational, cultural and religious characteristics; foreign and local investors; local and central government; service providers; politicians; advocates and so on, (Bhattarai, 2005)

2.3.3 Sustainability Defined

Sustainability, by our definition, is the ability of a project to initiate a process by which benefits are maintained. The word project is used in different ways by different stakeholders. In some circumstances, it is viewed as a temporary administrative arrangement, a budget, the physical infrastructure, a period of time,

and even as some combination of all four. Sustainability cannot be objectively quantified as it requires value judgments to actually apply the concept to specific projects and to come to conclusions as to whether or not the projects will supply sustainable benefits. Two fundamental problems arise:

(1) Though, a level of service may be maintained, that service itself has several dimensions of benefit, such as quantity, access, reliability, quality, and cost (QARQC).

(2) The adjective sustainable has strong normative connotations. Different participants in the projects (donors, host government, beneficiaries) will have different evaluations of sustainability based on the relative value of achieving the various goals. Benefit levels may be expressed in many ways. One frequently used measure is improved health, as indicated by a reduction in child mortality and morbidity from diarrhoea diseases. Or it may simply be stated as the number of people who have improved access to potable water and sanitation systems. In any case, benefit level implies a threshold value whereby goals are said to be achieved and consequently a project is pronounced sustainable. However, if one accepts that there are degrees of sustainability, and then one must abandon the distinction of "have they/"have "they not achieved all goals, and allow for tradeoffs among different goals. One would need an explicit preference function for the decision-maker to use. This implies a welfare function which would aggregate the different benefits by assigning relative value to the achievement of different goals. Even then, the concept of sustainability would require a time dimension. An operational definition which permits some degree of ordinal ranking by sustainability will have

to be narrow and specific. For instance, in a study of three African countries, Bowrt (1989) defined sustainability in terms of outcomes persisting at least two years after project termination; and in a comparative study of five countries in Africa and Central America (1990), he defined it as outcomes at least three years after project termination (meaning completion of construction). Honadle and VanSant (1985), in a study of sustainability of integrated rural development projects, defined it in term of "the percentage of project-initiated goods and services that is still delivered and maintained five years past the termination of donor resources." This latter definition appears empirically verifiable but in practice will be complicated by multiple outputs and lack of agreement about the verification of 'delivery' and "maintenance." Some definitions consider as a criterion of sustainability that the beneficiaries cover all costs after donor assistance has ended. This is a rigorous criterion that seldom applies even in developed countries, and it is appropriate that the DAC modified it to mean that a project could be considered sustainable even though some external support is provided, i.e., the capacity to implement a program or facility exists and the beneficiaries are self-reliant (but not necessarily self-sufficient). Resources could also come from transfers from other parts of the WS&S sector or intersectoral allocations. No attempted has been made to address the issue of sector sustainability -only projects.

In summary, sustainability is the ability of a WS development project to maintain or expand a flow of benefits at a specified level for a long period after external support has ceased. In simple language the project is the physical infrastructure established maintained and operated by beneficiary!

2.3.4 Sustainability of Water Supply Services

According to Mayombo, 2009 from Wikipedia (2009), the free encyclopaedia, Sustainability in general terms, is the ability to maintain balance of a certain process or state in any system. It is also said that for humans to live sustainably, the Earth's resources must be used at a rate at which they can be replenished. However, there is now clear scientific evidence that humanity is living unsustainably, and that an unprecedented collective effort is needed to return human use of natural resources to within sustainable limits.

In 1989, the World Commission on Environment and Development (Brundtland Commission) articulated what has now become a widely accepted definition of sustainability: "[to meet] the needs of the present without compromising the ability of future generations to meet their own needs (Wikipedia, 2009). The definition of sustainability according to Brikke and Bredero (2003) say a service is sustainable when: (i) It functions properly and is used, (ii) It provides the services for which it was planned including: delivering the required quantity and quality of water at all times. Providing health and economic benefits; and in the case of sanitation, providing adequate sanitation access, (iii) It functions over a prolonged period of time and equipment is replaceable, (iv) The management of the service involves the community (or the community itself manages the system); adopts a perspective that is sensitive to gender issues; establishes partnerships with local authorities; and involves the private sector as required, (v) Its operation, maintenance, rehabilitation, replacement and administrative costs are covered through alternative sustainable financial mechanisms, (vi)It can be operated and maintained at the local level with

limited, but feasible, external support (e.g. technical assistance, training and monitoring), and (vii) It has no harmful effects on the environment.

They also established key components of sustainability as effective water users' demand, local financing and cost recovery as well as dynamic operation and maintenance. Dynamic operation and maintenance is especially critical and has been largely overlooked by providers, operators and managers of water supplies. Harvey and Reed (2006) and Montgomery *et al* (2009) identified eight main sustainability factors as built in blocks which include Policy context, institutional arrangements, financial and economic issues, community and social aspects, Technology and natural environment, spare parts supply, maintenance and monitoring

According to Kaliba (2002), in any development projects, clearly defined indicators are essential for accurate and realistically measuring and evaluating results. For water and sanitation programs, a series of indicators have been identified to measure conditions relating to sustainability, and the effective use and replicability of the projects. Although there is no common agreement on a definition of sustainability, the principal idea contained in the various definitions is that any project is designed to produce a continuous flow of outputs, benefits or services throughout its intended economic life cycle. Effective use and replicability means that water facilities are operating optimally and consistently, and the process of implementing them can be repeated successfully in other places (Kaliba, 2002 from Narayan, 1995). In their study, sustainability is broadly defined as including effective use and replicability indicators.

2.3.4.1 Service Level

Service level has to be consistent with available financial resources. Should a service level exceed what is affordable from all forms of revenue, it will fail. It is important therefore, choice of service level is affordable, sustainable, and expectations match reality.

Service level has to be decided by the community, with reference to local and national norms. The starting point for any community has to ensure all members have access to the defined minimum basic service level. Only when the basic service level has been achieved for all, can higher service levels be offered to those willing and able to pay, preferably on a full cost recovery basis. This may include house connection and garden and flower watering. Most communities in Bunda rural part, are supplied with hand pups and as the case, they have to travel an average of not less than 500 round trip which is beyond the recommended 400m

2.3.4.2 Integrated water resources management

Domestic water supply service delivery is be based on principles of integrated water resources management. Domestic water supply is usually given priority at district and so is at national level on. Individuals and communities are not getting enough knowledge on principles of integrated water resources management, notably on: pollution prevention; demand management and minimization of unaccounted for water. There are laws that conflicts on minimum space to be left from water body fro human activities. The Environmental Management Act (EMA) stipulates different from that in water supply and sanitation act No. 11 of 2009. Consequently the lake Victoria shore is not sustained due to uncontrolled human activities near the lake.

2.3.5 Dimensions for Assessing Sustainability of Water Projects

According to Indian institute of technology, 2005 the ccritical analysis of sustainability of water supply schemes are; (1) Availability of adequate quantity of water at source (2) Quality of Water (3) Demand responsiveness (4) Physical condition of WSS (5) Technological options (6) Consumer Satisfaction (7) Cost Recovery (8) Community participation in O&M and willingness to sustain the WSS (9) Gender equity and woman empowerment and (10). Community based institutional arrangements, capacity building and training and according to http://www.africanwater.org/sustainability.htm accessed on 13 May 2010 the following are important factors to be considered for sustainable project assessments and these are (i) Technical issues, (ii) Social factors, (iii) Financial elements, (iv) The natural environment, (v) Durable gender equity and empowerment, and (vi) Institutional arrangements. Table below shows considerations that are worth remembering in opting for the sub-factors to best suit the material moment and environment.

Table 2-2: **Sustainability Assessment Factors and sub-factors**

Factors/Sub-factors	Description
Institutional	
WSUC	Water and Sanitation Users Committee (WSUC) Existence, Functionality, Activeness, Ownership and Meeting
VMW	Village Maintenance Workers (VMW) Availability, Skill, Training, Activeness, Continuity and Remuneration
Treasurer	Availability, Skill, Training, Activeness, Continuity and Book keeping
Mother & Child Tap stand Group (MCTG)	Existence, Regular cleaning & operating of tap, O&M fund collection
Women Technical Support Services Group (WTSSG)	Income Generating Activities (IGA), Use of WTSS fund in IGA
Coordination & Linkage	With local authorities and other agencies, training, dispute resolution
Social/Environmental	
Community Participation	In planning, decision-making, implementation and O&M
Health & Hygiene	HSE conduction, Latrine coverage, VHP working
Environment	Environmental mitigation measures, drainage
Financial	
O&M Fund	Existence, Bank Account, Use of O&M fund
Water Tariff Collection	Regular, Intermittent, As and when needed basis
Technical	
Source Yield Quality	Reliability, Adequacy, Depletion, Continuity, Physical, Biological and Chemical quality, Accessibility and chances of contamination
Design & Construction Quality	Design adequacy, Site & Technology selection, Condition and functionality of structures and system
Tap Functioning	Functionality of taps

Source: Bhattarai S. & Starkl, M (2005)

2.4 SWOT Framework for Water Supply Service Sector

2.4.1 Background

Detailed study of sustainability aspects is essential for any water supply project to avoid system breakdown and premature abandonment. The major constraints which cause failure of water supply systems are water quality and quantity problems, attitudinal, institutional and legal framework problems, lack of community participation, O&M problems and political interference.

The aim of this study is to assess strengths and weaknesses and select untapped areas (opportunities). Due to paucity of time, focus is made on water supply sector in

Bunda to identify the Strengths, Weaknesses, Opportunities and Threats (SWOT), and to study about the prevailing and potential schemes of the district and to choose one of the schemes for the detailed study for sustainability index determination. The main objective of the study is to find out sustainability aspects of the prevailing water supply schemes in Bunda district.

2.4.2 The strengths of rural water sector

(a) As all the existing rural water supply facilities were built by the government which is still in power to date then they know in and out of every single systems as to where they can start in order to rectify the situation may be only that they may be lacking resources. They don't need to invent a wheel.

(b) The government being the main employer in the country then it has an opportunity to employ even more highly qualified personnel to plant seed of sustainable water projects in rural and also the current personnel has good level of technical knowledge and years of experience covering the whole nation as staff tend to be transferred from one place to another place as government policy to not allow one staff to overstay in one location, but yet still water staff show to have social commitment towards the welfare of the people they are to serve.

(c) The government being the one entity which is still in the control of all the rural water supply service then it is easy to hold financial and technical accountability of all individuals involved in any of the processes in the planning, design, implementation and O&M of the schemes.

(d) Existence of national water policy –the right policy!

2.4.3 The major weakness of rural water supply sector

Despite the changes in rural water projects acquisition techniques, still there is limitation in involvement of community and even local bodies in project initiation, formulation and execution. From the past when project formulation was generally treated purely as technical exercise where local bodies were seldom involved in the process. During project execution also, there is little interaction with the local body. These factors have resulted in the lack of a sense of involvement of the public and local bodies in the schemes.

2.4.4 The opportunities of rural water supply sector

The Bunda district has very good opportunities to offer and support services for all water supply projects at ward and village levels.

2.4.5 The threats of rural water supply sector

The threat before Bunda district water sector is that, water user associations have the right to take independent decisions, they may avail the services to private agencies ignoring the district or central government's capabilities.

2.5 National Water Policy-NAWAPO

Traditionally, the water supply sector and the rural water supply sub sector in particular have been centrally controlled and implemented. Under NAWAPO, consultations and planning emphasized to start from the grass-roots; and implementation to be at the lowest appropriate level, close to the beneficiaries. Water users entities and user groups are not only responsible for operating, maintaining and sustaining the infrastructure but also responsible for planning and managing them.

Technical considerations on the design of rural or community water facilities is that, basic level of service of 25 litres per capita per day and a single water point to serve a maximum of 250 persons within 400 metres of homestead or in within 30 minutes round trip.

Financial element of it goes as far as considerations of $40 per capita subsidy ceiling in community water schemes is necessary to support it but higher level of service (e.g. house connection) fully paid for by beneficiary. Technical assistance & training fully financed by the project, communities to decide how O & M funds will be raised (direct payment as water is collected, monthly payment per household, payment based on seasonal harvests, etc). However, the direct payment model for water is most efficient and widely recommended.

Monitoring Methods suggested for DWST in dealing with rural communities are; annual Technical Audits if necessary to check value for money, Midterm year Review for the purpose of trucking O & M, Management Information System by whatever means possible, Periodic Sample Surveys to some community schemes, Specific in-depth evaluation studies of selected community schemes, Assessment of post environmental impact of built water schemes

Dimensions which can give an indication of whether the rural water supply service is sustainable or otherwise include; availability of adequate quantity of water at source, quality of Water, demand responsiveness, physical condition of water systems, technological options, consumer satisfaction, cost recovery, community participation

in O&M and willingness to sustain the systems, Gender equity and woman empowerment, community based institutional arrangements, capacity building and training.

2.6 Constraints to sustainability of systems

Under the Local Government Reform Programme (LGRP) District Councils have been assigned the responsibility for managing government services at the district level, including water supply and sanitation. However, District Councils have limited financial and human resource base, and at the same time growing administrative costs and increasing demands for services by communities (ADF, 2006 & URT-NRWSSP POM, 2002).

According to scoping study report of 2009, the technical facilitation team conducted by NETWAS in association with TAEES identified a missing laboratory (regional level) technician who could be providing support on the determination of water quality and capacity building. However depending on the schemes and general water activities, the DWE's office is still in need of another staff such as Electro-mechanic/technician, Water resources technician for data base management and 5 full technicians in civil that will operate the 5 pumped schemes in the villages and it could be the idea of the research to engage the technicians! These Full technicians will be supported by auxiliary technicians of grade test I or II qualifications available now.

2.7 Previous Studies

2.7.1 National Rural Water Supply and Sanitation Program (NRWSSP)

Various studies have been carried out to look at sustainability of water systems in Tanzania. In 2008, Giné and Pérez-Foguet conducted a study to assess the sustainability of National Rural Water Supply and Sanitation Program (NRWSSP) in Tanzania. In evaluating the 20 years program that was launched in 2007 by the Government of Tanzania to help achieve targets set out in the Millennium Development Goals by the year 2015, they saw eminent shortcomings threatening long-term functionality of the infrastructure that were to be built. First constraint was limited financial resources to fund the program components. The study also noted that the program was so rooted to fast production of schemes to meet MKUKUTA and MDG targets without concrete steps being taken towards promoting sustained use of the facilities through a participatory approach. The researcher referred to another study by Therkildsen that was conducted in1988 looking at the intervention of international donors to improve access to safe water for rural populations in Tanzania during the 1980s when 'free water' delivery approach was in place. This other study done over 20years back, did also arrive to a similar conclusion like this current study that was putting remark by complaining on the dilemma for policy makers stressing much on fast production of schemes without looking at the sustainability part of the so built facilities.

2.7.2 Project cases in study Area

Many pumped water supply schemes in Bunda district and Mara region at large suffer similar constraints. Here below are some case studies for water schemes in Bunda district;

(a) Nyamuswa – Makongoro – Bukama water supply scheme

This scheme provides service to three villages of Nyamuswa, Makongoro and Bukama. It was constructed early 1974 to initially service two villages of Nyamuswa and Makongoro using diesel driven pumps. Changing from diesel driven pumps to electrically driven pumps was done in 1988/1989, the process being financed by Government of Sweden (SIDA) organization through HESAWA programme. This rehabilitation nature of work was complete on 23rd of March the year 1989 and certificate of completion issued when handling over the rehabilitated scheme to the two communities. Very unfortunately the same water scheme stopped operating 2 years later. Problems were mainly technical in nature but also managerial incompetence of user communities contributed to the problem.

Technical constraints were: electrical accessories e.g. main switch, starter etc. were stolen, after water stopped flowing pipes were uprooted from the network, local community houses were built on top of pipeline, domestic water points (DP) were destroyed, outstanding electricity bills forced TANESCO to disconnect the power from the scheme and later on decided to remove even the transformer, water reservoir (tank) was leaking and no one was taking care of the facilities, water pump was requiring repair but there was no body to attend to it.

Managerial constraints: **N**o recognized institution to operate the water scheme, customers were not paying water bills and water users were still knowing that district council is still responsible for the scheme but the DC claimed to have handled over the scheme to the communities. The communities claimed they don't own the scheme and gave the following arguments;

- They are not collecting funds paid for the water consumed and instead the district council was collecting the water bills without the consent of the two communities,
- Pump attendants were all employees of the district council
- Spareparts for maintenances were provided by the district council,
- During hand over, the district council could not stipulate clearly the roles of the communities in operating and maintaining the water scheme
- The scheme has no scheme (network) attendant with exception of the watchman who is paid by district council

In view of the above, the scheme was rehabilitated again but with prerequisite of forming an institution responsible for the operation of the scheme. So a water Committee was formed and trained on skills for proper management of the scheme and given working tools to facilitate their new roles. This second time rehabilitation consumed financial resources from donor, district council and the communities themselves as follows;

Table 2-3: Partner contributions to Project

Contributors	Amount	Percentage
Donor (SIDA) HESAWA	9,500,000/=	62%
Bunda district Council	3,080,000/=	20%
Communities	2,850,000/=	18%
Total	15,430,000/=	100%

In a process of accruing funds, the water committee was asked to collect contributions from communities as agreed. Community funds were used as an indicator to demonstrate willingness to operate the scheme sustainably once it is rehabilitated. Also communities were made aware to involve themselves in the labour force to dig trenches, help builders (fundi) mixing cement/sand mortar, collect building materials i.e. sand and bricks during construction. District council's major task was to bring back the disconnected electric power plus the transformer and other necessary accessories.

After rehabilitation in 1992 it worked for 13 years until 2005 when the Ministry of water and Livestock Development allotted about 240million TZS to upgrade and expand the serve to a third Village namely, Bukama. Funds were released in 2006 and under the supervision of Bunda Water Department and consultative advice by Mara regional Water Office the project was successfully completed within one year.

The three village scheme is now doing well and formulation and registration of a water user association is under way. Its constitution is already formulated and forwarded to the Minister responsible for water affairs for registration.

(b) Bulendabufwe Gravity water scheme

Bulendabufwe gravity scheme was constructed between1991-1993 and officially handled over to the community with effective from 13 June 1993. There were 9 DP on design and more DP were still required and consideration to also bring the water to the nearby village of Igundu was also sought to be done but limitation was the source yield.

