UNIVERSITY OF ZIMBABWE

Department of Civil Engineering

Assessment of factors which affect multiple uses of water and their impact on the sustainability of rural water supply sources

A case study of Marondera, Murehwa and Uzumba Maramba Pfungwe districts, Zimbabwe

By
Luckson Katsi

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Integrated Water Resources Management

JUNE 2006

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Integrated Water Resources Management

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DECLARATION

I Luckson Katsi, declare to the Registrar of examinations at the University of Zimbabwe that the work contained in this thesis is solely a result of my own investigation and findings unless otherwise quoted.

Name…… Signed……

Date……...Place……..

DEDICATION

For my parents, Colleta and Jacob,
For your vision and wishes,
You gave me the best,
To be the best…
Mum, you are the best,
For you never gave up on me.
To my angel, Lleennee Panashe, this is a challenge to you
--I Know you can do better--

ABSTRACT

Water with all its multiple uses plays a pivotal role in the sustenance of rural people, especially the poor. As such, the provision of water which go beyond domestic to include water for productive uses can enhance peoples' livelihood options by making significant contribution to household income, food security, improved nutrition and health. All these multiple benefits, if combined can assist in the fight against hunger and poverty.

This study was conducted in Mashonaland East province, covering Marondera, Murehwa and Uzumba Maramba Pfungwe districts in Zimbabwe for the period December 2005 to May 2006 to assess factors which affect multiple uses of water and their impact on the sustainability of rural water supply sources. Methodology for participatory assessment was used for data collection. The survey found that people indeed require water for productive purposes apart from domestic uses, which are often given top priority. The study found out that multiple uses of water at household level can be affected by segmentation of water services into *domestic* and *productive* water supply schemes, technology and system design, water quality and quantity and distance to water sources among other factors.

The study recommends that water providers to be able to provide appropriate, efficient and sustainable services, they should understand and appreciate the livelihood needs and priorities of the communities they serve. This calls for the need for harmonization and coordination of water service providers to best respond to communities' multiple water demands.

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May God abundantly bless you all, with GOD everything is possible!!

ACRONYMS AND ABBREVIATIONS

AGRITEX	Agricultural Research and Extension Services
ATP	Ability To Pay
CBA	Cost And Benefit Analysis
CPWF	Challenge Programme on Water and Food
CSO	Central Statistical Office
DDF	District Development Fund
FAO	Food and Agricultural Organisation
GWP	Global Water Partnership
ID	Irrigation Department
IDWSSD	International Drinking Water Supply and Sanitation Decade
IRC	International Water and Sanitation Centre
IWMI	International Water Management Institute
IRWSSP	Integrated Rural Water Supply and Sanitation Programme
IWRM	Integrated Water Resources Management
PA	Pump Aid
PRA	Participatory Rural Appraisal
MDG	Millennium Development Goals
MMT	Mvuramanzi Trust
MUS	Multiple Use Water Systems
NWMP	National Water Master Plan
NGOs	Non Governmental Organisations
UMP	Uzumba Maramba Pfungwe
UN	United Nations
UNICEF	United Nations Children's Fund
VIPL	Ventilated Improved Pit Latrine
WHO	World Health Organisation
WTP	Willingness To Pay

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

In rural Zimbabwe, like elsewhere in Africa and many other parts of the developing world, rural water services provision is done by different bodies both government and the private sector. Since 1980, when Zimbabwe got independence, government and non-governmental agencies have continued to dedicate financial, technical, and organisational efforts, focusing on the provision of safe drinking water and adequate sanitation in rural areas of Zimbabwe as a developmental goal. However, the rural water supply situation in Zimbabwe has deteriorated in the past 7 years. This has been due to the collapsing economy, worsened by the withdrawal of donor funding, which has traditionally been the principal funders of rural water supply and sanitation projects since independence (Manzungu, 2001). Since independence, the water supply and sanitation sector has been characterised by a supply-focused approach based on norms that do not take account of productive water uses at household level. These approaches proved unsustainable and partially met the users' water needs. Instead, they have been mainly concerned with the health aspect of the rural people and this has left many rural people still caught in the vicious cycle of poverty (Robinson et al., 2004, Makoni et al., 2004).

Water with all its multiple uses plays a vital role in the sustenance of rural livelihoods. People require water for a wide range of activities essential to sustain and build their livelihoods. These varied water uses include but not limited to the following: *domestic* drinking, washing, cooking and sanitation and *productive* uses, such as small-scale irrigation, livestock watering, post-harvest processing, brick making or micro-enterprises. All these, if combined, can lead to multiple benefits to people, for example, improved health, income, food security and poverty alleviation among other positive impacts (Makoni and Smits, 2006).

In Zimbabwe, peoples' multiple water use needs have been evidenced by studies conducted by Manzungu and Machingambi (2003), Robinson et al., (2004) and Makoni et al., (2004). This fact has however been lost sight of in terms of policies, planning, design and provision of water services at rural household level. Few water supply systems have been designed with peoples' actual livelihoods needs in mind. Water service providers usually do not take into account the needs of small-scale productive users when they plan for domestic water supply. This has serious implications such as illegal connections, conflicts and sustainability problems (IRC, 2006).

Zimbabwe's Integrated Rural Water Supply and Sanitation Programme (IRWSSP) led to the provision of water to rural people but there was no attempt in the national programme to identify water requirements of rural communities apart from water for primary use since water for productive use was under the Ministry of Agriculture through the Department of Agriculture and Technical Services (AGRITEX), now AREX, a different

ministry altogether (Robinson et al., 2004). The IRWSSP was based on the concept of integrating the development of water and sanitation facilities with the promotion of health and hygiene education, the training and capacity building of personnel and institutions, the mobilisation of communities, the establishment of sustainable operation and maintenance systems and the transfer of technical and organisational skills and knowledge to user communities (Makoni and Smits, 2006).

Failure to design and provide systems, which are flexible to peoples' livelihoods needs has resulted in domestic water supply systems designed to provide basic amounts of water but denying people the opportunity to use water for productive purposes. Evidence can be drawn from Zimbabwe's national rural water supply and sanitation programme, which continued to focus on providing clean water for domestic use only from communal boreholes and deep wells (Robinson et al., 2004). Irrigation systems have also been designed but in most cases, they only provide water for crop production. This thinking fails to appreciate that farmers, apart from watering their plots also need water for domestic uses. As a result, water sources, uses and users have not been well integrated, leaving much scope for improvements in water use efficiency, livelihood, and equitable water use and this leaves the poor vulnerable (Morardet et al., 2005).

In Southern Africa, Zimbabwe is one of the countries rich in terms of existing experiences with the implementation of water services for multiple purposes (Lovell, 2000, Robinson et al., 2004, Makoni and Smits, 2005, Pump Aid, 2006). In Zimbabwe, these experiences are looked at in terms of water delivery technologies. Robinson et al., (2004) discusses a number of common rural water delivery technologies and their implications to multiple uses of water.

These technologies are:

- family wells
- bush pump
- rope and washer pump

Various organizations, departments and ministries have different approaches to water provision. However, many of these experiences are not systematically shared, and documented, leading to sub-optimal use of these services and no further mainstreaming in the sector (Makoni and Smits, 2005). In addition, it is noted that most of the documented experiences only focus at the community level or as an evaluation to donor initiated projects or household projects. Demand for water for productive uses at household level has, until recently, been insufficiently recognised in the planning and allocation of water resources in river basins (Moriarty et al., 2004).

Against this background, a call is made to follow a multiple use approach to water development projects. During the 2003 International Symposium in Johannesburg on Water, Poverty, and Productive uses of water at household level, the following statements were made in recognition and appreciation of multiple water use systems as well as multiple uses of water:

- *productive use of water at the household level by the poor reduces poverty*
- *people require more than their domestic water needs to be productive*
- *productive use enhances the sustainability of water supply systems and services*
- *people need local solutions and multiple sources for multiple uses*
- *an integrated approach is essential to achieve significant impacts on poverty* (Moriarty et al., 2004).

Professionals and academias in the region and the world over have been contemplating and suggesting in their discourses the need to follow a multiple use approach in designing, implementing and provision of water services. Suggestions have been that water service provision should in planning arenas be done at local level to satisfy all household needs (Moriarty et al., 2004).

This study was carried out in Mashonaland East province, covering Marondera, Murehwa and Uzumba Maramba Pfungwe districts for the period December 2005 to May 2006**.** The purpose of the study is to contribute to the current understanding of the situation in Zimbabwe by assessing the factors that hinder or promote multiple uses of water services and how men and women in different parts of Zimbabwe access and use water for multiple purposes, and what implications that has on their livelihoods as well as on the sustainability of water supply systems at household level.

1.2 Problem Statement

People need water for different uses from a given source but they are not getting it due to a number of reasons, including segmentation of water services into domestic water use, waste water use or productive water use. In Zimbabwe, a number of water supply systems exist in different agro-ecological regions but people do not get all they need from single water supply sources. There are dams, supplying water for productive purposes, boreholes, wells fitted and not fitted with lifting devices for domestic uses with the potential to supply water for multiple uses but can not in most cases due to sectoral policies and institutional arrangements. As such, very few systems really meet users' needs (Guzha, 2006).

The provision of water services has typically come with a narrow sub-sectoral focus, for example, water service providers tend to develop 'domestic' schemes, 'irrigation schemes', or 'livestock ponds'. All these systems are planned and designed for only part

of people's water needs. As a result, the design of some rural water supply systems lack flexibility to cater for users' concurrent water needs. The result is systems that are rigid to the needs of the people for whom they are meant to serve.

This rigid approach presents numerous problems in the delivery of water services in many rural societies. In domestic systems it often leads to system failure due to unplanned multiple uses, system over use and this jeopardizes the effectiveness and sustainability of water supply systems (Smits et al, 2004). It also fails to capitalize on the benefits in terms of poverty reduction and enhanced willingness and ability to pay that catering for productive needs can bring (MUS working paper, 2005). Ultimately, the water users are dis-empowered and left with the responsibility of owning and managing systems that are a partial answer to their livelihoods needs.

1.3 Scope of the study

This study acknowledges that apart from domestic and productive uses of water, people indeed require water for uses such as water for mining, tourism and recreation and worshipping among other varied uses. However, the study is rural-based and primarily focuses on productive and domestic water uses at household level.

For the purpose of this study, the term *domestic* will be used to refer to household water uses such as: drinking, cooking, bathing and sanitation while *productive* uses refers to water uses which are not daily household routines so to say and are mainly meant to enhance peoples' livelihoods for example gardening, livestock watering, post harvest processing among others. In most cases, productive water uses are highly dependent on the availability of reliable water in large volumes. For productive water uses, quantity matters most unlike quality which is an important factor for domestic water use. It is also important to note that productive uses of water in this study is looked at the household level and to some extent at community level. *Multiple uses of water* will also be used to refer to various uses of water within the domestic domain and also uses of water beyond domestic as well as uses of water within the productive domain as well as beyond productive while *Multiple Use Water Services (MUS)* refers to a holistic approach to service provision built upon participatory planning, design, and implementation of water infrastructure and institutions that effectively meet women's and men's multiple water needs, possibly drawing upon multiple water sources (Van Koppen et al., 2006).

1.4 OBJECTIVES

1.4.1 General Objective

To contribute towards the promotion of Multiple Water Use Systems in Zimbabwe at household level.

1.4.2 Specific Objectives

- Assess factors which hinder or promote multiple uses of water.

- Examine performance of different types of water supply systems and their implication to multiple water use patterns.

- Assess communities' willingness and ability to pay for water.

1.5 Research Questions

Given the above background and research objectives, the researcher set out to find answers to the following questions:

- What are various livelihoods activities of rural people?
- What are the specific benefits of multiple uses for men and women, and what are their costs?
- What are the types of technologies that are being used to supply water for multiple uses, and how do these perform?
- Are rural people willing to pay for water and which factors can affect their ability and willingness to pay for water?

1.6 Structure of the report

This study is organized into 6 chapters as follows:

Chapter 1 is the introduction. It gives a brief picture of the water and sanitation sector in Zimbabwe from independence up to the current situation. It highlights problems experienced in the water sector and the need to change focus and approach. It also contains the problem statement, scope of the study, objectives and research questions.

Chapter 2 is a review of literature on multiple uses of water. Case studies on poverty and productive uses of water at household level in countries like South Africa, Colombia, Morocco, Bolivia, India, and Nicaragua together with Zimbabwe have been reviewed under this section.

Chapter 3 is a descriptive summary of the study areas in terms of their geographical location, climate, population size and distribution, common soils, water sources, and major economic activities.

Chapter 4 gives an overview of the research methods and materials used to collect data for this study. It describes processes and procedures that have been followed in carrying out the study.

Chapter 5 is the presentation of results and discussions. It consists of narrative, tabulation, pictures and graphic presentation of the results of the assessment.

Chapter 6 contains conclusions and recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Rural water supply in Zimbabwe

From independence in 1980, Zimbabwe's focus targeted at providing primary water for domestic use to the rural areas where about 69% of the population lives as evidenced by the Integrated Rural Water Supply and Sanitation Programme (IRWSSP) (Robinson et al., 2004). Efforts to provide safe water to the rural areas were characterised by efforts of both governments and non-governmental organisations. These efforts were being guided by the 1985 National Water Master Plan (NWMP). As part of the NWMP, the IRWSSP was introduced with ambitious targets of achieving 100% coverage in access to safe drinking water within 500m of rural homesteads, together with Blair Ventilated Improved Pit Latrines (BVIP) for all households. This also involved the construction of 35 000 primary water supply systems and 1.4 million latrines, spread over a 20 year period at an estimated cost of US$525m (Robinson et al., 2004). This saw a significant rise in the provision of water for drinking, cooking, washing and for other related basic domestic uses from 38% at independence to 59% (CSO, 1998). However, it is important to note that the IRWSSP primarily focused on providing clean water for domestic use from communal boreholes and deep wells with boreholes and providing Blair Ventilated Improved Pit (VIP) latrines to meet sanitation requirements. Other technologies such as rainwater harvesting, family wells, rope-and-washer pumps and spring water capturing tended to be restricted to NGO initiatives and donor funded programmes. Often, these types of technologies provided more opportunities for multiple uses, and were embedded in programmes with a broader livelihoods focus, instead of only health (Makoni and Smits, 2006).

Zimbabwe's independence coincided with the launch of the UN's International Drinking Water Supply and Sanitation Decade (1981-1990), and the country witnessed a massive influx of donors and the country got international support for its efforts (Robinson et al., 2004). The country's commitment to improving the quality of the people was also shown by the emphasis it placed on the improvement of water and sanitation facilities for the rural people, and also its endorsement of the 1981-90 UN's International Drinking Water Supply and Sanitation Decade (Machingambi and Manzungu, 2003). This was indeed a major achievement in the water and sanitation sector. However, although Zimbabwe's IRWSSP has been viewed as the most successful of comparable programmes in developing countries, Robinson et al., (2004) noted that this was not enough in itself to improve the living standards of the poor. The segmentation of ministries and departments dealing with water has left many people's water needs unfulfilled. The proliferation of institutions in water provision and management has resulted in an uncoordinated approach towards water management and provision. Different ministries and organisations have different approaches, objectives and interests. This has posed

numerous problems as operational policies differs from one organisation to the other, one ministry to the other but all serving the same communities. For example, the Ministry of Health and Child Welfare is responsible for sanitation and shallow wells, including family wells. The then Ministry of Water and District Development Fund (DDF) are responsible for drilling and maintenance of boreholes and deep wells while the Ministry of Agriculture, Local Government and Community Development have been responsible for land use, planning, mobilisation, finance and co-ordination of water and sanitation projects at national level, provincial and district level. Robinson (2003) also discusses the government's rigid approaches in rural water supply for it continued to focus on providing clean water for domestic use only from communal boreholes and deep wells as a health benefit.

The view that provision and improvement of domestic water supplies is largely a public health benefit has even persisted beyond the 1980s where international agencies also continued to focus on *clean drinking water and adequate sanitation* as a basic human right and a developmental goal (Makoni et al., 2004). This thinking's major shortfalls, just like the IRWSSP was that they mainly focused on domestic water supplies for drinking purposes. This thinking failed to recognise and appreciate that peoples' water needs go beyond domestic to include water for productive uses to enhance their livelihoods. As such, it had a narrowly conceived health orientation and can be undermined by economic failures (Robinson et al., 2004).

It is important to note that this is not to say safe water and the health concerns are not important. Safe and clean water as well as adequate sanitation are and will remain fundamental to peoples' health and survival, and rightly so, there is a Millennium Development Goal (MDG) to support this claim. But it is also equally important to realise that meeting human basic needs should not just be about health and hygiene, nor do rural people always see safe water as their top priority (Moriarty et al., 2004).

The UN Committee on Economic, Social and Cultural Rights in General Comment No. 15 of July 2002 addressed the right to water under the right to livelihood in article 11 and 12 of the International Convention on Economic, Social and Cultural Rights (WHO, 2002). The Committee acknowledges and upholds the fact that people need water, which goes beyond meeting domestic needs. For example, it explained that; the human right to water implies that priority in water allocation be given to water for personal and domestic uses and furthermore, for water that is necessary to prevent starvation and diseases. This in itself implies that there is need for the provision of water for productive uses as well at household level.

The notion of primary water certainly speaks volumes to respecting basic needs. As such, the division between primary or commercial water does not sit well with the way of sharing, both with regard to safe drinking water and dry season gardens with available water (Hellum, 2004). The human right to water according to Hellum cuts across the division between primary and commercial water use or the economic divisions between domestic and productive water uses. Whether the water is provided for livelihood, it is

irrelevant, or whether the water is used to water vegetables consumed by the family or sold to get income to raise money for nutrition, education or health is also irrelevant. The right to water goes beyond clean drinking water to include water for irrigation, livestock watering, small-scale gardening and other water dependent activities which are essential for food, nutrition and health.

Against this background, Moriarty et al., 2004 recommended that it is very important that development of water resources and services be based on the understanding of all the uses of water. Robinson et al., (2004) also points to the urgent need to shift and expand the emphasis in rural water supply from safe supplies for domestic needs, and moving away from providing a small number of households with access to plots on formal irrigation schemes to strategies that also provide productive water on an equitable basis. This assists the planners and service providers to meet the needs of the people to which water is provided to. Robinson further suggested that future communal borehole projects should be sited and designed to provide sufficient water for both domestic and productive uses as well since people require multi-purpose water supplies that enable them to grow food and earn money at household level.

2.2 Rural livelihoods and poverty

Rural water supply programs tend to focus on only two social aspects that is improved access to domestic supply and improved sanitation. Less attention has been paid to how communities prefer to use water to sustain their livelihoods (Lovell, 2001). Until now, a majority of the water projects in Zimbabwe have focused on providing clean water for drinking and domestic needs in the rural areas whilst others have focused on water for irrigation (Thorpe, 2004).

Although improved access to water cannot itself alleviate poverty on its own, lack of it can effectively hinder progress towards poverty reduction strategies (Van Koppen et al., 2006,). Water deprivation is intrinsic to poverty in Southern and Eastern Africa. Its availability determines levels of income in cash and kind and also access to health and education. Water is a productive asset for the poor and an economic good, which, can be combined with other assets to generate financial and non-financial livelihood benefits (Mokgope & Butterworth, 2001).

