MANAGEMENT OF COMMUNITY WATER SOURCES AND THE SUPPLY OF SAFE DOMESTIC WATER USE IN GARDO DISTRICT, SOMALIA

A Dissertation Submitted to the College of Higher Degrees and Research Kampala International University. Kampala, Uganda in Partial Fulfillment of the Requirements for the Award of a Master Degree in Environmental Management and Development

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July, 2013

DECLARATION

"This is my original work and has not been presented for a Degree or any other academic award in any University or Institution of Learning".

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Date 14/12/2013

APPROVAL

"I confirm that the work reported in this was carried out by the candidate under my supervision".

Dr. Nowe J.B

Name and Signature of Supervisor

Date 14/12/2017

DEDICATIONS

To Almighty Allah who has guided me from birth up to now.

I dedicate this research study to my brother, Dr. Hussein Bare Musse, my Wife Ismahan kalif Mohamud and my son Hussein Mohamed Warsame, brothers and sisters who not only funded me but also encouraged me to expand my horizons and be that I am and my family for all the moral support and prayers they have rendered to me throughout this course.

ACKNOWLEDGEMENTS

This research is the result of combined efforts from a number of people to whom I wish to express my gratitude.

First of all, I would like to express my heartfelt gratitude to Dr. Nuwe J.B my supervisor, whose advice and comments have been of great importance towards the completion of this work. I am very grateful to him to have been available whenever I needed his help.

Secondly, my heartfelt gratitude goes to my brother Dr. Hussein Bare Musse for his encouragement, professional guidance and intellectual support to complete this report.

Thirdly, my thanks go to my family for the financial burden that I have imposed on them yet they were always willing to face it.

Fourthly, I would like to express my thanks to all KIU postgraduate lecturers, especially those from the Environmental management department. Specially:
Prof. Sunday , Dr. Daha and Dr. Kasim

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ACRONYMS / ABBREVIATIONS

BOD	-	Biological Oxygen Demand
CBO	-	Community-Based Organization
DFID	-	Department for International Development (UK)
DWD	-	Directorate for Water Development
JNA	-	Joint Needs Assessment
MDGs	-	Millennium Development Goals
NGO	-	Non-Governmental Organization
PPP	-	Public Private Partnerships
UNDAF	-	United Nations Development Assistance Framework
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environmental Programme
UNESCA	-	United Nations Economic and Social Council, Economic Commission for Africa
UNICEF	-	United Nations Children's Fund
WDA	-	Water Development Agency
WSS	-	Water Supply and Sanitation
WWTP	-	Waste Water Treatment Plant
WHO	-	World Health Organization

ABSTRACT

This dissertation is entitled "Management of community water sources and the supply of safe domestic water". It is presented as a result of a research that was carried out in Gardo district, in Somalia. The study was carried out basing on three specific objectives, i.e.; to establish access domestic water sources in Gardo district; to establish the challenges faced by local community in methods of getting safe domestic water; and to examine the relationship between management of water sources and the supply of safe domestic water to households in Gardo district.

The study was in form of a descriptive and comparative survey design, to describe and analyze the condition of the areas being studied as it was at the time. The study population comprised of 170 people from which a study sample of 120 respondents was chosen, using simple random and purposive sampling methods. Questionnaires were used in collecting both primary and secondary data. The collected data was analyzed using both qualitative and quantitative methods.

The findings of the study revealed that the main sources of water in Gardo district were; boreholes, piped water taps, shallow wells and rain water, in their order of significance. Also that the challenges of safe water supply included inadequate water supply, breakdown of the piped water system, inter-clan/tribal clashes over control of water sources, prolonged drought/irregular rains and water contamination. The findings indicated that there was a relationship between the management of water sources and the supply of safe domestic water in Gardo district, in Somalia.

From the findings of the study, it was concluded that the management of water sources has a significant relationship with the supply of safe domestic water in households in Gardo district in Somalia. It was recommended that there should be proper sensitization of masses about the need for proper management of water sources, procure equipment and technical capacity to develop new water sources and rehabilitate old ones, encourage effective water utilization, and awareness among the people about securing water sources.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Every year, millions of the world's poorest people die from preventable diseases caused by inadequate water supply. Hundreds of millions suffer from regular bouts of diarrhea or parasitic worm infections that ruin their lives (DFID, 1998). Women and children are the main victims who are burdened by the need to carry water containers long distances every day; they must also endure the indignity, shame and sickness that result from lack of hygienic sanitation. The impact of deficient water services falls primarily on poor unreached by public services. People in rural and peri urban areas of developing countries pay excessively high prices to water vendors for meagre water supplies. Their poverty is aggravated and their productivity impaired, while their sickness puts severe strains on health services and hospitals (DFID, 1998)

The cause of the global water crisis is believed to be far from a scarcity problem but rather a result of poverty, inequality, unequal power relations and flawed water management policies evident in most of the developing countries (UNDP, 2006). However, the fact that the voices of the marginalized groups especially women, are rarely heard by the policy makers illustrates another truth behind the water crisis (Perkins, 2008). Governments do not prioritize the needs of the marginalized and without support, even the NGO activities become unsustainable (Perkins, 2008). As a result, 1.1 billion People across the globe as reported in 2004 had no access to sustainable safe water sources with a majority of them living in the rural areas (UNDP, 2006; Alford, 2007).

Although water is seen as a source of life and a valuable natural resource that sustains the environment and supports livelihoods, it is increasingly being seen as a source of risk and vulnerability especially to the women (UNEP, 2004, UNDP, 2006). Women are the most vulnerable because in

most societies, it is women's responsibility to ensure that there is enough clean and safe water for their households. (Buckingham, 2000). In developing countries where coping with the water crisis is almost impossible, millions of women and girls spend most of their time looking for water to meet their households' water needs (UNDP, 2006). This limits their participation in productive economic activities especially for the women and low school enrolment for the girls (Coles, *et al*, 2005).

In 2000, approximately 36% of the population did not have access to a safe water supply and about 40% did not have access to sanitary facilities (Coles et al, 2005). The figures for different areas show greater disparities 50% of those in rural areas have no easy access to safe water compared with 14% in urban areas. As much as 52% of the rural population lacks sanitation, compared with 20% in urban areas and these gaps are widening making a large number of the population to suffer from water and sanitation related illnesses of water born, water arthropod, water washed and water related diseases of Malaria, Diarrhoea, Cholera, Dysentery and Bilharzias.

Somalia is slowly recovering from the civil strife that has hampered the country's development for the past decade. Consequently, the delivery of water and sanitation services in most parts of the country dramatically weakened. These services were formerly organized and operated by the Central Government agencies, which no longer operate on a nationwide scale and they were replaced by local public entities reporting to municipalities or directly to the state level e.g. Puntland. As peace started to establish slowly in some parts of the country, the population quickly drifted into towns resulting in an unprecedented growth of urban populations especially in the pacified regions, further stretching the deteriorated water resources.

In most parts of Somalia, water supplies are drawn from groundwater, but a few systems use surface water. The capacity of these systems in most urban areas is overstretched due to a growing urban population and increasing demand from rural populations, especially in the long dry season and during drought events, (UNICEF and WHO, 2000). As a result, people suffer from inadequate water supply and have few opportunities apart from reliance on aging water sources facilities to meet their needs.

As mentioned earlier, before the civil war, water supply systems were developed, operated and managed by central government agencies, which collapsed after the civil war due to destruction, looting and lack of adequate maintenance. Specifically, the Water Development Agency (WDA) was responsible from operation and maintenance of the urban and rural water sectors. Currently with support from UNICEF and the European Commission, Public Private Partnerships (PPP) were established and tested with local utility companies in selected urban centres in the country. This proved suitable for communities with minimum donor support.

Supplying adequate water services to urban areas also needs to be viewed within the wider context of overall urban environmental services including solid waste management, urban drainage, housing and urban planning.

This and other reasons promoted the researcher to take up this topic of study to explore the condition of the Gardo urban community as it regards water and safe domestic supply management.

1.2 Statement of the problem

According to UNICEF and WHO (2000), Somali people suffer from inadequate water supply and have few opportunities apart from reliance on aging water sources facilities to meet their needs.

The Somali urban water supply sector has suffered severe deterioration due to ignorance and lack of resources that have resulted from the civil war the country is currently facing. Donor support and interventions almost proved fruitless and unsuccessful. Numerous water supply system assessments and interventions implemented by UN agencies and international NGOs in the region, which have yet to attain the MDG target of reducing by half the proportion of people without sustainable access to safe drinking water by 2015. One of the most important assessments, the water and sanitation sub-cluster recently conducted by the Joint Needs Assessment (JNA) through the UN and The World Bank, provides a through situation analysis and Somali priorities for international support.

Despite the government's effort to increase supply of safe domestic water to the communities in Gardo district in Somalia, access methods to safe water is still a challenge. The shortage of domestic water supply has resulted into a number of problems such as diarrhea and cholera diseases. This situation is compounded by erratic rainfall patterns that produce both drought and flooding. It is estimated that 65 per cent of the population does not have reliable access to safe water throughout the year. Lack of safe domestic water supply significantly contributes to illness and death in Somalia. It is against such a background that the research investigated the influence of management of community water sources on the supply of safe domestic water use in Gardo district.

1.3 General objective

The general objective in this study was to establish the best methods of safe domestic water supply in Gardo District, Somalia.

1.3.1 Specific objectives

This study was geared towards achieving the following objectives:

1. To establish access methods of domestic water sources in Gardo district.
2. To establish the challenges faced by local community in methods of getting safe domestic water.
3. To examine the relationship between management of water sources and the supply of safe domestic water to households in Gardo district.

1.3.2 Research questions

In order to achieve these objectives, the following guiding questions were set:

1. What are the major domestic water access methods used ?
2. What are the challenges faced by local community in methods of getting safe domestic water supply in Gardo district?
3. What is the relationship between management of water sources and the supply of safe domestic water to households in Gardo district?

1.4 Hypothesis

There is no significant relationship between community water management and the supply of safe domestic water in Gardo district.