A scheme committee was formed and the water committee account was opened and has Tsh. 56,000 by 22nd March 1994. Scheme attendant was elected and trained for 3 months. After few other years the project was stunt due to following technical and managerial constraints;

Technical constraints are; materials and spareparts were stolen, intake cover, screen and fence were demolished at the water intake/source, the current water intake has diminishing water yield. Some busted pipes are leaking, PVC pipe across the culvert need replacement, water tank is leaking and cover no in place. Water tank not protected, people climb up the tank and rest there threatening water contamination. Gate valves not working properly and some plugged using tree trunks to stop leakage, water points are generally dirty, and more water loss due to broken taps, no

spanner and other necessary working tools for O & M and water is not enough for the increased population.

Managerial constraints; village government not aware if the scheme was handled over to the village, first scheme committee was not trained, was replaced and replaced again but now there is no water committee for the scheme, people have built houses and are doing farming on the upstream close to water intake, water funds amounting to Tsh. 56,000 was drawn and paid for school desks contribution which is contrary to the purpose of the funds, scheme attendant was forced to resign his job after allegations of untruthfulness', no bylaws to protect water scheme and todate no funds for O & M,

With regards to all the technical and above mentioned managerial problems, then through HESAWA programme the government of Tanzania decided to rehabilitate the scheme. HESAWA contributed 75% of all materials purchasable from industry or factory. Water users were required to contribute the remaining 25% of all materials purchasable from industry or factory and provide labour force. Bulendabufwe was urged to; prepare bylaws to control pollution of water intake, restrict farming, deforestation, prohibit inhabiting in the area near the intake, plant sisal around 100m diameter from the intake to restrict farming near the intake, plant water conserving trees in collaboration with V.I. Tree and other NGOs, Clean DP, plant tree around the DPs, make sure spill water doesn't make a pool at DP area, make a stop order for people to play on top of the water tank, convene village general assembly and announce the need for contributing funds for O & M and rehabilitations.

2.8 Roles of Private Sector and Civil Society

Both private sector and civil society organisations (NGOs, CBOs, etc) are entrusted to play major role in the management of community water facilities. And as part of the Government's broader privatisation strategy, the government stresses on the need for NGOs and CBOs to make significant contribution to the sustainability of water facilities in the rural part of Tanzania to enhancing service delivery and in a way create employment through investing in the rural areas.

2.9 Constraints to Sustainability of Water facilities

In Tanzania, rural water supply is very challenging in a sense that water supply coverage has been of a trend of 50% (2002), 53% (2003), 55% (2005) and 58% was recorded on 2008 meaning that the remaining 48% population plus the super increasing population growth without access to water puts facilities at risk because the available few water points are overwhelmed. Lack of reliable capacity for LGA to manage social services including rural water supply is another constraint. Inadequate financial capacity to sustainably accommodate sustainability component of the water supply. A wide range of partnership with both NGOs and the private sector will be necessary for improving rural water supply sustainability

Limited community capacity and financial resources: Under the LGRP, the community as main beneficiary need to assume operation and maintenance role of water supply services. But the community has neither training nor experience and exposure in this regard. Besides, maintaining water supply on a sustainable basis requires adequate financial outlays be made available. The poverty- stricken rural

community like Bunda which was ranked the poorest district in 2008 lacks this kind of capacity.

Integrated water resources management: Water catchment areas are also interfered with by a great deal of human activity including tree felling, bush firing, cultivation, free grazing, water sources pollution, fisheries etc.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Overview

The methodology for collection of data used in this study is given in this chapter. The chapter has been structured based on the data collection methods, which mainly included questionnaire survey in the study area, focus group discussion and key interviews. Further to data collection methods, the methods for data analysis have also been given.

3.2 Sample Design

In obtaining the sample size, the study applied the formula which was recommended by Bhandari and Grant (2007) from Arkin and Colton (1963) as follows:

$$n = \frac{NZ^2*P*(1-P)}{Nd^2 + Z^2*p*(1-p)}$$

Where,

n = sample size

N = total number of households

Z = confidence level (at 95% level Z = 1.96)

p = estimated population proportion (0.5, this maximizes the sample size)

d = error limit 5% (0.05).

Bunda district has a rural population of 213,822 in its 86 villages with 33,507 households (Census 2002). Sampling methodology focused on 3,278 households'

serviced with boreholes fitted hand pumps (functional and non-functioning). Using above formula it was found that working with 183 for hand pump user questionnaires was adequate.

Sampling for the four pumped schemes were done by first calculating the population saved and then number of households deduced as follows;

Kibara community water project	21% x 2,840=	596
Nyamuswa Communities water project	8% x 2,618=	209
Kasahunga community water project	3% x 2,160=	65
	Total	870 Equals 142 households

Using same Bhandari and Grant formula above it was found that surveying 40 households for the 4 pumped schemes was adequate. Thus, total households for survey were 223. Based on the estimated error limit of 0.5 the researcher prepared 235 questionnaires, but successful questionnaires were 205 (equivalent to about 91.4%)

3.3 Data collection

The survey data was obtained by administering pre-tested questionnaires, facilitating Focus Group Discussions (FGD) and key Interviews (KI). The questionnaires were used for collection of household's data; the focus group discussions were used for assessing the water governance issue of community participation. Key interviews on the other hand were employed to cross check correctness of provided data. Other information was obtained from a desk study.

Respondents were the groups charged with system management such as committee members, water users**.** Data collection was done using structured questionnaires, reports reviews, interviews and observations. The study also included qualitative data collected using participatory methods in a focus group.

Also interviews were held with technical staff from district water department, ministry of water and irrigation, non-government organization (NGOs) and private sector individuals with expertise in rural water subsector. Further more, the researcher paid field visit to obtain first hand information on existing status of water schemes and management modalities.

3.3.1 Desk Study

Data from desk studies that were used in this study was mainly obtained from national legislation, national water policy, engineering designs, text books from ministry and university libraries and scanty information from existing institutions. HESAWA retrospective review report, water sector development programme document package and studies by NGOs were also consulted.

3.3.2 Questionnaire Survey

A structured questionnaire was pre-tested on five households for clarity and usefulness in obtaining the desired information. Minor adjustments were made to come up with appended questionnaire **(Appendix. H),** which was used for data collection used in this study. The questionnaire was administered to 190 handpumps water user households and 45 households from piped water. Emphasis was on exploring qualitative relationships among aspects for water management. Survey

data was entered in SPSS 11.5 data sheet and checked for entry errors. Questionnaire entry errors were rectified by revisiting the households in question.

The questionnaire also comprised living standards aspects such as respondents' socio-economics, aspects of water management, water resources, water systems maintenances and environmental issues. Issues of proximity to water sources and reliability of water, demographic characteristics such as: sex, age, literacy level and educational level of respondents were asked.

Descriptive questionnaires were prepared and administered to senior water officer at Lake Victoria basin, Mara sub-catchment and at Mara region. Another type of structured questionnaire was administered to District Water and Sanitation Team (DWST) members to acquire necessary technical and district level institutional arrangements.

3.3.3 Focus Group Discussions

Focus group discussions were used as a tool for collecting qualitative data on the level of community participation in water resources management. The discussion involved group of a minimum of three and maximum of six water users responsible for the management of communal water points. Discussions were conducted for selected eight villages namely; Bulendabufwe, Iramba, Ligamba A, Nyamuswa, Nyamatoke, Kamkenga, Kung'ombe, and Nyabehu. Soon after conducting the entire focus group discussions, themes were synthesized and summarized immediately.

The FGD were conducted to assess the perceptions, experiences and level of participation in planning, development, operation and maintenance of their facilities and to learn their level of involvement hence ownership of facilities.

3.3.4 Key Interviews

Key interview was made to experienced personnel in water sector including staff at district, region, Ministry of water and irrigation and retired officials who at one time worked in the water sector. Desk studies were carried concurrently by reviewing water scheme reports, water sector development reports, WSDP manuals, strategic documents, policy, design manual to assess issues of community involvement and see funding of operation, maintenance and ownership systems by communities.

Key interview was also conducted with O & OD national facilitator, a senior officer based in Bunda to ascertain levels of poverty in Bunda rural. Other key Interviews were conducted to WATSAN committees in several villages to accrue first hand information pertaining water facilities technological options.

3.3.5 Tools for qualitative analysis

The tool for qualitative analysis of the data collected in the field by administering questionnaires was SPSS 11.5. The other data collected through literature review, key interviews, and focus group discussions was analyzed by desk analysis. From desk studies of water institution, roles and performance, water laws and existing policies, a level of water schemes management and ownership were studied. Similarly constraints were determined in reference to 2002 population and household

census general report and demographic data collected during the questionnaire survey.

3.4 Analysis of Questionnaire Data

3.4.1 Screening of data

The data collected were screened for recording and data entry errors checked before statistical analysis. Plotting data and calculating basic statistics used SPSS 11.5. Extreme values were checked and visual picture on how data were related was also taken, thus allowing in-depth understanding of the collected data. Later analysis of frequencies, percentages of respondents, charts and cross tabulations was done.

3.4.2 Characterization of water supply services

In the characterization of rural water supply services, questionnaire on availing water supply options was administered to DWST and essentially the water department office to list all possible water availability and abstraction means. In particular, the researcher looked into water infrastructure, type of water sources, abstraction methods, water distribution methods and established how communities are organized in managing their water supplies. Descriptive statistical method (SPSS 11.5) was again used to summarize data and obtain descriptive responses from questionnaire surveys. This method still deployed table of frequencies, cross tabulation and charts.

3.4.3 Investigating limitations in managing rural water supplies

The study used SWOT approach which stands for Strength, Weakness, Opportunities and Threats. First the Weaknesses were identified which were essentially the constraints or limitations to the sustainability of rural water services and weighed

against strengths of water sector in the study area. Opportunities were those potentials which are under utilized while threats were challenges in achieving the sustainability goal.

3.5 Sustainability Index

The assessment of Sustainability Index for rural water schemes in Bunda deployed a Mult-Criteria Analysis (MCA) Framework following, a case study that was conducted in Nepal by a scholar namely Bhattarai when monitoring rural water projects under Water Aid in 2009. He collected data and processed using Microsoft Excel Spreadsheet. Calculations were done using the same software and similar tables that were used in the framework are shown in section 3.5 that follows.

3.5.1 Determination of Sustainability Index

Methodology of data collection for determining sustainability index involved following steps;

i. Selecting a case study water scheme

ii. Arrival at project service area

iii. Planning and arrangement for assessment

iv. Complete village walk with community representatives

v. Key point observation, photo capture and sample survey

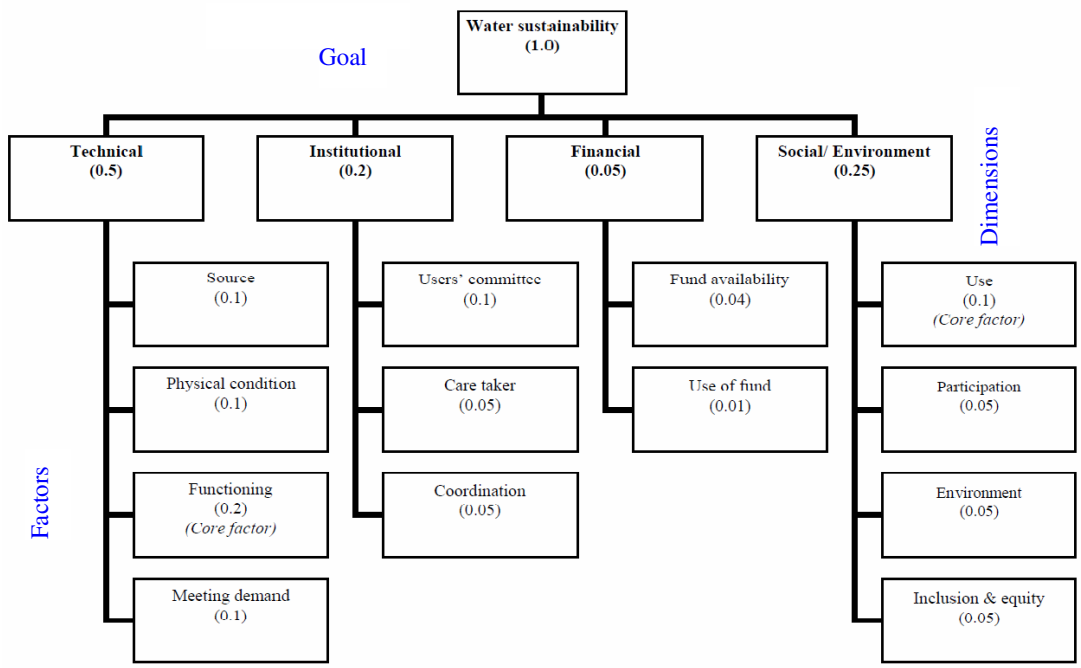
vi. On the spot interview with households owners and passer by

vii. Discussion and meeting with beneficiaries and their representative

viii. Completion of field judgement and assessment

3.5.2 Case study of Kibara-Busambara Water Users' Association (KIBWUA)

MCA Hierarchical structure for rural water micro-project sustainability index analysis, takes a logical framework below of Goal, Dimensions and factors with their weights adopted for drinking water facilities.



Source: Bhattarai S. 2009

Figure 3-1: Hierarchical structure for determination of sustainability Index

3.5.3 Sub-factors contributing to key Factors of Sustainability Index

Sub-factors are the lowest level contributors of the sustainability index. It is only at this level where, classification, measurement and ranking system was done manually in the field using different tools, guidelines and judgments. Depending upon the required attributions of the particular sub factor to the key factor, then the sub-factor was measured through a three point grade measurement system as shown in table below. The enumerator classifies each and every sub-factor in terms of excellent (E), good (G) or poor (P)

Table 3-1: Three Grade Point System of Measuring Sub Factors

Classification of sub-factor	**Range for Measurement for Three Grade points**	**Sustainability ranking of sub-factor**
Excellent (E)	70 – 100%	Sustained (S)
Good (G)	30-69%	Not Sustained (NS)
Poor (P)	30 – 69%	

Evaluation of sub factors were done by each sub factor weighted and the average of all sub factors under a particular factor were calculated to get a score of that factor. Should a community decide that one sub factor is more important than the other, then weights was flexibly possible to adjust according to majority vote of the assessors.

3.5.4 Sustainability Dimensions Analysis Framework

Calculation of score for each dimension is shown in summary here below and detailed analysis plus allocations of marks to each sub factor and their corresponding measurement and judgements see appendix

i. Technical Dimension

Sub-factor	Factor	Weight %	Score %
Type of water body	Source yield and water quality	10	6.5
Water quality at source			
Engineering components appearance	Physical condition of engineering components	10	5.9
Machines sheltering			
Project Design period (life span)			
Water supply technology			
Water pressure at draw point	Functioning of water points **(as core factor)**	20	11.7
Ration of functioning water points to total water points			
Unaccounted for water (UFW)			
Water Availability	Meeting required demand	10	5.8
Water Quantities			
	Total	**50**	**29.9**

ii. Institutional Dimension

Sub-factor	Factor	Weight %	Score %
Organizational Management of the Scheme	User's Committee	10	5.3
Management meeting held			
Involvement of women			
Staff per connections			
Machines Operator	Care taker	5	2. 3
Land ownership & infrastructure (pump house, machineries)			
Night shift watchmen			
Reporting	Coordinatio n	5	3. 3
Meetings between water users & Scheme management			
Roles and responsibilities			
	Total	**20**	**10.9**

iii. Socio-Environment Dimension

Sub-factor	Factor	Weight %	Score %
Functionality of Tap & leakage proof network	Use **(as core factor)**	10	5. 3
Unwanted plays at tap			
Cleanliness at water draw point			
Knowledge on running costs	Participation	5	2. 1
Sex wise participation on scheme management composition			
Top scheme management (Major decision			

makers)			
Willingness to pay for improved service			
Ability to pay (ATP)			
Participation financially			
Environmental sustainability at source	Environment	5	3. 1
Environmental sustainability at draw points			
Husbandry animals and livestock			
Consideration for poor and disadvantaged people	Inclusion & Equity	5	2. 6
Pipe network and DPs distribution			
	Total	**25**	**13.1**

iv. Financial Dimension

Sub-factor	**Factor**	**Weight (%)**	**Score (%)**
Funds	Fund Availability	4	3. 1
Bank Account			
Revenue			
Fund Management officer	Use of Fund	1	0. 5
O & M and purchase of spare parts			
Plumbing works			
	Total	**5**	**3.6**

3.6 Established Sustainability Index

Dimension	**Weight (%)**	**Score (%)**
Technical	50	29.9
Institutional	20	10.9
Financial	5	3.6
Social/Environment	25	13.1
Total	**100**	**57.5**

The discussion of the results above is that the water supply scheme, failed to obtain 70% scores in aggregate and obtained only 58% which is less than 70% in first *core factor* and the same scheme, acquired only 53% which is less than 70% in the second *core factor*. This then establishes that; Kibara-Busambara Water supply Scheme is "**Not Sustained"** Water Supply Scheme. From the basis of the above table, Sustainability Index (SI) is to **57.5%** or equals to **0.575** in decimal points

CHAPTER FOUR:

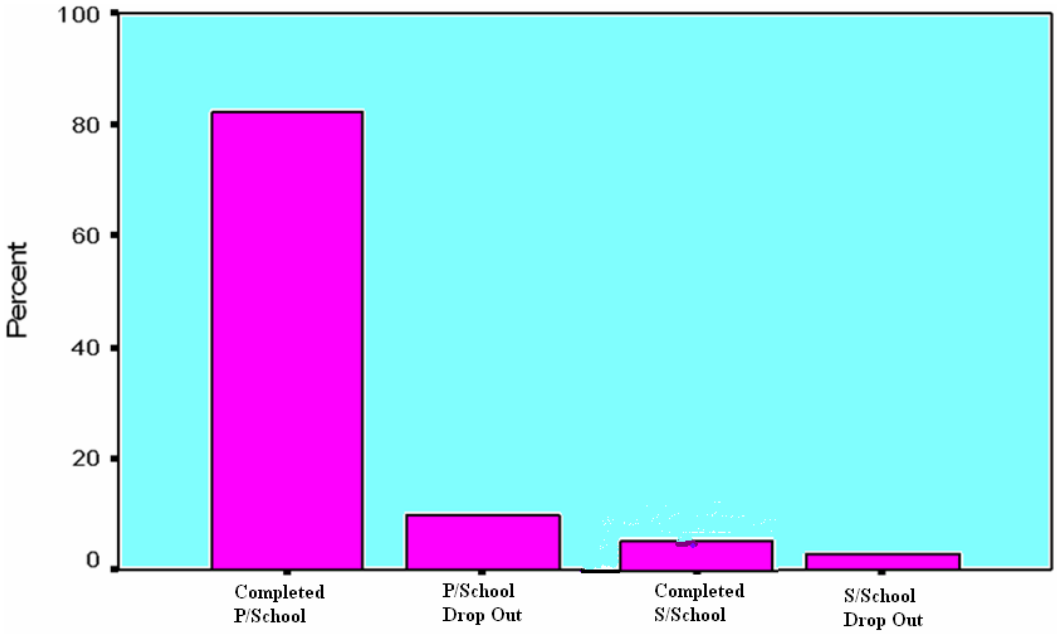
RESULTS AND DISCUSSION

4.1 Background

Out of the 235 administered questionnaires, the study received 205 (91.4%) thoroughly filled questionnaires, of which respondents were of varying ages majority aging between 18 and 45years, see appendix. Literacy level was primary education leavers who know to read, write and count. According to Bhandari and Grant (2007) who established that the demographic characteristics of the sample do not affect the results, then the study entrusted the respondents involved in the research irrespective of their age, literacy or gender as illustrated in section 4.1.1that follow. The responses from questionnaires hence make the research authentic. In the discussion, the study weighs the findings versus Tanzanian Standards, National water Policy (NAWAPO, MOWI guidelines and National Strategy for Growth and Reduction of Poverty (NSGRP) targets, in Kiswahili; *Mkakati wa Kukuza Uchumi na Kupunguza Umasikini Tanzania* (MKUKUTA). Opportunities to the sustainability of WS services were reckoned as recommendations. The sustainability level is 100% for "Sustained Water Supply Service" and 0% for "Not Sustained Water Supply Service" (Bhattarai, 2009).