Poor men and women often lack resources to capture water for improved productive uses through cropping, livestock and other water dependent household small and large scale activities (IWMI, 2004). Instead of only drawing drinking water from single use systems, people can also grow vegetables, undertake small enterprises, leading to poverty reduction through improved nutrition and income. People draw multiple benefits from having access to water for both domestic and productive purposes (Kasrils et al., 2004). In parts of Zimbabwe, for example, it was found that about 40% of people involved in community gardening spent money on education (Moriarty, 2003). Examples from Ambichinte, Colombia have also revealed that multiple uses of water can contribute to the fighting of poverty by addressing not only the health issues but also through increased agricultural production and income (Perez et al., 2004).

Case studies on poverty and productive uses of water at household level, Moriarty et al., (2004) have shown that provision of multiple-use water supply systems in rural areas help to reduce poverty and enhance livelihood options through provision of water of both acceptable quality and quantity. Studies by Robinson et al., (2004) shows that people can enhance their livelihoods through the use of available water sources for market gardening and planting fruit trees. For example, in Bikita 33 communities with access to high yielding water points were offered the opportunity to establish community gardens, which were of paramount importance during the 2001/2 drought period, as the produce from their gardens became an important part for them to survive. However, Perez et al., (2004) made an observation that this requires detailed analysis of different options for example, technical, economical, environmental feasibility and also considering the additional costs and benefits of providing water for productive uses.

In Zimbabwe, like many other developing countries, the impact of HIV/AIDS on poverty and livelihoods needs not to be lost sight of. With current HIV/AIDS prevalence estimates of 21% amongst adult population, with an estimated number of orphans at 1300 000, its impact on poverty is enormous. Accessibility to water of both reasonable quality and quantity in this scenario has critical functions in alleviating some of the impacts of the HIV/AIDS pandemic. Access to safe water and sanitation can reduce transmission of opportunistic diseases, such as diarrhoea, it can enable more convenience for those infected and also for their care-givers. Also, water for small-scale productive uses may enable people to grow more nutritious food, such as vegetables, which are crucial to keep up compromised immune systems (Makoni and Smits, 2006). Related to this, other studies have also shown that availability of water in large quantities has a beneficial health impact (Esrey *et al*. 1991; Jensen *et al.* 2001; Van der Hoek *et al.* 2001, 2002; Howard & Bartram 2003). Water quantity for cooking and consumption, if combined with improved hygiene behavior, has been found to significantly reduce fecal-oral diseases (Van der Hoek *et al.* 2002).

2.3 Multiple Use Water Services (MUS) Approach

This is a holistic approach to service provision built upon participatory planning, design, and implementation of water infrastructure and institutions that effectively meet women's and men's multiple water needs, possibly drawing upon multiple water sources. A framework of principles has been proposed to enhance multiple water use services (Van Koppen et al., 2006). To support people's water needs, Van Koppen and others (2006) further explained that what people desire is water for multiple uses, especially in rural areas where livelihoods continue to be based on a range of water-dependent activities. For example, when communities or individual families develop their own water sources, they often do so in such a manner that the sources cater for drinking, cooking, washing, bathing, cleaning, homestead horticulture, field irrigation, livestock, aquaculture and fisheries, tree growing, food processing ,beer making, coffee processing, butchery, brick making, market places, weaving and handicrafts (Moriarty et al, 2004).

However, many questions arise on how to implement and upscale MUS. Van Koppen et al., (2006). Figure 2.1 proposed a framework of principles for enhancing multiple use

services (MUS) at different levels.

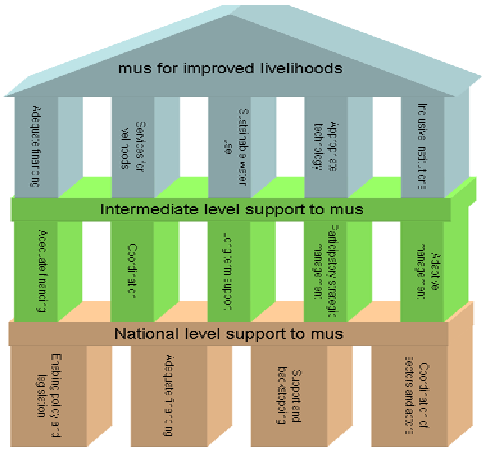


Figure 2.1 Framework for Multiple Use Water Services
Source: (Van Koppen et al., 2006)

The water requirements of the poor always extend beyond domestic needs. Without access to sufficient and reliable water for productive uses in and around the household, poor people are excluded from a range of options that would otherwise enable them to secure their sources of food and income. At the most basic level, poverty entails lack of opportunity (Upadhyay, 2004). However, Mokgope and Butterworth, (2001) are also of the opinion that any discussion of multiple uses of water should realise that there are equally important other religious, ritual and recreational uses for water that are neither basic nor productive, but more or less border on a health and hygiene-focused basic category.

The use of water for multiple purposes is not a new practice. Throughout history, people have used water for various purposes to build and sustain their livelihoods through drinking, washing, cooking, irrigating, brick making, and animal watering among other uses (Manzungu and Machingambi, 2003). In some cases, they allocate specific sources to specific purposes and more often they use the same sources to meet their multiple needs (Moriarty et al., 2004, Makoni et al., 2004). In Zimbabwe, for example, family wells have been protected and rope and washer pumps installed to pump enough water for both domestic needs and garden irrigation by NGOs like Mvuramanzi Trust and Pump Aid (Proudfoot, 2003).

Segmentation of ministries, department and donors dealing with rural water services provision has also meant that the poor peoples' multiple water needs are often not considered. For example, Pump Aid (2006) has noted that most rural water supply projects currently focus either on irrigation for agriculture or on clean water for improved health. Very few donors and policy makers encourage projects that incorporate multiple use systems despite the obvious advantages. This according to Pump Aid is because government departments and aid agencies usually focus on specific sectors and rarely

develop collaborative projects.

In Zimbabwe, it is important to note that some organizations, NGOs, in particular have realized the importance of the provision of water to cater for multiple uses. Efforts of organisations such as Mvuramanzi Trust, World Vision, Pump Aid, UNICEF, and Plan International among other initiators indeed recognises and appreciates rural peoples' livelihoods needs. For example, the water and sanitation programme of UNICEF Zimbabwe encourages the productive water use for livelihoods enhancement. UNICEF has made a provision for livestock drinking troughs, washing slabs in its water supply programmes (Makoni and Smits, 2006).

According to Makoni and Smits, (2006), Plan International has also continued to support projects that address poverty issues and income generation. Together with Mvuramanzi Trust, they have taken the lead in the promotion of drip kits to increase food yields. Pump Aid Zimbabwe has also been very instrumental in ensuring that at least people's livelihoods are enhanced through the provision of elephant pumps. Pump Aid builds appropriate technologies such as the rope and washer pumps, commonly known as Elephant Pumps that can be maintained by poor rural communities with little or no outside assistance (Pump Aid, 2006).

The success of NGO approaches is mainly because they are often less hindered by sector boundaries or government policies, and have a strong mandate to tackle poverty. NGOs tend to be able to operate more flexibly and holistically than can governments or many donor-driven programs. In a number of cases these approaches have been driven principally by technological innovation and a desire to provide sufficient water in or near the homestead (Van Koppen et al., 2006).

Around the world, water from irrigation canals is used for many other purposes in addition to agriculture. Evidence is from the North-East of Morocco, Zaio where the irrigation Agency facilitates and supports the multi-purpose use of irrigation water (Boelee and Laamrani, 2004). The South African case also shows that in some villages, failure to provide appropriate facilities for livestock watering resulted in cattle and goats being watered at communal taps, causing damage to facilities and this created health problems (Castresana, 2004).

MUS approaches seem to offer promising pathways in all poverty alleviation strategies. Global Water Partnership has also declared the need for MUS approaches as appropriate forms of Integrated Water Resources Management (IWRM) in poor areas with backlogs in infrastructure development (GWP, 2004). However, Perez (2004) noted that although multiple uses of water is not new, not much research has been done on these kinds of systems in terms of policies, design and management.

2.4 Water quantity

Access to water of acceptable quantity make people to embark on many activities with economic value, such as small-scale irrigation, fruit orchards, growing livestock feed,

dairy units, aquaculture and brick-making among other income generating ventures, all of which are vital in alleviating poverty (Lovell, 2000). There is also evidence that in most cases, people do not have water in the right place at the right time, in the right quantity and of the right quality (Rajabu et al., 2005). To access water of both acceptable quality and quantity, people need systems to supply, capture, or recycle sufficient water for domestic and productive requirements. Such systems offer the promise of being largely self-funding, as research suggests that the value of the small-scale productive activities is generally considerably greater than the marginal cost of providing the extra water (IRC, 2005).

Literature has suggested that people should have at least 25-50litres per capita per day for domestic use and approximately 50-200per capita per day for productive purposes (Gleick, 1996). During the Johannesburg Symposium in January 2003, it was agreed also among a wide range of practitioners, researchers and professional that a quantity of water sufficient for both domestic and at least some form of productive uses should typically be between 50 to 200litres per capita per day (Butterworth et al., 2003). However, although they are considered adequate and sustainable from a water point of view, these are proposed figures, which serve as a guide and can vary from time to time and from place to place to suit local use practices. For instance, a study by Castresana et al., (2004) in Bushbuckridge, South Africa, it was found out that amounts of water used can be affected by quality of the water and proximity of water supply systems, together with the size and wealth status of the families.

2.5 Gender roles and responsibilities

Substantial studies have been carried out on gender issues in water in Zimbabwe but these studies have been carried out either to increase the participation of women in projects or to show that the inclusion of women can guarantee the sustainability of facilities. Improved water availability promotes gender equity, as poor women are primarily responsible for fetching water. Women in Africa alone spend around 40 billion hours per year on this activity (GWP, 2000).

Throughout the world, women have universal responsibility for domestic water supplies. As such, Moriarty et al., (2004) argues that it is important to work with them on all water-development projects. Recognizing women's multiple roles as domestic and productive water users is an important aspect to consider in integrated water resource management (IWRM), and this aspect should not be overlooked by planners and policymakers. And, to ensure efficient, equitable and sustainable water use, to reduce poverty and to improve the well-being of communities, irrigation and water resources policies need to take into account all uses and users of water for better allocation policies (Upadhyay, 2004).

Water has multiple uses and ironically, in providing domestic water, the assumption is that domestic water supplies are specifically used for household chores only. This thinking is reflected in the designs of formal domestic water supply systems and services. Over the past several decades, development planners have assumed that women are only concerned about water for domestic purposes and men are responsible for productive

water use. This underlying assumption has not only led to a number of unsustainable development interventions around water, but has also underestimated women's productive role. Because of this assumption, water projects neither explicitly focuses on the need to promote equal balance of power between men and women nor recognize the need for equity in water allocation. Thus, water allocation has been gendered and in most cases women are ignored in terms of access to water for productive uses (Upadhyay, 2004).

A study by Makoni et al., (2004) in Bikita and Mt. Darwin showed that women and men usually rank uses of water differently. In the two districts, the survey established that women were playing more roles in water use and it was clear that they were the most users, managers of household water and hygiene.

Contrary to traditional popular beliefs that women are primarily interested with water for drinking, cooking and washing among other household chores, the same survey by Makoni demonstrated women's active daily involvement in livestock watering, brick moulding and other water-dependent income generating ventures. As such, their active involvement in decision making in water provisions is very important in ensuring sustainable water service provision. However, although many studies have shown the role played by women in daily water use and management, their knowledge and management of water has not received sufficient attention it deserves (Mkandhla, 2004). Women play a critical role in the management of water resources in rural areas. A study by Mukheli et al., (2002) also revealed that women could effectively manage common pool water resources in rural areas of Zimbabwe. Recognizing the multiple uses of water in and around households, where women play an important role in the use and management of water, in agriculture and in small-scale activities that allow both men and women to grow more crops, vegetables and to rear livestock is a mounting need (Upadhyay, 2004).

2.6 Multiple use versus sustainability

Multiple use of water provides multiple benefits. In other literature, however, it has been shown that although there are benefits for using water for multiple purposes, sustainability of some systems has been threatened in most cases. As such, conflicts over the use of drinking water for different purposes are receiving increasing attention in many parts of the world (Perez Alejanduro et al., 2004). Conflicts between conflicting interests on the use of water have been reported in Colombia and other Andean countries, such as Bolivia (Camacho, 2002).

Smits et al., (2004) also argued that unplanned productive use could lead to system overload and breakdown. Robinson (2004) also echoed the same sentiments and further explained that there will be more tear and wear on the pumps. For example, a study in Colombia by Perez et al., (2004) showed that sustainability of water supply systems has increasingly been negatively affected by management practices. In South Africa, unplanned, often illegal connections frequently caused systems breakdown (Mckenzie et al., 2003). It is in such a scenario that the poor continue to suffer and some breakdowns will never be attended to depending on the availability of alternative sources, be it

protected or unprotected.

The need to provide water for multiple uses has recently received attention and there seem to be consensus among professionals in the water sector that if well planned, multiple water use systems can lead to sustainability of water supply systems. The argument for this is the productive capacity of the income generating activities to generate financial capital that can be ploughed back to pay for repairs and maintenance. Makoni et al., (2004) has also made it clear that provision of water with restricted uses has in the past led to poor cost recovery mechanisms and this has a strong bearing on the sustainability of facilities. For example, piped water schemes developed in the 1980s have, in most cases, been abandoned due to poor maintenance, which in itself was a result of low or poor cost recovery mechanisms. Mudege (2003) also noted that significant improvement in cost recovery can be realised if water is provided not only as a social good but also as an economic good.

Viewing water as an economic good owes its origin to the 1992 Rio-Dublin principles (GWP-TAC, 2000), and in Zimbabwe, the 1990s saw a shift to new approaches in the water supply and sanitation sector, one of which has been the consideration of water as an economic good and the importance of demand as the driving force, which is also an important factor towards sustainability (Makoni et al., 2004). Makoni and others further explained that demand for water supply, together with a gender perspective can be important pointers towards sustainability of facilities. Given this, there is a high likelihood that those making a living from such systems are very much willing and able to keep it functional since their livelihood is dependent on the efficient running of the system. Evidence from Nicaragua on the case of hand pumps shows that the impact of income generation on sustainability has to be understood and capitalised on (Alberts and van der Zee, 2004). However, there appears to be another school of thought to the problem of system maintenance and sustainability. Alberts and van der Zee (2004) pointed out that where alternative sources of water are in the vicinity of the communities, the urgency to have it repaired is minimal. To this effect, water as a catalyst for development should at least be moved from its current straight jacket and be planned at a local level to satisfy all community water uses (Moriarty and Butterworth, 2003).

From the literature reviewed, not much has been done to investigate potential factors that can hinder or promote multiple –use water supply systems. No studies have been conducted in Zimbabwe to specifically look at factors affecting MUS. However, few studies conducted in Zimbabwe and elsewhere in the world seem to be advocating for the inclusion of both domestic as well as productive water in the planning and provision of rural water services. But, there is little or no information on factors affecting MUS.

Nevertheless, literature consulted vividly shows the impact of having water for multiple purposes. The issue of alleviating poverty through increased agricultural production and income together with improved health have among other benefits seen the increasing need to have water services, which cater for both domestic and productive uses as well. Moriarty et al., (2004) and many other researchers seem to be agreeing that there is an urgent need for governments and donor agencies to invest heavily in systems that address

the wider needs of the communities to which they are meant to serve. Alberts and van der Zee, (2004), Polak et al., (2004) also echoed the same sentiments and further expressed that there is need to implement systems that are designed to support mixed uses from the beginning.

CHAPTER THREE

3.0 STUDY AREA (S)

3.1 Study Area (s)

This study was carried out in Mashonaland East province, covering Marondera, Murehwa and Uzumba Maramba Pfungwe (UMP) districts. Statistics from the 2002 National census shows that the province has a total population of about 1 127 413. Of this total, 102 830 is from Marondera, 162 167 from Murehwa and 104 336 from UMP. Figure3.1 shows the map of Zimbabwe, showing the geographic location of study districts.

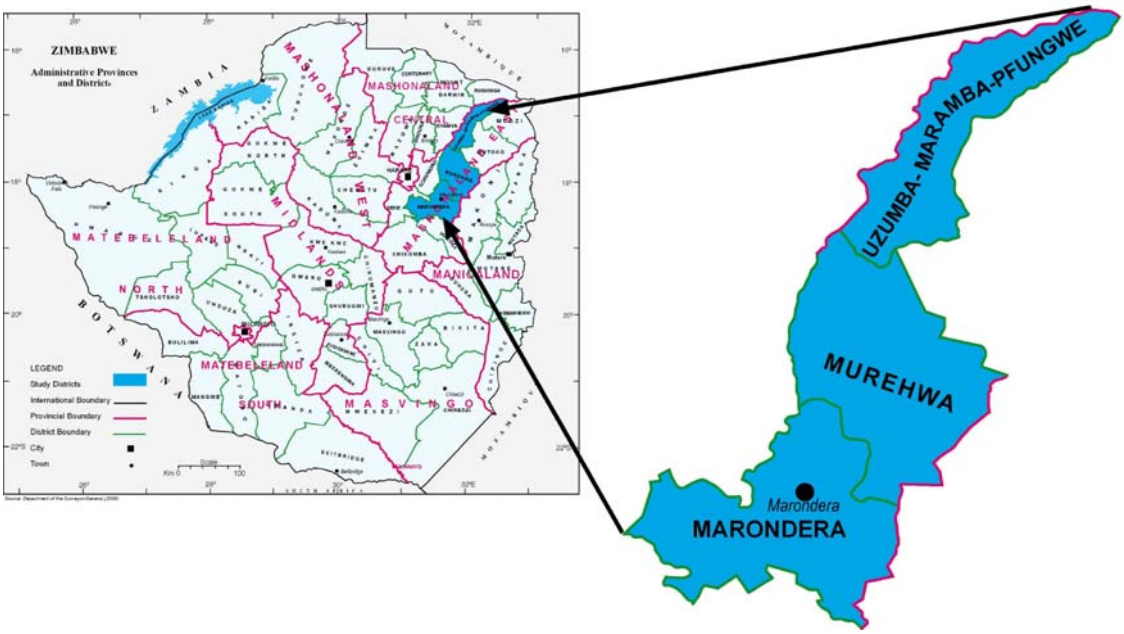


Figure 3.1 Map of Zimbabwe showing study districts

3.1.1 Uzumba Maramba Pfungwe (UMP)

Location

UMP is approximately 165 km north-east of Harare. Uzumba south is in agro-ecological region iib while Uzumba north is in region iii. Maramba and Pfungwe are in region iv. Maramba and Pfungwe sometimes experiences prolonged dry spells even during some rain periods.

Background

UMP was declared as an independent district after independence in 1980. Before 1980, it was just considered as Murehwa district (Gowe, personal communication). It comprises

of three distinct communal areas; Uzumba in the south, under Chief Nyajinha, Maramba in the middle, under Chief Chiutsi and Pfungwe in the north, under the Chieftainship of Chinyerere.

Population

The district covers an area of approximately 4 934km^2 and has a population of about 110 302 people (Mutawatawa hospital), a 5.7 % increase from 104 336 in 2002. Population density ranges from 10.4 to 3.6 per square kilometre in all the 15 Wards.

Rainfall Variability

Region iib receives rainfall in the ranges of 900-1000mm, region iii; 650-850mm and iv 450-650mm, respectively. Pfungwe is the driest part of the district and most rivers experience ephemeral flows with major river systems reduced to trickle or subsurface flows during the dry months. This diversity in agro-ecological regions and rainfall variability gives rise to different water sources and varied uses within these three communal lands.