1.5 Scope of the study

1.5.1 Content scope

The study was focused on the management of safe domestic water supply, specifically on finding out the management of water sources and

the sustainable supply of safe domestic water, effects of poor management of water sources on the supply of safe domestic water in the community and to suggest measures to ensure proper provision and management of domestic water supply in Gardo in Somalia. The study was guided by the game theory of water resource management.

1.5.2 Time Scope

The study was limited to the water sources management and supply of safe water for domestic use in Gardo district for a period of five years, from 2008-2013.

1.6 Significance of the study

The findings of the study will be beneficial to many different categories of people and in many different ways:

This study is of great priority to the government as a whole given the fact that effective water management is one of the core areas of public service, especially in semi-arid Somalia. The study findings will therefore be beneficial to policy makers as it will act as a tool in formulating the right policies that will enhance proper management of water sources and streamline the supply of safe domestic water to local communities in Gardo district.

The study will be of significance to the local community and the entire Somalia economy in that, it will act as a source of information showing current and future management application of urban water in the country.

The study findings and recommendations will help the rural, urban planners and managers to incorporate domestic water issues in planning and recognize the importance of safe and clean water in the growth of the economy.

The study will contribute to the available knowledge as well as act as a basis for further research on the same and related subjects.

This study will benefit by helping me acquire practical research skills and will also serve as a partial fulfillment of the requirements for the award of a degree of Master of Science in Environmental Management of Kampala International University.

1.7 Definition of operational terms

In this study the following terms were operationally defined to mean the following:

Safe domestic water; means the water that is safe enough to be consumed or used by humans domestically with low risk of immediate or long term harm. In most developed countries, water supply for household domestic use has to meet certain water safety standards.

Water resources; are areas or locations where water that is useful or potentially useful can be found.

Water supply; is the provision of water by public utilities, commercial organizations, community endeavors or by individuals, usually via a system of pumps and pipes.

A community; is a group of people sharing a populated environment in a social unit of any size that shares common values.

Water quality Is the physical, chemical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

Hygiene refers to the set of practices associated with the preservation of health and healthy living. Hygiene is an old concept related to medicine, as well as to personal and professional care practices related to most aspects of living.

Impurities are substances within a confined amount of liquid, gas, or solid, which differ from the chemical composition of the material or compound. Impurities are either naturally occurring or added during synthesis of a chemical or commercial product.

Contamination is the presence of a minor and unwanted constituent (contaminant) in material, physical body, natural environment, at a workplace, etc

1.8 Conceptual framework

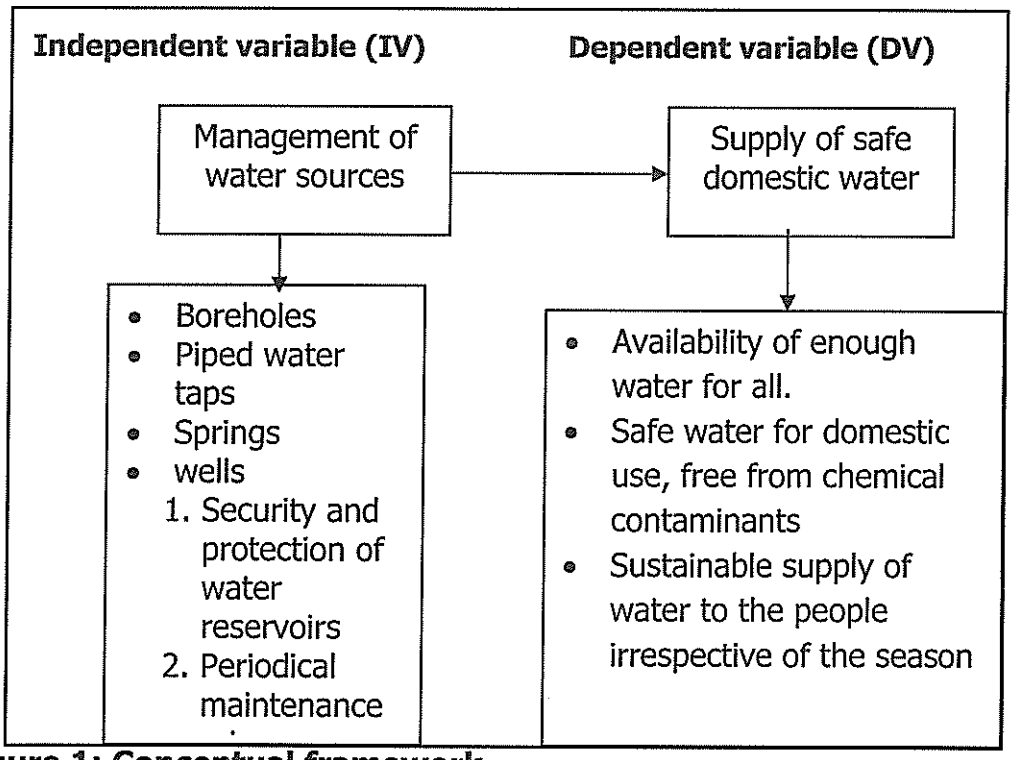

Figure 1: Conceptual framework

As shown in Figure 1, management of water sources is the independent variable while supply of safe water for domestic use was the dependent variable. The study was carried out basing on the interrelationships between the variables in the research problem. The conceptual framework examines the relationship between the management of water sources and the supply of safe water for domestic use in the local communities in Gardo district.

The conceptual framework demonstrated that management of water sources comprises of management of boreholes, piped water, springs and management of wells. Periodical maintenance and protection of water sources leads to increased availability of water, supply of safe water for domestic use and sustainable supply of water for people irrespective of season.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter examined the literature on safe domestic water supply management. The study focused on domestic sources of water, access methods, challenges faced by local community in methods of getting safe domestic water supply in Gardo district. It provides an introduction to many of the concepts and provides a framework to help understand the component of safe domestic water supply management. The chapter outlines following issues; water sources, effects of poor safe domestic water supply management and the way forward in ensuring sustainability of the safe domestic water supply management

Management of water resources

Water resource management is an activity of planning, developing, distributing and managing the optimum use of water resources. It is a subset of water cycle management. In an ideal World, water resources management planning has regard to all the completing demands for water and seeks to allocate water on the equitable basis to satisfy all uses and demands (Chartres *et al*, 2010).

One of the critical components of the Millennium Development Goals (MDGs) is increasing access to domestic water supply coupled with improved water resource management and development in rural areas (Lenton *et al*, 2008). According to WHO, domestic water is water used for all domestic purposes which include drinking, cooking and bathing. Therefore when measuring adequacy of water in the household all such uses should be considered (WHO, 2003). To ensure that households are safe water secure, it is necessary to evaluate the number, geographic location, yield, dependability, season and quality of the water sources (Kahinda *et al*, 2007).

Equipping people in communities with appropriate technologies and skills to enable them harvest rain water and/or excavate underground water together with effective management of these sources can provide sustainable solutions to the problems associated with the scarcity of domestic water supply in households (Malley *et al*, 2008). Improved water supply can in turn give women more time for productive endeavours, adult education, empowerment activities and leisure (Panda, 2007). Therefore, investment in community based organizations for water management can improve social capital for women through leadership, networking opportunities and solidarity building which can enhance their empowerment in society (Lenton *et al*, 2008).

There are diverse sources to supply domestic water. These include; conventional communal sources and self supply sources. The conventional communal sources are justified for improved water quality and use of high level technology like drilled boreholes equipped with hand pumps, collection tanks and protected springs (Carter *et al*, 2005). The conventional communal facilities in most areas in the developing countries have been proved to be not sustainable because of their high rate of breakdown as a result of poor operation and maintenance, congestion, difficulty in operating the pumps and long distances because sources are too few and yet households are many and scattered (Brett *et al*, 2007; Singh *et al*, 2004).

Conventional communal sources have also been observed as grounds for social unrest within the communities and are argued to be not funded enough to achieve the MDGs water target (Davidson *et al*, 1993; Sutton, 2008). More still, though the coverage of facilities has increased in most parts of the developing world, such facilities have been abandoned by the expected beneficiary communities because of the high iron content in the water (Martin, 2007). As a result, self supply initiatives have evolved as an alternative approach to water supply and management (Sutton, 2008).

Self Supply builds on the initiatives of private households or communities to improve water supply through user investment in water treatment, supply construction, upgrading and management (Sutton, 2008). Self supply initiatives are spear headed by people in the respective communities who have the income and are willing to invest in water supply sources (Carter *et al*, 2005). However, most of the people are poor and so they sometimes try to mobilize their friends and neighbours to improve traditional water sources using local labour and materials. But such sources are often associated with poor water quality and seasonal unreliability (Carter, 2006).

It is important to note that, though the self supply initiatives are private, the use and access to the water source by other households is usually shared at no cost or for a small fee, as a way of promoting social relations (Carter *et al*, 2005). This is because water is seen as a natural resource and as a result payment for water in the community setting is quite unacceptable (Shiva, 1989). However, this leaves the construction and maintenance costs in the hands of the households that initiated the construction of the self supply sources (Carter, 2006). This can compromise access to water among the disadvantaged groups in society especially the women who do not have the capacity and ability to construct and or maintain the domestic rural water supply sources (Alford, 2007)

Rainwater

The use of rainwater is a common technique in many countries. The rainwater is collected on an equipped surface (generally the roof of a house) and is brought by gutters in a storage reservoir. This technique of water supply can prove to be interesting in certain areas, either where it rains a lot, either very dry when the water resources are very scarce and any source of water should be used. Because of the great storage volumes required, this technique is used as a temporary resource in complement to others. In all cases, the main disadvantage of this water resource comes from the quality of water, polluted and charged with sediment during the filling (roof dusty or covered with animal excrements for example), and contaminated after a long period of storage. Moreover, the lack of minerals makes rainwater (often acid) corrosive towards metals (because no limestone is present to neutralize acidity), and if the rainwater is the only source of drinking water for the population, it might be necessary to add minerals to the food (iodine for example...) to compensate their absence in the drinking water (Action contre la faim, 2008).