4.2 Particulars of Bunda District Respondents

Particulars of respondents were in following categories; only one respondent 0.5% was under age of 18years, 69.2% were middle age of 18years to 45years and respondents aged 45years to maximum of 70years were 22.2%. Sex wise, 62.1% were male and 37.9% females. Respondents completed standard seven were 176 (82.2%), primary school drop out 21(9.8%), completed form four 11 (5.1%), secondary school dropout were 6 (2.8%). Literacy level varied across the respondents as 3 (1.4%) can only read and write, 10 (4.7%) can only count, 2 (0.9%) can only read and count and majority 198 (93%) can read, write and count, see figure below;



Source: This Study
Figure 4-1: **Education Level of Respondents**

4.3 Study Results and Discussions

4.3.1 Characterization of Rural Water Supply Services

4.3.1.1 Existing Water Sources in Bunda

Thirty three villages depend mainly on Lake Victoria as their source of water for human and livestock. The remaining 54 villages have major sources of water from hand dug shallow and machine drilled bore holes. However some few population of Kunzugu ward especially Tamau village were in acute situation despite bordering dirty river Rubana. The river is usually dirty due to animal activities upstream from Serengeti national park. Out of 16 chaco dams, there are nine Chaco-dams used both for livestock and human beings. Nine communities include; Kabainja, Karukekere, Kisangwa, Mekomariro, Bitaraguru, Kihumbu, Mugeta, Salama-Kati, Kyandege, Kinyambwiga, Nyamatoke and Makongoro/Nyamuswa village. There are also ten institutional rain water harvesting tanks (RWHT).

Table 4-1: Type of Water sources by Ward in Bunda District

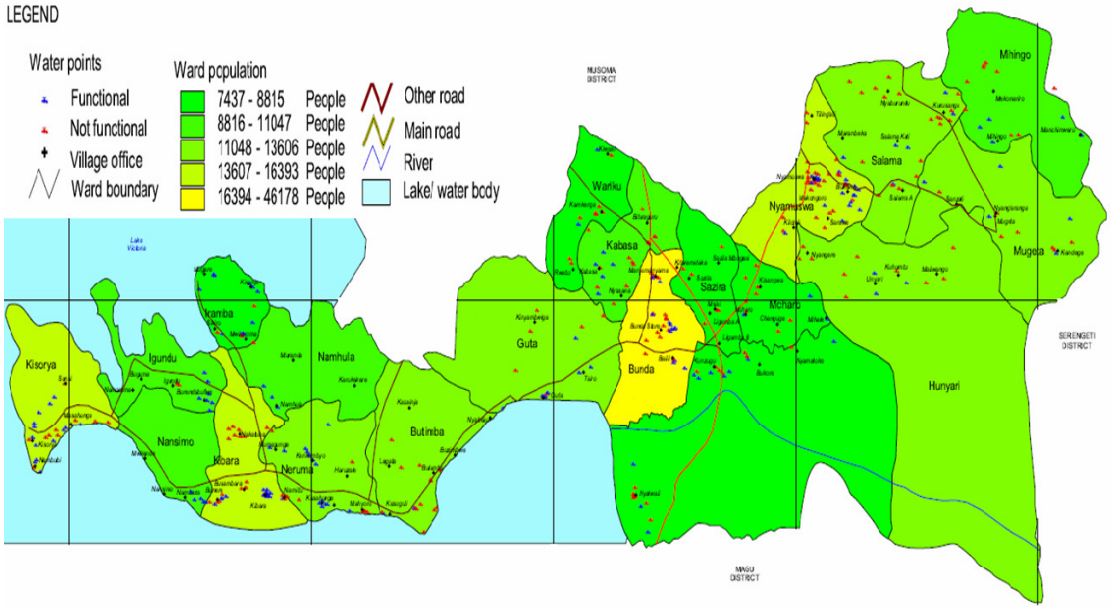
	Ward	Charco Dam	Spring	Functional SWs	RWHTs	BHs	Piped Schem
1.	Bunda	0	4	61	1	4	3
2.	Kisorya	0	0	21	0	0	0
3.	Igundu	0	1	5	1	2	1
4.	Nansimo	0	0	27	1	0	0
5.	Kibara	0	0	16	0	0	1
6.	Neruma	0	0	6	1	2	1
7.	Namhula	1	0	0	0	3	0
8.	Iramba	0	0	8	0	1	1
9.	Butimba	1	0	3	1	1	0
10.	Sazira	1	0	5	1	5	0
11.	Kunzugu	1	0	16	1	4	0
12.	Mcharo	1	0	5	0	7	0
13.	Guta	2	0	4	0	5	0
14.	Wariku	1	0	8	0	1	0

15.	Kabasa	1	0	7	0	1	0
16.	Nyamuswa	1	0	34	0	7	1
17.	Salama	1	0	8	1	3	0
18.	Mihingo	2	0	5	1	1	0
19.	Mugeta	1	0	4	0	11	0
20.	Hunyari	2	0	4	1	9	0
	Total	**16**	**5**	**247**	**10**	**67**	**7**

Source: Water department-Bunda district, 2009

4.3.1.2 Shallow Wells

In total there are 357 shallow wells (SWs) mainly built by donor funded programs such as HESAWA (203), MARAFIP (68), LVEMP (6), IFAD (16), Grumet River camp (1), and GOT (63). Todate there are only 247 shallow wells working. Some handpumps stolen or vandalised and others lack spare parts, see figure 4-2 on functioning and non functioning water points.



Source: Researcher & WaterAid, 2009
Figure 4-2: **Spatial distribution of Functioning and non functioning DPs**

4.3.1.3 Bore Holes

There are 67 deep boreholes (BHs) funded by HESAWA (2), TASAF (2), DDP (6) MARAFIP (6) VIP (15) and GOT (23).

Table 4-2: Type of Water supply Technologies by Ward in Bunda District

Ward	Type of Technology For Conveyance of Water					
	Wind Mill	Electric. Pumped	Diesel Pumped	SWs Fitted HPs	Gravity	BHs fitted HPs
Bunda	0	4	0	52	0	4
Kisorya	0	0	0	11	0	0
Igundu	1	0	0	0	1	2
Nansimo	0	0	0	17	0	0
Kibara	0	1	0	6	0	0
Neruma	0	0	1	6	0	2
Namhula	0	0	0	3	0	3
Iramba	0	0	1	9	0	1
Butimba	0	0	0	3	0	1
Sazira	0	0	0	3	1	5
Kunzugu	0	0	0	15	0	4
Mcharo	0	0	0	5	0	7
Guta	0	1	0	5	0	5
Wariku	0	0	0	6	0	1
Kabasa	0	0	0	5	0	1
Nyamus	0	1	1	24	0	7
Salama	0	0	0	8	0	3
Mihingo	0	0	0	5	0	1
Mugeta	0	0	0	4	0	11
Hunyari	0	0	0	6	0	9
Total	**1**	**7**	**3**	**247**	**3**	**67**

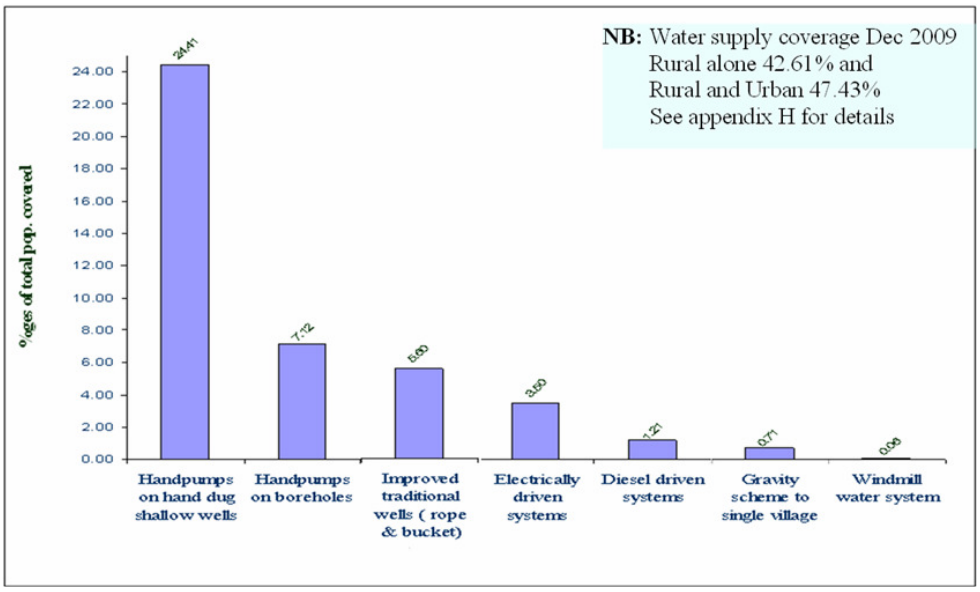
Source: Water department-Bunda District , 2009

4.3.1.4 Piped Water Schemes

In rural areas there are four piped pumped water schemes and only one scheme that supplies Bunda Township.

Kasahunga pumped scheme supplies Kasahunga health centre and some villages of Neruma and Kenkombyo. Kibara pumped scheme supplies Kibara centre, Namibu

and part of Busambara village. Iramba scheme supplies Isanju, Mwiruruma, and part of Sikiro village. Nyamuswa piped scheme supplies three villages of Nyamuswa, Makongoro and Bukama. Bunda Township pumped scheme supplies Guta village at the intake and Tairo village along its main raising pipe. Also there are three gravity flow schemes namely Nyaruga gravity scheme supplying Bunda teachers college, Balili gravity supplying Bunda Designated District hospital (DDH) and Bulendabufwe that supplies Bulendabufwe village only (Bunda DC LAAC Report (2006). Rural part of Bunda, on its own has water supply coverage of 42.61% and when combined with Bunda Township it is 47.43% figure below articulates the extent of water coverage by type of supply technology.



Source: This Study

Figure 4-3: **Rural water supply Coverage by technological supply options**

4.3.1.5 Groundwater:

Ground water usually free from pathogens and is filtered by soil. Threat includes dirt contamination due to poorly sited latrines or poor construction of a well and is

susceptible to contamination in fissured rocks strata. Sometimes ground water may contain metals such as iron (Fe) manganese (Mn) or hydrogen sulfide (H_2S). Yields in some areas may be too low for practical use or it may require drilling uneconomically too deep. Underground water may not be available every where and abstraction is by pumps with exception to artesian flow. Well construction can be difficult, dangerous and expensive.

Villages along the Lake gets water directly from this lake and other have their own sources i.e. shallow wells in their yards whose major means of abstraction is by rope and bucket with exception to few with hand pumps. Ten villages of Nyamuswa, Makongoro, Bukama, Kibara, Kasahunga, Namitwebili, Busambara, Isanju, Bulendabufwe and Sikiro have piped water systems. Water springs at Ligamba A village although they have been banned from using so that water can flow to Bunda teachers college. About 33 villages, depend on deep and medium boreholes as main source of supply. Roughly it seems fair to say that groundwater (deep boreholes and shallow wells) and surface water (Lake Victoria) are of equal importance across the sample villages.

4.3.1.6 Surface water:

There is only one river namely Rubana traversing Serengeti national Park passed Kunzugu ward and part of Hunyari ward. No pumped scheme is taped in this river because it is always dirty due to animal activities upstream (park) and the river is not perennial however. Geographically this river passes south of Bunda district. The western part of Bunda district is surrounded by Lake Victoria making communities

around these areas to use water directly from the lake. The eastern part of the district which is in the highlands part, groundwater is almost the only option that remains. The problems associated with borehole supplies include high levels of breakdowns, high electric bill, low yields and high cost of fuel for diesel driven pumps. On one hand, handpumps are considered despised to fetch water but also mechanised pumped schemes are always on and off due to systems failures or lack of funds to operate them.

Fluctuation of lake Victoria water levels are shown on figure that follows; Lake Victoria water levels were recorded from 1961 through 2005 (The Kenyan East African Standard of August 22, 2005, The Ugandan Daily Monitor, September 13-19, 2005 and http://www.fas.usda.gov/ pecad/highlights/ 2005/09/uganda_26sep2005/ retrieved 28/6/ 2010).

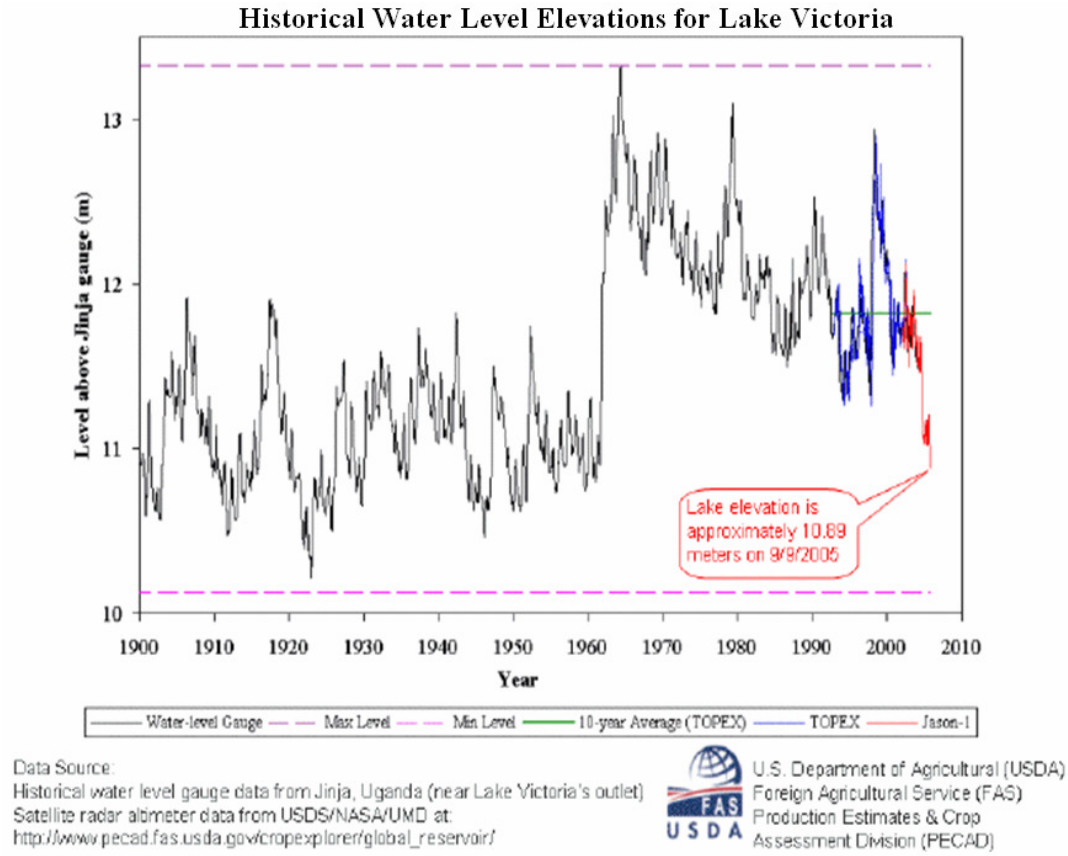


Figure 4-4: **Historical water elevations for Lake Victoria**

4.3.1.7 Rain water harvesting

Roof water harvesting is not very popular at present, even in areas of water scarcity. Its application suffers from low and irregular rainfalls, particularly in the eastern portions of Bunda. Also requires individual storage facilities, corrugated roofs and gutters. This if well sensitized may be a useful additional source. As was reported by NBS, 2002 major constraint includes 75% of rural houses in Bunda being thatched with grass on which it is difficult to fix gutters for water collection.

4.3.2 Findings from the characterization of water services

After characterization of the rural water supply service in the study area the following were the findings

(a) Ground water

Firstly the researcher established that important source of WS for Bunda district is ground water (22%) through use of hand pumps. The widely used hand pump being TANIRA, India Mark II, Afridev and SWN80/81 hand pups to lesser extent because todate they can not be obtained off the shelves.

(b) Surface Water

Lake Victoria is certainly an excellent source for supplying water to 47 villages which are within a distance of less than five (5km) kilometres. And the researcher noted the following;

i. There is no clean Perennial River for the entire district except Rubana river carrying turbid water emerging from Serengeti national Park and crossing Kunzugu ward to villages like Tamau. Because of its dirtiness (turbidity) it is not used for human consumption. In fact this is the very river that brings algae into Lake Victoria and hereby suffocating the Guta intake for water supply in the township. It is for this reason that decision was taken to change the intake to Nyabehu a further point from the river entry into the lake.

ii. There is no adequate wind speed for wind driven pumps (windmills)

iii. Rainfall is inadequate ranging from 700 to 900mm per annum.