Water sources

Approximately, there are 12 dams in UMP. There is Nyakasoro irrigation scheme in Pfungwe. The whole district has 448 boreholes. During the time of this study, rehabilitation and repairing of boreholes was being carried out by World Vision under its Echo 4 project. There are 152 deep wells, 93 shallow wells and 147 family wells and also springs and seasonal rivers. According to a survey in 2002, 8% had their main source of water on premises. 35% collected water from a distance of 500 metres or less while 41% fetched from a distance of 500 to 1000 metres (CSO, 2002).

Geology and economic activities

Geologically, 75% of the soils are sandy clay loams, derived from granite rocks. About 25% are reddish, brown clays from dolorite rocks, especially in Pfungwe, making the area suitable for cotton and rapoko. Economic activity is mainly market gardening, alluvial gold panning, agriculture, aquaculture and livestock rearing.

Mutawatawa growth point is the major service centre for the district, with small townships scattered all over. Figure 3.2 is the UMP district map, showing study wards:

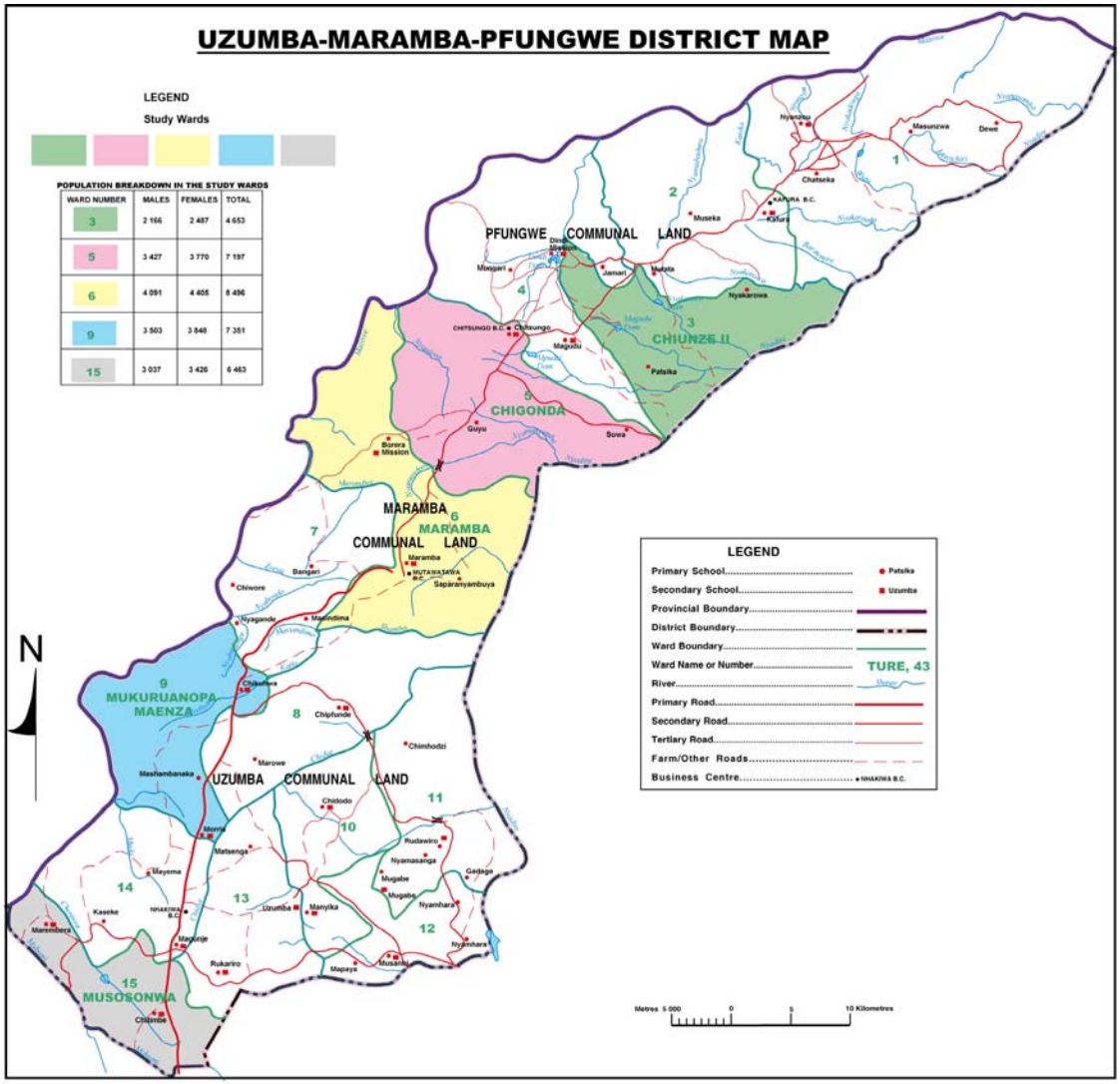


Figure 3.2 Map of UMP district

3.1.2 Murehwa

Location
Murehwa lies approximately 85km north east of Harare. The district falls in region iia, iib and iii. The district is divided into 30 Wards. Ward 3, 4 and 10 were selected to participate in this study. Fig 3.3 shows Murehwa district map, showing study wards:

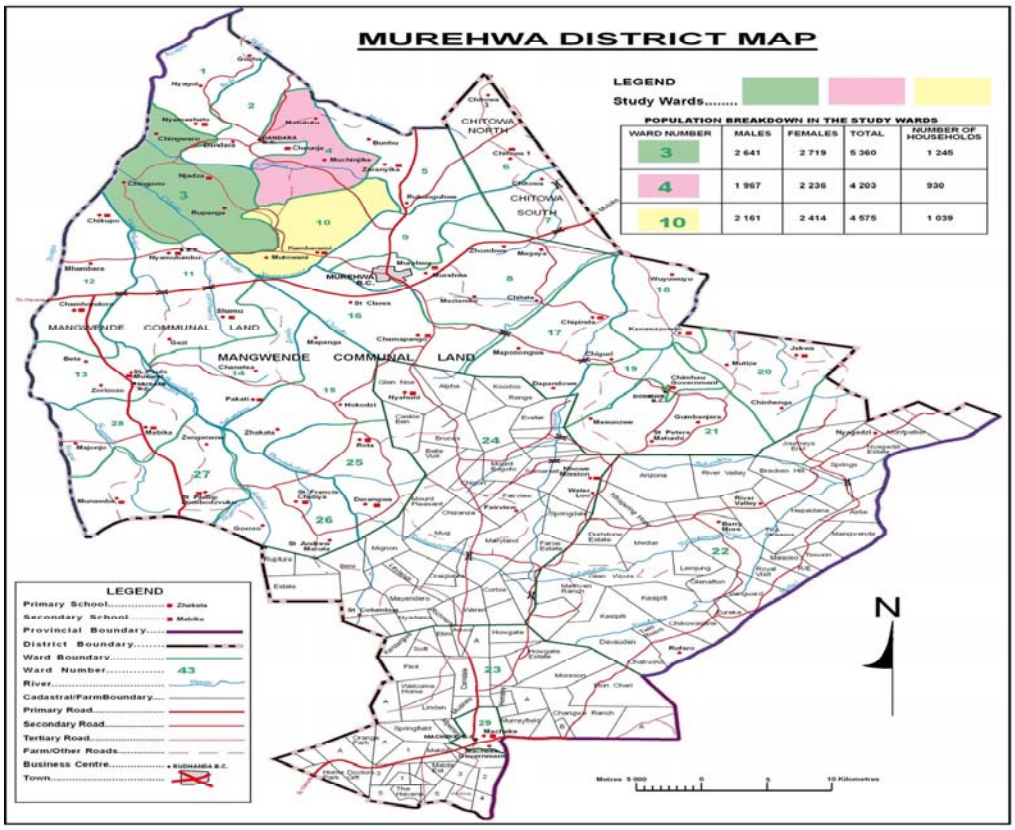


Figure 3.3 Murehwa district map

Rainfall and soil types
The average mean annual and effective rainfalls received in the district ranges between 700-1000mm, respectively. The soils of the whole district are varied in derivation, texture and depth. They are sandy loam and sandy clays with undulating lands, distinct hills and granitic rock outcrops with few portions of dolerite uplands and basalt in low lying areas.

The soils are of poor inherent fertility (Zimuto, personal communication).

Water sources and economic activities
Respondents mainly rely on boreholes and family wells. According to the 2002 National Population Census, 24% of the households had water on premises, 46% had water sources located within 500 metres, 26% covered approximately 500-1000metres and 4% had water sources located 1000 metres or more away from homesteads. Main economic activities are; agriculture that is maize growing, groundnuts, sunflower and rapoko, poultry, fisheries, horticulture and livestock breeding.

3.1.3 Marondera

Location
Marondera district is approximately 78km north of Harare. There are 21 wards in the

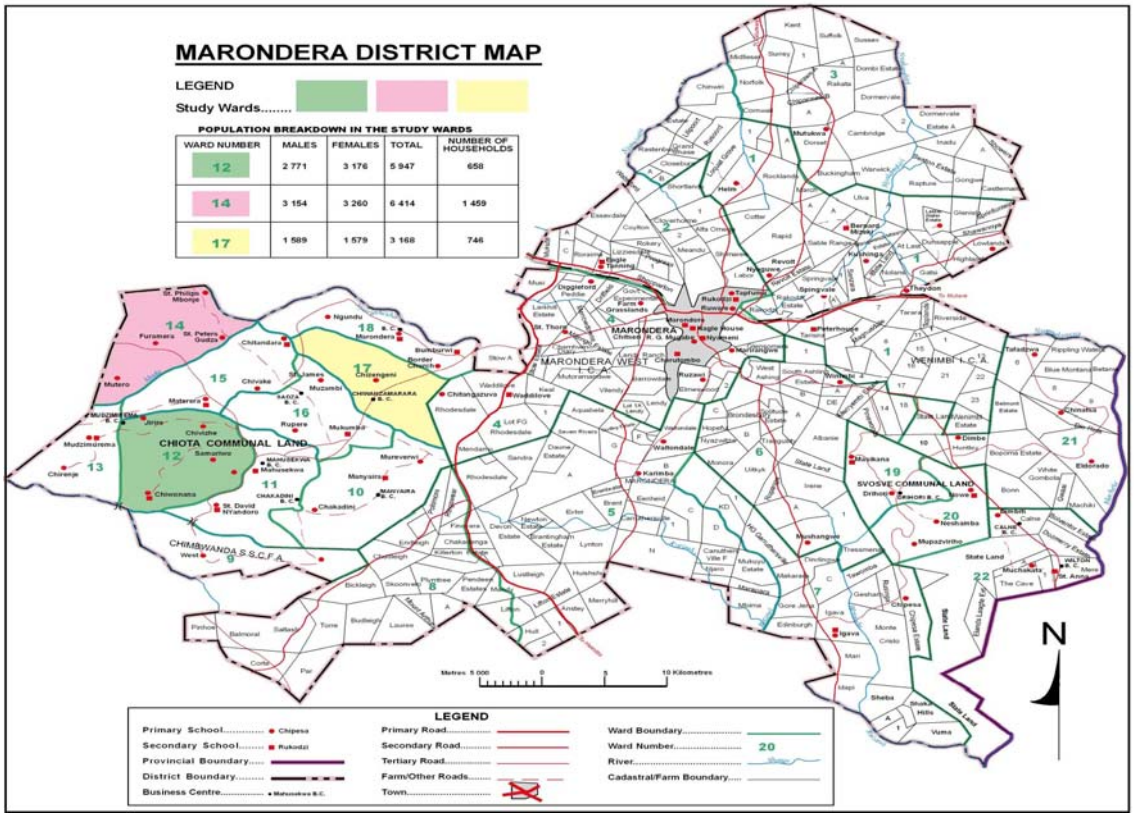


Figure 3.4 Marondera district map

whole district. Ward 12, 14 and 17 were selected for this study. The study wards are shown in Figure 3.4. The district comprises of 6 communal lands and resettlement areas. The communal lands are under 6 Chiefs with distinct administrative boundaries namely; Chihota, Mudzimurema, Samuriwo, Nyandoro, Nenguwo and Svosve. Mahusekwa is the growth point for the district.

Water sources
About 25% of the population in the district have their main sources of water within their premises. Family wells, rope and washer pumps are commonly used than boreholes. Close to 53% of households covered a distance of 500 metres or more to get to their nearest water source (CSO, 2002). About 6 km south east of Mahusekwa lies Nyandoro irrigation scheme. People in this district have easy access to Marondera town because of well developed road networks.

Rainfall and economic activities
Geographically, 5 communal lands are generally flat except the Svosve area and some resettlement areas with undulating lands, distinct hills and granitic outcrops. Marondera lies in a watershed area. The district is in region ii and receives high rainfall, especially in the resettlement areas. Average rainfall ranges from 600-1200mm per annum. Common soil type is sandy loamy. Major economic activities are; horticulture and livestock rearing. Marondera district map, showing study wards:

3.3 Selection of study districts

The three districts are popular for supplying the city of Harare and local communities with horticultural, market gardening, piggery and poultry products among other water dependents activities. MMT, which also funded this study, has been instrumental in improving water supply sources in this district. As such, this study has been conducted there as an evaluation of some of the technologies provided by the Trust. Proximity and accessibility of these districts as well as easy communication networks have also been considered.

3.4 Study sites selection

Six wards were selected: three in Murehwa, three in Marondera and five in Uzumba Maramba Pfungwe. All in all, this survey covered a total of 11 wards and 33 villages. The selection of study wards was made on the basis of the following criteria:

- Communities have access to a mix of natural and man-made water sources.
- The sites represent different water dependent activities being carried out.
- Participating households and other respondents accepted and cooperated voluntarily to participate in the study.
- Accessibility from major road networks.

CHAPTER FOUR

4.0 METHODS AND MATERIALS

4.1 Research Design

The following section briefly outlines the methods used in gathering and collecting both primary and secondary data for this thesis. As shown in Figure 4.1 the study started with the development and submission of the research proposal. After the proposal was accepted, the researcher made preliminary visits to study districts where the study was introduced and also meeting with key officials in various government departments and ministries who later on became contact people as well as key informants. At district level, key informants were personnel from AREX, MoH, DDF and RDC. An introductory stakeholder's workshop was held in Murehwa. The process of data collection followed.

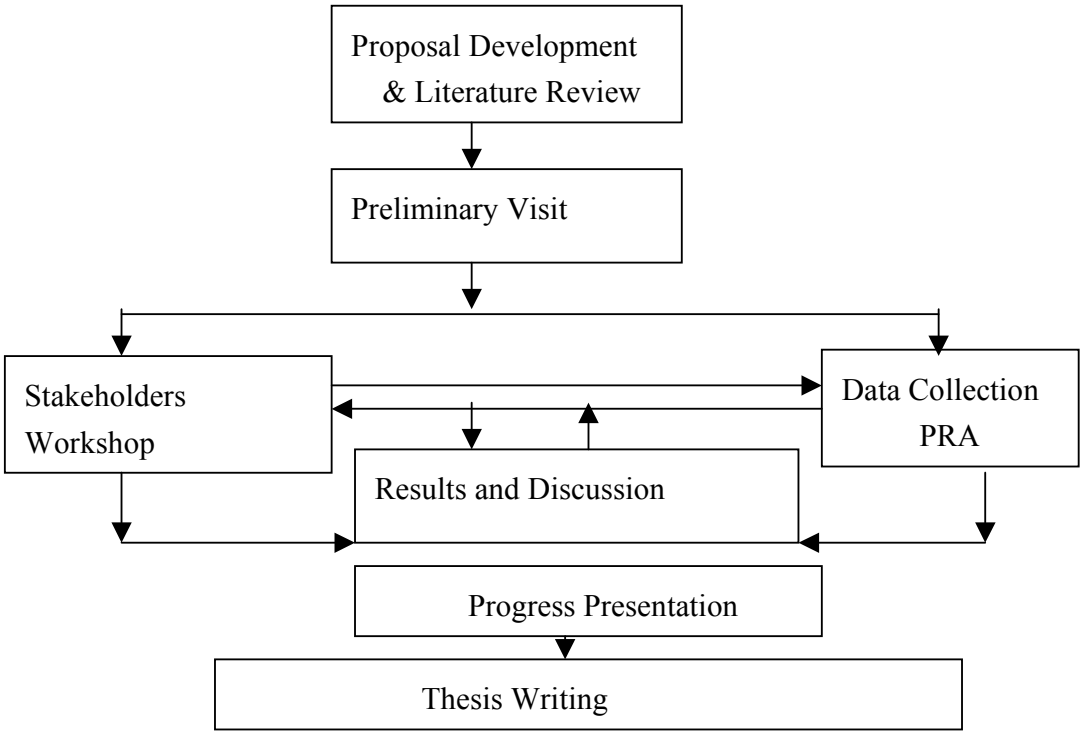


Figure 4.1 Research Design

4.2 Data Collection

This study, which was carried out between December 2005 up to May 2006, used both qualitative and quantitative methods in gathering data. For primary data collection, a one-day stakeholder's workshop was held at Chibanguza hotel in Murehwa. This workshop was meant to gather baseline information and to get an overview of existing water

sources, multiple water use practices and existing policies at district level. A plenary session was held during the workshop in which various district representatives cited water related projects in their districts and various water use practices. These ranged from; drinking, cooking, washing, livestock watering, piggery, poultry and fish breeding among other uses.

This was followed by a visit to study sites, which have been identified during the workshop to ascertain the validity of the information obtained during the workshop. Participatory Rural Appraisal (PRA) techniques were used to enable participating communities and key informants to express and share information freely and to stimulate discussion and analysis. These included discussions and interviews with stakeholders at various levels in the selected districts. At community level, discussions were held with ward councilors, village headmen, Village Health Workers, Water Point Committee Members, Village Pump Minders and participating households.

At household level, discussions were held with respondents to explore their background, knowledge, water use practices, views and perceptions to existing water sources among other water related issues. At district level, interviews and discussions were also held with key stakeholders representing government departments to obtain information related to water services provision in the three districts. Dialogue was maintained with key stakeholders throughout the period of study, data analysis and documentation.

A structured questionnaire was administered to 140 households. 50 in Marondera, 40 in UMP and 50 in Murehwa. Questionnaire administered at household level focused on issues of water use, sources, monetary returns on productive uses of water, reliability of water sources, operation and maintenance issues, problems encountered, existence of Water Point Committee, role of MoH, DDF, and AREX among other government ministries and departments. The target group for administering the questionnaire was generally household mothers or fathers. Children were also talked to but the adults were deemed to have reliable adequate knowledge on issues being investigated.

Purposive, convenience random sampling was used to get questionnaire respondents at community level. Copy of the sample questionnaire is attached **(Appendix A 1-page 74).** Differences in perceptions, realities, roles and priorities between women and men were also assessed through focus group discussions. In addition to interviews, observation was also used to examine the physical appearance and state of some of the technologies in use in various villages visited. To supplement questionnaire responses on water quantity, a household water use diary was used. Sample household water use diary provided **(Appendix A 2-page77).**

Literature from a wide range of published and unpublished sources was also undertaken to consolidate the field study and to identify key issues that were relevant to this study. It must be noted that not much academic work has been done in the field of MUS although there is a lot of experience within rural communities and some other donor agencies. As such organisations such as Plan International, UNICEF, Mvuramanzi Trust and Pump Aid provided valuable literature for this study.