Surface Water

Surface water has the advantage to be usually easily accessible (ponds, lakes, rivers); near of the people's living place, but unfortunately this water is extremely vulnerable to pollution (suspended substances, pathogens). Some of the surface water points can dry out in dry season. Surface water sources are varied and it exists numerous ways to use them, they include: (i) Direct intake from the river. This is a simple and quick solution which requires a minimum level of infrastructures: creation of catchment areas along the river according to the different use made of the water. Upstream of all other activities, a zone will be reserved to fetch water for human consumption, (ii) Direct river catchments. This is where rivers catchments are done through a pipe equipped with an inlet filter connected to a pump. Water is pumped in a reservoir then distributed through a distribution network. A water treatment will always be necessary given all the possible

risks of pollution. The yield which it is possible to pump depends on the type of pump, the population to be served and the river flow (average yield along the year, taken into account also the lowest yield, i.e. dry season). The catchments should be done upstream of the populations living place, where risks of pollution are lower. It is necessary to clean river banks on a certain distance and a dam/reservoir can be necessary to stabilize a river if this one has an irregular flow, (iii) Indirect river catchments. This system it is possible to improve the quality of river water by using as a natural filter the alluvium layer often located under the bedrock: infiltration well, bottom filters, and infiltration galleries or even a borehole drilled in the alluvium, (iv) Catchments from a lake or from a dam. This is when a stagnant water (or still water) is in good conditions, it presents the best resource for surface water. Indeed, if the water duration stay is long enough, harmful substances either settle in the bottom of the lake/pond, or accumulate at the surface, or can also oxidize and then settle down. The catchment should not be too deep, so that the water caught is clear and oxygenated enough, and should not be too shallow, so that water does not contained too much organic substances (indeed, organic substance often develop near the water surface where more sunlight is available). Ideally, the depth of the catchment should be between 10 and 20 m. One must take care that the water resource does not contain any wastewater (action contre la faim, 2008).

Groundwater

Groundwater presents in general a good bacteriological quality, due to their long decantation and auto-purifying properties of the ground. They are therefore often appropriate for consumption: in that case, the treatment will not be necessary. The deeper the catchment is, the better the quality of water will be. However, they can also present mineral pollutions, emanating from the rocks dissolved by water in the ground (notably iron, sodium chloride, calcium, magnesium and fluorine).

Moreover, rocks present in a crystalline ground can present cracks and can therefore contain groundwater polluted by direct transfer of surface pollutions in the cracks (absence of usual filtration process by the soil). In addition, any groundwater located at a depth lower than 3 m is considered to be surface water.

Spring catchment

A spring is a natural flow of a groundwater reserve in the open air. It is the easiest way to protecting it from outside pollutions, especially from faecal origin. Every spring catchment is a particular case: it is therefore not possible to offer an example adapted to all situations. They can however be classified in two types: reinforced concrete catchments box, or buried drains. The catchment is made by the mean of a drain; once collected by the drain, water goes directly to a header tank.

Hand Dug Well

A well is an infrastructure dug manually, which collects a moderately deep or deep aquifer. Its depth and diameter vary according to the context. Generally speaking, the diameter of a well is from 1 to 2 meters and its depth does not exceed 25 to 30 meters. After this depth, work is very dangerous and expensive. The most important parts of a well in terms of water quality are the surface infrastructures, which protects it from of surface water infiltrations and facilitates the water access and use.

Borehole

A borehole is deep ground water catchment. It consists of a long-narrow tube inserted in the ground by the mean of a drilling machine. Its usual diameter is 10 to 20 cm. The drilling of a borehole requires most of the time the intervention of a drilling machine (expensive!). However, manual drilling, at low cost, under good conditions, can reach 60 m of depth. Borehole must be equipped with a pump (powered by hand or not) and with roughly the same surface infrastructure than a hand dug well

(reinforced concrete apron, drainage ditch and fence which prevents the access to the animals) (Action contre la faim, 2008).

Safe domestic water supply in perspectives

A large proportion of the World's people do not have access to improved or microbiologically safe sources of water for drinking and other essential purposes WHO/UNICEF (2000) have estimated that 1.1 billion people do not have access to "improved drinking-water sources". Consumption of unsafe water continues to be one of the major causes of the 2.2 million diarrheal disease deaths occurring annually, mostly in children (WHO/UNICEF, 2000).

People now drinking unsafe household water also include those in rural as well as urban settings. Many rural dwellers lack indoor plumbing or nearby outdoor piped water from a safe supply (from wells, boreholes, protected or upland surface water sources, etc.). Often they have to travel considerable distances to reach any water source, regardless of quality, for collection and household use. Many urban dwellers also lack safe water (WHO, 2000; Swerdlow *et al*, 1992).

Research and experience by WHO continually confirm that a safe water supply is not sufficient and that adequate sanitation facilities and hygiene practice are essential to improving the health of the local population (Van Derslice and Briscoe, 1995). It is estimated that currently more than one billion people do not have access to safe drinking water. About 2.4 billion people are not served by any type of reasonable sanitation, and one-half of the world's hospital beds are occupied by people suffering from water-borne diseases (Wilderer, 2005). It is well accepted that safe water supply problems cannot be solved with concrete and pipes and that integrated approaches to water supply that put people at the centre need to be used. This means from a social development perspective understanding and involving users and responding flexibly towards their concerns.

Sustainability of water supply as a concept

Sustainability pertains to multiple aspects of a rural water supply, with institutional, social, technical, environmental and financial dimensions (Well, 1998). This accounts for the fact that understanding and measuring sustainability is so difficult, and why solutions are highly context specific. Sustainable rural water supplies ensure the ongoing provision of a service that is fundamental to improving health, reducing the burden of carrying water long distances, and enabling users to live a life of dignity (Haysom, 2006). Therefore, in our context, sustainability is best defined pragmatically as "whether or not something continues to work overtime" (Abrams, 1998).

According to these authors, a motivated community is the one that needs the service more and therefore considers the scheme as its own property. As a result schemes constructed by community motivation are likely to be sustainable. Effective operation and maintenance is essential for sustainability and village level operation and maintenance is one of the ways through which sustainability can be achieved. In cases of scarce government resources the money collected from cost recovery can be used for capacity building such as sanitation, education and village level maintenance training which can play great role in sustaining the services. Services can't be always managed by the community alone. For example at times where village level maintenance trainees are lost from the community new training should be given to the trainees. Village level rural operation and maintenance has limited success if ongoing support is not provided.

Water supply development projects need to extend their scope beyond simply the provision of sustainable water supply infrastructure. The greatest beneficial on the health of the local population is derived from an integrated multidisciplinary approach that works in close collaboration with

the local population. Demand-driven approaches are effective since communities are capable of making decisions, maintaining services, and making their contributions to capital costs, operations and maintenance. In addition, a strong and well-structured information campaign is necessary to empower communities to make an informed choice (UNESCA, 2005). Poor programme conceptualization, unimaginative planning, use of inappropriate technologies, and rigid management approaches had contributed to high rates of programme failure.

Implementation approaches which resulted in non-sustainability of water supply projects should be identified so that they would not be repeated in the future. At the same time implementation approaches, which resulted in sustainability of water supply projects should be identified so that they can be used as a base for future project implementations. The chances of achieving the Millennium Development Goals by halving the proportion of people without access to safe water by 2015 will be seriously hampered unless levels of sustainability can be greatly improved, (Haysom, 2006). Therefore, it is necessary to follow approaches which can lead to the sustainability of rural water supply.

The background of safe domestic water supply management

Water is one of the most important natural resources because access to safe water is vital for survival. However, despite significant investments in the water sector, the outlook on access to safe water remains grim globally (World Bank, 2001). Rural Africans have the lowest level of access to clean water when compared to other developing areas of the world (UNESCO-WWAP, 2003). This holds also true in Somalia. Lack of access to clean water is a major cause of diarrhoeal diseases, which in turn account for a large fraction of childhood morbidity and mortality (Janvier et al, 2002).

It is generally accepted that lack of potable water services remains one of the world's most urgent health issues. Inadequate access to sufficient good

quality water will exacerbate already difficult situations, e.g. where people are being treated for chronic and/or possibly fatal illnesses such as HIV/AIDS (Ngwenya and Kgathi, 2006). In a review of over 60 studies, Esrey et al (1985) found that the largest benefits of service improvements in reducing morbidity-related diarrhoea were improved water availability (25%), improved excreta disposal (22%), and water quality (16%).

2.1 Theoretical perspectives

The management and supply of safe domestic water may be conceptualized using a number of theoretical constructs. The purpose of theory is then to explain systems of regularities that cannot be explained with scientific laws. Theories are considered milestones of scientific development. Theories are usually introduced when previous study of a class of phenomena has revealed a system of uniformities. Formally, a scientific theory may be considered as a set of sentences expressed in terms of a specific vocabulary. Theory will always be thought of as formulated within a linguistic framework of a clear specified logical structure, which determines, in particular, the rules of deductive inference (Najem & Strunk, 1994).

According to Mustafa (1993), it is crucial to theories development to integrate theories from other bodies of knowledge, as well as the clarification of the definitions of core concepts, and mapping out key issues, such as domains, epistemologies and anthologies. The function of science is to build up systems of explanatory techniques; a variety of representative devices, including models, diagrams and theories.

The Game theory of water resource management stipulates that managing water resources systems usually involve conflicts. Behaviours of stakeholders, who might be willing to contribute to improvements and reach a win–win situation, sometimes result in worse conditions for all parties. Game theory identifies and interprets the behaviours of parties to

water resource problems and describe how interactions of different parties who give priority to their own objectives, rather than system's objective, result in a system's evolution (Davidson *et al*, 1993). Outcomes predicted by game theory often differ from results suggested by optimization methods which assume all parties are willing to act towards the best system-wide outcome.

Game theory provides a framework for studying the strategic actions of individual decision makers to develop more broadly acceptable solutions. However, game theory is not yet well integrated into general systems analysis for water resources. Thus, game theory's value might remain unclear to the water resources community due to lack of understanding its basic concepts (Davidson *et al*, 1993). As with other disciplines (e.g. economics, political science, social science, computer intelligence, etc.) water scholars will become more interested in game theory as they come to realize its novel and useful insights into water resources problems which are not obtainable from conventional systems engineering methods. In general, game theory results are closer to practice as this method better reflects the behaviours of the involved parties, something often neglected by conventional optimization methods for solving multi-criteria multi-decision-maker problems.