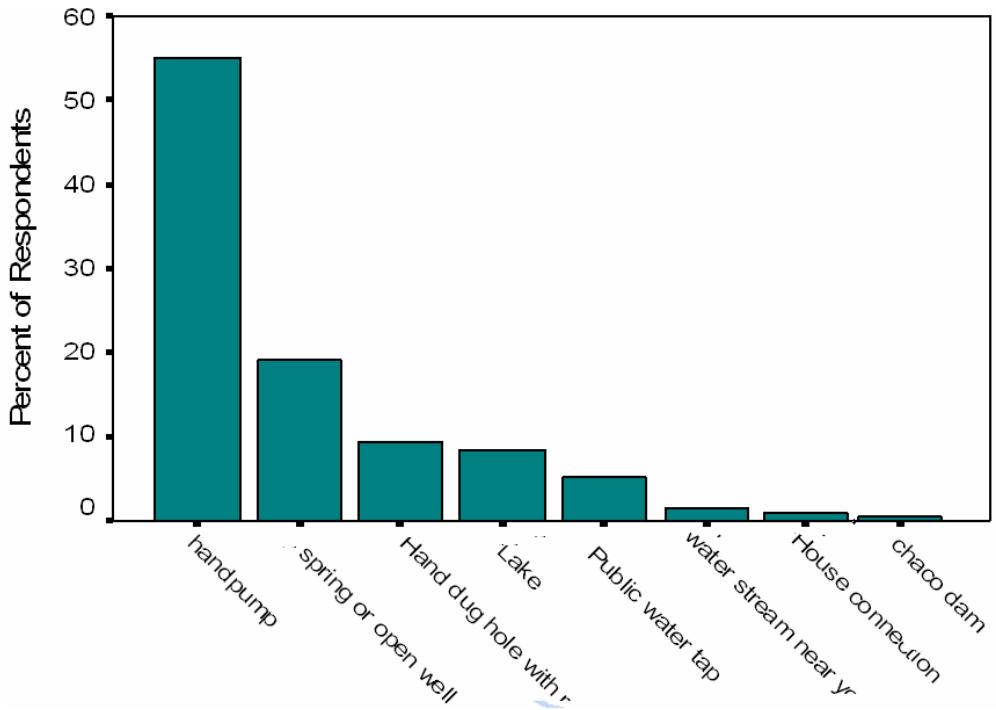
iv. Majority of rural houses (over 50%) are grass thatched making it difficult to use the roof tops to harvest rain water.

The fluctuation of lake Victoria water level affected water provision for Bunda town and villages along the rising main, in a number of ways; When water level was critically low, the suction pipes were left hanging in the air and so a need aroused to elongate suction pipe to an extent the surface pumps were no longer able to suck. So a temporary ring well was fixed near the shore and wait for water that comes in during midnight when wind blows back to the shore. The situation was very difficulty in months starting May through December 2006. Awaited wind starting midnight at 0200hours to 0500hours that brought water toward the shoreline and some were trapped in a ring well and pumped for less than 3hours as opposed to 10hours in normal condition. Floating pump was necessary to fix it at the mid of water depth, and push to the shore where surface pump could pick and pump to Bunda town.

Hardly there were no adequate water for the nearby Guta village, other villages along the rising main and at Bunda town which is 22km away from Guta intake. Refurbishment was costly and required financial ad added technical support from national level. The figure 4-5 gives a historic water level elevations trend of Lake Victoria water level from year 1900

4.4 Water supply coverage

Figure below shows sources for drinking water and other domestic uses;



Source: This Study
Figure 4-5: **Water accessed for domestic uses**

Table 4-3 shows a summary of population covered by ward. Detailed district water supply coverage (by village)

Table 4-3: Population Covered by Ward

Division Name	Division Population 2002 Census	Ward Name	Ward Population 2002 census	Total Villages in a Ward	Pop. Served by Scheme in Ward	Percentage of Population Served in Ward
Nansimo	52,509	Kisorya	16,342	5 villages	5,317	32.54%
		Igundu	9,308	4 villages	2,349	25.24%
		Nansimo	10,597	4 villages	1,500	14.15%
		Kibara	16,262	5 villages	13,602	83.64%
Kenkomboyo	44,209	Neruma	13,662	7 villages	9,559	69.97%
		Namhula	9,739	3 villages	2,750	28.24%
		Iramba	8,351	4 villages	8,351	100.00%
		Butimba	12,457	6 villages	4,320	34.68%
Serengeti	100,420	Bunda	45,881	14 streets	15,640	34.09%
		Sazira	8,541	5 villages	5,000	58.54%
		Kunzugu	8,788	4 villages	7,442	84.68%
		Mcharo	7,563	5 villages	3,000	39.67%

		Guta	12,022	4 villages	5,587	47.47%
		Wariku	7,417	4 villages	4,663	62.87%
		Kabasa	10,208	4 villages	5,185	50.79%
Chamriho	61,792	Nyamuswa	15,463	6 villages	11,796	76.29%
		Salama	12,743	5 villages	6,750	52.97%
		Mihingo	9,413	3 villages	3,500	37.18%
		Mugeta	11,339	4 Villages	2,500	22.05%
		Hunyari	12,834	4 Villages	4,000	31.17%
	258,930				**122,811**	**47.43%**

4.5 SWOT Analysis for Water Supply Services

Detailed study of sustainability aspects is essential for any water supply project to avoid system breakdown and premature abandonment. The major constraints which cause failure of water supply systems are water quality and quantity problems, attitudinal, institutional and legal framework problems, lack of community participation, O&M problems and political interference. The sections that follow discusses constraints (section 4.2.2) and opportunities in section 4.2.3

4.6 Constraints to Sustainability of Rural Water Supply Services

Basically the study captures financing mechanisms, institutional, technology and socio-environment elements as key to sustainability of rural water supply services. It is considered in this study that once communities are well capacitated in these areas then, water service which is lifeline commodity will be rendered in a sustainable manner.

4.6.1 Institutional arrangements

Most of the Bunda district population reside in rural areas. The district has a total population of 258,930(2002 census) of which 45,881 live in the town.

Administratively it has a district commissioner supported with the District Administrative secretary plus a few other staff. The District Executive Director heads the executive teams. There are 7 departments under the DED namely; Water, Education, Agriculture, Treasury, Human Resources, Works and Community Development. Also there are four units namely; Planning unit, internal Audit unit, Legal unit and Procurement unit.

The water Department is headed by the District Water Engineer supported with water supply technician, Hydrogeologist and the Manager for running the water affairs in Bunda town.

DWE's office directly manages 5 rural water schemes on daily basis. The WS for Bunda town is run by the Manager and is not covered by this study. The five schemes managed by DWE's office are Nyamuswa-Makongoro-Bukama village water supply scheme, Kibara-Busambara water supply scheme, Kasahunga-Kenkombyo water supply scheme, Iramba-Neruma water supply scheme and Bulendabufwe Gravity scheme.

Only Nyamuswa-Makongoro-Bukama village water supply scheme uses a deep borehole intake coupled with a submersible pump, Bulendabufwe Gravity scheme tapes water from a spring and the remaining three water supply schemes have their intake in Lake Victoria and delivers water upstream by using centrifugal surface pumps.

With exception to the Bulendabufwe Gravity scheme which is operated by the Bulendabufwe Village Water Committee, the remaining 4 water scheme has one person employed by DED to be supervise the scheme. The person is in-charge of day to day activities of the scheme including smooth operations of machinery, pumps, repair works and minor breakdowns. In each piped scheme there is one support auxiliary technician to assist plumbing works. Also there are two pump attendants and a water bill distributor and collector who also work as scheme treasurer.

Institutional Constraints: From the questionnaire survey that was conducted, the following emanated from the respondents as shown below; Current organizational constraints revealed in Bunda district are summarized below;

i Inadequate coordination and undefined demarcation between government offices leading to weak planning and performance in such areas as budget based planning and activities implementations

ii District to have a stringent action plan that gives priority to less covered villages to be served first in new endeavours.

iii A political will is sought to be vital for a change to happen for water sector in the district

iv Give more emphasize on strict supervising newly constructed water projects not to fall below standard. But then enough supervision funds is to be secured

v Shortage of skilled technicians in the District Water Engineer's office (DWE) for O & M leading to delayed innervations in rectifying faults in WS facilities.

vi Reinstate the non functioning Village Water Committees (VWC), WATSAN Committee and Water User Entities (WUE)

vii Poor knowledge of book keeping leading to weak sustainability of water facilities

To mitigate these institutional constraints, it is the idea of this report that a need is sought to clear hazy atmosphere in organisations roles of the Ministry responsible for water and related ministries, the region, the local government authority, and the beneficiary communities in the villages. Some suggestive mitigation measures may include the following:

- Strengthen the cluster for water, Healthy and environment at RAS' office to discharge its functions/duties in more efficient manner
- The District Water and Sanitation Team (DWST) should be capacitated to provide technical support to communities in the villages in operating and maintaining water facilities and efforts be made to disseminate information to communities on the roles of the DWST
- Establish responsible bodies or community water organisations to help in managing water facilities in their villages. Such water management bodies at community level may take a shape of Water User Association (WUA), Water User Group (WUG) for hand pump or water point level or can take a shape of a Board of trustees, etc

In reference to human capacity in District Water department's office, the following table articulates;

Table 4-4: Staff establishment at Bunda District Water Department

Professional	Established (Required)	Available	Deficit
Engineer	2	2	0
Hydrogeologist	2	1	1
Civil Technician/ Water Resources	12	6	6
Hydrogeologist Technician	4	1	3
Auxiliary Technicians	12	9	3
Electro-Mechanical Technician	2	1	1
Mechanical Technician	4	2	2
Support staff	13	12	1
Total	**51**	**34**	**17**

Source: Bunda district council, Main report NRWSSP 2009

Water department in Bunda district has shortages of water resources technicians to run community water schemes. A minimum number of 11 technicians are needed, two per scheme and one management information officer based at district water department office. Two electro-mechanics are required to replace plumbers charged with repair of pumps instead of plumbing works. An auto-electrician in place suffices if there are few related breakdowns but should there be concurrent breakdowns related to electricity he will be overstretched. Present District water engineer is more of an administrator which brings in the need for a site engineer to support techniques of water systems on design and guide to operation and maintenance. Geophysical and land surveyors are not on demand since this services are only needed once in a while thus hiring from basin office and regional water advisor's office is the best option to keep overhead cost down.

It was noted during the study that qualified technical personnel are not willing to work in rural areas. Once they are employed they stay one year probation period and

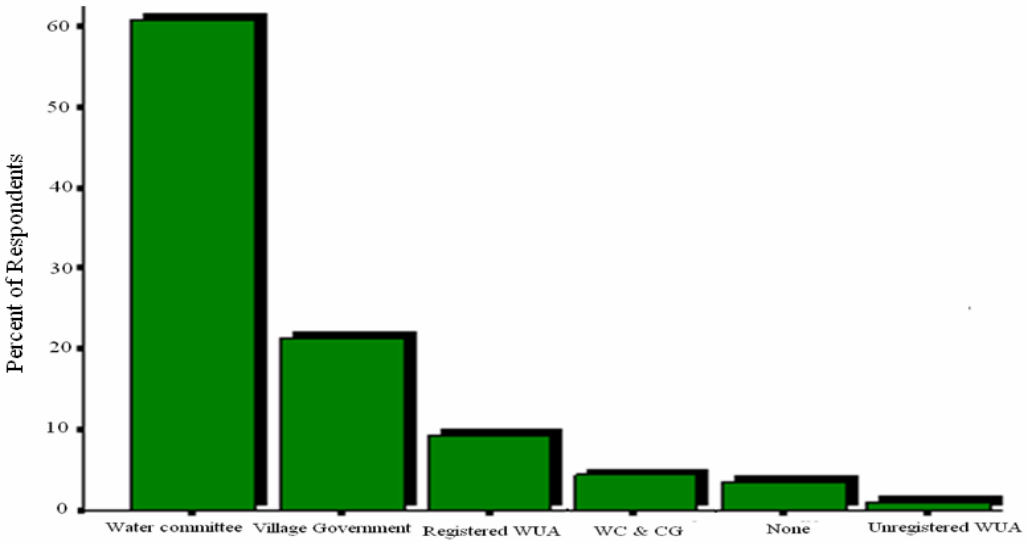
once confirmed (vetted) they either seek transfer to urbanised districts or they apply for career studies. It was noted that in a period between 2005 and 2009 four qualified technicians have come in Bunda and one transferred, two went to school and one did not turn up the appointment. This has a consequence of pumped schemes left on the hands of unqualified grade test auxiliary technicians. All the 4 pumped and piped water schemes in Bunda are managed by artisans with trade test grade I and II. These are primary school people with limited capacity of management skills. Only that they went through short courses of 1 to 3 months to upgrade their skills and particularly drilling of shallow wells, auger drilling, plumbing works and simple pump mechanics. Generally they have little scientific skills and limited management skills. See appended tables showing staffing level and competences for Bunda District Water Department.

4.6.1.1 Community organizations for water system sustainability

Another factor limiting sustainability of water management is the non-existence of formal community organization that operates the facilities. Here the management arrangement was addressed to see how water schemes were built. The concept of most appropriate management level, Water Users Management Entities (WUE), water committees, water user groups; board of trustees, water user associations, subcontracting to independent service provider and other models depending on the nature and complexity of water scheme. In the district, most water services are managed as follows; district council through the district water and sanitation team (DWST) manages literally all the piped and pumped schemes, Water scheme committees exists as informal local water boards in each piped scheme. And water

user groups formed at every outlet point or water point manages water services at that water point. Hand pump facilities are managed by water and sanitation committees (WATSAN).

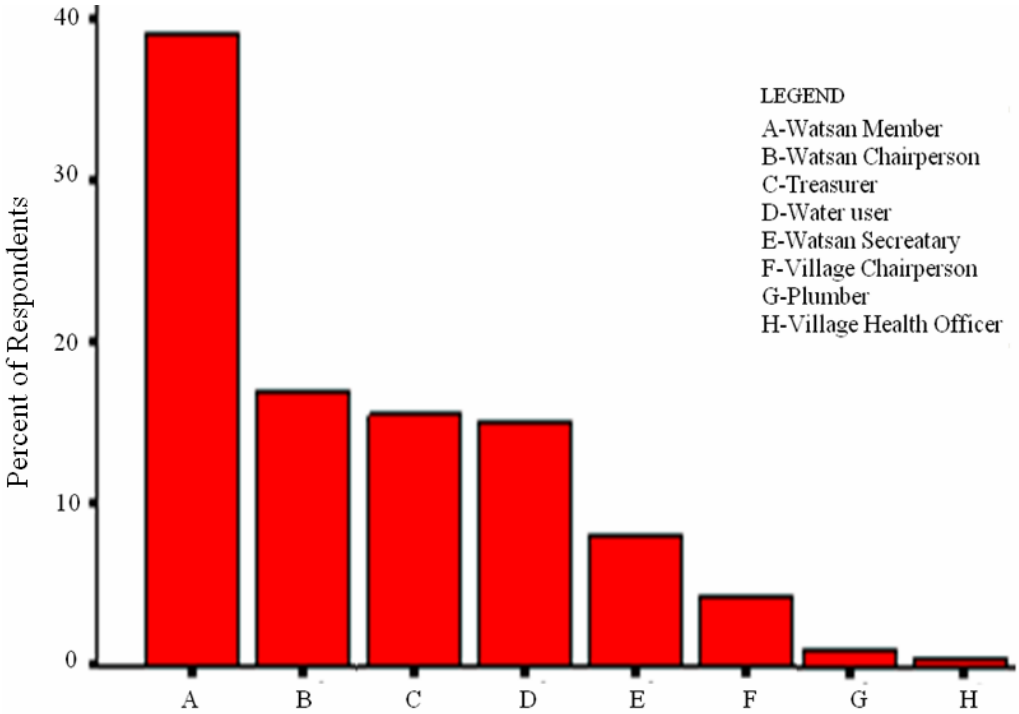
However results from the questionnaire survey showed that out of the 223 responded as follow; 87.9% knows that water and sanitation committees (WATSAN) manages their water schemes, 5.8% said no management organisations is in place at present including those formed in the past and 6.3% said there is no exactly organisation. The Village Government have taken control over Bulendabufwe gravity scheme while Teachers Training College manages Nyaruga gravity scheme. Table below shows type of water institutions that manages water services on daily basis.



Source: This Study
Figure 4-6: Water facilities Management Arrangements

Water service management here includes; overseeing the operations, conducting preventive maintenances, collecting water tariffs, ensuring that repairs are made and doing payments for repairs, keeping records of financial transactions, manuals and

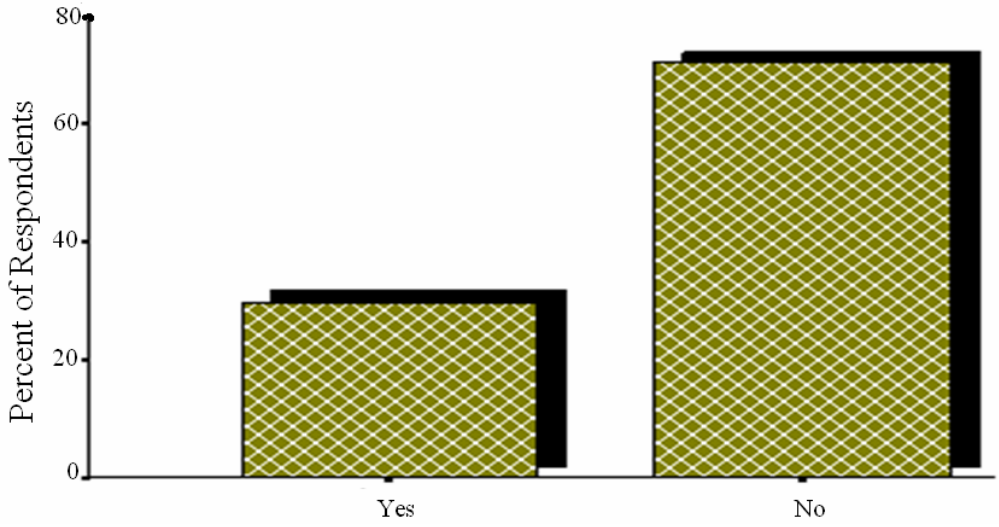
blueprints or design drawings, sanctioning people for non-payment,. The study found water services were fairly in good order in communities that had a defined form of management and systems were in poor conditions for those lacked such an organization, and hand pumps were vandalized or stolen



Source: This Study
Figure 4-7: Title of respondents in water facilities management

4.6.1.2 Water Facilities Security Arrangements

Out of the 223 respondents, only 28.3% responded there are nightshift watchman however it was still questionable as to whether they actually guarding at night or not. The fact that they are not paid for guarding and instead they are exempted from attending village development duties which highlights the doubt. According to respondents in questionnaire survey, the table below gives results of respondents for the availability of night shift watchman at water facility point.