Communities' demand for different water services and their perception of the prevailing situation in their villages was assessed. A willingness to pay (WTP) and ability to pay (ATP) survey was also carried out in all participating communities and individual households. Specifically, the survey focused on communities' and individual families' willingness to pay and ability to pay for water given the following scenarios:

- Installation of rope pumps
- Upgrading of family wells
- Piped water
- Repairing and maintenance of community boreholes

The same survey also gathered data on estimated costs of upgrading simple family wells to rope and washer pump.

4.3 Water quality assessment

200ml sterile bottles were used for water samples collection. Water samples were collected from 2 selected boreholes in Chigonda and Maramba wards, Maramba and Pfungwe areas, respectively. A sample was also collected from Maguranga river, an alternative source for both domestic and productive uses in Pfungwe. The membrane filtration method was used for faecal coliform detection because of its accuracy and speed of results. The three samples were analysed for bacteriological quality and some physio-chemical parameters at Mutawatawa hospital **(Result sheet for the bacteriological water quality test is attached as Appendix A 3-page79).**

4.4 Data analysis

Data analysis was done using the Statistical Package for Social Sciences (SPSS). Tables, pie charts, percentages and other variables were run for different variables. Water quality as a factor affecting multiple uses of water was assessed by comparing results from collected water samples with the universally acceptable World Health Organisation (WHO) guidelines for drinking water quality and Zimbabwean standards **(Appendix A 5, for WHO and Zimbabwean Guidelines on Drinking water quality standards-page 80)**

CHAPTER FIVE

5.0 DATA PRESENTATION AND DISCUSSION

5.1 WATER SOURCES AND USE PATTERNS

A survey in ward 12, 14 and 17 in Marondera revealed that 21.9% use rope and washer pumps and 62.5% use family wells. In UMP, 73.7% have access to boreholes but do not use them all the time. Of all the respondents in study villages, 66% use rivers and dam as main source for both domestic and productive uses. The remaining percentages, use rope and washer pump 5.3% and upgraded family wells. 57% of the respondents had private water sources within their homesteads, which according to them was through own drilling.

In Marondera, those with lined family wells got cement from Mvuramanzi Trust and the Ministry of Health and Child Welfare. No rope pumps were observed in Murehwa. In Marondera, it was Mvuramanzi Trust, which provided this type of technology. In Uzumba, some families got this technology around early 90s from World Vision. In 1998, one farmer in Mukuruanopamaenza ward in Uzumba was the first one to get a modified pump from the one he previously got from World Vision. It was Pump Aid Zimbabwe, which installed a modified pump on his premises. The differences in the design of this pump, as will be explained later on technologies had a strong bearing on the use of water for multiple purposes.

In Marondera and Murehwa and some parts of Uzumba, respondents emphasized that individual water sources are viewed as family property rather than communal property. Mistrust was cited as one reason why families did not want their sources to be for public use. However, it was evident from discussions with family heads that very close relatives could be allowed access to get water from such sources.

Water use patterns for productive purpose were largely determined by source type, distance and availability of water while for domestic uses, source type mainly influenced the uses. The majority of sources used in Murehwa for domestic were communal boreholes fitted with hand pump. Since independence, rural water supply has been largely restricted to groundwater sources through the provision of boreholes with hand pumps (Makoni and Smits, 2006). Borehole use was not so popular in Marondera where majority of the respondents rely heavily on family wells and rope and washer pumps. Boreholes were also very common in Maramba and Pfungwe.

In Marondera, 59% used their sources for domestic only, 37% for both domestic and productive and 3.1% for productive only. In Murehwa, 68.8% of all the sources were used for domestic only, 25% were used for both domestic and productive uses and 6.3%

were used for productive only. In UMP, 78.9% use sources for domestic only, 5.3% use sources for both domestic and productive uses while 15.8% use sources for productive only. Table 5.1 shows common water sources observed in study wards. The sources are listed in order of their priority of use. Non existence of piped water schemes in study villages is for obvious reasons of high capital and maintenance costs of running such schemes, an observation already made by Robinson et al., 2004. However, a WTP survey revealed that 66% households, in Marondera were willing to pay to have such infrastructure while respondents in Murehwa and UMP explained that what they require is not a sophisticated water supply system but at least systems that can meet their water demands.

Table 5.1

Commonly used water sources in study villages

District	Source
Marondera	Protected wells, Rope and Washer Pump, open wells, Nyandoro irrigation scheme, roof top rain water, boreholes and rivers
Murehwa	Boreholes, protected wells, Hand pumps, unprotected wells, river, roof top rain water
Uzumba Maramba Pfungwe	River, protected wells, Rope and washer pumps, (in Uzumba), unprotected wells, rivers, Nyakasoro irrigation scheme in Pfungwe, springs, roof top rain water and boreholes

5.1.1 Domestic water uses

In all the 33 study villages, participating households use water to meet their everyday basic needs. Domestic water use patterns are generally similar in all the study villages regardless of the type of the water sources and the distances covered to reach the sources. Water is used for drinking, cooking, bathing and washing of utensils and clothes. However, what was observed to be different across the study villages are consumption levels as shown in Figure 5.1. Statistical differences in consumption levels were mainly influenced by the size of the family, proximity to the source and also the wealth status of the family. Although some respondents could not estimate the amount of water they needed for daily household uses, a household water use diary was used to capture some of this information. The amount of water needed by an average household was observed to be in the range of 25 to 250 litres per day per household with a mean of 60 litres per day.

Estimated quantities obtained from the questionnaires were cross checked and combined with recorded quantities from the household water use diaries. The data obtained seem to

show a significant difference in domestic water consumption levels. This can be explained in view of availability of water sources within premises. UMP appears to have the greatest number of respondents with a consumption level in the ranges 25-60litres per day per household. There is no significant difference in consumption levels of respondents in Murehwa and Marondera in the range of 70-100litres. This is because they have access to sources within premises or less than 800m. Sources within premises provided respondents with easy access to water supplies and it was also established that those with easy access to water supplies use more water for bathing and washing. Families without water sources within premises more often go to nearby rivers for bathing and washing. The common practice was to go to the river, water the garden and then bath later towards dusk.

Respondents who use around 100-250litres were found to be highest in Marondera and Murehwa and this was mainly because of proximity of water sources. However, the actual consumption levels might be slightly lower than these figures but what was being recorded was the water fetched and not used in this case, especially in Marondera where not all the water fetched was used for domestic but was later used for watering backyard gardens and fruit orchards around the home the following day.

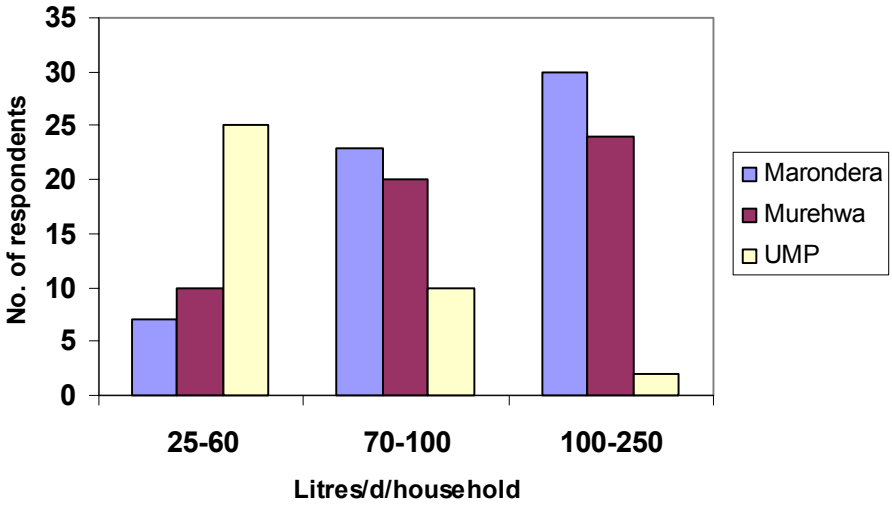


Figure 5.1 Domestic water use consumption levels

There were no clear time specifications for fetching water from those families with individual sources within premises. It was explained that water is normally fetched when there is need to use. However, storage containers are normally filled around 5-6pm for evening use. If the water is not finished, they water fruit trees around the home or cleaning of utensils the following morning before they fetch fresh water.

It was also established that those households without sources within their premises normally fetch water three times a day for domestic uses. Water is usually fetched early

in the morning around 6-10am, then from mid day to 2pm and then from around 5-6pm. In all the study villages, 67% fetch water for drinking from protected sources. Unprotected sources are sometimes used for other domestic uses such as cooking, laundry and bathing. Of the remaining percentage, 23% confirmed boiling water for drinking while the remaining respondents explained that there was no problem in drinking the water without any form of treatment. They argued that boiling water makes it tasteless. Supplementing water from protected sources with water from unprotected sources was very common with those families with protected sources about 2kilometres or more away from their homesteads. Water for daily use was stored in kitchens in 20litre plastic containers or in big clay pots with a storage capacity of 20litres or more.

There were no restrictions on water quantities to be drawn from communal sources for domestic uses. However, frequent visits to the boreholes with large containers or pulling carts by one family was not allowed in more than 50% of cases. This was mainly because there were doubts if the water was still being fetched for domestic use or for other uses such as brick making or gardening.

5.1.2 Productive water uses

A wide range of water-dependent activities were observed. These are; dairy, piggery, poultry, brick making, beer brewing, gold panning, livestock watering, gardening, small scale irrigation, banana plantations and orchard plantations. Piggery, poultry and dairy were common in Murehwa while gold panning was reported in Pfungwe.

It was established that while some of these activities are about lifestyle improvements, 87% needed water for profit-oriented activities. Whether there was a reliable source of water close by or whether the sources were far from homesteads, all respondents had family gardens of approximately 20-100m^2. These gardens are used to grow vegetables such as tomatoes, cabbages, cucumbers, kovo, butternuts, rape, onions, sugarcane, carrots and beans among other household crops. These are mainly for home consumption. When there is surplus, some would sell to neighbours who might not have the vegetables that season or exchange for other goods and services. In Marondera, Murehwa and UMP, the local growth points are the first receiving markets and then Mbare Musika in Harare. Most households who supply local markets and Mbare Musika are those families with plots in irrigation schemes, cooperative or big family gardens.

Water use for brick making and building purposes was drawn from open wells and river, normally more than 500m away from the home. Water is usually collected in jerry cans or 25 litre buckets. Women carry water on their heads while men use wheel-burrows or donkey-drawn scotch carts. No brick making was allowed to be done close to boreholes or to use water from such sources. Reasons cited were that some were doing this for business and would deprive others of water for domestic uses. It was also explained that in case of breakdowns, it would be difficult to tell people to contribute to meet repairing costs when some of the contributors do not use such huge quantities. Brick making was cited by 67% as a business venture in all the study villages.

Beer making was also cited as a common practice by all participating households. Beer making was mainly reported to be the role of women, especially those in the age group of 50years and above while some considered it as a survival strategy and age do not matter. Beer making was highest in UMP, particularly in Pfungwe, Uzumba Maramba, Murehwa and Marondera, respectively. Beer making was cited by 63% not only as an income generating business but as an important traditional practice. Beer was regarded as important during celebrations and traditional gatherings such as:

- Marriage ceremonies
- Weddings
- Easter holidays
- Heroes day
- Independence day
- Christmas holiday
- Rainmaking ceremonies
- Inheritance gatherings
- Traditional ceremonies such as *Kurova guva*
- Appeasement gatherings

> *"It is our ancestors who give us all this water you see, son…" Beer is good and it keeps us going", explained one old man in Murehwa.*
> *"But we are not happy with restrictions on this borehole where we are not allowed to fetch more than a 100litre drum, yet for beer brewing, one needs not less than 300litres", complained one old woman*

During such functions, beer is to be taken free of charge. For money making, beer brewing was said to be on weekly or monthly basis. The frequency of beer brewing was said to be influenced by the need to have money to meet family needs such as food, payment of schools fees and money for going to grinding mills among other uses.

Beer brewing was met with mixed feelings in all the study villages. People were not allowed to draw water for beer making from communal sources such as boreholes because of the required large volumes of water. Families who belong to certain church denominations also viewed beer brewing and partaking of it as unacceptable and they went on to give biblical verses to support their claims while respondents from some other church sects and those who claim not to have any church affiliation strongly believed that beer making and drinking was not bad at all. As such, there was no need for restrictions on where to get water for beer brewing. Beer brewing and drinking was considered to be a normal practice to grace traditional ceremonies. For rain making, some people believed beer is needed to please their ancestors whom they strongly believe gives them the rains. Table 5.2 summarises water use patterns in the study villages.

Table 5.2

Summary of water use patterns per district

District	Water use	Source
Marondera	Drinking, bathing, washing, livestock watering, beer brewing, gardening, brick making, dairy, banana plantations watering	Boreholes, *protected wells*, *open wells, rope and washer pumps, roof top water rain water*
Murehwa	Drinking, bathing, washing, livestock watering, beer brewing, gardening, brick making, dairy, piggery, poultry, fruit tree watering, gum tree plantation watering	Boreholes, *protected wells, unprotected wells, river, hand pumps, roof top rain water*
Uzumba Maramba Pfungwe	Drinking, bathing, washing, livestock watering, beer brewing, gardening, brick making, banana plantation watering, gold panning,	*River,* boreholes, *protected wells, open wells, rope and washer pumps, springs, dam, rivers,* Nyakasoro irrigation scheme

* Sources in italics are the ones being used for both domestic and productive water uses.

In summary, there seemed to be great confusion on what constitutes domestic and productive water at both household and community level. In some instances, respondents seemed to consider the daily importance of water to their livelihoods and whether it generated income or not before classifying it as domestic or productive. Some respondents seemed to be confused by this classification to an extent that they were not sure of whether beer making, gardening and livestock watering should be classified as domestic or productive. This was mainly because some households sold vegetables from their gardens while almost everyone practiced gardening for subsistence purposes but can still sell in case of surpluses. For example, one can not let surplus tomatoes to rot in the

garden when there is a ready market to buy. Beer making was also done for business while some were brewing it not for profit making. The same applied also for those with livestock, some sell when they have financial problems, for example to send children to schools and colleges yet some keep livestock not for selling but as a family pride.

At rural household level, people indeed require water for multiple purposes. However, this survey found out that people usually do not get all their water needs from single sources. This study identified factors which affect multiple uses of water in all the study villages. It was also found that these factors maybe positive or negative and they have a bearing on water use patterns as well as on the sustainability of some water sources. These factors are; Technology and system design, segmentation of water services, institutional and policy issues, water quality, quantity, distance to sources, ease of operation of the water points, donor initiatives and approaches, financial costs and market issues. A detailed assessment of these factors and how they affect multiple uses of water and their impact on sustainability was done as shown below.

5.2 FACTORS AFFECTING MULTIPLE USES OF WATER

5.2. 1 Technology and system design

Technological innovation can enhance, promote or hinder multiple uses of water. Technologies such as the rope and washer pump, rope and bucket, drip kits, boreholes and rainwater harvesting were observed and their operation analysed.

5.2.1.1 Rope and washer pump

The rope and washer pump is a simple hand operated pump that was developed in Nicaragua and brought to Zimbabwe in 1982 by John Lambert of Cambridge University in the United Kingdom. First trials of the pump were done at the University of Zimbabwe's Civil Engineering department but the pilot project did not go beyond piloting. In 1991 World Vision International adopted the technology and made extensive trials in UMP district. During the period 1991 to 1994 a total of 285 pumps were made and distributed to smallholder farmers in the district. The technology was very crude involving wooden moving parts both the axel and honge, this made the pump very difficult to operate and many women shunned it because of the difficult with which it was being operated. The pump could not also be developed further because of the low water table that existed in most parts of the districts (Guzha et al., 2006).

Field observations have revealed that under normal conditions, a standard rope and washer pump delivers 200litres per every 4minutes. Water to be delivered by the pump according to Guzha and Chimbunde (2005) depends on the speed at which the wheel is turned. The higher the speed, the higher the delivery. A family can easily pump 10 000 litters of water in 8 working hours using the rope and washer pump. The maximum

standard depth reached by the pump, according to Alberts and van der Zee (2004) is normally 40m. However, this can be adjusted to 60m with adjustments and a double crank. Depth is usually influenced by the water table level and the geology of an area. Table 5.3 shows the pumping capacity of the rope and washer pump. These estimates are based on the operation of the pump under normal conditions.

Table 5.3 Rope and washer pump pumping capacity according to depth

Depth (m)	Adult (L/min)	Child (L/min)	Time needed for an adult to fill a 200l Barrel (min)
10	41	19	5
20	20	10	10
30	14	6.5	15
40	10	4.8	20

Source: (J. H. Alberts and J.J. van der Zee, 2004)

To date, different organizations such as Pump Aid, World Vision and Mvuramanzi Trust in Zimbabwe have provided the rope pump with different designs. In Marondera, Mvuramanzi Trust introduced this technology with modifications having realised the need to reduce labour burdens from using the rope and bucket system. The Trust, conducted first trials of the pump in Marondera in 1998. Figure 5.2, 5.3 and 5.4 show these different technological designs on the rope and washer pump. The rope and washer pump design in 5.3 was by World Vision. During the early years of the pump in Zimbabwe, World Vision designed this pump in such a way that it allowed the users to use water for gardening, which is productive use only while the one in Figure 5.3 by Mvuramanzi Trust allows users to use the technology for both domestic and productive uses. The other pump design in Figure 5.4 by Pump Aid is also a bit modified in that it allows the users to draw water for both domestic and productive using bicycle-like pedals, hence the name *Chibhasikoro* unlike the Mvuramanzi Trust type where water is drawn using a windlass.

Figure 5.2 World Vision pump design, Uzumba. Figure 5.3 Mvuramanzi pump design, Marondera

Figure 5.4 Pump Aid design, Uzumba Figure 5.5 Elephant pump: www.pumpaid.org

Figure 5.2 and 5.3 has the same mode of drawing water. The only significant difference between the design in Figure 5.2 and the other three designs is lack of protection to the source, which makes it only suitable for productive uses. The bicycle-like *(Chibhasikoro)* by Pump Aid type according to one beneficiary farmer in Uzumba needs very little energy to lift a certain volume of water due to the continous flow of water and reduced friction as compared to the World Vision design he had prior to the Pump Aid design. Elsewhere, the *Chibhasikoro* has been reported to be one of the technologies which most rural schools in Zimbabwe have turned to. Pump Aid's observations are that the *Chibhasikoro* type is very safe, easy and fun to use even for children and the elderly. At schools where the bicycle-like system is installed, children have been known to come to school early to play on the pump while filling up a tank of water for the school vegetable garden. The Pump Aid rope and washer pump design is commonly known as the elephant pump in some parts of the country. This low-cost technology, was developed by Pump

Aid staff in Zimbabwe from 1996 - 2000. Since 2000, the organization has installed over 1,200 pumps around rural areas in Zimbabwe. It is suitable and sustainable for even the most remote areas and, with an extraction rate of around one litre per second; it can be used to irrigate nutrition gardens. The elephant pump, according to Pump Aid, allows sustainable harvest of groundwater even after several years with poor rains. In some cases, the pumps will be used to sustain field crops through dry periods in poor rainy seasons but the primary use will be to establish small irrigated plots which can include integrated livestock projects and tree nurseries. It is these designs which this study identified which can best explain whether these technological designs can enhance, promote or hinder multiple uses of water.