Stable outcomes of the game predicted by game theory are not necessarily pareto-optimal. The main concern of players is to maximize their own benefit in the game knowing that the final outcome is the product of all the decisions made. Game theory provides more realistic simulation of stakeholders' interest-based behaviour (Davidson *et al*, 1993). The self-optimizing attitude of players and stakeholders, represented in game theory, often results in non-cooperative stakeholder behaviours even when cooperative behaviour is more beneficial to all parties. Game theory can help provide some planning, policy, and design insights that would be unavailable from other traditional systems engineering methods.

2.2 Related studies

A study of the relationship between water management and health in Kumasi Ghana by Akumiah (2007) confirmed that drinking water related diseases are on the increase with the most affected people being the poor living in shanty and informal areas of Kumasi. It was also found that most people in the city are willing to render any services to provide safe drinking water. Wesonga (2012) studied water supply and sanitation in Kenya and found out that water supply and sanitation in Kenya is characterized by low levels of access especially in Urban slums and in rural areas as well as poor service quality in the form of intermittent water supply. Alhasan (2012) also assessed chemical quality of portable water sources in Abuja in Nigeria. The aim of the study was to determine the level of some chemical parameters in samples of potable water sources namely tap, borehole, open well and bottle water. The results revealed that pH, NO3, CU, AL, TOT-N and Fe are not limiting factors to the quality of drinking water in the study area. It was recommended that there is need for Nigeria's National Agency for Food and Drug Administration and Control to focus on promoting the safety of potable water, most especially the sachet and bottle water sources. It was also observed that the efficient management of water sources in Nigeria's Urban and Peri-Urban centres is increasingly becoming necessary if the health and well being of the residents is of utmost importance. While Ajibade (2004) found that 2 billion people globally live in areas where there is chronic shortage of water. Similar studies carried out in different parts of Nigeria (Yerima *et al*, 2008; Waziri and Ogugbunja, 2010; Akan *et al*, 2010; Mauzu *et al*, 2012) and other parts of Africa (Demeke, 2009, Meseret, 2012) revealed that various sources of drinking water have been contaminated at varying scales. Lack of safe drinking water is considered a leading cause of many communicable diseases. Studies have estimated that the provision of clean water and basic sanitation alone would curtain the incidence of diarrhea by 50%, sleeping sickness by 80% and guinea worm infestation by 100%

(Anwar,1993). Consequently, access to safe water is recognized to be the foundation of sound health (Kumar and Younger, 2000; Rakesh, 2006).

Providing access to safe water and sanitation to combat poor health is an integral part of the strategy to alleviate poverty in many countries according to the United Nations Development Assistance Framework (UNDAF, 2006). NEMA (1994) has it that, the main causes of mortality and morbidity are environmental in nature since they are caused by living and non-living agents in the environment, poor sanitation and hygiene, and poor feeding habits. It is therefore, not surprising that malaria, diarrhoea and malnutrition are among the top 10 causes of mortality in Uganda.

According to WEHAB working group, August 2002, diarrhoeal diseases, a result of lack of adequate water supply, in the past ten years have killed more children than all people lost to armed conflict since World War II. The widespread failures in water supplies have been attributed by Carter et al (1999) to a number of factors in a project: (1) the intervention was not desired by the community, (2) the capital and/or recurrent costs are too high for the community, (3) lack of ownership results in neglect of maintenance and repairs, (4) the promised benefits do not materialize, (5) education programs are too short, and (6) trained members of the community move away or lose interest (Carter *et al*, 1999), (7) water source contamination which attributed to human activities.

Measures to ensure proper management and provision of safe domestic water supply

Providing access to safe water to combat poor health is an integral part of the strategy to alleviate poverty in many countries according to the United Nations Development Assistance Framework (UNDAF, 2006). However, unless strategies are found to motivate rural and urban communities and create a demand for water, we cannot achieve the United Nations Millennium Development Goal of halving the proportion of the global

population without sanitation and access to safe water by the year 2015 (Waterkeyn and Cairncross, 2005). Clearly, more resources need to be applied to solving the water supply and sanitation problems of rural and urban people alike.

And for this stronger methodologies for fostering rapid implementation must be devised, and answers must be found to why sanitation and hygiene programmes are often non-sustainable. These approaches followed by different urban water supply and sanitation service providers in different areas need to be evaluated so that those approaches resulting in sustainable services can be identified. Similarly, those approaches which resulted in non-successive urban water supply and sanitation services need to be identified so that they will not be used in the future by providers (Waterkeyn and Cairncross, 2005).

Approaches to community management at the local level vary greatly depending on local conditions and the nature of the services to be delivered. In general successful community management takes place in a supportive environment where careful upfront planning to identify suitable approaches is supplemented with access to long-term external support. Robust financial strategies and professionalism seem also to play an important role in ensuring that community-managed services are sustained in the long term. Examples include professionally-managed pay-to-use community toilets, water kiosks and commercial septic-tank and pit-emptying services.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

In this chapter the methods of the study were presented and discussed. Attention was given to the research design, the population and sampling, data collection procedures, the research ethics to be adhered to, the instruments and measures to employ, and the techniques that were utilized for analyzing the data.

Description of the study area

As indicated in Figure 2, Gardo town is situated at North East of Somalia and 250 km from Bossaso (Puntland). It is a centre for commercial business of Nugal, Bari and Sanaag regions. Due to its geographical location, the town is the centre for livestock pasture. It has been inhabited for more than 200 years, and was the centre of Italian colony in North east regions.

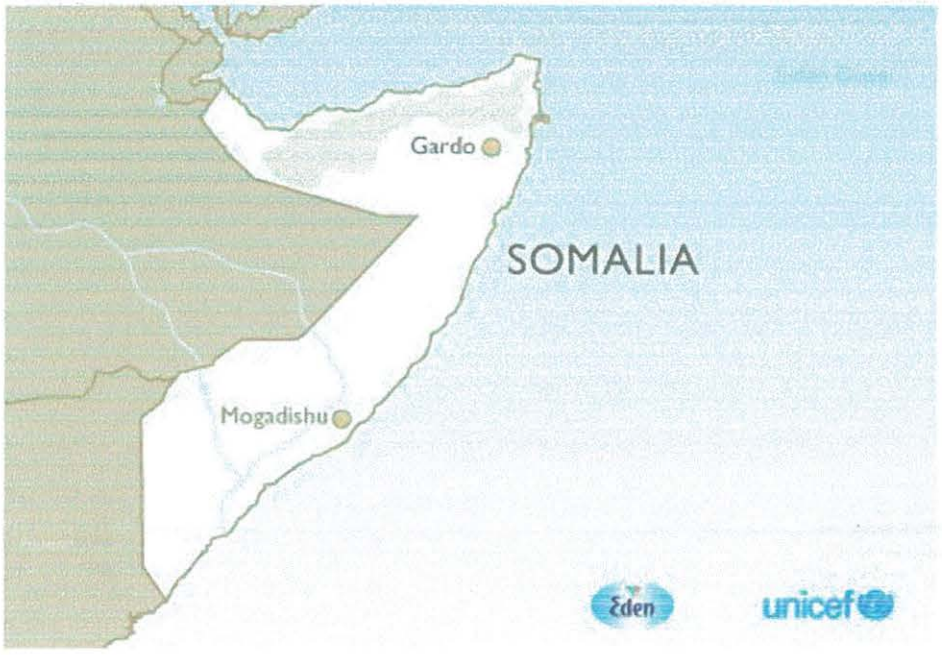

Figure 2: Gardo, Somalia map

After the collapse of the Central Government, Gardo became one of the biggest cities in North Eastern, because of the continuous influx of people evading from civil strife in southern part of Somalia. The resident population of Gardo is an estimated 36,000 people and all from different parts of Somalia. The population varies in seasons and in years due to the influx of families from drought affected communities from the rural areas. It is estimated that as many as 1,000 destitute families live in the town's outskirts in slum settlements near the major boreholes. When it is very hot in the coastal areas, another 1,500 households shift to Gardo to benefit from its more moderate climate and the availability of livestock products. This puts additional pressure on the already limited water resources in the town. During the colonial time, deep shallow wells were used as sources of Water supply.

1.4 Research design

According to Shajahan (2006), a research design is a logical and systematic plan prepared for directing a research study. It specifies the objectives of the study, and the methodology and techniques to be adopted for achieving the objectives. It constitutes the blueprint for the collection, measurement and analysis of data.

The research took the form of a descriptive and comparative survey designs, and the reason for this is because it is aimed at describing the current situation so that it could be understood clearly in order for the gaps identified to be addressed. It also adopted a case study approach to investigate the current development and promotion practices of urban water and sanitation management. Since it would be impossible to carry out research in the whole country, the research used a case study of Gardo district, and the information obtained from there would be treated as representative of the entire country at large. The design was appropriate because it involved drawing small samples in order for in depth analysis to be made.

The study was both qualitative and quantitative. The quantitative data was obtained using structured questionnaires from different residents, civil servants and non-government organizations workers both dealing in water related issues and non water related issues since water affects all, while the qualitative data was obtained from key informants, through interviews and observations.

3.2 Research population

According to Amin (2005), the population is the complete collection (or universe) of all the elements (units) that are of interest in a particular investigation. In the study, the target population were residents and both private and government owned organizations dealing in water related issues. These three categories of respondents were considered because they had adequate information on the aspects considered in the study. The population of the study in this research was comprised of 170 people.

3.3 Sample size

According to Amin (2005), the sample is the collection of some (a sub-set) elements of a population. The sample for this study consisted of 120 respondents chosen from among the residents, civil servants and non-government organizations workers both dealing in water related issues in Gardo district. The population was divided into strata of residents, government and non-government organizations. Through stratified random, sampling was determined the extent to which each stratum in the population would be represented in the sample and it guaranteed representation for all the population. Samples of 73 households, 25 local government officials, 30 civil servants and 42 non government organizations workers were considered (Table 1).