Source: This Study
Figure 4-7: Availability of night shift watchman at HP in Bunda Villages

4.6.1.3 Data management and information flow

No system has yet been devised or put in place that is able to consolidate the water supply and data generated by district villages to convey meaningful village level information on water supply at the regional and hence at national level. There is a lack of coordination among the various institutions involved in water supply provision in the district for monitoring and easy trucking of coverage. Although plenty of data are available at village level but they are not well documented. Very little information is available on the relative significance and adverse impacts of different types of pollution of water sources areas resulting from agriculture and tree falling for Chaco making.

Water supply data from various sources within the district can be obtained and stored in a database and stored data can be provided over the web using a graphical user

interface for different management options. Although there is ICT4RD (Information and communication technology for rural development) just started in 2006 and water is not given a good stake in it. Again it is not popular to rural dwellers except few district officials. Providing people with information about the potential health benefits of an improved water supply changes the way they value their water source and thereby improves their willingness to sustain the system. A quote from Bunda website: http://www.bunda.go.tz/?q=node/37 accessed 1st July 2010 at 12:20hrs "Information and Communication Technology for Rural Development (ICT4RD) is the Research and Development program which is striving at providing connectivity in rural Tanzania using existing infrastructures, was conceived and planned in years 2003-2005 and started in year 2006. The focus is improving services by making information easily available and accessible in the areas of education, health and local government management for the aim of narrowing the communication gap"

4.6.2 Applied Technology

(i) Gravity schemes are relatively cheap to operate and maintain but according to the geographical formation of Bunda district, there are only 2 Gravity schemes with limited yields

(ii) Hand pumps are abundantly spread in rural areas but some are located in remote areas into the bushes and security arrangement is not certain such that vandalism persists

(iii) Mechanization for abstracting water from a BH: In some cases windmill is suitable but requires professionalism in equipments installation plus bigger capital cost and in most cases only low yields can effectively be handled. Electricity is not available in most remote areas. Diesel is very expensive and

(iv) Rain water harvesting is viable in rural areas especially for drinking purposes but most houses are thatched with grasses and few in corrugated iron sheets.

(v) Electricity is another constraint because there is no power in rural areas especially the national grid

(vi) Dynamic water levels of BHs force installation of HP at greater depths instead of shallow levels which are manageable. Deep installation involves more risers and hence costly. In some cases submersible pump have to be installed instead of surface pumps which are cheaper. NB: Surface pumps can suck water a maximum of 7m.

(vii) Wrong citing has consequences such BH sited near or in cemeteries or near graves were not used by intended community because it was against their belief and custom to fetch water from the tombs of their dead ancestors.

(viii) A design period of 20years implied higher initial capital investment to users of respective water schemes, simply because if the system could be designed for say 10 years in any case will be cheaper than one designed to serve a 20 years life span.

4.6.2.1 Training on use of technology

Training for household members and for water committees improves sustainability by building capacity and commitment.. It is known that even when communities have high demand for water, they may lack the capacity to operate and maintain the system on their own. In addition to providing knowledge on how to operate and repair the water system, training informs people of what expectations they should have for their water system and how to identify and address minor problems in the system before they become major. It was unleashed that out of the 8 piped system incharge there is only two who attended a short period course in last 3 years.

4.6.2.2 Quality of construction

The study found that construction quality had a major impact on sustainability. Poor construction quality lowers chances that the system would be sustained. Poor construction quality is likely to occur when supervision is lacking and where contractors or project staffs are accountable to a distant project manager rather than directly to communities. The researcher observed a newly constructed Chaco dam at Kinyambwiga village where the tender was floated by the Ministry of water and irrigation which also supervised the project from head office in Dar es Salaam and as a result the Chaco dam was poorly finished. Nyambere dam in Nyamuswa/Makongoro villages also delayed. This Nyambere dam was under construction at Nyamuswa village, and was to be completed 2 years ago, so it is behind schedule for at least 2 years up to the time of this study). And there were a number of reasons given include variation of works i.e. Blasting

4.6.2.3 Inflexibility in technical options

The researcher happen to learn that some projects applied design standards that promoted over-design to some extent and did not allow much service level flexibility, regardless of project rules that allowed for community choice. The 25 litre per capita per day was in fact found much high as some people were able to use as low as 5litres in acute shortages. These were areas such as those where majority dwellers are livestock keepers e.g. Kinyambwiga, Mugeta and Kisangwa village. The 25litres as advocated in NAWAPO can some how lead to over design of projects in

rural areas where most people are not able to recover O & M costs after water facilities are built.

Gravity systems were often considered most reliable technical option and were easier to maintain by communities. Instead it was noted that Bulendabufwe gravity scheme lacked consistent maintenance of their system. One of the two intakes had clogged and they were using the remaining one. According to village chairman, they never cleaned their 45cums water tank for about a year at least up to the time of this study. The study noted that users had a strong preference for house connections and there were strong willingness to pay additional costs of connections if water could suffice. The project was designed to provide only a minimum service level and did not take this incremental demand into account leaving alone poor intake management that were witnessed which also lowers the yield. If users could tape water to their homes then technical viability of the system will be jeopardized and majority on the tail side or downstream will not get water.

4.6.2.4 Appropriate and flexible technology

Technology must be appropriate for the physical and socio-economic environment. The range of technological options available to communities should be sufficiently flexible to support both the achievement of full coverage at minimum service levels, and the ability to respond to changing demand for higher service levels. The tension between flexibility (necessary to achieve locally appropriate solutions) and standardization (necessary to achieve sustainability and economies of scale) needs to be managed at national and service level by the selection of a range of nationally acceptable technology options. These must achieve cost effective full coverage, and

respond to the legitimate aspirations of individuals and communities for increased service levels.

Citing of wells need to be incorporate local indigenous people because sometimes wells are drilled to cemeteries and once completed were abandoned, for no one visited the place. So the flexibility should be in a way such that if a deep BH cannot fit here then it can fit somewhere also but not to drill a Bore hole simply because the survey tells you there is water.

4.6.3 Financial Resources

4.6.3.1 Ability to pay (ATP) and Willingness to pay (WTP) for improved Water Supply Service

(a) Ability to Pay (ATP)

Water users are not able to pay because they are poor and in 2008 the district was ranked the poorest in the country. Again Tsh. 56,000 which was in water account at Bulendabufwe gravity scheme were drawn and paid for education contribution (making pupils' desks). This implies that either they are so constrained with a number of developmental contributions from different sectors which has become a heavy burden to them leading to dwindling morale. The bad thing with water sector as opposed to other sectors is; when the communities are not able to pay (ATP) for the improved service tend to resort to previous traditional (un improved) water sources. Thirdly, even to WATSAN, WUG and water user who are paying for O & M they pay too little. For example a house hold of 6 people can pay only Tsh.20 and fetch water for 30 days long. This is as good as nothing

Approved Budget versus Released Funds for water Department in Bunda DC was assessed for the past 3 financial years. In accordance with the records made available it was found that funds released to the water department for both development (Dev) and recurrent expenditure (OC) fall far below the actual requirement of the department. In the fiscal year 2007/2008 the released development funds were less than half the approved budget, see table below. The reason given for such situation is the poor financial position of the district. Revenue of the district has always been lower.

Table 4-5: **Budget ad Expenditure fr Past Three Financial Years**

Fiscal Year	Budget	Actual requirement	Approved Budget	Amount released	Actual expenditure	Deficit release
2007/2008	Dev OC	437,310,100 369,692,780	437,310,100 369,692,780	206,000,000 369,692,780	206,000,000 369,692,780	52% O
2008/2009	Dev OC	487,662,000 278,000,000	437,310,100 278,000,000	303,026,000 278,000,000	303,026,000 278,000,000	31% 0
2009/2010	Dev OC	487,662,000 278,000,000	487,662,000 278,000,000	(on going) 278,000,000	(on going)	

Source: Bunda District LAAC Reports and MTEF, 2009

From the table above shows those actual disbursements of development budget are much less than approved budget. This leads to postponement of planned projects year after year which is a major constraint to planning and service delivery.

(b) Willingness to Pay (WTP)

Willingness to pay is verbally shown in the sample survey but a question comes how much they are willing to pay? Tsh. 20 per 6 people per month is too little which

means that their willingness is also limited up to how much they can be stretched. Again can find in Kurya ethnic settlements where most are livestock keepers, one can pay for what was to be contributed by all and these individuals then leaves everything on him. Proposing well drilling site and most of the time it is located near their homesteads and becomes their own property and no longer belongs to entire village. Once it is broken no one contributes to repair it.

The district representative officials such as DED, DPLO and other senior Council officials usually express their willingness to support sustainable water use but are most of the times constrained with limited financial resources and time.

Another constraint is the ability to *clearly see the communities'* willingness and ability to pay. Although the communities in the study area have in the past been involved in donor funded projects which propagated similar policies of cost sharing projects such as DDP (District Development Programme-SIDA) and HESAWA (Health and Sanitation through Water).

The extent to which communities are willing to pay can be seen from the table below showing water accounts and their funds that were deposited todate.

Table 4-6: **Village water committees and Water funds**

Ward	**No. of Village** Village	**Village Water Committees (VWCs)**	**Village Water Funds (VWFs)**	**Total Funds (Tsh.) as at 31/10/2009**
Bunda	1	1	1	2,500,000
Kisorya	-	-	-	-
Igundu	2	2	2	600,000
Nansimo	-	-	-	-
Kibara	1	1	1	1,800,000
Neruma	2	2	1	113,000
Namhula	3	3	3	1,260,000
Iramba	-	-	-	-
Butimba	2	2	2	370,000
Sazira	2	2	2	234,000
Kunzugu	-	-	-	-
Mcharo	1	1	1	870,000
Guta	2	2	2	940,000
Wariku	-	-	-	-
Kabasa	-	-	-	-
Nyamuswa	1	1	1	1,500,000
Salama	2	2	2	310,000
Mihingo	-	-	-	-
Mugeta	1	1	1	500,000
Hunyari	2	2	2	240,000
Total	**22**	**22**	**21**	**11,237,000**

Source: Bunda DC Water department Office, 2009

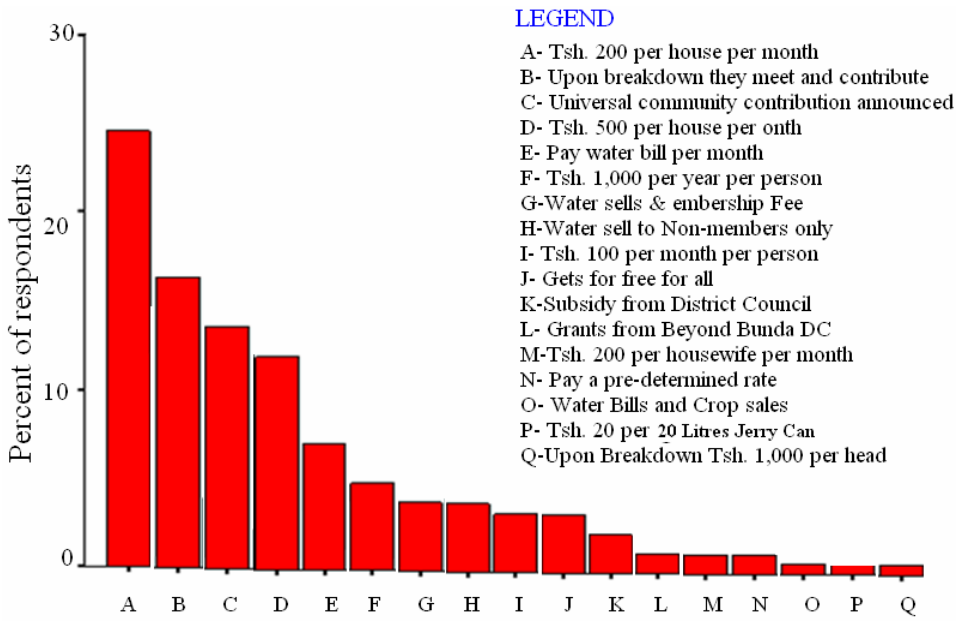
The ratio of villages with water accounts to all 87 villages, it was established that the willingness to pay was very low. In percentage wise, only 25% had some funds in their accounts, but majority had not even thought of opening a bank account.

4.6.3.2 Financial and accountability

During focused group discussions, it was noted that, there is lack of accountability and transparency in some community management entities led to lack of trust by community members. Also communities complained about construction of water systems being to hands of non-responsive agencies. Communities complained to have no way of ensuring contractors or government agencies honour technology options of their choice. Still they are not able to hold project staff accountable if a system is poorly constructed, incomplete, or construction is delayed. This demoralization even were also seen when hand pump users surveyed, they kept no records of system costs or how much communities contributed to the water system. Interrogating Mcharo Village Chairman-Mcharo on the O & M of their existing HP, it was noted that money for HP maintenance at Mcharo was pocketed by a trusted treasurer of their group who by that material time was admitted at Bugando hospital and the village HP is out of use. On humanity basis, no WUG member was able to ask for the money to maintain the HP.

4.6.3.3 O & M Fund Raising

Most facilities set very little contribution from communities that were not collected however. The study found that communities were paying Tsh.20 per month to use water by a wife, husband and say 6 children. The amount which was far less compared to the least cost spare part once is broken and requires replacement to recover the service.



Source: This Study

Figure 4-8: **Operation & Maintenance Fund Raising Modality**

4.6.3.4 Technology choices and Prices

When choices are not linked to prices, households view contributions as a tax rather than an expression of demand and ownership. In a demand-responsive approach, the choices that people make should be linked transparently to prices so that people can make informed choices about their participation. Here the study looks at deep drilling being opted in a place where shallow drilling can work and hence increase cost. These were observed in the 13 villages under NRWSSP where communities wanted the service they can sustain for few years but the programme seeks for a long serving (population) project. See project support from the communities in the table below

Table 4-7: **Communities in the First Phase of NRWSSP of WSDP in Bunda**

Village	Sub village	People 2002	Technology	5% comm. Contrib. Tsh.	Contributed March 2010
Kung'ombe	6	4,564	Dam and piped network, electricity power	21,400,000	-
Salama Kati,	4	1,573	B/Hole with piped network, diesel power	10,000,000	100,000
Kiroreli	6	3,837	B/Hole with piped network, electricity power	20,900,000	-
Nyamuswa	6	3,224	B/Hole with piped network, electricity power	22,250,000	800,000
Nyang'aranga / Mugeta	9	4,848	B/Hole with piped network, electricity power	48,250,000	821,950/=
Bulamba	5	2,133	Lake Victoria with piped network, electricity power	14,250,000	100,000/=
Ligamba A	6	1,258	Nyaruga natural spring with piped network	10,000,000	50,000/=
Kitaramaka	6	1,836	B/Hole with piped network, electricity power	15,000,000	-
Nyamatoke	6	1,952	B/Hole with piped network, diesel power	15,000,000	-
Kinyambwiga,	7	3,221	Lake Victoria with piped network, electricity power	27,500,000	570,000/=
Kibara,	7	6,657	Lake Victoria with piped network, electricity power	13,250,000	460,000/=
Karukekere,	5	4,089	Lake Victoria with piped network, diesel power	19,000,000	100,000/=
Mumagunga,	5	1,618	B/Hole with piped network, diesel power	10,000,000	45,000/=

Source: Bunda DC report, 2009

The 5% of capital contribution was to be contributed by communities in the period of 2007 through 2009. Many household members perceive their contribution as a tax or a call from the government of which they must obey and therefore they don't take it as a sense of demonstrating ownership. Costs of different options were not presented well in simple way for laymen to make decisions, so were presented in a calculus terms making hard to calculate and get proper answers of really costs anticipated. In addition, project staff or community leaders did not always give individuals *enough time to internalise* options. Contribution level could be ranging from *nothing* and up to 5 percent of capital costs.

4.6.3.5 Cost sharing mechanisms

Revenues to match costs must be identified, as must cost sharing mechanisms.