In Marondera, rope and washer pumps are used for a mix of both domestic functions and small scale gardening and watering of domestic animals. This survey established that communities in Marondera are quite happy with this type of technology. The rope and washer pump, according to respondents is very useful to them. They no longer walk distances of about 1km or more to get water from communal sources away from homesteads. A number of households who uses the rope and washer pump have witnessed marked increases in area of production with some families increasing area under irrigation from 0.5ha to a 1ha. Time reduction in watering the plots has also been cited by those using the pump to be from 8hours to less than 3hours. The burden among women and the girl child of carrying 20liters of water x 100 per irrigation time has also been reduced since a hosepipe can be used to irrigate. The 5hours saved as a result of rope pump means that in many households mothers spend more time with their children, improving the quality of care to their children. In case of children they no longer walk longer distances to fetch water; this frees their time to spend on school work.

In Uzumba, the headmaster at Chitimbe primary school was quite happy with the performance of the rope and washer pump, which is used in combination with drip irrigation. According to him, the rope and washer pump offers many advantages, which the school has also witnessed. For example, girls can spend longer in the classroom in a healthier learning environment due to the presence of clean water on the school premises. Girls no longer miss lessons to collect water from distant sources and no longer bring water in containers from home to drink and clean toilets. The pupil's attendance has also been improved by the existence of the rope pump together with the drip irrigation kit. Pupils also come to school early before the actual starting time to play around these technologies, filling the tank for watering the school garden. These observations were similar to the ones by Pump Aid. The reduced prevalence of water borne diseases is also a major health impact. Together with the use of the drip irrigation kits, the rope pump has also enabled the school to grow a variety of crops to sell. Part of the money is used to buy school stationary, sports wear and also assisting with payment of school fees of those children from disadvantaged families.

This technology according to Mvuramanzi Trust is cheap since it can be made from locally available materials, making it also easy for user families to do prompt repairs once trained. Evidence that the technology is cheap for rural communities is also from

Pump Aid. Recently, Pump Aid, Zimbabwe agreed to work in partnership with Oxfam in Zimbabwe. Under the terms of this partnership, Oxfam will fund the installation of Elephant Pumps and the training of Oxfam staff by Pump Aid. This will enable Oxfam to establish cheap and sustainable water supplies for poor rural communities in various parts of the country (Pump Aid, 2006). Text Box 5.1 is a case study of a family using the rope and washer pump in Uzumba.

Box 5.1 Uzumba case study on the use of the rope and washer pump

In UMP district, there is one farmer, married to two wives. He has fourteen children. Prior to the use of the rope and washer pump, they used to irrigate 1ha of land using buckets and watering cans. This small plot was used for the production of green vegetable, tomatoes and the larger part for maize only. In 1992, this farmer acquired a rope pump. Through pump use, the family managed to increase their hectarage from 1ha to 2.5ha. In 1995 he also managed to acquire another rope pump due to huge financial returns. This also meant an increased hectarage to more than 5ha. With two pumps, it is important to note that the hectarage increased more than five-fold allowing the family to increase the variety of crops grown from being known as a chief maize grower, he began to grow 0.5ha of tomatoes, 0.5ha of beans. 0.25 okra, 0.5ha butternuts, 1ha sugar cane, 0.5ha cucumbers, 1 ha green leaf vegetables, 0.5ha carrots, 0.5ha ground nuts and the remainder for fruit trees. According to him, the pump is a miracle to the family. They managed to buy four cattle, a scotch cart, sending children to school, built a nice four roomed house. He also married a third wife.

Source: E. Guzha and E. Chimbunde, 2005)

5.2.1.2 Rope and bucket system

This type of technology was observed to be very common in Marondera, Murehwa and some parts of Uzumba. It allows user families to draw water from a well manually using a rope and bucket or using a windlass. This technology, according to all users in study villages is very labour intensive and strains the users, particularly the backbone. It is also time consuming especially for women, lifting and carrying water from such sources. Very small areas of about 0.25ha can be irrigated with watering cans. Figure 5.6 and 5.7 show these design differences.

Figure 5.6 Rope and bucket (Manual), Marondera Figure 5.7 Rope and bucket (with windlass, Uzumba)

In Marondera, in Chizengeni village respondents indicated that they were willing to pay for the rope and washer pump, a commonly used technology in ward 14 in the same district. Figure 5.6 shows a rope and bucket technology, where users draw water manually while Figure 5.7 is an upgraded version of the one in Figure 5.6. The one in Figure 5.7 allows users to use the windlass, making water abstraction easy as compared to the manual system. Labour required to abstract water limits the quantities to be drawn from such sources, thereby making the use of such sources for multiple uses quite limited.

From these technologies, it was noted that water might be plenty but sometimes abstraction technologies might not be in place. For example, three brothers Murehwa use watering cans to water their 100m^2 garden. Their efforts are hindered by the use of watering cans. A lot of time is lost every day, fetching water with cans and then going round their 100m^2 garden. The three of them wake up every day at around 5pm to work in the garden and spend the whole day in the garden. Sometimes, they divide duties among themselves, one going to the market, the other two remain working in the garden. Apart from supplying Chibanguza hotel with fresh produce, large companies such as Inter fresh, in Harare also obtain some of its farm produce from this family. Their wives mostly help with preparing food and looking after the family.

"No time to drink, we need to be here the whole day. Sometimes, our wives even feel neglected; we do not have time with them. We are busy and by the time we go home, it's late and very tired". explained the elder brother.

The three explained that although they were making progress, the use of watering cans was indeed quite tiresome. They indicated that they have only heard about the rope and washer pump but have not seen it and were prepared to invest in this kind of technology.

In UMP, in Maramba, one farmer acquired the drip irrigation kits from *Pundutso*, a World Vision credit loan scheme meant to benefit farmers. The farmer has the same field, measuring 100m^2 but with the use of drip irrigation kits, he can pump water to fill the 2000litre drums and then open the taps to water the fields while he is busy with some other field work. He explained that it takes about 30minutes to fill these tanks. Water from these tanks can water the 100m^2 plot for about 2hours and can pump the water again if there is need to. Through this technology, the farmer has also been able to repay the loan within six months instead of the stipulated one year.

5.2.1.3 Boreholes

In Zimbabwe, boreholes have since independence been used as the best technologies for underground water abstraction for rural domestic water supplies. In ecological regions 1 and 2 where the water table is relatively high and where water is in abundance and flowing in rivers, borehole water has been restricted to domestic use only. However, in areas where the water table is very low for example in ecological regions 4 and 5 of Zimbabwe borehole fitted with bush pumps are also being used to supply water for domestic, brick moulding, construction work and animal watering for example in Tsholothso district (Guzha et al., 2006). Productive uses of high yielding water points have also been reported in Bikita and many communities benefited during the 1991/92 drought through mixed uses of water points (Robinson, 2004). This study has also found that although boreholes are meant to provide water for domestic uses, a survey in the study villages showed that even within the domestic domain, not all boreholes were designed to cater for all domestic uses.

Boreholes without washing slabs were observed. Some boreholes also by nature of their design do not allow users even to water their livestock around them as evidence by the absence of cattle drinking troughs. In the 1998 Water Act, livestock watering seem to be implied under primary water uses. However, in terms of services provided for that there is no specific policy on water for livestock watering. This thinking fails to appreciate that livestock are equally important in enhancing and sustaining rural livelihoods. But under the Integrated Rural Water Supply and Sanitation Programme, provision of cattle troughs or dipping tanks to boreholes were included as part of the standard technology package. Later it was observed that not in all communities were these facilities being used and part of these were not maintained in some cases. In response, it was decided that it should be left upon the community to decide whether they would want add-ons to head works of boreholes, such as cattle troughs, and that they should bear the costs of providing such headwork-associated components. In reality, it meant that those were often omitted and that community was not given the choice (Makoni and Stef, 2006). In some parts of Murehwa, fencing material has been stolen by people to allow their livestock access to

water.

One such structure where users have been denied access to wash their clothes and water their livestock on site is the one shown in Figure 5.8. The prohibitive instructions on the right corner written in red and blue clearly indicate what not to do at such a source.

Figure 5.8 Borehole without washing slabs and a cattle drinking trough in Murehwa

Systems such as the one shown in Figure 5.8 are just a partial answer to peoples' water needs. People are not getting all they want from such a source. As such, they are forced to use other alternative sources to compliment the one available. This is time consuming, according to many respondents. For example, one has to come to fetch water to drink, and then go to a river about 3km away to wash or bath or to water the cattle. The productive time lost is never recovered yet this time could be used to do other household chores as is the case with many families in Marondera. Efforts to reduce poverty among the rural poor remain hampered by productive time lost in search of water. It is in such cases that peoples' water needs are affected and consequently willingness to pay is sometimes affected by the type of the source and also this has a bearing on the sustainability of such sources.

Where the water table is high for example in Marondera and some parts of Murehwa and Uzumba, families have resorted to individual sources where the owner decides on what to use the source for unlike communal water points where the kraal head is overally responsible for ensuring that all the laws pertaining to the source are strictly adhered to with no objection.

In Murehwa, for example, the village kraal head, together with the water point committee oversees that no one in the village disobeys the water point rules. On what is the possible action to take to those who disobey water point rules, one respondent pointed out that one risks being evicted from the village. Contacted for comment, the kraalhead for this village clearly indicated that disobeying water point rules attracts a fine although he could not say what type of a fine. It is important to note that communal sources are the ones where restrictions were more pronounced. However, of all the respondents, there was one incident in Marondera where a certain household was told not to use the neighbour's family well for washing because the water was not enough. Instead, they were supposed to use river water for washing and were allowed to get drinking water

only from this source. Asked why they were not using river water for washing, this family indicated that the river was about three kilometers away and the path to the river was bushy, making them afraid to go there even during the day.
In Murehwa, respondents also complained that the donor who gave them the borehole set the rules for the borehole.

> *"They only told us this is purely for drinking and no reasons were given on why we are not allowed to use it for watering our cattle onsite, doing our laundry or watering nearby fruit orchards…."*
> *"There are a lot of restrictions on this borehole. We are tired of these endless rules…", complained one respondent, visibly angry.*

In reality, telling beneficiary communities what to do with water can be acting against their wishes and expectations. This in itself does not consider how the same users prefer to use water to develop their own livelihoods. However, such prohibitions can be in response to the yield of some water points as was later explained in Pfungwe. As such, prohibiting certain water uses could be a conservation strategy. But all the same, it calls for the need to have a through assessment of high yielding points and ensure that at least boreholes are sited where they can serve the people. There is also need for an explanation to the users on why certain water use activities are not allowed.

Lack of adequate water has a bearing on multiple uses of water as has been repeatedly cited in Murehwa where for example in ward 10, four villages were using one borehole and this source also serves a nearby school. Thus, restrictions were instituted but can be understood if accompanied by an explanation.

The failure of boreholes to yield enough water quantities has also been sought during this study. The siting of boreholes in some study wards as was reported by respondents has been influenced by politics. Two incidents have been reported where boreholes have been sited where there is insufficient underground water for the sake of pleasing people. It has also been revealed that influential figures in the villages also influenced the siting of boreholes and this meant some boreholes ended up being drilled close to Chiefs, headsmen or kraal heads even if there was not sufficient underground water. For example, in one village, respondents complained that the borehole, which serves the whole village, was wrongly sited because the kraal head wanted it to be close to his second wife's homestead, his in laws.

It is also important to mention that although this study found boreholes like the one in Figure 5.8, two sites in Pfungwe where visited where World Vision had installed water tanks at some borehole sites to encourage productive uses of water together with domestic at such sources. Sustainability of such boreholes was reported to be quite high in Pfungwe. People are prompt in making sure that if there is a breakdown, the necessary repairs are made in time. This is particularly so because the users apart from getting clean

water for domestic use, they also draw water for their small plots in the cooperative garden. Their willingness to pay for maintenance costs can also be explained in view of the income they generate from selling some of the produce from their small plots. It is this money which is very essential to many families at household level.

In figure 5.9 the water tank was not available at the time of this study. It was indicated by the ward councilor that since there was plenty of water flowing in the rivers, people could take advantage of that. The tank was mainly considered useful during the dry season and removing it was due to fear of some thieves who might take it for personal use.

From Figure 5.9, people can do their laundry on spot, water their family gardens and get water for other domestic uses. This source is very different compared to the one in Figure 5.8 in Murehwa. From the set of headworks at this borehore shown in Figure 5.9, it can be said such a source promotes multiple uses of water.

In reality, it makes sense to ask someone getting some form of income from using water from sources such as the one shown in Figure 5.9 than asking someone whose water needs are partially met by some sources. Figure 5.9 shows one such a structure in Pfungwe where people use the source for both domestic and productive and their willingness to contribute for operation and maintenance of this source is very high.

Figure 5.9 Borehole being used for both domestic and productive purposes in Pfungwe.

5.2.1.4 Spring piping and runoff concentration

In UMP, runoff concentration has enabled livestock watering, small-scale irrigation and fish farming to be done at one point. In Uzumba, one farmer got pipes from Mvuramanzi Trust to harness water from springs and is using the water for multiple purposes. It is worth mentioning that if this water was to be let flowing, the environment in general was going to benefit to maintain ecological integrity since it is also a legitimate water user. But Figure 5.10 seem to suggest that although the environment is important but livelihoods need to be sustained first and this can only be through making use of the

available water for various productive uses.

Figure 5.10 Spring piping and runoff concentration in Uzumba

5.2.1.5 Rainwater harvesting

Rainwater harvesting also promotes multiple uses of water, enabling people to use water for domestic and productive uses. In Marondera, rooftop rainwater harvesting to supplement family water sources was a common practice. Rooftop water harvesting, a trend reported by respondents to be associated with the well up families was very common with 63.6% harvesting water and 36.4% not harvesting. The water is used for drinking, cooking and laundry among other average household water needs. In Murehwa, respondents indicated that rooftop water was better than boreholele water in terms of quality.

Contrary to this, residents in Chiweshe village explained that this water is a health hazard when the collecting vessel is rusty. It was also revealed that an incident of serious stomach pains was once reported after drinking water from a vessel that was later found to be rusty. Rusty water was also considered not to be fit for laundry of white clothes, rendering it not fit for multiple purposes.

In Matongore village in Murehwa, one household is using the harvested water to water livestock, gum tree plantation, orchard with apple trees, bananas, avocados, peaches and for growing vegetables. For drinking, cooking and other domestic water needs, they use an open well in their garden. Asked why they were using this unprotected source, their response was because this source was close by unlike a village borehole approximately a kilometer away.

5.2.1.6 Drip Irrigation kits

Technologies such as the drip irrigation have scored less in Marondera on social acceptance. Respondents' low willingness to pay for drip kits could be linked to the fact that the district receives high amounts of rains. As such, the water table is very high. The less importance value of this technology can also be explained in light of those families who already have them but not using them. Discussions with respondents showed that filling the tanks manually is on its own very labour intensive, thus undermining the perceived benefits. The size of the hectrage where drip kits can operate was only said to be small meaning to say that the benefits were not significant to them. Social acceptance of this technology by the community at large was also cited as a problem to the use of this technology by other community members. In Marondera, respondents without the drip kits complained that the approach that was used by Mvuramanzi Trust when they first introduced the technology was discriminatory. According to respondents, this technology was meant to benefit the poor. As such, acceptance by other community members was very low since they did not want to associate themselves with the poor peoples' things.

Considering complains from Marondera, this is not to say drip irrigation kits are of no value to rural communities. Instead, the Marondera experiences offers a valuable lesson that for any technology meant to enhance peoples' livelihoods, there is need for livelihoods-based assessments to consider issues such as Cost Benefit Analysis, appropriateness, relevance, management structures, potential yield as well as potential activities. However, contrary to this, drip kits have been reported to be quite excellent in Maramba, and most households in Murehwa have shown interest in such technologies. However, it is important to realize that the ones in Maramba are used in combination of treadle pumps, making it quite easy to pump the water unlike the ones in Marondera where manual lifting of cans was reported to fill the drip containers. At Chitimbe primary school in Uzumba, the school authorities are very happy with the operations of the drip kits. In this case, the success is attributed to the fact that they are being used in combination with the rope and washer pump, which is used to fill water into the tanks.

In light of these mixed feelings from Marondera and UMP, it can be said that improvement of the drip irrigation technology can be through using it in combination with treadle pumps or in combination of the rope and washer pump. Evidence can be drawn from Chitimbe primary school and one farmer in Marmaba. These beneficiaries have cited the following advantages:

- Minimization of water losses through evaporation since water is provided directly to plants,
- There is reduced labour once the tanks are full-making users free to carry out other activities and also,
- Minimizing the spreading of diseases on crops.

This study found out that although the drip irrigation was found to be quite beneficial, it was observed during surveys that the choice of crops is one factor which makes this technology seem like it is being under utilized. There is need for extension workers to identify farmers in their areas of operations and see how best they can assist them to enable them benefit fully from the use of such technologies by growing high value crops. Market identification is the most important issue to be considered. One has to grow crops on demand to realize maximum financial returns.

Studies in Zimbabwe have however, shown that the performance of drip irrigation kits have not been evaluated (Senzanje, 1997, 1998). It is against this observation that there is need to evaluate the performance of drip kits. Performance evaluation, according to Chigerwe et al., 2004, is very important not only for those who design them but also for end users for this will also help them in making choices of which technology to use.

To summarise on technology, this study indeed found that technology is one factor which can greatly affect multiple uses of water. From the survey carried out in 33 villages selected from Marondera, Murehwa and UMP, technology and system design was found to be a factor with the potential to enhance, promote or hinder multiple uses of water. Technologies observed were different designs of the rope and washer pump, rope and bucket system, boreholes, drip kits, runoff concentration and rain water harvesting. Rope pumps allow the production of off season vegetables and crops. Rope and washer pumps can be ideal for promoting multiple uses of water at household level while bush pumps and boreholes are mostly considered appropriate for domestic purposes only. However, where a borehole is a high yielding one, it is advisable to encourage productive use of such sources as was observed in Pfungwe. The use of drip irrigation kits and different technological options available need to be explored and understood by both providers and users. It is also quite important to harvest water and use it for multiple purposes for improved livelihoods. It is investment and spread of such small-scale, technologies that has great potential to increase incomes and food security at household level.

5.2.2 Financial costs and financial benefits

The fact that technology can enhance and promote multiple uses of water should also be viewed in the light of the costs that are to be incurred for one to have such technologies. For example, people might want to use drip irrigation kits or rope and washer pumps for multiple uses but might not have the necessary money to buy the materials. The rope and washer pump is very simple for rural communities to adopt it for use for both domestic and productive purposes, especially at household level. A simple rope and washer pump can be made with the use of locally available materials. However, a standard pump can require an initial capital investment of about (US$300 000-00 as at May 2006 with the current official exchange rate of 1Z$/US$:101 195,54). If all the materials are acquired locally, these costs maybe far lower than this but might jeopardize the extraction rate and the sustainability of such systems. A detailed cost estimate is shown in Table 5.4. These costs are made with an assumption that the well already exist for example, where a lined

rope and bucket has been in use or a simple well. As such, these costs are notional (Robinson et al., 2004). Washers in this case have also not been costed since they can be made from old tyres. It is also difficult to charge labour in monetary terms. This varies from place to place. In many rural areas of Zimbabwe, payment for labour can be in form of food, goats or any other token of appreciation, making it difficult to quote it in financial terms.