Table 1: Sample size and sampling procedure

Category of respondents	Population	Sample size	Sampling Method
Local government	25	18	Random
Civil servants	30	21	Random
Non-government organization employees	42	30	Purposive
Residents (households)	73	51	Random
Total	**170**	**120**	

3.4 Sampling procedure

Stratified random sampling was used in order to get a representative sample of the study population. This technique ensured representation of significant sub-groups of the population. After putting the target population into strata, simple random sampling was used in selecting the civil servants, non-government organization workers and residents from the study area. A sample had to be carefully selected if there was to be confidence that the findings from the sample are similar to those that would be found among the rest of the category under investigation.

In this study, a sample of 120 respondents was used. These were selected using both simple random sampling and purposive techniques. Purposive techniques was used more in order to attract respondents who are capable of providing the most appropriate information on the subject matter. In determining the sample, the research was guided by Sloven's sample selection formula as follows;

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

Where;

n = Sample

N = population

e = the confidence at 0.05

3.5 Research instruments

The main methods of data collection used in the field included questionnaires and interviews. The research designed the questionnaire in such format where there were closed and open-ended questions. For closed questions, respondents were supposed to pick responses from a list, category of questions. For open-ended, respondents were requested to give their own opinions.

In some cases face to face interviews were organized and conducted with respondents and record the findings. The interview method helped to collect information from purposively selected respondents who would not have time to complete the questionnaires and those who could not read or write. The interview method also enabled to gather detailed information from the respondents since this method involved face to face interactions. Direct observation in addition to secondary data collected through consultation of secondary materials including text books, journal articles and internet sources.

3.6 Validity and reliability

In this research validity of the respondent's instruments questionnaire was established through a content validity index CVI by given the instrument to expert in his/her field and they judge whether the instrument is valid or not.

The researcher computed the content validity from experts judgments by using content validity index formula.

$$CVI = \frac{\text{Number of questions declared valid}}{\text{Total number of questions}}$$

The test-retest technique was used to determine the reliability (accuracy) of the researcher devised instruments to eight qualified respondents, four from ministry of health and four from ministry of health. These respondents were not being included in the actual study. In this test- retest technique, the questionnaires were administered twice to the same subjects.

3.7 Data gathering procedures

The study was collected in both primary and secondary data relevant to the study, using questionnaires and interview guides. The data collection process was organized and conducted in three stages;

Before collecting data; In this stage preparations based on the conditions in the field of study were made. It was also important to make an assessment of the weather conditions, literacy levels and linguistic characteristics in the study area so as to determine the best methods to use as well as preparing questionnaires and interview guide.

During data collection; At this stage appointment schedules with all the respondents were made so as to enable the researcher to meet all respondents at the scheduled time. This helped to keep time and ensure the convenience of respondents.

After collecting data; At this stage, the data obtained from the field was systematically organized in preparation for analysis and presentation.

3.8 Data analysis

The frequency and percentage distribution were used to determine the profile of respondents.

The mean and standard deviations was used for the levels of community water management and, supply water that is to demonstrate the strengths and the weaknesses of the community water management and Water supply. From these strengths and weaknesses, the recommendations were derived.

The chi-square was used to analyze if there is significant relationship in the level of community water management and supply of water on their profile characteristics.

3.9 Ethical considerations

This involved seeking permission from the senior officials in the district. Permission was also sought from the relevant authorities with respect to the respondents' views. This was important for the protection of the respondents from harm or harassment and the confidentiality of the respondents and their superiors' sensitive information.

There was also need to use professional and ethical standards to plan, collect and process data. To obtain the study objectives the study ensured that only those techniques for which they were qualified by education, training and experience were used. Whenever in doubt, clarification from the research community especially the immediate supervisor and research colleagues was also sought.

The data collected was interpreted according to general methodological standard and also the elements that were irrelevant to data interpretation were excluded from the report. The anonymity for respondents who

wished to be protected from exposure were guaranteed, and ensuring that all the information given was kept very confidential and used only for purposes indicated in the purpose of the study.

Solicit permission through a written request to the concerned officials of the Gardo District.

3.10 Limitations in the study

There may be some problems which can reduce the validity of this study such problems include the following; i) The limitation of study period and financial resources, ii) Extraneous variables which was beyond the researcher's control such as respondents' honesty, personal biases and uncontrolled setting of the study, ii) Research assistants needed more time to be oriented and briefed on the procedures to be done in data collection.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter is a presentation, analysis and interpretation of the data based on the findings from the field of study. This chapter therefore shows the profile of the respondents, community water sources in Gardo district, how the water sources are managed, as well as the supply of safe domestic water to households in the local community in Gardo district.

Demographic information of respondents

The study used a sample of 120 respondents from Gardo district in Somalia, and was carried out based on three specific objectives; i.e. to establish domestic water sources in Gardo district; to establish the challenges faced by local community in getting safe domestic water; and to examine the relationship between management of water sources and the supply of safe domestic water to households in Gardo district.

Efforts were made to sort and present findings based on study objectives. However, for more systematic discussion and analysis, the first section presents the demographic characteristics of the respondents. The demographic characteristics of the respondents were in terms of age, education level and sex. The age distribution of respondents is presented in Table **2.**

Table 2: Percentage distribution of respondents by age

Age group	Frequency	Percentage
Below 20 years	10	8.3
21-30	17	14.2
31-40	37	30.8
41-50	21	17.5
51-60	23	19.2
61-70	12	10
Total	120	100

As indicated in Table 2, the ages of respondents were divided into six categories; 10 respondents were aged below 20 years (representing 8.3%), 17 respondents were aged between 21 – 30 years (representing 14.2%), 37 respondents were aged between 31 – 40 years (representing 30.8%), 21 respondents were aged between 41 – 50 years (representing 17.5%), 23 respondents were aged between 51 – 60 years (representing 19.2%), and 12 respondents were aged between 61 – 70 years (representing 10%). This implies that the study involved respondents from all age groups, bringing in the views of all age groups in the population.

Table 3: Percentage distribution of respondents by sex

Sex	Frequency	Percentage	Cumulative percent
Male	74	61.7	61.7
Female	46	38.3	100
Total	120	100	

Table 3 shows the distribution of respondents by sex. The majority of the respondents were male 74 (61.7%) and 46 (38.3%) were female of the

total number of respondents. This shows that the number of males is more than the number of females.

Table 4 Percentage distribution of respondents by Education level

Education level	Frequency	Percentage	Cumulative percent
No education	44	36.7	36.7
Primary	25	20.8	57.5
Secondary	34	28.3	85.8
Degree	17	14.2	100
Total	120	100	

The results in Table 4 also show the perspective of education levels, where 17 respondents were University Degree holders (representing 14.2%), 34 respondents were secondary school holders (representing 28.3%), 25 respondents (representing 20.8%) primary school dropouts and 44 respondents had no education at all (representing 36.7%).

Sources of domestic water in Gardo district

The first specific objective was to identify the sources of domestic water in local communities in Gardo district, in Somalia, and in achieving this objective, respondents were asked to mention the various sources from which they obtain safe water for domestic use in their household. Figure 3 shows the various responses from the respective respondents.

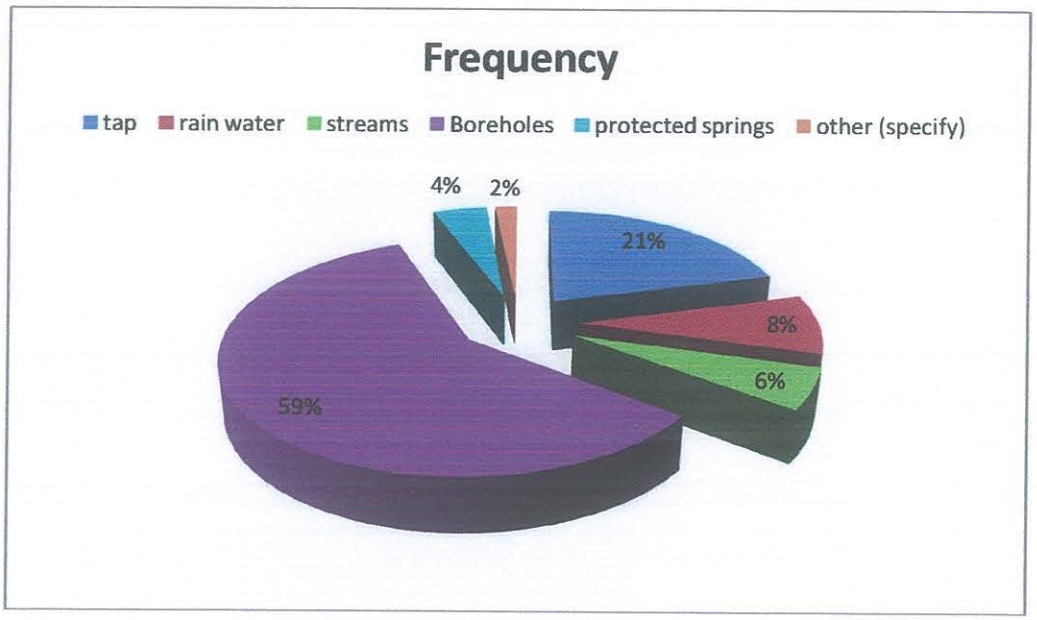

Figure 3: Responses on the sources of water

The findings in Figure 3 show that 21% indicate that their main source of safe domestic water was piped water supplied through the town water system. This is a reliable but expensive source which is limited to the central areas of Gardo town and even then, it's beyond the affordability of most of the population. Some respondents (59%) said that their main source of water were the boreholes, which are the most common source of water in Gardo and its outskirts, according to the respondents, and from the observations. Respondents (8%) said that their water source was rain water. Respondents (6%) said that their water resources were streams.

The result show 4% of the respondents said that their water resources were protected springs, while 2% of the respondents said that their water resources were purified water. Boreholes are the most widely spread source of safe water, mostly constructed by local government, by not-for-profit non-government organizations, by combined local community initiatives, and by private citizens for private use.