Revenues coming from inside the service area (in the form of rates, taxes and user fees) and outside the service area (in the form of grants, subsidies, or loans) must be identified and accounted for in a transparent manner. The issue, is that for a given level of service, revenues match costs. Who pays how much for what is a political issue to be decided within ward or project jurisdiction and in fact decisions need to be made clear to beneficiaries. The constraints were that water users are not willing to pay and sometimes not capable of paying for water used, see a case of KIBWUA revenues versus expenditure in the table below

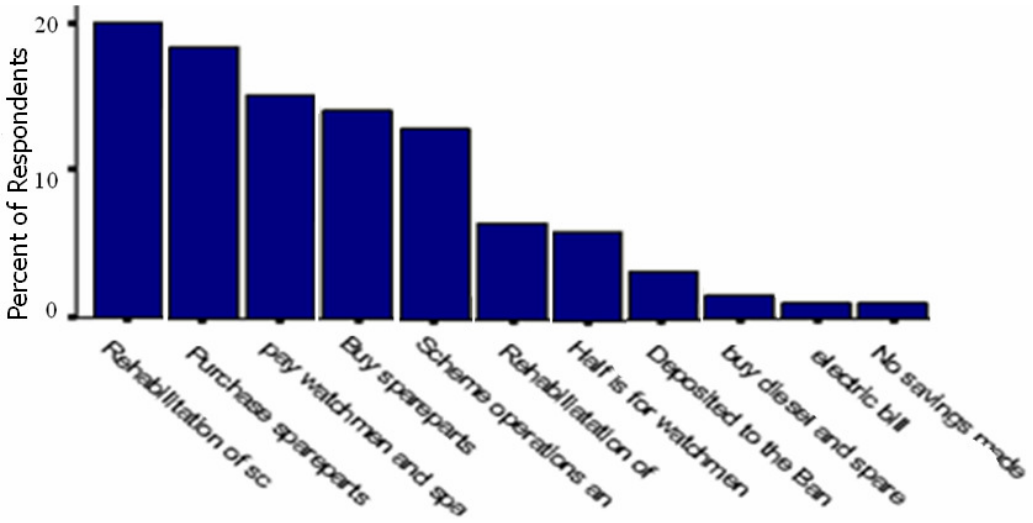
Table 4-8: **Calculated KIBWUA Revenue and Expenditure per Month**

Revenue per month		**Expenses per month**
Revenue from metered 150,000		Electricity bill 200,000
Bills & flat rate bills 350,000		Scheme incharge 200,000
		Plumber 75,000
		Watchmen (2) 150,000
		Treasurer 30,000
		Honorarium 50,000
		S/Allowances 100,000
Total Tsh. 500,000	**IS LESS THAN**	**Total Tsh. 805,000**

Source: KIBWUA Secretary, Bunda

4.6.3.6 Fund Raising and Utilization

The researcher obtained the following results of fund raising and utilization in many of the hand pumps and few piped schemes, see figure below

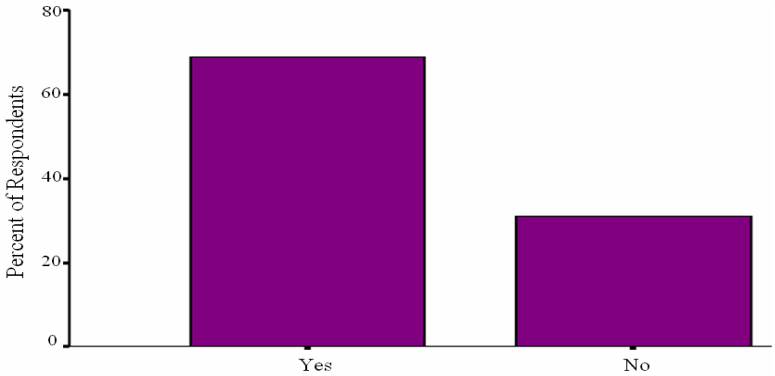


Source: This Study
Figure 4-9: **Utilization of funds (detailed table in appendix: B)**

4.6.4 Socio-Environmental

4.6.4.1 Social equity and Access to Service

An equal right to participate or be represented in the control of their services is important, but no special mechanisms were in place to ensure women, marginalised groups & the poorest are able to make use of this right. No efforts to ensure representation in decision making and control structures by women, marginalized groups and the poorest.



Source: This Study
Figure 4-10: **Water reliability (availability) in a year**

4.7 Opportunities for water sector in Bunda

Quoting from Bunda district website: http://www.bunda.go.tz/?q=node/44 accessed on 1st July 2010, on 12:30hrs under sub heading "Investment Opportunities in Water Supply" it says Bunda district is endowed with various types of water sources, however, the district has very few or nothing pipe water sources. Investment is hence needed in regard to the supply of pipes, drilling and pumping equipment and the increase of the capacity of water storage. Investment is also needed for the supply of electricity to be used in electricity pump"

Apart from Lake Victoria and potential ground water source, the researcher was able to ascertain only 3 water spring sources already utilized and the renown dirty river Rubana.

Opportunities pertaining to water services in the study area are mentioned below;

(i) Bunda district is endowed with Lake Victoria, which is a prominent water source; however, the district has only 4 pumped water schemes drawing water from Lake.

(ii) Geophysical survey and underground water survey conducted on 2009 showed that wider area of Bunda district has abundant underground water. This now calls for investment in deep and high yield ground water drilling as opposed to existing shallow wells which dries on summer. These deep BH is likely to have good yield that can even be provided to the next village if possible.

(iii) Bunda unlike other part is connected to the national power grid and therefore requiring just drop down transformers to lower the high tension voltage to be

consumed domestically and traverse the same to remote areas to drive water pumps.

(iv) By virtual of Bunda bordering the biggest Serengeti national park, if strongly collaborate may can get grants to build more viable water projects apart from the available efforts to help only communities around the park with few BHs.

(v) The district being along the international transit road connecting Kenya, Rwanda, Burundi and Uganda is an potential which has not been tapped yet.

(vi) An average rainfall of 700mm in a year is well above the minimum recommended (200mm) for rain water harvesting which is also an opportunity

(vii) Bunda has for the past couple of decades benefited from intensive Japan International Cooperation Agency (JICA). Todate there are a number of projects under plan to be implemented by JICA. Development partners with Bunda district include; SIDA, GRUMET fund, Bulamba Gunnery and Villian. At national lever when we consider implementation of WSDP and especially NRWSSP, we see donors such as Word Bank, JICA, BADEA etc.

(viii) Geographically, Bunda is not very well positioned in regards to accessibility by various kinds of implementing agencies, such as contractors, consultants, service providers and specialized services like laboratory for water quality analysis because majority of service providers have their head quarters in Dar es Salaam which is about 1322km. The table below show few service providers that have ever worked with Bunda district.

Table 4.9: Projects implemented in Bunda District and implementers

S/N	Donor	Project	Activities and Area covered
1	WORLD BANK	Rural Water Supply and Sanitation	Implementation of Rural Water Supply and Sanitation programme
2	GRUMET FUND	Rain Water Harvesting	Implementation of rain water harvesting for ten (10) secondary schools.
3	JICA	Rural Water Supply and Sanitation	Ground water drilling, Geophysical and Topographical survey, Installation of pump, Pipe laying and water supply for Mcharo village.
4	BADEA	Village Water Supply and Sanitation	Ground water drilling, Geophysical and Topographical survey, Installation of pump, Pipe lying, water supply and sanitation for five (5) villages of Kunzugu, Bitaraguru, Kiwasi, Igundu and Namalama.
5	BULAMBA GINNERY	Village water supply	Population makes use of one (1) public tap at supplied from Ginnery, pumped supply from medium depth well.
6	IKIZU	Village water supply	Population makes use of one (1) public tap at SDA Mission, pumped supply from borehole.
7	VILLIAN	Village water supply	Some people make use of water supply of Villian Ginnery, pumped supply from borehole.
8	HESAWA	Mara, Mwanza and Shinyanga	Health, and Sanitation through Water All two phases Completed

4.8 Sustainability Index

4.8.1 Categorization of Sustainability Status

Categories of sustainability are three;

- **Sustained project:** The project obtains a 70% score (or more) in all sustainability dimension in aggregate and in each core factor

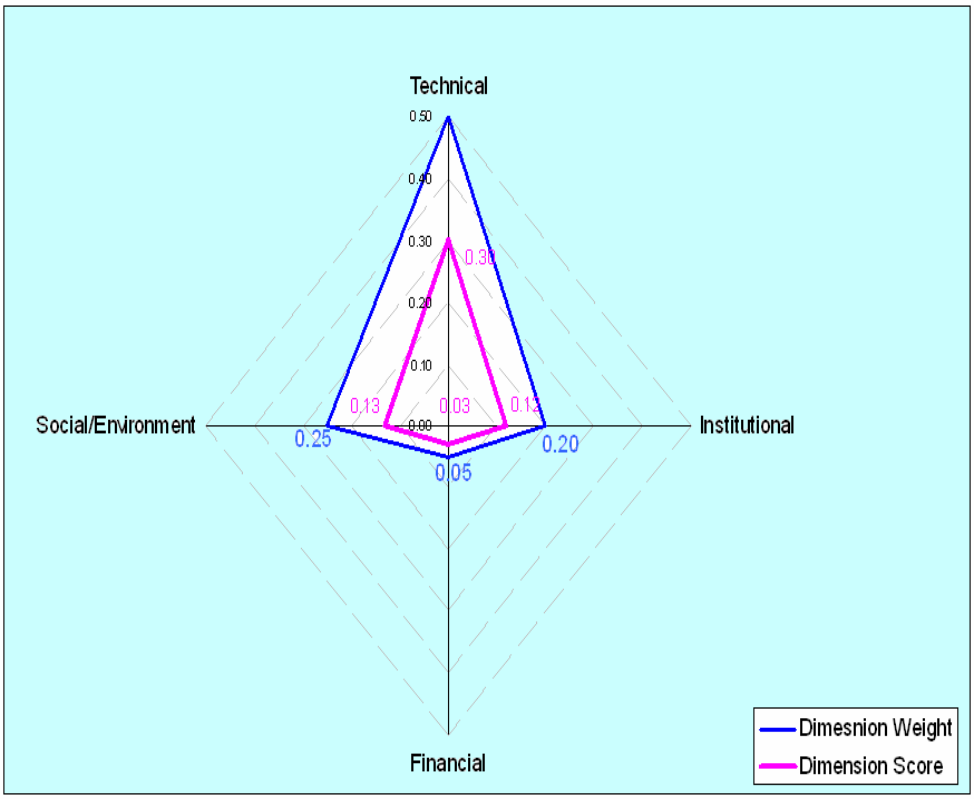
- **Sustained but at risk project:** The project obtains a 70% score (or more) in an aggregate form and in each core factor, but fails to obtain a 70% score in any one of the sustainability dimensions
- **Not sustained project:** The project fails to obtain 70% score in an aggregate form or in any of the core factors

4.9 Discussion of Findings

Results for the four researched dimensions were as follows; Social-Environment at 52% (0.13 out of 0.25) scored least of all and the rest scoring 60% (technical 0.3 out of 0.5, financial 0.03 out of 0.05 and Institutional o.12 out of 0.2). The final sustainability index is about 0.58%.

Fro categorization of sustainability status, then Kibara-Busambara water project falls under ***"not sustained project"*** because it could not obtain 70% scores in aggregate and in each dimension. Also failed to obtain 70% score to the two core factors as it obtained only 58% <70% in first core factor and got 53% <70% in second core factor. This could have been caused by a number of factors such as; Bunda district council not injecting enough funds that will fully cover Kibara and Busambara villages. Currently the project is covering only 8%. Water meters are not installed to customers and majority enjoy flat rate and communal or public draw points. The study reveals social/Environment scoring relatively poor and amongst sub factor being community participation, water use, and environment, inclusion & equity of marginalized and poor people. A lot has to be done pertaining to this but also to the rest of the dimension because at large no dimension scored 70%. Figure below gives

a pictorial representation of sustainability score for the four dimensions that were researched.



Source: This STudy

Figure 4-11: **Dimensions Scores Forming the Sustainability Index**

4.9.1 Unsustainable water facilities management Practices

Below are plates showing housing in the study area, portraits of inadequate maintenance and operation of rural water facilities in Bunda

Plate 4.1: Unsecured hand pump operated unsustainably. **Source**: Researcher, March 2010

Plate 4-2: Long suction pipe due to lowering of Lake Victoria water level-Isanju village

Source: Researcher, March 2010

Plate 4-3 and 4-4: Fordged spare parts and the threaded Joint is welded at Kibara Scheme

Plate 4-5: Improper O&M of DP at Bulendabufwe Gravity scheme

Plate 4-6: Broken down HP with its rods sustained by a piece of bicycle chain and manila rope

Source: Researcher, March 2010

CHAPTER FIVE:

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

5.1.1 Summary

Constraints to the sustainability of rural water supply services are of different facets and multidimensional however this study was constricted to major four dimensions, and these are; Technical, Financial, Institutional and Social/Environment dimension. The pre and post construction of rural water facilities must take these major four dimensions on board from the very initial stage of the pre construction up to post construction in order for the sustainability goal to be attained. Development, operation and management of rural water facilities have their respective constraints and opportunities. Reflecting on the above 4 dimensions a number of constraints were identified including lack of resources (funds and human power), also inadequacy technical attendance of O & M activities of rural water facilities and Inadequate participation of stakeholders (women, NGOs, CBO, central government and DC). Enforcement lacks in many ways i.e. incoherent laws such as water law and environmental laws not talking to one another are not revised to help communities take only on one law to protect water sources. Deforestation on the upstream of water sources, cultivating near water sources and water intakes is going on unabated. Lack of night guards to ensure security of hand pumps in remote areas lead to vandalism of the same and the researcher suggests a need to establish a cost recovery law for rural water services.

This study have characterized water supply services in Bunda district, investigated on the constraints that encounter sustainability of rural water supply services, and determined the sustainability Index of water facilities in the study area.

A number of constrains and opportunities have been identified and sustainability index determined. Water facilities in the study area are ***not sustained water supply services***. Critical dimension of sustainability was Social/Environment scoring less than half its weight.

It is not an easy task to study sustainability at community level, because the idea first looks to be out of this world such that is more of imaginary thing. And this because for the sustainability to be felt it require thoughtful design, well-managed project, adequate constructed/implemented, and local capacity built to support the project. On the other hand we should also bear in mind that realizing sustainable cannot be an overnight duty, and neither is it a rocket science nor breakthrough scientific discoveries and dramatic technological advances is necessary but simply commitment and determinacy. Of course the gap between what is researched and implementation must be closed and communication gaps also filled. Methods and financing mechanisms together with fully stakeholders' participation will roll the wheel further ahead towards sustainable rural services.

Often, there is no systematic expenditure for maintenance and rehabilitation to most community water facilities and re-building the infrastructure has a much larger consequence both on the economy and also on the environment. The development of

sustainable maintenance practice is vital as a strategy to minimize life-cycle cost and this will lay a mile stone for sustainability rural water services.

5.1.2 General Conclusion

Rural water supply sector (RWSS) has been an integral part of the Government's overall strategy for rural development and poverty reduction. National Poverty Reduction Strategy and the Tanzania Millennium Development Goals (TMDGs) place high priority on RWSS. Limited access to safe water, results in poor health, lost productive time due to sickness or the need to care for sick family members, missed schooling opportunities for children, and increased medical expenditures. Women (especially female heads of households) and children, who bear the primary responsibility for collecting water, are the worst affected. From the overarching goal defined in WSDP (2006–2026), as sustainable poverty reduction then to achieve this, the WSDP rests on three strategic pillars: (i) sustainable pro-poor economic growth, (ii) inclusive social development, and (iii) good governance and improved public service delivery that include sustainable water services in the rural area where over 80% of Tanzanian population live. The improved health and quality of life for the rural population as a strategic goal of inclusive social development has some constraints. The key constraints on achieving this goal are (i) lack of investment and maintenance of drinking water facilities and (ii) insufficient community awareness of the links between safe water, sanitation, and health, resulting in low willingness to pay for improved water services hence poor hygiene practices.

Other renown challenges or constraints so to say are the changing dynamics in water supply Management due to policy reviews and policy changes such that every time there is a need for management institutions to use innovations in order to reorient them effectively and serve efficiently in a sustainable manner and give quality service. Trust building among stakeholders (government, district, regional, private sector, local body and other stakeholders) and to communities is a challenge such that they are not showing practically to work diligently beyond doubt to serve communities. Thirdly, coping with dynamic environment which goes as far as population increase against the depletion of water resources and thus educating the public and local communities about their take on sustaining rural water supply services comes eminent challenge. Poor sustainability of water facilities due to lack of maintenance inappropriate technologies, based on non-participatory dwindling senses of ownership and lower down morale for affordability of service which eventually translates failure of water systems.

5.1.3 Specific Conclusion

From the results of this study, the overall conclusion is that water services are not sustainable because most of the rural population in the area were built during “free water era” thus obsolete systems. Another conclusion drawn by this study is that poverty nature of communities in the study area also escalates the impossibilities to operate these water facilities sustainably because the district authority was ranked the poorest in 2008 and literally there is no intentional efforts being shown to prove otherwise. Poverty indicators that emanates are such as grass thatched houses, subsistence farming and fisheries, vandalism nature, unnecessary homicides, bush

firing and charcoal making as energy source that can be afforded next to firewood. Being in the periphery of Tanzania puts the district on disadvantage side to many government benefits which compound in Dar es Salaam and other nearby regions. Literacy being low, as majority (98% respondents) being standard seven leavers and most of them household heads. This amalgamates the problem of rural communities being unable to capture new ideas including the dynamic and changing water policies.

5.2 Recommendations

Based on the findings of this study the following are recommended:

Their study recommended on the strong need to support community projects financially because rural populations who cannot manage three meals a day it is hard to pay for operation and maintenance of their water scheme despite that they are happy to have improved water supply but they are literally not able to pay for the service costs. This is in reflection of a 6 people household paying only Tsh. 20 for 30 days water fetching. This is literally nothing for it cannot buy anything even a nut. The district council should also be strengthened financially, and equipment wise to be able to strategically move the current rural water supply service to another level. Training to rural communities is either not adequate or no training at all so this is capacity building which is appraisingly recommended by this study. Train on fund management, customer care, environmental protection tips, Facilities Management Plans (FMP) and on technical know how to operate and maintain their facilities. The private sector should be encouraged to venture in and operate community projects under well organized agreements and this will be a management alternative. The

current water policy (NAWAPO 2002) is a supportive policy but lacks enforcements. In terms of achieving sustainability, a cost-recovery for domestic water supply needs to be formulated. After it is done should be propagated national wide and this policy be a stepping stone towards sustainable community water projects. When cost recovery will be seen as mandatory rather than demand responsive then a journey towards sustainability will be started. Also to the current policy should not leave verge sentences for disadvantaged groups but rather allow as to whatever means feasible for them to contribute for O & M, be it in cash or in kind. This means that if they cannot afford by whatever means feasible then the central government should bare that burden at the expense of rescuing the water facility from breaking down for good.

The study recommend on rehabilitating existing facilities, establish legal water user groups, build capacity of the established entities by providing training and skills on O & M and importantly involve women to greater extent in all crucial processes.

Potential needs of rural beneficiaries in relation to the sustainable rural water supply schemes include (i) access to appropriate improved water supply services (ii) skills development in the operation and management of the facilities; and (iii) more awareness of the link between health, hygiene, and sanitation. The need to exercise their indigenous norms favouring sustainable water practices to help conserve water resources and environment at large. In selecting population for a water scheme guidelines to follow may include considering poorest first.

5.2.1 Enabling Working Environment

To be able to retain water staff who keep on fleeting from rural to towns, one important thing must be done. First a nice work place environment has to be prepared including reputable offices and off course good pay. Houses must be provided to every water scheme in the village. And this house must be complete with rooms and toilets. Transport menses must be organized in form of readily available public transport, district vehicle, motorcycle or bicycle whenever feasible. Working gears and tools for mechanics and plumbers are not to be questioned about, they have to be there.