Table 5.4

Estimated costs of a standard Rope and Washer Pump as at May 2006

Materials	**Costs (U$)**
Windlass	US$70
Wood poles	US$20
P.V.C pipes	US$120
Rope	US$20
Bucket	US$2
Cement for apron (4 bags at 2 000 000-00)	US$80
Washers	Sometimes not costed
Labour	Varies
Total costs	**US$300 000-00**

This cost can considerably be higher than the above quoted figure if the well has to be deepened and lined for more quantities to be extracted. Whether one considers to use this type of technology or any other like the drip irrigation, its necessary to have a cost and benefit analyses to find out whether the costs of investing into that particular technology is better than relying on the ordinary rope and bucket system or any other open well.

For those families with the pump, they have been using it since 1998 with no major breakdown problems, except replacement of the rope and washers. For the purpose of this study, an assumption is made that the pump has a life span of five years. Family A invests into this technology and family B continue using the open well.

Discussions with those already using the pump have shown many advantages already explained on technology. For the purpose of this discussion, benefits can be weighed considering labour investment, opportunity cost of time lost in lifting water with watering cans and then going round watering, hectarage to be watered using a watering can compared to using the pump. For example, Robinson (2004) has shown that a household of 2-3 people using buckets or watering cans can manage a plot of 300m^2 (0.03 ha) at a watering rate of 25mm per week and doubling this size might be problematic in terms of

manpower. Comparing this to family A with the rope pump, a family using the pump can effectively increase watering capacity from 0.1 litres per second to around 1 litre per second and this makes it possible for one person to water a plot of at least 2,400m^2 (0.24ha), which mathematically translates to eighty times the area managed by family B using watering cans and buckets. Given the large area to be irrigated and also assuming that the crop mix is the same, family A is likely to reap more than family B. Family A can also get water for both domestic and productive uses, getting extra health benefits.

Based on findings of this study, it is quite beneficial to use the rope and washer pump than an open well. Apart from labour advantages, the use of watering cans and buckets can result in the loss of a considerable amount of water through overflowing and consequently low water use efficiencies, making families to operate below potential and sub-economical levels.

Financial returns from families using different water sources were difficult to get, making it also very difficult to make precise calculations and comparison on financial benefits. In general financial returns largely depended on labour and time investment, size of the plot apart from technology. On average, families get US$50-1000 per month or more on different activities. But an attempt was made to get financial returns from some households. For example, one dairy farmer in Murehwa has three cows for milk production. The farmer gets approximately US$100 per month. On poultry, he gets about US$150. Although there were no official records and receipts on the inputs but this is clear that a family using a water source for a mix of uses is better off than a farmer who has the same source but using it for domestic use only. A family using their source for both productive and domestic uses can also plough back the income into source development or for other cash related issues.

One respondent, a retired Zimbabwe Republic Police Senior Official in Murehwa uses a family hand pump for domestic as well as productive, which includes piggery and poultry. The pump has been in use for the past 40years. Major repairs to the pump involve cylinder replacement, which is at the time of this study in the range of about US$4-5. He has 43 pigs and is a member of COLCOM, a large commercial industry for processing pork products countrywide. According to him, this actually making good business and is earning more than what he used to get when he was still employed. A kilogram of pork is sold at US$8-10 and per month if combined with returns from poultry, gets something in the range of US$500-1000.

In Uzumba, one respondent also uses water for poultry. At the time of this study, he had five thousand broilers and three hundred layers. During the visit to the compound, seven women, his sister and close relatives were slaughtering the broilers They inicated that the engine, which is used to pump water right into the poultry run was not working due to a technical problem and this meant that water has to be carried on the head to the poultry run, a labour intensive and labourious activity. Monthly returns were not readily available since the owner was not there but they made estimates, which amounted to roughly US$500. This figure was arrived at considering that one broiler currently is in the range

of US$8-10. If 50 broilers are sold per week, this automatically translates to the estimated cost. However, there is need for inputs such as transport costs to take the broilers to Murehwa growth point about 40kilometres away. He has own transport but with fuel costs and sometimes being scarce in Zimbabwe, sometimes found on the black market at the price of about $2 per litre need to calculated together with labour costs and stock feeds.

Gardening was the least activity which brought huge financial gains. However, at household level, this activity was considered to be a very good financial base. In all the study villages, the main crops grown are; kovo, tomatoes, beans, cabbage and butternuts among others. Respondents sell a bundle of vegetables for about US1-2. For tomatoes, the prices range from US$1-3 using a plate or a small dish.

Comparing prices for tomatoes, they were more expensive in Marondera than in Murehwa and Uzumba Maramba Pfungwe, with the cheapest being in Maramba, where people have access to more open sources although they lack abstraction technologies such as the rope pumps. One farmer in Maramba, however, lamented that 2005 has been a bad year for him, with the unexpected *Clean Up Exercise, Murambatsvina.* His market and customers in the nearby towns were affected and this also dealt a serious blow on his part as the producer. His produce ended up being absorbed by local markets but demand was lower than the supply, resulting in tomatoes rotting in the garden.

Income, according to respondents is often used for meeting household needs including food, education, clothing and medical needs. These basic needs have been cited in all the three districts. Productive use of water in Marondera, Murehwa and UMP is an economic activity that highlights the crucial function of water in enhancing rural livelihoods in terms of food, health, improved nutrition and education.

Based on the findings of this study on financial costs and returns, it can be said that good financial returns promote multiple uses of water once families realize that there is much more to get from their water sources. This can actually make people more willing to invest in certain technologies. Sustainability of water sources is also enhanced since there are monetary benefits to be realized in keeping such water sources functional.

5.2.3 Water quality

Of the 448 boreholes in UMP, 49% were not in use either for domestic or productive although they were functional. Reasons cited for not using them varied from having a high soap consumption to unpleasant taste. The general taste of the water was said not to be satisfactory, rusty and salty. Against this background, 3 water samples were collected from different sources; two boreholes, one in Chigonda and the second one in Maramba ward. The third sample was collected from a river used as an alternative source in Chigonda. These samples were tested for colour, pH and bacteriological parameters at Mutawatawa hospital.

5.2.3.1 pH

pH is a measurement of how acidic or basic water or a solution is. The pH scale ranges from 0 (most acidic) to 14 (most basic). Pure water has a pH of 7, the centre of the range neither acidic nor basic. Respondents' acceptability to the taste of water varies considerably from community to community. Borehole water complaints were not reported in Marondera and Murehwa but were very high in UMP, particularly in Pfungwe. pH value of 9.6 and 5 were recorded from two boreholes and these were not within the WHO guidelines for drinking water quality of optimum pH range of 6.5-9.5.

5.2.3.2 Colour

Physical observation of water from observed sources revealed that the water was very clear soon after fetching it. However, colour from the two different boreholes started to change from clear to orange after about 30minutes. The more it stayed in the open, the more the colour intensity increased. The gradual colour change might be as a result of water from deep underground being exposed to oxygen. According to WHO (1993), anaerobic ground water may contain ferrous iron at concentrations of up to several milligrams per litre without discoloration or turbidity in the water when directly pumped from a well. On exposure to the atmosphere, the ferrous iron oxidizes to ferric iron, giving an objectionable reddish-brown colour to the water. Exposure and interference with air might as well caused this colour change **(See Appendix A 5 for these water samples showing colour changes).**

An observation also made was that the water which was kept in closed sampling bottles took time to change while that which was not closed changed within 30 minutes. This colour change clearly proved the respondents' complaints who had given their water a name; *mazowe orange crush*. In Razor village, they attributed this colour change to rusting of pipes since they were not using the borehole because of the bad taste. Colour, although quite subjective, change of this water after 30minutes was very noticeable. After three days, the water changed from the yellowish colour to clear colour again. However, this study could not go into detail on what exactly caused these colour changes and the information available seems inadequate to give a solid conclusion on the causes of this. But from literature, colour is usually due to the presence of coloured organic matter (primarily humic and fulvic acids). Colour is strongly influenced by the presence of iron and other metals either as natural impurities or as corrosion products (WHO, 1993). The geological structure of the area might as well have caused colour and taste discomforts. Results of this study on perceived colour concurs well with Hoko's 2005 study in Nkayi and Lupane districts, Matebeleland.

It is worth mentioning to say that apart from taste, rusty and colour problems, bacteriological quality tests confirmed borehole water as being very satisfactory as compared to Maguranga river, which respondents had turned to as an alternative source.

5.2.3.3 Bacteriological quality

Laboratory results revealed that borehole water in Chagonda and Chiunze (2) for drinking purposes was bacteriologically safe as compared to river water. People can be encouraged to drink water from the boreholes after aeration and filtration in their storage containers.

Table 5.5 Bacteriological water quality results

Source	**Volume**	**Colour at first**	**Colour after 30minutes**	**Colour after test**	**Results**	***E*. coli count**
Maguranaga river	100ml	clear	clear	Blue	*E.* Coli present	43
Borehole1, Razor village	100ml	clear	Yellowish/orange	Green	*E.* Coli absent	Nil
Borehole 2, Chirinda village	100ml	clear	Yellowish/ orange	Green	*E.* Coli absent	Nil

According to the WHO/ Zimbabwe guidelines for drinking water quality, *E*. coli counts within the range of 0, the water is excellent for human consumption. From table 5.4, physical counting, showed *E.* coli count of 43 signifying that the water was not fit for human consumption. Water from such sources can be used for gardening, brick making or any other productive use.

However, although *E* coli levels were recorded to be high on river water, the respondents seem quite comfortable with rivers as their sources for drinking water since the boreholes close to their homes have not met their expectations. Domestic water supply sources such as boreholes may be rejected because of unpleasant but not harmful, aesthetic water quality parameters such as colour, taste and odour (Carter, 1996). Soap consumption (an indirect measure of hardness, according to Hoko, 2005), was perceived as high by 67% in Pfungwe, 0% in Marondera, 10% in Mangwe and 17% in Murehwa.

It is important to mention that the use of rivers is a seasonal trend since most of them are ephemeral streams and dry up around August/ September. Faced with this dilemma, communities have no option but to go back to their neglected boreholes. Drying of some wells was also cited in Marondera (26%) and 32% in Murehwa. Respondents explained that they would use neighbour's sources, which are perennial sources.

In UMP, drying up of surface water sources may result in increased demand for water for both productive and domestic. 32% of reported cases were misunderstandings among

water users on what exactly to use water for during the dry season. Restrictions on water quantities were also explained in Pfungwe, for example, people were not allowed to bring large containers such as drums or scotch carts to fetch water. Wheel burrows were allowed if it was for domestic only. Huge volumes of water were only allowed in cases of funeral gatherings or other authorized gatherings such as church meetings or celebrations at community level to which permission was to be sought from the kraal head. The kraal head in Chiunze (2) explained that boreholes in their area are not meant to be used for other purposes apart from domestic. He explained that even within the domestic domain, some issues such as laundry at the boreholes were not allowed because boreholes in their area cannot sustain domestic uses let alone productive.

However, it is important to note that results of this study on water quality can not be conclusive at this point since a single laboratory examination of any water does not justify the conclusion that the water is bad or good. According to Cheesbrough (2000), drinking water contamination is often intermittent and may not be revealed by the examination of a single sample or when samples are tested at lengthy intervals or not during both dry and wet seasons. However, the fact that water quality affects multiple uses of water remains valid based on these results and users' responses from different sources who could neither use some sources for domestic nor for productive.

5.2.4 Ease of operation of the water points

The number of strokes required before getting water from boreholes varied from 2-100 strokes in some cases. In Zimbabwe, a maximum of 4 strokes is generally acceptable (Hoko, 2005). However, highest number of strokes was recorded from some boreholes and this according to respondents restricts them to use water for multiple purposes. The higher the number of strokes, the more one quickly gets tired and can not keep on pumping large quantities of water. As such, respondents complained that this restricted them to fetch for example 10litres instead of say 20litres. Children below the age of 15years can not draw more than 10litres of water from those boreholes, which requires too many strokes.

Although the generally recommended strokes in Zimbabwe is said to be 4 strokes. However, one DDF Technician in Murehwa indicated that 10-15 strokes, are still acceptable for a borehole to be considered good and indicated that very few boreholes were within the generally acceptable range. Reports from users also revealed that strokes ranged from 5-50 and some boreholes have been abandoned because of the labour one has to apply to get water. A random attempt to pump water from some boreholes in all the three districts revealed a range from 10-more than 30. The number of strokes per borehole can be an indicator of the level of underground water. In Marondera, for example, average rainfall ranges from 600-1200mm per annum and the water table is very high. This can best explain why the highest number of strokes on functional boreholes is 10 in Marondera and 30 or more in Pfungwe, the driest part of Uzumba

Maramba Pfungwe district with rainfall averages of 450-650mm per annum. Figure 5.11 show these variations.

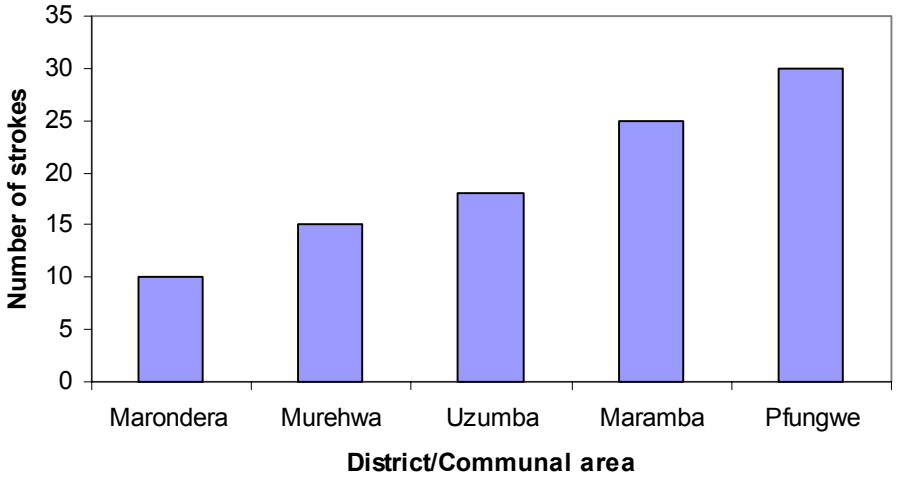


Figure 5.11 Highest number of strokes per district/communal area

Greatest amounts of water use were recorded by those families with sources within homesteads. Per day such households could use more than 100litres on domestic only. Water estimates for a herd of three dairy cows were said to be in the range of 60litres, considering that one cow approximately needs 20litres.

5.2.5 Walking Distance

The reported distance of the respondents' water sources from their homesteads was moderate to near, not far, far and very far according to 85% of respondents in Marondera, 65% in Murehwa in Maramba, 67% and 86% in Pfungwe. Generally an acceptable walking distance to a water point should be 300m (Carter, 1996). Although some respondents could not say with certainty distance they travel to reach their water sources. Their responses varied from; *not far, very far, far, beyond those mountains.* The perception of near, not far, moderate is subjective and relative (Hoko, 2005). But generally, the common reported distances in all the three districts ranged from 0-500m, then 500m-5km. Time estimates were also not reliable since most of the respondents were old and illiterate. Longer distances were reported in Kayangwa village in Pfungwe, where families drive their cattle to Nyadire river, about 5km. They have a nearby borehole but the borehole does not have a cattle drinking trough and they have no option but to take their livestock to the river.

Distance to water points apart from affecting water uses was also cited as a factor with a direct effect on people's willingness to pay or contribute in any way. In Marondera, in ward 12, there is no borehole in Mhuruyekunze, Mutimura and Muchareva villages.

Respondents from these villages travel to Kapara village, about 3 kilometres away. As

such, they indicated that they are not willing to pay or contribute in any form to this borehole. They want to contribute to any central source. The fact that they sometimes get water from Kapara village was dismissed as not valid for them to be told to pay for such a facility. Those with water sources such as boreholes located about 3 km away had to use convenient water sources as alternative sources. People ended up using open wells for drinking purposes.

Water quantity is affected by distance to the sources. As such, multiple uses of water which is obtained from far away sources was explained not to be common by 67% of the respondents. Such water was in most cases, restricted to a single use for example drinking only. For productive purposes, women in Pfungwe, in Chiunze (2) ward who had small family plots in Nyakasoro irrigation scheme complained that the irrigation scheme was far from their households and this meant that much of their time was spent away from homes. Sometimes, they also have to carry water in wheel-burrows or on the head back to their homes but the water was of limited quantities.

The opportunity cost of watering gardens with watering cans, wheel-burrows and taking cattle to rivers for drinking can be viewed as a serious constrain to rural livelihoods. For example, in Chiunze (2) ward, 68% complained that about 5hours is spend daily taking the cattle to the river and this has serious implications on the productive time lost and this also greatly affects milk production and sometimes causes accidental cattle abortions.

Women felt that they suffered most since they have double functions in the homes that are both productive and reproductive functions. They also lamented that going to rivers affects the education of their children because they have to help them in the irrigation scheme some days, making them miss classes.

In Pfungwe, about 68% households in Chiunze 2 ward cited that although they owned gardens in cooperative lands, their problem was the distance from their households to the gardens and the fact that water had to be carried more than 200 metres in wheel burrows or on their heads to water their small plots. This is indeed a constrain to their endeavours. It is in such scenarios that the rope and washer pump can be provided to lessen their burden of carrying water.

5.2.6 Policies and institutional arrangements

5.2.6.1 District Level

At district level, there was evidence from discussions with personnel that there was no a proper approach to water development among sector ministries with different mandates and their own budget allocations. This segregated sectoral approach has not done much to improve the lives of the poor and is increasingly being challenged internationally

(Moriarty *et al*., 2003). In this study, the roles of Ministry of Health and Child Welfare (MoH), Agricultural and Extensions Services (AREX) and District Development Fund

(DDF) were explored. A questionnaire was administered to personnel from these ministries.

Ministry of Health and Child Welfare (MoHCW)

Mainly focuses on the health of the community. In this study, it was found that in all the districts, the ministry is concerned primarily with domestic water quality and sanitation. It is also responsible for training of Village Health Workers. 13.4% acknowledged receiving some form of support from Ministry of Health. This support was explained in terms of chlorine tablets, training of village health workers and some received cement for upgrading their wells, 74.6% indicated that were not receiving assistance from MoH on water-related issues and 11.9% were not sure.

Agricultural Research and Extension Services (AREX)

AREX plays a pivotal role in farmer training and extension services. Overally, providing technical services to farmers on good agricultural practice, soil conservation, cropping patterns and livestock production. They also have critical functions in water and environmental resources management. This survey showed that 50.7% acknowledge receiving advisory services from AREX, 40% said no support and 9.0% were not sure if AREX was helping anyone in their communities.

District Development Fund (DDF)

The study has also been conducted closely with DDF personnel in all the three districts. DDF's main function, according to key personnel at both provincial and district level is the drilling of boreholes, training of village pump minders/mechanics free of charge and construction of small reservoirs. DDF works closely with the Rural District Council (RDC) and uses RDC wards as entry points to various communities via ward councilors. DDF also works very closely with AREX but within its defined mandates. A household questionnaire administered in all the three districts revealed that at least 20.9% people are aware of DDF and its role in their lives. The majority of people were in Murehwa, Maramba and Pfungwe, 74.6% explained that they were not receiving any support from DDF while 4.5% were not sure.

Questionnaire responses and discussions with key personnel in all the three districts revealed that segmentation of ministries and departments is indeed a problem, emanating from policies made at national level. Results from this study on the roles of Ministry of Health and Child Welfare, concurs well with Robinson (2003). Indeed, the Ministry of

Health through Environmental Health Officers and Technicians is mainly responsible for sanitation and shallow wells, including family wells. DDF is mainly responsible for drilling and maintenance of boreholes and deep wells. AREX is responsible for irrigation schemes.