However, these boreholes are not enough to serve the communities' water needs and are often laden with long queues where people spend an average of three to five hours to get water. Respondents were also asked to reveal who provides water safety education and the results are given in Table 5.

Table 5: Providing safe water education

	Frequency	Percentage	Cumulative percent
Political leaders	**50**	**42**	**42**
Community facilitators	**22**	**18**	**60**
Extension workers	**36**	**30**	**90**
Volunteers	**12**	**10**	**100**
T0tal	**120**	**100**	

According to Table 5 the majority of the respondents 50(42%) agreed that safe water education is provided by politicians, 36(30%) agreed that safe water education is provided by extension workers, 22(18%) agreed that safe water education is provided by community facilitators while 12(10%) revealed that safe water education is provided by volunteers.

Challenges of obtaining safe domestic water in Gardo communities

The second specific objective of the study was to examine the challenges faced by local communities in trying to acquire safe water for domestic use, and to achieve this objective, respondents were asked to give their response on the various challenges they faced as regards to obtaining safe water for their household use. Their responses were analyzed using percentages computed through the SPSS programme and are shown in Figure 4.

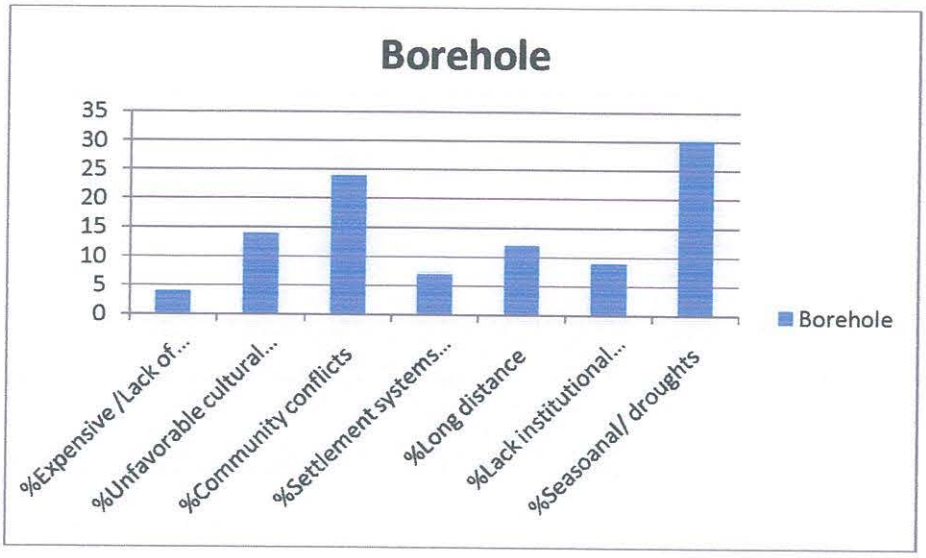

Figure 4: Challenges of boreholes as a source of water

Figure 4 shows the Percentage distribution of the challenges of boreholes. The results show 30% of the respondents indicated that most challenges of boreholes are seasonal related (droughts), while 24% of the respondents indicated that their challenges of boreholes are community conflicts and 9% of the respondents indicated that challenges of boreholes are related with lack institutional structures and good Policy.

Again 12% of the respondents indicated that their challenges of boreholes are related long distance since they are located outskirts of the city, while 4% of the respondents indicated that their challenges are expensive because of lack of capital and 7% of the respondents indicated their challenges are settlement systems (slums), while (14%) indicated cultural beliefs.

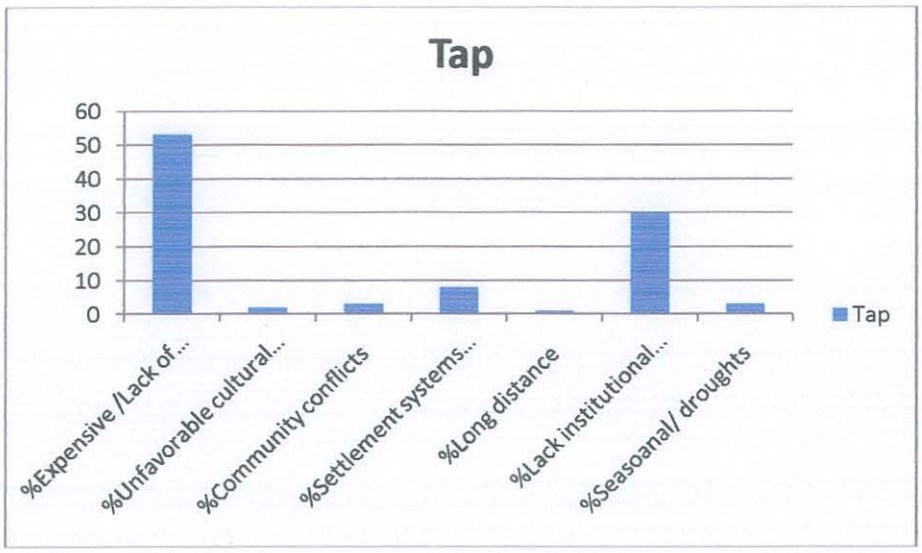

Figure 5: Challenges of tap water as a source of water

Figure 5 shows the Percentage distribution of the challenges of tap water. The results show 53% of the respondents indicated that most challenges of tap water are expensive (lack of capital), while 30% of the respondents indicated that their challenges of tap water are lack institutional structures (good Policy) and 8% of the respondents indicated that their challenges of tap water are settlement systems (slums).

Again 3% of the respondents indicated that their challenges tap water are community conflicts, while 1% of the respondent indicated their challenges are long distance and 3% of the respondents indicated their challenges are seasonal (droughts), while 2% indicated cultural beliefs.

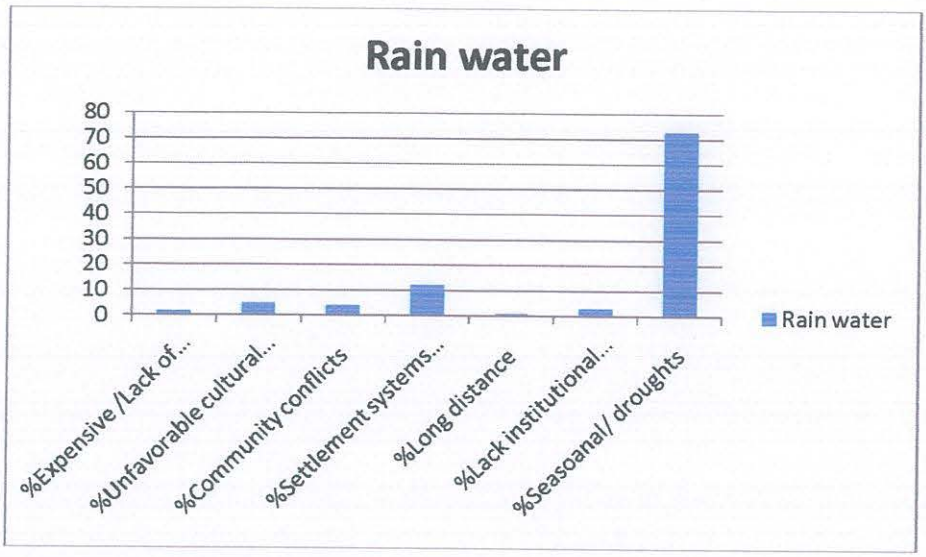

Figure 6: Challenges of rain as a source of water

Figure 6 shows the Percentage distribution of the challenges of rain water. The results show 2% of the respondents indicated that their challenges of rain water are expensive (lack of capital), while 3% of the respondents indicated that their challenges of rain water are lack institutional structures (good Policy) and 12% of the respondents indicated that their challenges of rain water are settlement systems (slums).

Again 4% of the respondents indicated that their challenges of rain water are community conflicts, while 1% of the respondent indicated their challenges of rain water are long distance and 73% of the respondents indicated their challenges are seasonal (droughts) while 5% indicated cultural beliefs.

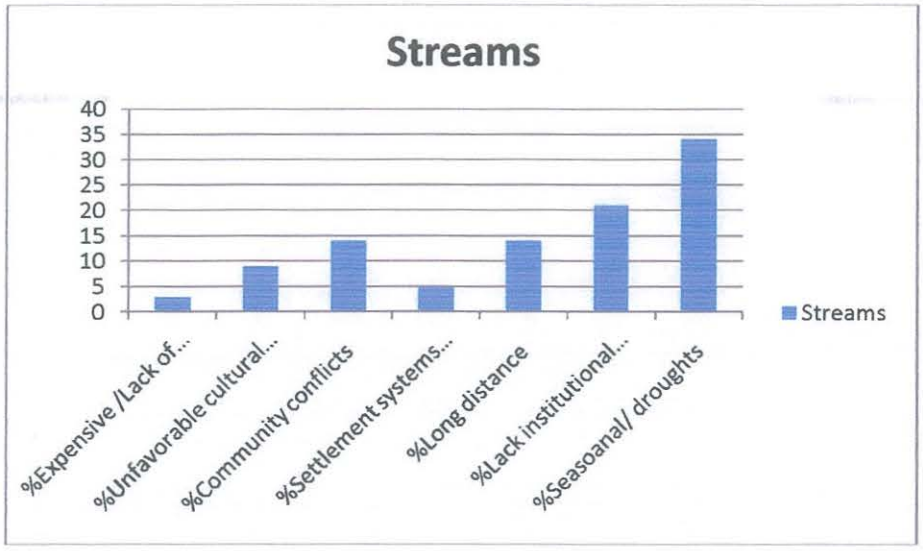

Figure 7: Challenges of streams as a source of water

Figure 7 shows the Percentage distribution of the challenges of stream water. The results show 3% of the respondents indicated that their challenges of stream water are expensive (lack of capital), while 21% of the respondents indicated that their challenges of stream water are lack institutional structures (good Policy) and 5% of the respondents indicated that their challenges of stream water are settlement systems (slums).