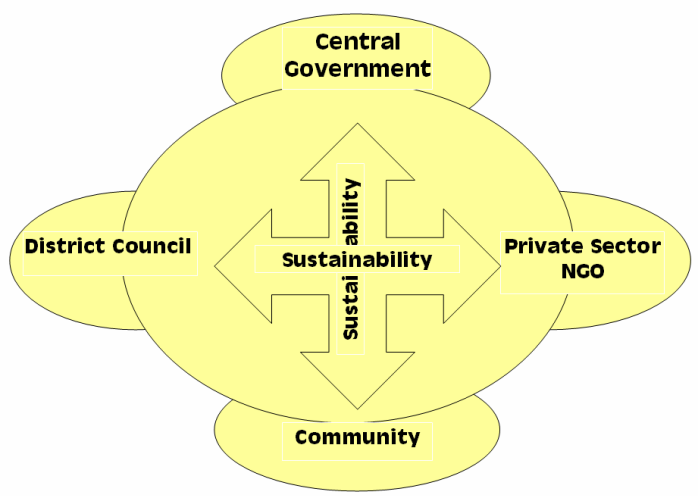
5.2.2 Need for Management Information System

Proper Management Information System should be in place that will allow communication between the district headquarter by the all the 20 wards to start with and eventually the MIS should reach all the villages. MIS will monitor and collect data from community sub projects and in a way it will enhance the district planning capacity for further water infrastructure development. Looking again to the other 4 piped schemes that were not critically assessed but observed the study sees sustained rural water supplies far behind true realization.

5.2.3 Four ways Partnership between: GoT, LGA, Communities & PS

In the study area, most of the piped schemes were built early 1970s during free water era and they are obsolete. They were built by central government and upon changes in policy they were handed over to the concerned authority and the government never looked at them keenly until others are in very critical condition and others almost

defunct. In order to improve sustainability of rural water supply facilities, it is important to employ a four way partnership as shown in figure below



Source: This study

Figure 5-1: **Four-Ways partnership (Gov, LGA, Community and PS)**

In a sense that the central government has to continue supporting the facilities so built in a form of technical back stopping and regulation through regional secretariat. Private sector to play an important role of establishing spareparts centres to shorten the supply chain of spares and machineries. Technical, facilitation service providers, NGOs and CBOs upon ascertaining well convincing capacity can be hired to operate schemes on behalf of the communities. Communities being the lowest appropriate level so far it has to be capacitated to be able to take up on the major role of managing their schemes.

A wide range of partnership with both NGOs and the private sector will be a necessary for improving rural water supply sustainability in array of perspective i.e. investing on supply of spareparts, simple and feasible shallow well drilling works, merchandise of hand pumps spares and spareparts for other water delivery

machineries, water assessment equipments such as geophysical/geological assessment equipments for deep boreholes.

5.2.4 Backstopping Community water facilities

Community members should be enabled and held primarily responsible for day-to-day operations and maintenance (O&M) activities. They must be strengthened and empowered to meet their responsibilities through formation and development of a recognized structure (water user entity). In addition to an increased role for the community, there is also a need for external institutional support in the long term to maintain respective project benefits over time. District authority and central government should play a role that goes beyond direct intervention in order to also do monitoring of systems, coordination and facilitating availability of resource (funds &, staff)

5.2.5 Social/Environment Dimension as Number one Constraint

Following the **social/Environment dimension** performing poorly in the assessment of sustainability index by scoring least over all dimensions, then this study makes specific recommendation such that this should be viewed as a number one constraint for rural water supply if at all the sustainability is to be attained and further recommends:

- The community itself has the primary responsibility for operating and administering its water supply system, including the maintenance of the physical system, to ensure financial viability for recurrent costs and to maintain health benefits.

- To be able to assume this responsibility, the community must be strengthened through the formation of a dedicated structure (WUEs) and must be empowered to perform key tasks through adequate and appropriate training and knowledge transfer.
- Even when a rural community is well trained and organized to operate and administer its systems, it will still needs some form of external support and guidance over the long term; this is especially the case for rural community, which may lack the economies of scale and resource base.
- Bunda district authority should have a non stop long-term support to a rural community on a number of important functions, which include active monitoring of system performance, coordination and facilitation of linkages between community and key resource entities, and, where appropriate, direct interventions to resolve specific problems that the community itself cannot manage on there own in reasonable period.

5.2.6 Water Sources Areas Conservation and Protection

The district should formulate good and appropriate strategy to enhance implementation of integrated water resources management in a bid to foster environmental management and conservation and specifically water sources areas. The aim shall be to prevent negative environmental impacts from human activities and community sensitization on restoration of degraded areas by doing the following:

(i) Establish environmentally friendly indigenous tree nurseries

The district must have a good plan to help community transplant tree seedlings from wild and to designated catchment enriched areas especially water sources areas

(ii) Plant trees around water sources areas

For the aim of improving the hydrological functions of the water sources areas by planting wild seedlings and those species that will be developed from the nurseries.

(iii)Demonstrate use of environmentally friendly energy sources e.g. earth cooking stoves, bio-gas, solar energy and low energy coal

In order to lessen the current over dependence on woods as a major source of cooking fuel then a hands-on practices to improve community understanding, appreciation, support and use of conservation friendly energy sources.

(iv) Conduct meetings on environmental education and awareness raising including community by-law and national policies

As part of capacity building and facilitation of enforcement of by-laws, the community will be exposed to these by-laws including environmental related policies and water policies in order to solicit their support and implementation.

(v) Reward community members demonstrating outstanding water conservation performance

For the aim of boosting morale and enthusiasm of the best community based conservation practices, those community members with outstanding performance should be awarded through several rewards including issuing them with certificates.

(vi) Conduct meetings to increase awareness on community population planning

Because the over expanding human population in Bunda poses considerable impediment to conservation efforts as it is associated with both increased natural resources needs and destructions including water resources. Thus is of paramount important that the rate of population increase (hence water resource utilization) continues to be kept low so that the conserved resources are not over exploited.

Finally, further studies on constraints to the sustainability of rural water facilities are recommended to establish in-depth results. The studies should be able to work on all the 4 piped pumped schemes in the study area in order to capture different elements such as geographical difference for part of the area being to the low land towards Lake Victoria and other being on upper land inhabitants so involved in farming activities. Also to capture different types of pumping technology such as electrically driven pumps, solar driven, diesel driven, mechanical pumping (HP) and gravity flow. Behaviour, beliefs and customs of the 2 ethnic groups should be assessing to observe their impact on sustainable management of water facilities in their locality. Two antagonistic tribes are mainly, Kurya whose majority are livestock keepers and there literacy level is low compared to their counterparts Gita. The Gita whose majority are a found alongside shore of Lake Victoria majority does fisheries and there literacy level is better off.

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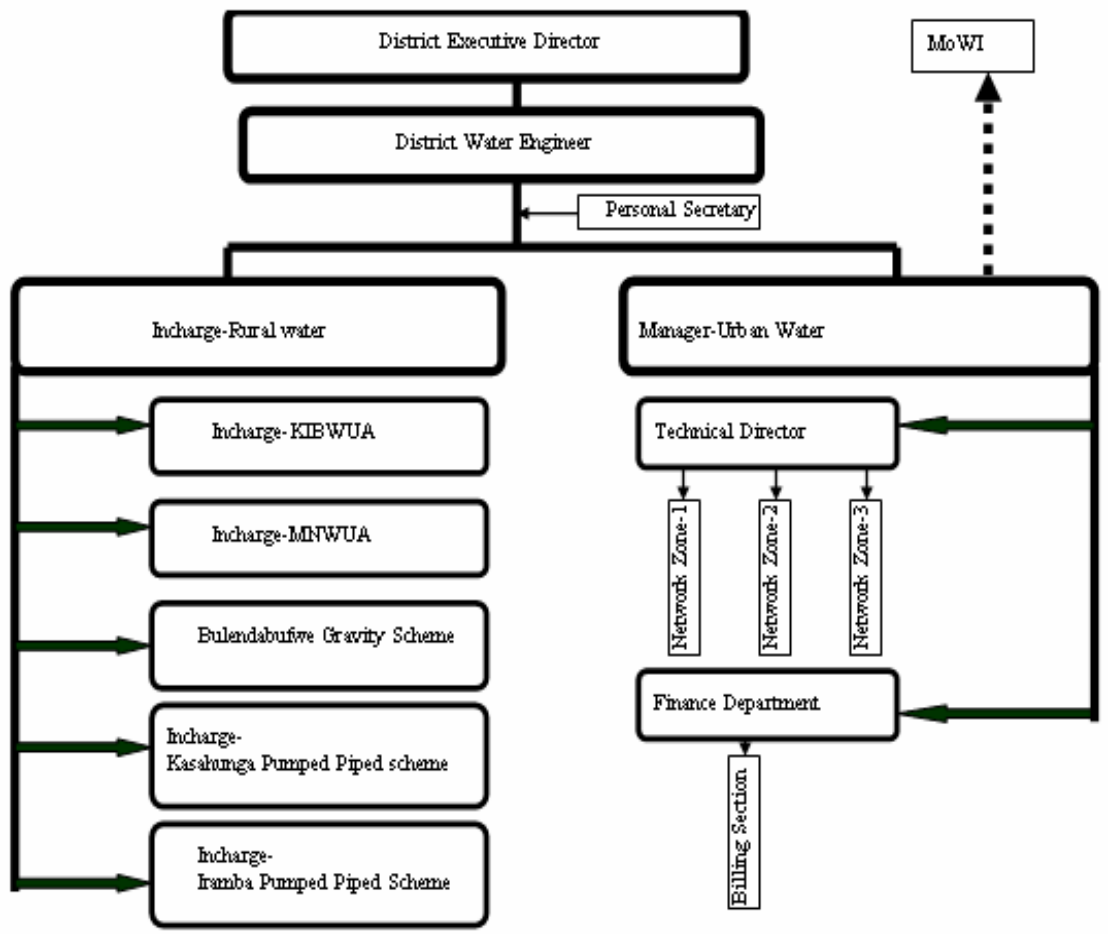
APPENDICES

APPENDIX A: MANAGEMENT OF WS SCHEMES – BUNDA



APPENDIX B: CASE STUDY RESULTS

A: Tables Showing Particulars of Respondents

Table 1: Age of respondents

	Frequency	Percentage
< 18 years	1	0.5
18 to 45 years	154	69.2
46 to 70 years	50	22.2
Total	205	100

Table 2: Sex of Respondents in the Study Area

	Frequency	Percentage
Male	127	62.1
Female	78	37.9
Total	205	100

Table 3: Formal Education level Attained by Respondents

	Frequency	Percentage
completed std VII	169	82.2
Completed Form IV	10	5.1
std VII drop out	20	9.8
Form IV drop out	6	2.8
Total	205	100

Table 4: Literacy Level of Respondents in the study Area

	Frequency	Percentage
read and write	3	1.4
count only	10	4.7
read, write and count	198	93.0
Read and Count	2	0.9
Total	213	100

B: Tables Showing Institutional Arrangements in the study Area

Table 5:Institution That Manages the Water Supply Scheme on Daily basis

	Frequency	Percentag
Water committee	125	60.7
Water user Association -KIBWUA	19	9.2
Village government	44	21.4
None	7	3.4
water committee and Village	9	4.4
Water user association MNWUA	2	1.0
Total	206	100.0

Table 6:Is there Night shift Watchmen at pump house and for Hand pumps

	Frequency	Percentage
Yes	63	29.7
No	149	70.3
Total	212	100.0

Table 7: Relationship between Scheme management Team with Respective Village Government

	Frequency	Percentage
Good	177	88.5
Bad	18	9.0
Not strong relationship	4	2.0
adequate cooperation	1	.5
Total	200	100.0

Table 8: Responsibilities in Management of their water supply Service

	Frequency Respondents	Percentage
Cleanliness	63	32.8
Fencing	1	.5
handpump maintenances	2	1.0
caring for family	42	21.9
Participate in meetings	11	5.7
Fetching water	29	15.1
Restrict children from	2	1.0
put stones for people to	2	1.0
sensitize people to pay	5	2.6
Sensitization & fetching&	9	4.7
Fetch & clean around HP	26	13.5
Total	192	100.0

Table 9:Position (Stake) of Respondents in Water management

	Frequency	Percentage
WATSAN Committee	83	39.0
WATSAN Committee	36	16.9
WATSAN Committee	9	4.2
water user	33	15.5
WATSAN Committee	32	15.0
Village chairperson	17	8.0
Plumber	1	0.5
Village Health officer	2	0.9
Total	213	100

Table 10:Handing Over of Completed Water Supply Schemes to Beneficiaries

	Frequency	Percentage
Yes	66	46.8
No	75	53.2
Total	141	100.0

Table 11:Existence of Water and Sanitation (WATSAN) Management Committee

	Frequency	Percentage
Yes	196	93.8
NO	13	6.2
Total	209	100.0

Table 17: Alternative Water Sources incase of breakdown of existing scheme

	Frequency Respondents	Percentage
lake	96	48.7
Open unprotected well	83	42.1
Buy from water vendors	8	4.1
Water source from too far	10	5.1
Total	197	100

C: Tables Showing Social/Environmental Results of water services in study area

Table 18: Social Economic activities of Respondents in Study Area

	Frequency	Percentage
Subsistent farming	129	61.7
Employed	10	4.8
Livestock keeper	24	11.5
Ducks and chicken keeper	39	18.7
Grocery or kiosk	3	1.4
Fisheries	4	1.9
Total	209	100.0

Table 19: Sources of Drinking Water to Respondents in Study Area

	Frequency	Percentage
water stream near your	3	1.4
Public water tap	11	5.1
handpump	118	55.1
Hand dug hole with rope	20	9.3
spring or open well	41	19.2
Lake	18	8.4
Chaco dam	1	.5
House connection	2	.9
Total	214	100.0

Table 20:Bylaws for protection of water sources areas Passed

	Frequency	Percentage
Yes	180	93.8
No	12	6.3
Total	192	100.0

Table 21: Water Availability in Wet and Dry Season

	Frequency	Percentage
Yes	140	69.0
No	63	31.0
Total	203	100.0

Table 22: Distance (one way) from household to Water Source

	Frequency	Percentage
0m To 200m	87	45.1
201m To 400m	41	21.2
401m To 1,000m	43	22.3
1,001m To 2,000m	16	8.3
2,001m To 5,000m	6	3.1
Total	193	100

Table 23: Can One Get water in exchange with goods o

	Frequency	Percentage
Yes	75	40.8
No	109	59.2
Total	184	100.0

Table 24: When Water Source were Constructed

	Frequency	Percentage
1970 To 1979	14	6.7
1980 To 1989	21	10.1
1990 To 1999	95	45.7
2000 To 2009	78	37.4
Total	208	100

Table 25: Constraints to sustaining Water Supply Services in the Study Area

	Frequency	Percentag
water yield lowers in dry spell	12	12.2
old deteriorated distribution network	3	3.1
scheme management not effective	1	1.0
need rehabilitation	1	1.0
inadequate subsidy for rehabilitation from DC	1	1.0
Frequent machine breakdown and pipe bursting	2	2.0
Inadequate diesel to run engine	1	1.0
Spare parts are difficultly found at high prices	4	4.1
Forest at Nyaruga is becoming thicker and	1	1.0
Open well and dirty water	1	1.0
Lack of funds for expansion	1	1.0

lack of funds for O & M, expansion, deteriorated	1	1.0
LUKU is a problem to pay before using	1	1.0
deteriorated pump, lack of diesel & less subsidy	2	2.0
HP Breakdowns	9	9.2
Not paying bill	1	1.0
VG & WATSAN not in good terms & hence poor	2	2.0
Pop Increase &Low Yield &Lack Spares	8	8.2
distance from HP to long	1	1.0
Borehole is shallow hence low yield in hot period	2	2.0
Not trained to handle O&M & no pump mechanic	8	8.2
No disinfectant was put from 1993 todate 2010	3	3.1
No technical personnel to maintain HP	6	6.1
Lack of spares & maintenance skills	1	1.0
Lack of spares & financial skills	2	2.0
Limited mgt skills & lack of spares	2	2.0
less income to operate HP	6	6.1
No watchman & poor HP usage hence frequent	1	1.0
Few HPs &no training & pupils to pay for water	1	1.0
HP silted and cylinders disintegrates into small	2	2.0
Frequent disconnection of raisers (PVC pipes)	4	4.1
Replace HP with bigger HP because yield is high	2	2.0
Congestion of water user at HP	1	1.0
Theft of HP	1	1.0
poor pumping by children	1	1.0
Cylinder frequently out of order	1	1.0
Dirty water in rain season	1	1.0
Total	98	100.0
water yield lowers in dry spell	12	12.2
old deteriorated distribution network	3	3.1
scheme management not effective	1	1.0
need rehabilitation	1	1.0
inadequate subsidy for rehabilitation from DC	1	1.0
Frequent machine breakdown and pipe bursting	2	2.0
Inadequate diesel to run engine	1	1.0
Spare parts are difficultly found at high prices	4	4.1
Forest at Nyaruga is becoming thicker and	1	1.0
Open well and dirty water	1	1.0
Lack of funds for expansion	1	1.0
lack of funds for O & M, expansion, deteriorated	1	1.0
LUKU is a problem to pay before using	1	1.0
deteriorated pump, lack of diesel & less subsidy	2	2.0
HP Breakdowns	9	9.2
Not paying bill	1	1.0
VG & WATSAN not in good terms & hence poor	2	2.0
POP INCREASE &LOW YIELD &LACK SPARES	8	8.2

distance from HP to long	1	1.0
Borehole is shallow hence low yield in hot period	2	2.0
Not trained to handle O&M & no pump mechanic	8	8.2
No disinfectant was put from 1993 todate 2010	3	3.1
No technical personnel to maintain HP	6	6.1
Lack of spares & maintenance skills	1	1.0
Lack of spares & financial skills	2	2.0
Limited mgt skills & lack of spares	2	2.0
less income to operate HP	6	6.1
No watchman & poor HP usage hence frequent	1	1.0
Few HPs &no training & pupils to pay for water	1	1.0
HP silted and cylinders disintegrates into small	2	2.0
Frequent disconnection of raisers (PVC pipes)	4	4.1
Replace HP with bigger HP because yield is high	2	2.0
Congestion of water user at HP	1	1.0
Theft of HP	1	1.0
poor pumping by children	1	1.0
Cylinder frequently out of order	1	1.0
Dirty water in rain season	1	1.0
Total	98	100.0