5.2.6.2 Community Level

Water Point Committee (WPC)

At community level, structures such as the Water Point Committee and the role of headmen were also explored and results also seem to suggest that they affect multiple uses of water in one way or the other. In all the study wards, 32.8% acknowledged the existence of Water Point Committees in their villages, 28.4% said there were no such committees, 35.8% were not sure and 3.0% said they were once there. Water Point Committees were observed to be very active in Murehwa and UMP, where households use boreholes than any other source, unlike in Marondera where only 6.3% use boreholes and the rest use family sources. The WPC in the study wards mainly consists of 7 village Members as shown in Table 5.6.

Table 5.6

Water Point Composition and Roles in Razor Village, Maramba

Position	Function/Role
Chairperson	• Leader • Reports to Kraal head
Caretaker	• Greasing the borehole • Removal of bolts when there is breakdown • Informs users when there is need for cleaning of borehole surroundings • Reports to Chairperson
Secretary	• Record minutes of WPC meetings • Record information on what needs to be done
Treasurer	• Handles cash • Disburses cash when there is need
Pump Minder	• Making repairs
Health Worker	• Educates on health and hygiene issues on the borehole
Committee member	• Help with suggestion

Evidence from Murehwa and Maramba Pfungwe where WPC were said to be very active

in some villages, the chairperson keeps records of community contributions, breakdown frequencies, type of repairs needed in case of a breakdown and also spares to be bought or what to request from DDF. It can be said that the level of awareness to the existence of a water point committee may be related to the level of concern and willingness of the ordinary villager to ensure that the water source is kept functional.

Kraal head

In all the villages, kraal heads have a crucial role in settling water related disputes and the overall management of the environment. It was confirmed that the chairperson of any WPC reports to the headmen if there were misunderstandings or if there was need to have a village meeting. The kraal head also enforces the water point rules for example villagers are not allowed to use sources such as boreholes for other uses apart from domestic. Confirmed cases were from Mupfuwiranga, Mutizwa villages in Marondera, Kambrami, Chaneta and Matumbura villages in Murehwa. These cases where there were restrictions on what to use water for were also very common in some parts of UMP, for example Kayangwa, Chibukwa, Nyabvedzi and Razor village.

Discussions with one kraal head revealed that failure to comply with the rules; one might risk paying a fine. Asked on what type of a fine, the headman indicated that one can be asked to brew beer and slaughter a goat for villagers to feast. Failure to do this, one also risks being expelled from the village and the case further taken to the Chief. Asked if there were such cases, he explained that reported cases were of those who were refusing to pay for the water. The solution, according to the headman was to make sure that all those who refuse to contribute in any way, are not allowed access to the water source. About 66% respondents complained that it was not fair for them to be told what to do and what not to do with water while others supported the enforcement of laws on water usage. However, this study found that in some cases, the laws on what to use water for are not meant to deny people their right to water as was being expressed by other respondents but water uses laws were put in response to the water quantity available in some areas. As such, they are meant to conserve the water for the benefit of the people. Such cases were very high in UMP, especially Pfungwe, the driest part of the district.

Common belief that borehole water should be used solely for domestic purposes only was evidenced in one village. People were not using the borehole for drinking and washing because of the salty taste and the brownish colour. Asked why they were not using this borehole for other uses such as gardening or brick making since the source was just being neglected. This suggestion was met with mixed responses. The kraal head's response was that the source was not meant for such uses and once people start gardening, there were high chances that even if there was drought and people would want to come back to the borehole for drinking water, it was going to be difficult to stop people from such activities. According to him, it was better for the borehole to lie idle. The emphasized that this borehole was strictly meant for domestic and gardening, according to him will in the long term result in the drying up of the source. Other respondents on the same issue felt they were being disadvantaged. They also complained that they had not chosen this site

either but the headman wanted it to be in the field of his young brother who is this kraal head.

According to Hoko (2005) neglect of water sources and availability of alternative sources has a strong bearing on the sustainability of facilities. A lengthy discussion with him on benefits of using this borehole productively made him to think otherwise.

> *"It sounds quite well but I do not want my people to override the rules that this borehole is specifically for drinking. I do not deny what you are saying. I will see whom I will talk to. Its not everyone but priority will be given to those who support the ruling party since it is the one which facilitated the drilling of this borehole…"*

The kraal head's hesitations in allowing people to use the water for other uses beyond domestic seem very valid. For example, McKenzie et al., (2003) gave a case where such uses ended up causing problems and explained that it's not always beneficial using domestic systems for productive uses. Their point was that unplanned productive use of domestic water causes problems for users. However, in this case, it still remains reasonable for the headman to allow those who wanted to use water for other uses do so on condition that they pay for operation and maintenance costs and also to give preference to domestic uses when surface water has dried up.

5.2.7 Donor initiatives and approaches

In Zimbabwe, many projects which are meant to provide people with water for multiple purposes have mainly been by Non-Governmental Organisations (NGOs). However, it is important to note that although they operate within the legal framework, these NGOs have also established collaboration with sector ministries for example with Ministry of Health and Child Welfare. In Marondera, Mvuramanzi Trust has been very instrumental in supporting water and sanitation projects at household level while in Uzumba Maramba Pfungwe, World Vision has been reported to be quite effective in promoting nutritional gardens around high yielding water points. At the time of this study, World Vision was repairing and rehabilitating boreholes in UMP. Pump Aid also installed rope and washer pumps in Uzumba. From the approaches of many NGOs in Zimbabwe, it is quite clear that they are trying to respond to peoples' multiple water needs to enhance rural livelihoods.

Table 5.7 shows some of the approaches and strategies used by some NGOs in enhancing rural livelihoods through the provision of water that caters for multiple uses.

Table 5.7 Strategies of NGOs to promote multiple uses of water

Institution	Focus areas	Strategies relevant to multiple uses
UNICEF	Children's rights, survival, development and protection. Their Water and Environmental Sanitation (WES) programme deals with the provision of water and sanitation services.	Encourages the productive uses of water to enhance rural livelihoods. For example, water facilities implemented through their programmes have provision for drinking troughs for livestock, washing slabs, and encourage water use for gardens.
Plan International	Focus mainly on improving health care, education and income.	Plan has continued to support projects that address poverty alleviation and income generation.
Care International	Focus on long-term development projects in areas of agriculture and natural resources.	Promotes household livelihood programmes in an integrated multi-sectoral intervention with a purpose is to reduce vulnerability and improve livelihood security of people in drought prone areas in communal areas
Mvuramanzi Trust	Supports rural water supply and sanitation initiatives	The Trust's focus shifted from primarily working on communal water points (usually bore wells fitted with hand pumps), to a focus on family water sources that relieves the burden of pumping from family wells, through the development of low-cost pumps. Specific attention to water and livelihoods, for those infected and affected with HIV/AIDS.
FAO	FAO's mandate it is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy	Supports community programmes and projects dealing with water use for agriculture, irrigation, aquaculture, livestock and other uses of water. Amongst others it aims to improve water productivity by use of better technology in irrigation.

Source: Makoni and Smits, 2006

5.3 WATER USE RELATED ISSUES

5.3.1 Reliability and sustainability

Marondera and Murehwa had fairly high respondents having reliable family wells at 62.3% and 50%. To be sustainable, water-supply sources need to continue to deliver the required amounts of water of good quality and quantity well into the future. This means on-going investment and maintenance. If a system fulfils all people's needs, they will be more willing to pay for its establishment and upkeep.

Reliability of water sources varied from district to district and sometimes from source to source. In general, reliability of water points was highest in Marondera, followed by Murehwa and UMP. While reliability and sustainability of boreholes in particular was high in Murehwa and Uzumba as compared to Marondera and Maramba Pfungwe, the existence of village pump minders was also a pointer to sustainability of communal water sources. Village pump minders were reported to be available by 28% of responses in Marondera, 47% in Murehwa and 58% in UMP and the remaining respondents were not sure whether village pump minders were there or not in their villages. This was easily captured where there were two or more respondents, trying to recall but failing to give a conclusive response, sometimes arguing among themselves. The frequency of borehole use and users' perceptions on the usefulness of such sources was related to the role and existence of village pump minders. According to respondents in all villages, most of the people who were previously trained by DDF had either left the village to relocate somewhere under the land reform programme, death or gone for work elsewhere. In UMP, training of village pump minders was done by both DDF and World Vision.

Use of rivers for example Maguranga and Dewe, as alternative sources for both domestic and productive was reported highest in Pfungwe with some 58.5% of the respondents using rivers instead of nearby boreholes. In UMP, most sources dried around September and it is only during this period when people would go back to their boreholes. Apart from seasonal variations, silting of these rivers due to excessive gold panning is also a serious threat to water availability, hence affecting the reliability and sustainability of such sources.

User satisfaction with water sources was also noted to have a strong bearing on sustainability of boreholes. Figure 5.12 shows responses on water sources satisfaction in all the three districts. The majority, 50% were not satisfied with their water sources for one reason or the other as shown below.

Those who said they were happy with their water sources represented 40% of the respondents while 10% were not sure. These responses were mainly obtained from elderly respondents or the children.

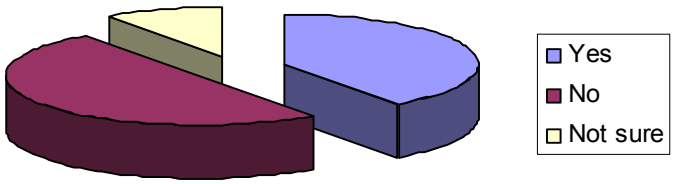


Figure 5. 12 User satisfaction with water sources

Reasons cited by those who were not happy with their water sources included the following:

- Salty water
- Rusty water
- Too many strokes on boreholes before water tricked (30-100)
- Sometimes dry up in August/September
- Water unclean
- Sharing of sources with animals
- Distances too far ranging from (5km, the furthest)
- No cattle drinking troughs on some boreholes
- No washing slabs on some boreholes

On average, about 83% boreholes were not in use, 27% wells were not being used for domestic. The high proportion of boreholes not in use and wells not being used for domestic purposes yet so near to users has a strong bearing on pattern use as well as on the sustainability of such sources. In Chigonda and Chiunze 2 in Pfungwe, 3 boreholes have been down for the 5 months yet this is the driest part of the district and these boreholes were mainly meant to serve them with drinking water. Asked on why the Water Point Committee was not making any efforts to bring these boreholes back into life, responses were mixed, the major one being that repairing these boreholes was a

waste of resources since they were no longer interested in using them.

Reliability and sustainability of water supply sources was also observed at institutions such as schools and clinics. In Marondera and Murehwa some villages have access to boreholes at schools when they have a breakdown in their village. The downtime of such sources was reported to be between 5 days-1 week. This seems to explain that there is mutual understanding and agreement at such institutions to ensure that they have a continued water supply.

Based on this study, it looks like user satisfaction can affect sustainability of water points. Discussions with some respondents clearly showed that most respondents were willing to maintain or to contribute to have sources which they can use for various uses.

5.3.2 Ownership of water sources

This survey found that several households in Marondera, Murehwa and some parts of Uzumba have with the help of donors, invested work and money in family wells and other private water sources. Those who do not have family water sources cited financial problems as being prohibitive and this greatly affects their daily living. In Maramba and Pfungwe, family wells were considered to be the least feasible option due to the dry nature of the area. Ownership of sources has a bearing also on what to use it for with no community restrictions. Those with family sources used them for a mix of uses and they were prepared to invest into their sources to ensure that they were functional.

On communal boreholes, site visits confirmed missing parts on some boreholes for example bolts and nuts as being highest in Marondera. Fence was also missing on some boreholes and the general cleanliness of borehole surroundings was not pleasing. This is a pointer to ownership of such facilities and has a detrimental effect on water uses and sustainability. Responses on the role and presence of the WPC were mixed, with some confirming their presence (18%), some not sure (14%), some saying it was once there (42%) and (37%) simply do not know of such committees. Those who indicated that they were not aware of such committees were those households with family sources and rarely use communal water points where local arrangements have been laid down to all users, in most cases, regular users.

In case of borehole breakdown, Marondera had the highest reported cases of 6 times per year and sometimes take a maximum of 6 months before DDF is consulted. Murehwa and UMP recorded a downtime of 2 weeks-1month and normally prolonged stay of a borehole before being repaired was reported to be when there was a major breakdown, which was in most cases beyond the capacity of trained village pump minders. In case of some villages in Murehwa and UMP, where WPC were reported to be active, breakdowns are reported by caretakers to pump minders for prompt repairs. If the problem requires community contributions, the water point chairperson reports the issue to the village kraal head who will then call for a village meeting.

Commonly cited borehole breakdowns in all the villages were loosening of some

components, missing parts or rubber cylinders. Many respondents attributed this to misuse by children while vandalism and theft was also cited. In Murehwa and UMP, these breakdowns were regarded as minor and it was the duty of the water point committee to mobilize resources from users. Mobilisation might be a daunting task, especially in some villages in Marondera where the majority use family sources. As a result, when there is a breakdown, sometimes minor, sources are abandoned for alternative open wells and this points to the importance of Water Point Committees. However, this is not to say Water Point Committees are a panacea to reliability and sustainability of water sources.

Some 46% of those who were using boreholes in Marondera showed that they were not so sure whether they owned such facilities. In case of breakdowns, they indicated that DDF should come and make repairs since it was their duty to do so.

> "*They are paid to do so and we do not want to be burdened. The truth is they get money from donors and government to do these repairs but they buy their cars. We know all this. They used to come but now they have stopped".*

The role of DDF in Marondera was not clearly understood and in terms of water supply, Mvuramanzi, a local NGO was cited as the only leading player.

DDF's principal role in Marondera on water, like in other districts has shifted from that of being providers and then minders due to national and global trends to give user communities the authority to own and manage their water supply systems. At national levels, according to Robinson (2002), there has been a drastic cut in the government's budgetary allocation for maintenance of rural water infrastructure and this gave birth to Community-Based Managemement (CBM), a phenomenon where communities are supposed to take charge of their water supply and supply facilities and regard them as their own facilities. In case where Water Point Committees were active, respondents clearly understood their roles and they indeed confirmed that these facilities were theirs and were prepared to take all necessary measures to ensure continued water supply. However, they cited increasing costs of spare parts as one of the serious problems they were facing. From this, it can be said that ownership of water sources can determine the sustainability of such sources. The perception regarding ownership of water sources can be expected to have a strong bearing on respondents' willingness to pay for establishment and repairing such sources as will be seen in the following section on WTP, an observation also made by Manzungu and Machingambi (2003) in Mutare and Chimanimani districts, Zimbabwe.

5.3.3 Willingness to Pay (WTP) and Ability to Pay (ATP)

Results have shown that 63.8% of all the respondents are willing to pay for personal sources than they are for communal systems. Willingness to pay is also very high where

families are prepared to combine financial resources, for example those in cooperative gardens. Respondents in Murehwa and Maramba Pfungwe are willing to pay considerable amounts more than respondents in Marondera. This is because in Marondera, they already have water sources within their premises and they are interested only in meeting maintenance costs of their current water sources and not installation costs. Most respondents in Pfungwe use open water sources. As such, given an option, they are willing to contribute more.

Technologies such as the rope and washer pumps and drip irrigation kits are not common in Murehwa and Maramba Pfungwe, where about 60.6% respondents said they have not seen the rope and washer pump and 30.3% have not heard about it while 9.1% have heard about it and were anxious to see it. As such, respondents expressed a high willingness to pay for this technology. The relatively high willingness to pay in these two districts can be linked to high incomes from piggery, horticultural, poultry and dairy projects among other income generating ventures where over 65% of the respondents earned more than US$ 100 per month. It might also be assumed that one other reason why a lot of respondents were willing to pay for improved water services is because of their ability to pay as well as their perception of how doing so might lead to an even more improved life status.

In all the three districts, all households without private water sources within their homesteads and those with sources which usually dried up around August/September of every year had a higher willingness to pay for more reliable water sources. Respondents without any form of water source within their yards, 64% were prepared to meet payments for prompt repairing of communal boreholes. Those with family wells, which they said usually dry up in summer were willing to contribute to deepen their wells and also to contribute if there was a donor to help with the purchase of cement for lining the wells. For example in Marodera**,** 58% said they wanted Mvuramanzi to bring cement to them for lining their wells and then they could pay the builder. There was a low willingness to pay for drip irrigation kits in Marondera. This could be linked to the low value attached to such technologies in the district and the general social acceptance of this technology. However, contrary to the Marondera responses, there was a high willingness to pay for this technology in Murehwa and Maramba Pfungwe.

Data on WTP and ATP clearly show that demand for water has a strong bearing on peoples' willingness to pay. ATP is also a major factor, where more than 65% of the respondents in Murehwa and Maramba Pfungwe showed a high willingness to pay for the rope and washer pump since they were getting money from their daily productive water use activities. Average monthly to be paid was not stated but respondents were just asked how much they were willing and prepared to pay. The amount ranged from US$10-20. This range signifies the Ability to Pay of different individuals. From the responses, it seems like the ability to pay can be enhanced by promoting income-generating activities and increasing the economic opportunities for the rural poor.

The majority of those who relied on community boreholes indicated that they were willing to pay if there was a breakdown. However, most respondents indicated that

although they were willing to pay monthly, they cited ever rising costs of spare parts as being prohibitive to their willingness to pay with an inflation rate of over 1000%. Table 5.8 gives a summary of willingness to pay for certain water delivery technologies in all the three districts.

Table 5.8

Summary of Willingness to pay for water supply technologies

	MEAN WILLINGNESS TO PAY		
	Marondera	**Murehwa**	**UMP**
Rope & Washer Pump	Low	High	High
Upgraded family well	Low	High	Low
Tap water	High	Low	Low
Communal borehole	Low	High	High
Individual boreholes	High	High	High
Drip Irrigation	Low	High	High

5.3.4 Gender Roles and Responsibilities

Data on gender division show that total mean working hours of women and the girl child is significantly higher than that of men in all the surveyed villages. Women have dual functions, both productive and reproductive to fulfill culturally defined duties. This involves maintaining the house, family, fetching water and firewood, nursing children, gardening, assuring food supply and going to the market.

In all the study villages, women respondents were 67.2% and 32.8% were men although 61.2% represents male-headed households and 38.8% female-headed households. During questionnaire administration and discussions, it was apparent that women are water users, managers and custodians of household water and hygiene. Even where the research team found both husband and wife at home, most husbands directed the research team to get answers from the wife. In some cases, if the wife had gone somewhere not far, the researcher was told to wait for the mother. Asked on why they wanted their wives to respond, they explained that it was women who knew more on these water uses, forgetting that they too use water and their responses were equally important.

Although most men distanced themselves from responding to questionnaires, discussions revealed that most men had their names registered in Nyakasoro irrigation scheme in Pfungwe. Men were also cited to be very dominating on production of high value crops such as cotton in Pfungwe while women to a large extent provide for the families through produce for consumption and selling from small gardens, the cash in some families, pocketed by the husband. Polygamous families are also common in families where cotton brings reasonable income. However, women responses and discussions with them showed that they are more likely than men to be motivated to do whatever is necessary to obtain and keep more convenient and reliable water sources because of their regular access to water and also guaranteeing the well-being of the family.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Based on the findings from study villages in Marondera, Murehwa and Uzumba Maramba Pfungwe districts, this study concludes by saying the following:

- People need water for multiple purposes. Multiple uses of water can be promoted, enhanced or hindered by the following interdependent factors:

-Technology and system design. Technology and system design can promote multiple uses of water for example, technologies such as the rope and washer pumps were observed to be promoting multiple uses of water at household level.