Again 14% of the respondents indicated that their challenges of stream water are community conflicts, while 14% of the respondent indicated their challenges of stream water are long distance and 34% of the respondents indicated their challenges are seasonal (droughts) while 14% indicated cultural beliefs.

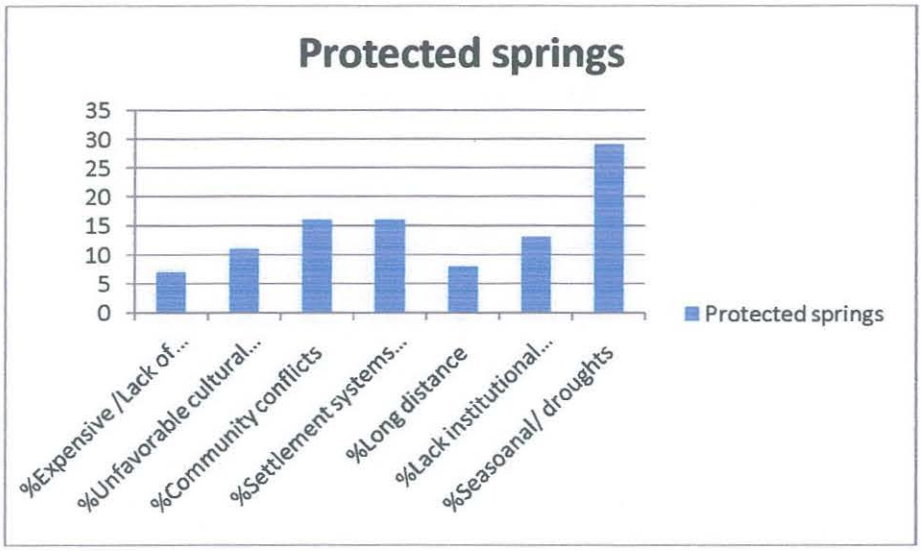

Figure 8: Challenges of protected springs as a source of water

Figure 8 shows the Percentage distribution of the challenges of protected springs. The results show 7% of the respondents indicated that most challenges of protected springs are expensive (lack of capital), while 13% of the respondents indicated that their challenges of protected springs are lack institutional structures (good Policy) and 16% of the respondents indicated that their challenges of protected springs are settlement systems (slums).

Again 16% of the respondents indicated that their challenges protected springs are community conflicts, while 8% of the respondent indicated their challenges of stream water are long distance and 29% of the respondents indicated their challenges are seasonal (droughts) while 11% indicated cultural beliefs.

According to the local government officials, access to safe water is a major challenge in Gardo, mainly because the water sources are inadequate to adequately serve the water needs of all the people in Gardo district. As such, many people do not have access to enough safe water for their

domestic use, and many people, especially women and girls, spend much of their time waiting to get water, thus minimizing the ability of women to fulfill other domestic tasks in their households, and also limiting the opportunities for girls to attend school.

Relationship between management of water sources and supply of safe domestic water

The third and last objective in the study was to examine the relationship between the management of water sources and the supply of safe domestic water to households in the local communities in Gardo district. The study took a null hypothesis that there is no significant relationship between community water management and the supply of safe domestic water in Gardo district. To test this hypothesis, the Chi-Square was used. The summary of r-value of those variables is presented in Table 6.

Table 6: Chi-Square on the relationship between management of water sources and the supply of safe domestic water to the community in Gardo district

Chi-Square Tests					
	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.073[a]	1	.001		

Since the p value (0.001) is less than the level of significance α (0.05) then this implies that there is a significant relationship between the management of water sources and the supply of safe domestic water to households, that the current methods used in the management of water sources are significantly related with inadequate and irregular water supply, which results into lack of access to enough safe water for domestic use in the households. The current methods used in the management of water sources are also significantly related with breakdown of the piped water supply system, leading to unreliable access to safe water by those communities served by the tap systems. The current methods used in the

management of water sources are also significantly related with water contamination, making the water unsafe for domestic use in households.

The current methods used in the management of water sources are also significantly related with inter-clan clashes over the control of water sources, thereby limiting access by the weak and the poor. The current methods used in the management of water sources are also significantly related with prolonged droughts, which result into irregular rains.
Accordingly, the null hypothesis is rejected, and thus it can be stated with certainty from the findings of the study that the management of water sources has a significant effect on the supply of safe water for domestic use in the households in the local communities in Gardo district, in Somalia.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter makes a presentation of the conclusions reached from the study and the recommendations made. The study used both qualitative and quantitative methods of analysis.

5.1 Summary

The findings show that Gardo being as a centre for commercial business of Nugal, Bari and Sanaag regions and 61.7% of the respondents were male, while 38.3% were female. Of the respondents 8.320% were aged below 20 years, while 14.2% were aged between 21 – 30 years and 30.8% were aged between 31 – 40 years, also 17.5% were aged between 41 – 50 years, while 19.2% were aged between 51 – 60 years and 10% were aged between 61 – 70 years.

As far as education levels 14.2% of the respondents were university degree holders, while 28.3% were secondary school and 20.8% were primary school, while 36.7% had no education at all. Also, 12.5% of the respondents were local government officials, while 16.7% were civil servants and 25% were employees of Non-governmental organizations, while 45.8% were local residents (households).

The findings show that 59% of the respondents indicated that their main source of safe domestic water was boreholes, while 70% of the respondents said that their main source of water were boreholes and 8% of the respondents indicated that their water was rain water. Also, 6% of the respondents indicated that their water resource was streams, while 4% of the respondents indicated that their water resources was protected

springs and 2% of the respondents indicated that their water resources was purified water (bottled water).

According to the local government officials, access to safe water is a major challenge in Gardo, and findings show according to their water sources, boreholes are their main sources of water with the major challenges of the community conflicts and seasonal (droughts), while the major challenges of people using tap water sources are lack of capital (expensive) and lack of good policy to govern and manage the systems.

Some communities use a rain water source with major challenges of being seasonal due to long droughts therefore, are not reliable and again due to conflicts from inter-clan clashes overcrowded population. Results highlight the major challenges of people using spring water as being less being not protected well and also having inter-clan clashes. Again Gardo water supply through protected springs is very expensive and the respondents indicated the long distances of traveling to obtain water.

The findings indicated that there is significant relationship between the management of water sources and the supply of safe domestic water to households, in that current poor management of water sources leads to inadequate and irregular water supply; breakdown of the piped water supply systems; water contamination; and crowded settlement and inter-clan clashes over the control of water sources.
Accordingly, the hypothesis is rejected, and thus it can be stated with certainty from the findings of the study that the management of water sources has a significant effect on the supply of safe water for domestic use in the households in the local communities in Gardo district, in Somalia.

5.2 Conclusions

A highly populated Gardo district being the centre for commercial business of Nugal, Bari and Sanaag regions with many local communities not being educated. Urgently need better well understood management systems of community water sources and supply of domestic water. This will reduce the current poor management, being not protected well, being expensive and long distance of traveling for water sources leads to inadequate and irregular water supply; breakdown of the piped water supply systems; water contamination; and crowded settlement and inter-clan clashes over the control of water sources that include boreholes, taps, streams, rain water and springs.

Somalia authorities should follow one of the critical components of the Millennium Development Goals (MDGs) which is to increasing access to safe domestic water supply coupled with improved water resource management and development in urban and rural areas. Access to safe water supply is essential to health, a basic human right and a component of effective policy for health protection.

The importance of water, sanitation and hygiene for health and development has been rightly emphasized in the outcome of a series of international policy reforms especially the millennium development goal number 7, which is concerned health providing access to safe water to over 1 billion slum dweller.
This also reflects World Health Organizations' (WHO) directives were domestic water for all domestic industry purposes which include drinking, cooking and bathing to be supplied safely, and secure by measuring adequacy of water in the household all such uses should be considered.

The game theory of water resource management was upheld by the findings of the study. This is because the study has illustrated that the

various sources of safe water in Gardo are mainly determined by different parties with different interests, both as individuals and collectively, and that they face various challenges and also that a significant relationship exists between how the water sources are managed, and the supply of safe domestic water to households. This is in line with the game theory of water resource management, which states that managing water resources systems usually involves conflicts. Behaviours of stakeholders, who might be willing to contribute to improvements and reach a win–win situation, sometimes result in worse conditions for all parties (for example the inter-clan clashes), and that different parties give priority to their own personal interests, rather than the common interests.

The study indicates the most reliable sources of the water are tap water, in this community the water tap is very expensive and the government should subsidize so that the community can afford and get more time for other tasks especially women and children.

Also this study records indicate that, water is poorly managed; water managers perform poorly, as only a section of the community enjoy safe adequate drinking water. The rest (poor and informal settlements face a high risk of contracting all sorts of water related diseases). In a number of countries, the provision of water supply services is devolved to local communities, it is believed that, this will ensure service delivery more attuned to consumer priorities, and that providers are more accountable for their actions. Depending on the actual conditions and priorities of this community, many more options may be welcome.

Poverty, education and trust seem to be the major barrier to community participation in its earlier introduction in Gardo district. Nevertheless, if stakeholders should be identified and recognized and allow to freely contribute, the people will play important role in improving the efficiency of water service provision and management in the Gardo district.

The hypothesis adopted by the study was rejected, and a positive hypothesis was vindicated. The study found out that there is a significant relationship between the management of water sources and the supply of safe domestic water to households, since the p value (0.001) is less than the level of significance α (0.05). This therefore rejected the hypothesis of the current study.

The gaps have been bridged in the literature, for example, though many of the reviewed studies concentrated on other areas, the current study concentrated on the management of water sources and the supply of safe domestic water to households in Gardo district, in Somalia.