D: Tables Showing Financial Implications of Water facilities in Study Area

Table 26: Mode of Fund Raising for Operation and Maintenance

	Frequency	**Percen**
Tsh 200 per house per month	45	24.6
Tsh 500 per house per month	22	12.0
Tsh 20/= per 20lts bucket of water	1	.5
community contribution in kind	25	13.7
Subsidy from Bunda DC	4	2.2
Pay for water at predetermined rate	2	1.1
Tsh 200 per house per month and pay 2,000 special	2	1.1
Don't know	6	3.3
Pay water bill	13	7.1
Bunda DC subsidy and water bill returns	2	1.1
water bill & crop sales	1	.5
Upon breakage we meet and contribute for repair	30	16.4
Sell water to non-members	7	3.8
Tsh 100 per monyh per HH	6	3.3
water sells & Membership contribution	7	3.8
Tsh 1,000 per year per water user	9	4.9
upon breakdown Tsh 100 per household contribution	1	.5
Total	183	100.0

Table 27: How Funds Were Utilized

	Frequency	Percentage
Purchase spareparts for	34	18.4
pay watchmen and spare	28	15.1
Rehabilitation of scheme	12	6.5
Deposited to the Bank	6	3.2
No savings made	2	1.1
electric bill and spareparts	2	1.1
Scheme operations and	24	13.0
buy diesel and spareparts	3	1.6
Rehabilitation of HP	37	20.0
Buy spareparts	26	14.1
Half is for watchmen	11	5.9
Total	185	100.0

E: Tables Showing Technological difficulties and Related its Results

Table 31: Who Maintains Water Schemes

	Frequency	Percentage
water scheme artisan	30	16.1
Bunda DC	20	10.8
Central government	6	3.2
District water engineer's office	25	13.4
technical sub committee	32	17.2
communities	28	15.1
No one	7	3.8
Donors(VIP/Grumet/HESAWA/DDP)	38	20.4
Total	186	100.0

Table 33: Nature or type and frequency of breakdowns

	Frequency	Percentage
water not coming out	11	6.7
raisers sinking	4	2.5
water being lower than a cylinder	11	6.7
livestock rearing near water	3	1.8
gate valve breakages	26	16.0
Deteriorated pipes	16	9.8
Bursting of pipes due to irregular	22	13.5
head bearings and bush	6	3.7
no	27	16.6
drought	2	1.2
pump hail to suck and push water	32	19.6
Locks breakage	3	1.8
Total	163	100

Table 34: Is There Preventive Maintenance Practices

	Frequency	Percentage
Yes	147	75.8
No	47	24.2
Total	194	100.0

Table 35: Kind and extent of preventive Maintenances done

	Frequency	Percentage
reinstating fence	13	10.4
Rehabilitating breakout gate	4	3.2
repair distribution pipes	20	16.0
repair suction lines	9	7.2
repair main line	1	.8
greasing and tighten nuts	24	19.2
repair busted pipes	9	7.2
De-silting	14	11.2
dismantle and repair pump	31	24.8
Total	125	100.0

Table 36: How Often is the Preventive Maintenances done in a year

	Frequency	Percentage
Monthly	35	20.1
once in six months	22	12.6
Annually	10	5.7
ad hoc	10	5.7
quarterly	50	28.7
As necessary	45	25.9
When damage occurs	2	1.1
Total	174	100.0

Table 37: Availability of tools and working gears to Plumbers and Pump Mechanics

	Frequency	Percentage
Available	88	44.4
Not sufficient qty	18	9.1
Not available	89	44.9
Don't know exactly	3	1.5
Total	198	100.0

Table 38: Training undertaken for maintaining scheme

	Frequency	Percentage
Yes	109	52.4
No	99	47.6
Total	208	100.0

Table 39: Type of machineries, Hand Pump make and type of Surface pump

	Frequency	Percentage
Afridev	51	28.5
NIRA AF85	55	30.7
Indian Mac II	46	25.7
SWN 80/81	11	6.1
Gravity scheme-1	3	1.7
diesel driven surface pump	5	2.8
pump Movi 40/6 and motor	2	1.1
Grundfos submersible pump	3	1.7
Lister peter HR3 &KSB	3	1.7
Total	179	100.0

Table 40: Who Operates the Water scheme Account

	Frequency	Percentage
Committee treasurer	43	45.7
Chairperson	1	1.1
Trusted member in the	1	1.1
Village government	1	1.1
Committee Secretary	18	19.1
deposited to NMB Bunda branch	17	18.1
Scheme bank account	4	4.3
SACCOS	9	9.6
Total	94	100.0

APPENDIX C: LIST OF NON-FUNCTIONING HAND PUMPS – BUNDA

Ward	Village	Qty	Problem
1.Kabasa	Kung'ombe	5	Stolen
	Kabasa	2	Stolen
	Nyasana	4	Stolen
	Bitaraguru	4	Dried wells
	Kabasa	3	Stolen
2.Mugeta	Nyang'aranga	1	Dried well
	Mugeta	1	Not functioning
	Kyandege	1	Dried well
	Sanzate	1	Not functioning
3.Hunyari	Nyangere	3	Stolen
	Kihumbu	1	Stolen
		2	Dried well
	Mariwanda	2	Not functioning
4.Mihingo	Mekomariro	2	Stolen
		2	Dried well
		1	Not functioning
	Mihingo	3	Not functioning
	Manchimweru	1	Not functioning
5.Nyamuswa	Kiroreli	2	Stolen
		1	Not functioning
	Bukama	1	Stolen
	Makongoro	8	Stolen
	Nyamuswa	4	Stolen
		1	Not functioning
6.Kibara	Busambara	1	Dried well
	Bunere	2	Not functioning
	Namalebe	13	Stolen
	Nakatuba	10	Stolen
7	Sikiro	2	Stolen

Ward	Village	Qty	Problem
10.Sazira	Kitaramaka	5	Stolen
	Sazira	1	Stolen
		1	Stolen
	Misisi	2	Sinking of pump cylinder
		1	Dried well
	Ligamba "A"	2	Stolen
	Ligamba "B"	1	Stolen
11.Kunzugu	Bukore	1	Stolen
		1	Dried well
	Kunzugu	6	Stolen
	Nyatwali	5	Stolen
	Tamau	3	Dried well
		2	Stolen
12.Neruma	Kasahunga	1	Stolen
	Haruzale	1	Not functioning
	Mahyoro	4	Stolen
13.Namhula	Namhula	4	Stolen
14.Butimba	Bulamba	5	Stolen
	Mwiseni	4	Stolen
	Kasuguti	1	Dried well
		3	Stolen
15.Mcharo	Mihale	1	Sank raisers
	Changuge	1	Sinking of raiser main
	Kisangwa	4	Stolen
16.Guta	Kinyambwiga	1	BHs clogged
	Tairo	1	Stolen
17.Kisorya	Kisorya	2	Stolen
	Masahunga	3	Not functioning
		1	Dried well

	Isanju	1	Not functioning
	Mwiruruma	3	Dried well
8.Nansimo	Nambaza	1	Dried well
		2	Not functioning
9.Wariku	Kamkenga	8	Stolen
		2	Not functioning
	Kangetutya	3	Stolen
		1	Broken
	Rwabu	1	Not functioning

	Nambubi	2	Dried well
		2	Stolen
18.Salama	None		
19.Igundu	None		
20.Bunda	Township		

Key:

i Stolen hand pumps: 37

ii Dried wells: 117 Shallow wells drying up in summer were not considered

iii Not functioning due to

a. Sinking of raiser mains: 4
b. Dropping of stones in the hole: 1
c. Sinking of cylinders: 2
d. Vandalized pumps and missing spareparts & miscellaneous causes: 23

APPENDIX D: QUESTIONNAIRES SURVEY

I: Communities Level Questionnaire for WATSAN and water Users

DEMOGRAPHIC INFORMATION

1. Name(s) of respondent_____
2. Name of Water User Entity/Village_____
3. Tick your sex: male_____ Female _____
4. Tick if you are attending school_____, Dropped out of school_____, completed school_____, or Never attended school_____
5. State the level that you are now attending school_____, or the level attained_____ (if you drooped out of school or completed school)
6. Tick if you can: read_____ Write_____ Count_____
7. What position do you hold in management of water scheme? _____
8. Tick the category of economic activity you are engaged with such as ; Farming_____, Employed _____, Livestock(goats/sheep and cattle)_____, Small animal keeping (hens, duck etc)_____Shop/Kiosk___

WATER SUPPLY SERVICES INFORMATION

9. What type of water sources are used for general purposes include drinking?
10. Is the water source reliable (Tick)

Water is available throughout the year_____
Water not available some months of the year _____
Design year of the water scheme_____
Which benefits have the women experienced as a result of water scheme __
How do women make use the saved time _____
What problems do the women experience in management their water scheme
What roles/tasks do women perform in O&M _____
Are contributions made on monthly or yearly bases? _____
Do you know how funds are utilized _____
Is contribution also made in kind? _____
How are they managing their water scheme? _____
Is there any system of keeping the DP clean? _____
Do the women feel involved in the election of WUG? ___
Who maintains the water scheme _____
Who supervises the work? _____
When scheme is out of order, where do you get the service _____
Are the tasks clearly defined at DP? _____
What are the frequent breakdowns _____
Do you excise preventive maintenance _____
Do you have a tool kit _____
Are you trained to maintain the scheme _____
What type of preventive maintenances activities are carried out and how often?

Do you have bank account for water scheme _____
What amount is in the bank _____
Who operates the account _____

11. Which institution is the main responsible for daily management of the water supply scheme?
12. How do you protect the water source _____
Mention type of Hand pump _____
What opportunities do you have _____
What constraints do you have _____
Suggest mitigation measures to your constraints _____

II: Focussed Group Discussion Interview Guide - WATSAN and DWSTs

A: INSTITUTIONAL SUSTAINABILITY GUIDE QUESTIONS

1 Is water dept a separate department under DED(Yes or No)_____
2 If Not, what is the main department_____
3 List constraints in the existing institutional setup _____
4 If yes, how? _____
5 What is the link btn district and region, sub basin and main basin in managing water resources (attach structure if any)_____
6 How do you handle environmental defaulters _____
7 Total water user entities _____ (attach membership composition)
8 Responsibilities of water user entities (attach)_____
9 Established DWST(Yes or No)_____ Total Members _____
Mention titles of DWST members'_____
10 How often DWST meet and please attach minutes & functions of DWST
11 Approach used in project formulation (PRA, O & OD or mention) _____
12 How do you handle criminal offences such as theft and vandalism of water infrastructures, and list cases of theft, vandalism and abandonment of HPs
13 Give organization structure of water department and that of district council
14 Attach major responsibilities of District Water Engineer (DWE)
15 Constraints in developing and managing water supply in rural areas_____
16 Give total staff in water dept _____and how many are women __
17 Mention Private sectors involved with water in the district_____
18 What are shortfalls of the existing institutional setup (if any)_____

B: TECHNICAL SUSTAINABILITY GUIDE QUESTIONS

1 Give district water supply coverage (attach details)_____
2 Mention water supply technologies applied and their respective number of schemes
3 List make of hand pump e.g. AFRIDEV, India Mac II, deep India Mac II, SWN80, SWN81, TANIRA WALIMI, Kangaroo etc) with their respective quantities
4 What is the average monthly O & M per technology _____
5 What HPs are Widely used _____and why_____

Give its average operating cost for that HP_____
Is operation manual for that HP (available/Not)_____
What are frequently replaced spares for that HPs_____

6 What is the average status of water quality in the district_____
7 Total people served with HPs___, and those served with pumped schemes
8 Where do you procure spares (Dar, Bunda, Mza, Foreign countries) ____
9 State constraints of water supply technologies such as HP, Gravity, Windmill, Electricity, diesel and rain harvesting) _____
10 How many rain water harvesting tanks (personal and institutional) _____
11 Is there Facility Management Plans (FMP) for water schemes? (Yes or No)

C: FINANCIAL SUSTAINABILITY GUIDE QUESTIONS:

1 How is money for O & M mobilized (cash or in kind) __
Average amount per household/individuals/scheme_____
2 Who pays salaries for scheme attendants_____
3 Who pays electric bill or buys diesel_____
4 Give average operating cost per month cost of electricity or diesel per month
5 Who does major rehabilitation _____
6 Economic status of majority water users (farmers, shop keepers, livestock keeper, peasantry small animal keepers etc fishermen or specify_____
7 Mention type of food crop widely grown_____ cash crop widely grown Reasonable amount of money one earns in a year
8 Are there communities Able To Pay? (ATP) for Operations (labour))(Yes or No) Maintenance (spares) (Yes or No)__
9 Are there communities willing To Pay? (WTP) for Operations (labour))(Yes or No)___ Maintenance (spares) (Yes or No)_____
10 What is the prevalence of water related diseases_____
11 How does the disadvantaged people get access to water service_____
12 Mention opportunities for sustainably management of water scheme in the district
13 National per capital in come of the user communities _____
14 Mention NGOs, Donors and development partners supporting water ____
15 What financial constraints do you face _____

D: ENVIRONMENTAL SUSTAINABILITY GUIDE QUESTIONS:

1 What conservation measures are deployed to water sources (tree planting, fencing , restrict human activities within 60m radius etc)_____
2 Do you have Environmental Management Act or any Bylaws (Yes or No)_
3 Are communities aware of the need to conserve water sources (Yes or No__
4 Is EIA usually done before project construction? (Yes or No) _____
5 Was resettlement done and compensation affected to those who owned land and other amenities before? e.g. where water tanks and booster pumps and attendant houses are built, BH drilled, where fruit trees were fallen down and other cash and food crops uprooted (attach supportive description if any)__
6 Are there clear demarcating boundaries, beacons or any agreed monumental features for the water schemes for e.g. attendant houses, pump houses, water tanks, BH sites etc? (Yes or No)

7 Is there district plan for environmental protection (yes/No)_____
8 Is there any specially organized day for environmental care in the district
9 Is there water structures for livestock_____
10 Measures deployed to prevent Chaco dams from siltation_____
11 Are Cattle troughs provided to Chaco dams (yes/No) _____ are they maintained (Yes/No)
12 List NGOs dealing with environment issues in the district _____
13 Are there water sources protected by law in the district? (Yes/No)_____
14 If yes mention them_____
12 Is human activities beyond 60m from HP (e.g. Pit latrines, farming, residents)

III: Focus Group Discussion Interview Guide - water practitioners

A. Help to identify institutional gaps which are hindering the sustainable management of rural water supply services
B. Please avail technological difficulties in developing and managing rural water supplies
C. Give environmental challenges in water resource management
D. The fact that most rural people are poor, still they are obliged to pay for operation and maintenances of their water schemes. What do you think has to be done in this regard?
E. Principally, water basins are the water resource managers, list challenges encountered in managing water resources against the rural poor population
F. Explain the kind of support that water staff at regional level provides or are obliged to offer to local Government Authorities
G. Give your opinion on what is to be done to bring spareparts closer to rural areas in order to facilitate easy and relatively timely maintenances of water schemes

Poor Data management is bottleneck to sustainable management of rural water supply services, so kindly suggest mitigation measures in this area.

APPENDIX E: BUNDA DISTRICT PROFILE IN SUMMARY

Male population……	123,978
Female population……	134,952
Total district population……	**258,930**
Annual average Intercensal Growth rate 1988-2002 Censuses	1.8%
Dependency Ratio……	110
Sex Ratio (Number of males per 1000 females)……	92
Average household size (persons per household)……	6.0
Percent of population with disability……	2.3
Percent of child orphans……	1%
Literacy rate, 5 years and above……	68%
Net enrolment rate……	80%
Employment in: ……	
▪ Agriculture (Subsistence Farming)……	73%
▪ Business operations……	9.5%
▪ Elementary occupations……	7%
▪ Fishing ……	4%
▪ Livestock keeping……	3%
▪ Office work……	2.3%
Main materials used for walls (sun dried Bricks)……	60%
Main materials used for floor (Mud)……	78%
Main materials used for roofing (Grass)……	55%
Main Source of Energy for Lighting (Wick Lamp)……	58%
Main Source of Energy for Cooking (Firewood)……	81%
Main Source of Drinking water (Protected Well)……	29%
Main Type of Toilet Facility (Traditional Pit latrine)……	86%
Main Asset Owned by Most of the Private Households (Radio)	61%
Average Persons per sleeping Room (Persons per Room	3.0

Source: *The United Republic of Tanzania, 2002 population and housing census*

APPENDIX F: WATER DEPARTMENT STAFF LIST - BUNDA DISTRICT

S/N	Name of staffs	Ages	Sex	Professional qualification	Present Position
1	Tanu I. Deule	37	M	BSc. in Civil Eng. Masters (Being Pursued)	District Water Engineer (DWE)
2	Bonus B. Matekele	50	M	F.T.C in Civil Engineering	Principal Technician
3	Mufungo Malegesi	40	M	F.T.C in Civil Eng.	Technician I
4	Joseph Makukula	46	M	F.T.C in Electrical	Technician I
5	Dickson Gidion	29	M	F.T.C in Civil Eng	Technician I
6	Matondo Ndaturu	52	M	STD VII trade test I	Technician II
7	Maduhu Masalu	45	M	STD VII trade test I	Technician II
8	Marwa Mtatiro	43	M	STD VII trade test I	Technician II
9	Patrice R. Maijo	52	M	STD VII trade test I	Technician II
10	John Bwanikila	58	M	STD VII trade test I	Technician II
11	Stephano Mangilima	43	M	STD VII trade test I	Technician II
12	Nyegoro Malangu	51	F	STD VII trade test I	Technician II
13	Elam Simon	58	M	STD VII trade test I	Technician II
14	James P. Maguzu	47	M	STD VII trade test I	Technician II

APPENDIX G: PORTRAITS OF ENVIRONMENTAL AND WATER INFRASTRUCTURE – BUNDA DC

Rural Housing and Subsistent farming in Bunda

Pump Attendant house at Nyamuswa village

Vandalised shallow well hand Pump-Kung'ombe

Uncovered PVC gravity flow main on cow trail Bulendabufwe gravity scheme

HP not cleaned & is away from households Kung'ombe village

RWH tank without bib coke and plug-Sazira Sec

Source: Source: This Study