-Policies and institutional arrangements. Water might be available but policies and institutional arrangements can be prohibitive in some way.

- Availability of water of acceptable quantities and quality can also promote or hinder multiple uses of water

-Financial costs to upgrade single water supply systems into multiple water supply systems

-Walking distances to water sources. Water sources which are far away from users are likely to prohibit multiple uses of water since quantities can be affected by distance. However, in case of those sources within or near households can promote multiple uses of water.

-Ease to operate water supply systems. In case of boreholes, too many strokes can limit quantities to be abstracted and this prohibits multiple uses of water.

- At rural household level, domestic water supply sources are not completely an answer to peoples' water needs. Instead, people require water which goes beyond domestic to include water for productive purposes to enhance and sustain their livelihoods.

- Users' willingness to pay for water services is enhanced by the provision of water for productive uses. Having water for productive purposes will not only enhance livelihoods but also generate income, which can be used to ensure sustainable operation and maintenance of facilities. Unplanned multiple uses can jeopardize water supply systems and this calls for planning for multi-purpose systems.
- The use of water for multiple purposes is not a new practice in Mashonaland East province. However, it seems new in terms of documentation and understanding by development practitioners and researchers. This study has therefore tried to contribute by quantification of practical cases and conceptualization of terms.

6.2 RECOMMENDATIONS

Against the assessment of multiple water use practices in Mashonaland East province in selected districts and the findings of the whole survey, this study recommends the following:

- Where communities have access to high yielding water points, productive use of such sources should be encouraged.
- Government to support and upscale donor initiatives that are meant to enhance rural livelihoods and promote efficient and effective water use for both domestic and productive uses at household level.
- Donors and other water service providers to carry out a through user needs assessment before bringing any technology meant to benefit the people. This should be done to assess social acceptance and financial implications.

- Hydro-geological investigations should be thoroughly carried out before developing water supply infrastructure.

REFERENCES

Alberts, Henk, and J.J. van der Zee. 2004. A multi-sectoral approach to sustainable rural water supply: the role of the rope pump in Nicaragua. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

Boelee, E., and H. Laamrani. 2004. Multiple uses of irrigation water in Northern Morocco. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

Butterworth, John, Ines Restrepo, Rocio Bustamante, Stef Smits, and Isabel Dominguez. 2005. Utilising water supplies for multiple uses: an opportunity or a threat for sustainable services and livelihoods? Paper presented at International symposium AGUA 2005, October 2005, Colombia www.cinara.org.co.

Camacho, A. 2002. Estudio de caso sobre el Sistema de Agua Potable y Saneamiento Villa Serrano. Paper presented at the workshop on a strategic approach for integrated water resources development and management, 12-14 November 2002, La Paz, Bolivia.

Castresana Mendiguren, P., 2004. Productive uses of water at the household level: Evidence from Bushbuckridge, South Africa. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

Carter, R.C. 1996. Strategies for hand pump water supply programmes in less developed Countries. Journal of the Chartered Institution of Water and Environmental Management, 1996. Vol. 10.

Central Statistical Office, 1998. Poverty in Zimbabwe, Harare, Zimbabwe, CSO.

Central Statistics Office, 2002, Provincial Profile, Mashonaland East, Harare, Zimbabwe, CSO.

Chigerwe, J. 2004. Low head drip irrigation kits and treadle pumps for smallholder farmers in Zimbabwe: a technical evaluation based on laboratory test. Physics and Chemistry of the Earth, Volume 29, Elsevier Science Ltd. Amsterdam.

Cheesbrough, M., 2000. District Laboratory Practice in Tropical Countries, Part 2. Cambridge University Press, United Kingdom.

Esrey SA, Potash JB, Roberts L, Schiff C. 1991. Effects of improved water supply and sanitation on ascaris, diarrhoea, dracunculasis, hookworm infection, schistosomiasis and trachoma. Bulletin of the World Health Organization 69(5): 609-621.

Gleick, P.H., 1996. Basic water requirements for human activities: meeting basic needs. In Water International, Vol.21.

Global Water Partnership, 2000. Defining IWRM (Online) Available at **http://www.gwpsatac.org.zw**. Date accessed: 14/09/ 05.

Global Water Partnership Technical Committee, 2003. Poverty Reduction and IWRM. The Background Paper No. 8. Elandous Novum, Sweden.

Guzha, E., Chimbunde, E., Khoza, S., 2005. Technologies for multiple use systems in Zimbabwe. Working paper. Grey literature.

Guzha, E., 2006. Factors which enhances multiple uses of water. Workshop presentation, Chibanguza hotel, Murehea, Zimbabwe, Unpublished.

Howard, G and Bartram J., 2003. Domestic water quantity, service level and health. Informal paper WHO/SDE/WSH/03.02, Water Engineering and Development Centre (WEDC), Loughborough University, UK, and Water, Sanitation and Health Programme, World Health Organization (WHO), Geneva, Switzerland.

Hoko, Z., 2005. An Assessment of the water quality of drinking water in rural districts in Zimbabwe. The case of Gokwe South, Nkayi, Lupane, and Mwenezi districts. Physics and Chemistry of the Earth, Volume 30, Elsevier Science Ltd. Amsterdam.

Hoko, Z., and Jochen, H., 2005. An evaluation of the sustainability of a rural water rehabilitation project of Zimbabwe. Proceedings of the sixth Waternet/WRFSA/GWP-SA Annual Symposium, Swaziland.

International Water Management Institute (IWMI), 2004. Implications of Customary Laws for Implementing Integrated Water Resources Management. Inception Report. IWMI, South Africa.

IRC International Water and Sanitation Centre, 2006. Multiple Use Systems. Information brochure. Delft, the Netherlands.

Lovell, C., 2001. Productive Water Points in Dry land Areas: Guidelines on Integrated Planning for Rural Water Supply. London, UK, Intermediate Technology Development Group Publishing.

Machingambi, M., Manzungu, E., 2003. An Evaluation of rural communities' water use patterns and preparedness to manage domestic water sources in Zimbabwe. Physics and Chemistry of the Earth, Volume 28, Elsevier Science Ltd. Amsterdam.

Makoni, F. S, Ndamba, J., Manase, G., 2004. Patterns of domestic water use in rural areas of Zimbabwe, gender roles and realities. Physics and Chemistry of the Earth, Volume 29, Elsevier Science Ltd. Amsterdam.

Makoni, F. and Smits, S., 2006. Stakeholders Workshop Report on Multiple Uses of Water Sevices, Murehwa, Zimbabwe.

Makoni, F. and S. Smits, 2006, forthcoming. Policies and institutional framework for multiple use of water in Zimbabwe, Working paper, IRC, the Netherlands.

Mckenzie, R.S., Lombard, H., Constantinedes, G., Meyer, N., and Adams, N. 2003. Evaluation of the water supply situation in the western highveld area, South Africa.

Mkandhla, M., 2003. "Pro-Poor Strategies To Meet Basic Needs: The Case of Women and Rainwater Harvesting in Kajiado District, Kenya". African Water Journal, Pilot Edition UN-Water/ Africa. Addis Ababa.

Mokgope, K. and Butterworth, J. A., 2001. Rural water supply and productive use: A Rapid Survey in Sand River Catchment. WHIRL working paper 4.

Mudege, N., 2003. Access to water for food production. Personal communications. IWSD.

Mukheli, A. et al., 2002. "Is the Pungwe Water Supply Project a Solution to Water Accessibility and Sanitation Problems of Households of Sakubva, Zimbabwe?" Physics and Chemistry of the Earth, Volume 27. Elsevier Science Ltd. Amsterdam.

Morardet, S., Lefebvre, M., Montginoul, M., Farolfi., 2005. How to finance multiple use water systems for the rural poor? Lessons learnt from the domestic water sector in the Olifants River Basin, South Africa.

Moriarty, P., Butterworth, J., van Koppen, B (eds.). 2004. Beyond domestic – Case studies on poverty and productive uses of water at the household level, Delft, the Netherlands, IRC International Water and Sanitation Centre. IRC Technical Paper Series; no. 41).

Moriarty, P., Butterworth, J., van Koppen, B., Soussan, J., 2004 Water, poverty and productive uses of water at the household level, in Moriarty et al (eds.) 2004.

Perez de Mendiguren Castresana, J.C. 2004. Productive uses of water at the household level: evidence from Bushbuckridge, South Africa. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

Perez, M.A., Smits, S., Bernavides, A., Vargas, S. 2004. Multiple Uses of Water, Livelihoods and Poverty in Colombia: A Case Study from the Ambichinte Micro-Catchment. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI,and IWMI.

Polak, P.,D. Adhikari, B. Nanes, D. Salter, and S. Suryawanshi. 2004. Transforming access to rural water into profitable business opportunities. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI,and IWMI.

Pump Aid and the Elephant Pump in Zimbabwe, 2003. (Online) Available at http://www.pumpaid.org. Date accessed: 31/10/06.

Rajabu, K.R.M., Mahoo, H.F., sally, H., 2005. Water abstraction and use patterns and their implications on downstream river flows: a case study of Mkoji sub-catchment in Tanzania. Paper presented during the East African Integrated River Basin Management Conference, 7-9 March, Morogoro, Tanzania.

Rama Mohan Rao, M.S., Batchelor, C.H., James, A.J., Nagaraja, R., Seeley, J. and Buttorworth, J.A. 2003. Andhra Pradesh Rural Livelihoods Programme Water Audit Report. Hyderabad, India, APRLP.

Robinson, P., Mathew, B., Proudfoot. D. 2004. Productive water strategies for poverty reduction in Zimbabwe. In: Moriarty, Patrick, John Butterworth, and Barbara van Koppen (Eds). 2004. Beyond Domestic. Case studies on poverty and productive uses of water at the household level. IRC Technical Papers Series 41. Delft: IRC, NRI, and IWMI.

Senzanje, A., 1997. Development and testing drip irrigation technologies for smallholder farmers. Proceedings of the Joint International Conference on Agricultural Engineering Technology, Vol. 1, Dhaka, Bangladesh.

Smits, S. et al., 2004. Towards multiple use water services; Background Paper; IRC, Delft, the Netherlands. Date accessed: 11/10/05.

Sokile, C.S., Tukai, R., Kimambo, Z., Mhamba., 2003. Private Water Public Grime: Domestic Water Supply and Poverty Alleviation in Tanzania. Proceedings of the 4th WATERNET/WARFSA Annual Symposium, 15-17 October, 2003, Gaborone, Botswana.

Thorpe, I. 2004. Pump Aid and the Elephant Pump in Zimbabwe. Case study for E-conference: Tackling poverty through multiple use water services, 17th May to 25th June 2004.

United Nations Development Programme (UNDP), 2003. The Millennium Development Goals. The Millennium Project, **www.unmillenniumproject.org**

World Health Organisation (WHO), 1993. Guidelines for drinking water water quality. Second edition, Volume 1 Recommendation, Geneva.

Van der Hoek W., Konradsen F., Jehangir W.A. 1999. Domestic use of irrigation water: Health hazard or opportunity? In: International Journal of Water Resources Development.

Van der Hoek W, Konradsen F, Ensink JHJ, Mudasser M, Jensen PK. 2001 Irrigation water as a source of drinking water: is safe use possible? Tropical Medicine and International Health 6: 46-55.

Van Koppen, B. 1998. Water Rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development, International Irrigation Management Institute, Colombo, Sri Lanka.

Van Koppen, B., Moriarty, P. and E. Boelee 2006, forthcoming Multiple-Use Water Services to Reduce Poverty and Enhance Gender Equity: A Framework for Action-Research. IWMI Research Report.

APPENDICES

APPENDIX A 1

Household Questionnaire

Introduction/General questions

District……

VIDCO/WARD…….

Village……

1. Household Type: ☐ Female headed / ☐ Male headed
Other (s)…….

2. Sex of respondent: Male ☐ Female ☐

3. Age of respondent……

4. Employmet: Formal ☐ Informal ☐

Explain your answer……

5. What type of water source do you use? Borehole/Shallow well/deep well/open source/spring/tap/river and other, specify…….

6. How far is it from your homestead……

7. What are the uses of this source……/……/……../
……/……../……/……../

8. What are the problems related to the use of this source(s)……..

…….

9. Do you have specific sources for specific uses…….if your answer is yes, which are they…… and for what uses……./……../……./
……./……/

20. Do you harvest rainwater and for what uses

11. Are you satisfied with the water source (s) you are currently using……..
Which source is that……

……

12 Water quantity required per day……

13. Approximate distance covered to get to your water source……..

14. In case of boreholes/ fitted pumps, how long does it take to have it repaired……..by who……..
……

15. Are there people trained to do the repair…… who trained them……
Do you also wish to be trained……...
……

16. Do you have water point committees in this village……
Are they useful, explain your answer……
……...

17. Are you willing to contribute in any way to the operation and maintenance of water sources: Yes ☐ No ☐

18.Explain how if your answer to the above is yes……
……..

……

……

……

……

19. Are there water partners working in this area……., if your answer is yes, which are they and what are they doing

……

……

20. What type of assistance do you get from your local authorities for example from the RDC / DDF/MoH, AREX

APPENDIX A 2

Household Water Use Diary

District…….

Ward……

Village…….

Family Name……..

Responsible person for recording water quantities……

Day, eg Monday 03 April 2006……/……/……

How may people stay at your home……..

1. Where do you get all your water?

2. What are the uses of this water?

3. Indicate how much water for each purpose per day for example, how many buckets or gullons

4. How far is the water sources……..

5. Do you keep animals for example: dairy, piggery, poultry, fish etc

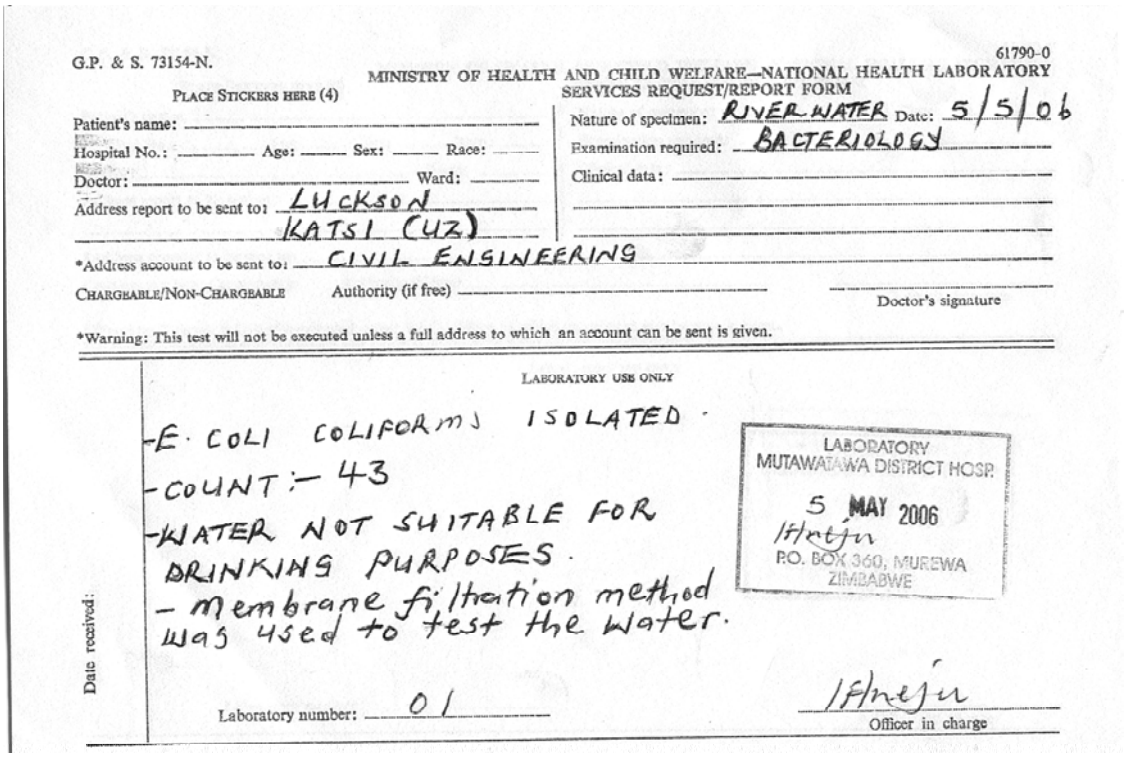
6. Indicate water quantities required per day on each category

7. Put a cross for each bucket of water you get on a day, and then for which purpose you use it.

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Drinking							
Washing							
Cooking							
Laundry							
Cleaning							
Animals							
Garden irrigation							
Others (specify)							
Other							

APPENDIX A 3

BACTERIOLOGICAL WATER QUALITY TEST RESULTS



G.P. & S. 73154-N. 61790-0

MINISTRY OF HEALTH AND CHILD WELFARE—NATIONAL HEALTH LABORATORY SERVICES REQUEST/REPORT FORM

PLACE STICKERS HERE (4)

Patient's name:

Hospital No.: Age: Sex: Race:

Doctor: Ward:

Address report to be sent to: LUCKSON KATSI (UZ)

Nature of specimen: RIVER WATER Date: 5/5/06

Examination required: BACTERIOLOGY

Clinical data:

*Address account to be sent to: CIVIL ENGINEERING

CHARGEABLE/NON-CHARGEABLE Authority (if free)

Doctor's signature

*Warning: This test will not be executed unless a full address to which an account can be sent is given.

LABORATORY USE ONLY

Date received:

-E. COLI COLIFORMS ISOLATED.
-COUNT:- 43
-WATER NOT SUITABLE FOR DRINKING PURPOSES.
- membrane filtration method was used to test the water.

LABORATORY
MUTAWATAWA DISTRICT HOSP.
5 MAY 2006
P.O. BOX 360, MUREWA
ZIMBABWE

Laboratory number: 01

Officer in charge

APPENDIX A 4

WHO/Zimbabwean Guidelines on Drinking Water quality

Parameter	**WHO Guidelines**	**Zimbabwean Standards**
Total coliforms as *E.coli* (CFU/100ml)	0	0
Faecal coliforms as *E.coli* (CFU/100ml)	0	0
Ammonia – nitrogen (mg/l)	n/a	n/a
Nitrite – nitrogen (mg/l)	3.0	0.001
Nitrate – nitrogen (mg/l)	10	10
Total phosphorus as ortho-phosphate (mg/l)	n/a	n/a
Conductivity (µs/cm)	n/a	700
Turbidity (NTU)	5	1
PH (^{o}C)	6.5-9.5	6.5 – 8.5

PHOTO GALLERY

APPENDIX A 5

Borehole water soon after being collected from the borehole in UMP, Pfungwe

Colour change after 30minutes

APPENDIX A 5

Picture 1. Data Collection in pictures in Pfungwe, looking on is Mr. Gowe, an Environmental Health Officer, Mutawatawa hospital.

Picture 2. Women (Left)use river water for washing since water from a nearby borehole makes soap consumption very high while the one (Right) side is fetching water for drinking from the river bed because the borehole water is salty and rusty.

Picture 3. Researcher pose for a photograph in a mixed crop field with Mr. Chikuwira, one of the drip irrigation users in Maramba.

Picture 4. In Uzumba, the water source shown on the left side above is used for gardening, banana plantation watering, piggery and poultry, representing the multi-nature of the source. However, this water source is not being used for domestic purposes such as drinking due to lack of protection.

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