5.3 Recommendations

1. The concerned government authorities should improve the current poor management of water sources that leads to inadequate and irregular water supply.
2. The government cooperating with the local communities should establish management systems for regular maintenance and protection of water supply systems to reduce breakdown of the piped water supply systems.
3. Existing institutions in the water sector in Gardo district are weak. Such institutions should be strengthened at community and regional levels to guide the process of project implementation especially regular Environmental Impact Assessment (EIA) that involves monitoring and while guiding implementation process and checking water contamination and other related environmental safety issues.
4. There is need to improve and promote technical capacity to for establishing and maintenance of safe water sources such as, boreholes, taps, streams, rain water, springs and other alternatives.
5. The government of Somalia should do upfront planning to identify suitable approaches is supplemented with access to long-term

external support, purchase new equipment for safe water supply while being guided by the critical components of the Millennium Development Goals (MDGs) and World Health Organization (WHO) as it plans, programmes, implements, monitors domestic and industries water supplies in Gardo District.

6. The government should establish gender sensitive policies to promote general education levels and the water safety awareness especially within women, girls and boys improving the current non-sustainable participatory mechanisms in Gardo District safe water supplies.
7. Getting safe water being a human right, the Somalia government authorities should provide appropriate budget for capital to establish enough easily access water sources, while subsidizing operational costs and providing other financial strategies with the necessary professionalism which play an important role in ensuring that community-managed services for sustainability. Also this provides alternatives environmentally friendly sources, and motivates communities to participate in the management of the community water sources and the supply of safe domestic water source.
8. Cost-benefit analysis should be done to evaluate the possibility of pay-to-use safe water services such as community toilets, protected springs, water tap kiosks, commercial septic-tank, the safe water sachets and bottled water, hygiene programmes, pit-emptying services and other sanitation systems.
9. Local councils should participate in mobilizing the masses for periodical maintenance of water sources. This involves members of the community working together to keep their water sources clean and safe.
10. Civil society should also take an active role in increasing public, scientific and business knowledge on the management of water sources, water supply and access, and spread awareness through research and advocacy campaigns. Since local community

participation in management safe water supply is affected by cultural and religious beliefs, it is important for the relevant Community Basted Organizations (CBO), Non-government Organization (NGOs) together with government authorities should promote the necessary awareness to different clans. This encourages government to take the issue seriously and to begin to act.

11. Civil society organizations also need to continue increasing consumers' knowledge of water management by placing the issue on the public agenda through collaboration with the media. Residents need to be informed of their role in water sources management, water utilization, and encouraged to adopt responsible water use behavior.
12. There should be proper sensitization by relevant Community Basted Organizations (CBO), Non-government Organization (NGOs) together with government authorities of the masses about the need for proper management of local community water sources. Sensitization campaigns where the masses are educated about the need of proper water management should be set up. This will deal with the problem of the ignorance of the masses.
13. There is need for establishing and improving formal and informal educational institutions providing appropriate syllabus and programmes for training communities about adequate methods of water management is also important. This will ensure that the water sources are secured and improve access to safe water.
14. The district administrative authorities should restructure the such that it directs enough includes funds towards effective management of water sources.
15. To reduce the conjunction, overcrowding over water resources, construct new boreholes and rehabilitate old ones, expand the piped water supply systems, and dig more shallow wells is encouraged to increase access to water to local communities.

16. The government should provide favorable conditions to encourage privates sector to construct and develop water sources, for example by offering tax holidays or not taxing them entirely (the investors.)
17. The district administrative authorities should review and set up, policies and laws to protect and govern water resource management standards and should establish organizations to monitor the observation of these laws.
18. The people should also be encouraged to utilize water effectively. Effective water use can include recycling, for example, water used for cleaning utensils and washing can be drunk by animals. People should also be encouraged to ensure that the water sources are not in the proximity of dangerous contaminating materials like petroleum waste, human and animal waste and are protected from sand storms. Government should clearly define and allocate dumping grounds for proper disposal of the solid wastes.
19. Water quality is a major concern in Gardo district. It should be done much in the region to address the problem, but more needs to be done to sensitize so as to stop viewing water availability only in terms of quantity, but quality as well. Such an approach would alleviate the regular outbreaks of water-borne diseases e.g., diarrhea.
20. Further research and studies are needed to evaluate the number, geographic locations assessing water source distances, yields of different sources, and deferent water user dependability causes of inter-clan clashes, population control, safety checks, policies, seasonality, alternative safe sources e.g. the safe water sachets and bottled water, and quality of the water sources. This will improve the management of the community water source and the supply of safe domestic water in Gardo District.

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APPENDICES I: TRANSMITTAL LETTER

Dear Sir/Madam,

Greetings,

I am a candidate for Masters of Science in Environmental Management and Development of Kampala International University with a thesis on "Management of community water sources and the supply of safe domestic water in Gardo district, Somalia". As I pursue to complete this academic requirement, I humbly request you to assist me by being part of this study.

The objectives of the research are: to find out the sources of water; to establish the challenges faced by local community in getting safe domestic water; to examine the relationship between management of water sources and the supply of safe domestic water to households in Gardo district.

You have been selected to respond to this questionnaire therefore your contribution is needed to ascertain the management and provision of water and sanitation in Gardo, Somalia. This is purely an academic research. All information you will provide that may be personal will remain confidential.

How to complete this questionnaire

- ☞ Persons completing this questionnaire should be residents of Gardo, civil servants or employed in the private sector within Gardo
- ☞ Tick where options have been provided
- ☞ Should you wish to add a comment on this research, please add it in the space provided

Kindly provide the most appropriate information as indicated in the questionnaires and please do not leave any item unanswered. Any data from you shall be used only for academic purposes and shall be kept with utmost confidentiality.

May I retrieve the questionnaires two weeks after you receive the? I thank you very much in advance.

Yours truly

.....

Mohamed Warsame Ainab

APPENDICES II: RESPONDENTS' INFORMED CONSENT

I am giving my consent to be part of the research study for Mr. Mohamed Warsame Ainab, which will focus on Management of community water sources and the supply of safe domestic water in Gardo district, Somalia.

I shall be assured of privacy, anonymity and confidentiality and that I will be given the option to refuse participation and right to withdraw my participation at anytime.

I have been informed that the research is voluntary and that the results will be given to me if I ask for them.

Initials: _____

Date: _____

APPENDICES III: QUESTIONNAIRE FOR USER COMMUNITIES

DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Dear Sir/Madam,

My name is Mohamed Warsame Ainab, master's student in Environmental Management and Development candidate of Kampala International University. Part of the requirements of the award is a thesis. My study is entitled, Management of community water sources and the supply of safe domestic water in Gardo district, Somalia. Within this context, may I request you to participate in this study by answering the questionnaires; kindly do not leave any option unanswered. Any data you will provide shall be for academic purposes only and no information of such kind shall be disclosed to others.

1. What is your age?

≤20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	>70

2. Gender of respondents

Male	Female

3. What is your level of education?

Not attended school	primary	Secondary	university

4. How many people, including yourself, are in your household?

1	2	3	4	5	>5

Sources of water

1. What are the major sources of water in this community

   Tap ☐ Rain water ☐ Streams ☐ Boreholes ☐ Protected ☐ springs other (specify)

   .....

2. Are there different uses for water from different sources (drinking, cloth washing and bathing)? Yes ☐ No ☐

   If your answer for Q2 is yes, which source(s) of water do you use for drinking, most of the time?

   Tap ☐ Rain water ☐ Streams ☐ Boreholes ☐ Protected ☐ springs other (specify)

   .....

3. If your answer for Q2 is yes, which source(s) of water do you use for washing cloth, most of the time?

   Tap ☐ Rain water ☐ Streams ☐ Boreholes ☐ Protected ☐ springs other (specify)

   .....

4. If your answer for Q2 is yes, which source(s) of water do you use for bathing, most of the time?

   Tap ☐ Rain water ☐ Streams ☐ Boreholes ☐ Protected ☐ springs other (specify)

   .....

5. Is there a safe supply of domestic water to households in Gardo district? Yes ☐ no ☐

6. Who, if anyone, provides any water safety education in the community?
   1. Political leaders ☐
   2. Community facilitators ☐
   3. Extension workers ☐
   4. volunteers ☐

7. Did the community share experience with other communities who have best experience in water safety? (With the help of the organization)

   Yes ☐ No ☐

8. What are the challenges of obtaining safe domestic water in Gardo communities?

	Expensive /Lack of Capital	Unfavorable cultural believes	Community conflicts	Settlement systems (slums)	Long distance	Lack institutional structures/good Policy	Seasonal/ droughts
Borehole							
Tap							
Rain water							
Streams							
Protected springs							

Effects and what has been done to ensure provision and management of water and sanitation

9. Which one of the following bodies responsible to teach communities about safe domestic water supply has the greatest positive influence on you to construct latrine
    5. Political leaders ☐
    6. Community facilitators ☐
    7. Extension workers ☐
    8. volunteers ☐
10. Is the water point functional now? Yes ☐ No ☐
11. If your answer to question 19 is no, when did it stop functioning?
    1-5 months ago ☐ 6-10 months ago ☐ 11 months ago and beyond ☐
12. If your answer to question 19 is no, how long did it serve the community before it stopped functioning?
    Less than 6months ☐ 6-12months ☐ One year and above ☐
13. If your answer to question 19 is no, why it is not functioning? (Cause of non-functionality)
    Prolonged drought ☐ Poor maintenance ☐

(Other) specify.....

14. If you are not using the water supply service, what is the reason for not using the service?

Inaccessibility ☐ Unaffordable ☐ Long queues at source ☐

(Other) specify .....

15. What is the distance of the source from your home?

Less than 1 kilometer ☐ 2-5 kilometers ☐ 6 and above kilometers ☐

16. What time it takes to fetch water from the source and return back?

Less than 5minutes ☐ 6-30 minutes ☐ 31-60 minutes ☐

(Other) specify

.....

17. For how much time you have been using the water supply and sanitation services provided?

Less than 1 month ☐ 2-6 months ☐ 7-12months ☐

(Other) specify

.....

18. By whom the responsibility to fetch water most of the time in your household lies?

Woman ☐ Man ☐ Children ☐

(Other) specify.....

19. Is there a proper way of managing the water sources in your community? yes ☐ no ☐

20. What are your comments for achieving sustainability of safe domestic water supply services in urban areas?

Increasing awareness ☐ Improved accessibility ☐ improving solid waste management ☐

(Others) specify.....

Thank you for your cooperation