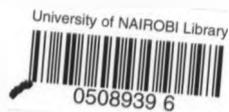


**RURAL-BASED WATER SECURITY COPING STRATEGIES: A CASE OF
MUHURU-BAY MIGORI DISTRICT, WESTERN KENYA**

By

Onditi, Francis Odari

**A Research Project Submitted in Partial Fulfillment of the requirements for the
degree of Masters of Arts in Development Studies**



**INSTITUTE FOR DEVELOPMENT STUDIES
UNIVERSITY OF NAIROBI**

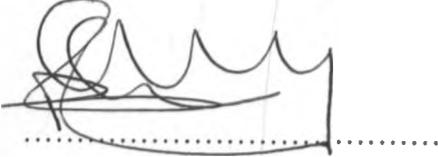
OCTOBER 2010

DECLARATION

This project paper is my original work and has not been submitted for examination in any other university.

Onditi, Francis Odari

Date



19-11-2010

This project paper has been submitted for examination with our approval as university supervisors

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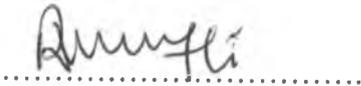
Date



19/11/2010

Dr. Rachel Musyoki

Date



19th Nov, 2010

Institute for Development Studies, University of Nairobi

DEDICATION

This work is dedicated to,

My mother Sarah Onditi for her prayers and my late father, Nicodemus Onditi

Obimbo in his memory

My daughter Lynne who was born at the time I joined the Institute for the Masters
program also shares this dedication

ACKNOWLEDGEMENT

The author wishes to thank all the people who contributed to the success of this research project paper. Special appreciation goes to my supervisors Prof. Mohamud Jama and Dr. Rachel Musyoki for their constructive guidance throughout the period of research. My gratitude also goes to the entire teaching staff of IDS for their academic and moral support.

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Last but not least, I wish to convey my heartfelt thanks to the Ex-chief of East Kadem, Mr. Siso Lwero for accommodating me during the tempting moment of field work. My deep appreciation goes to the entire Olando community for their hospitality during the period of field research.

ABSTRACT

Rural-based water security coping strategies (RUBAWACS) among rural communities is a common phenomenon not only in Kenya but worldwide. These strategies are seen as response to risks associated with water scarcity and contamination such as reduction in water per capita and water-borne diseases. However, response to these risks by communities through various strategies is hampered by a number of factors such as limited resources, cultural barriers, policy gaps as well as institutional challenges.

The rural-based water security coping strategies are informal responses that people rely on to solve resource-based problems that the government and other formal institutions cannot easily address. In spite of the importance of these strategies in supporting local communities in ensuring water security, studies are yet to fully address the question of how the various strategies contribute to water per capita and household sanitation. The main objective of this study was to investigate the impacts of rural-based water security coping strategies (RUBAWACS) in addressing challenges of water scarcity in Muhuru-Bay, Migori district. We utilized the livelihood theory as advanced by Chambers and Conway (1992) and Ellis (2000; 10) to describe the emergence and impacts of RUBAWACS on domestic water security in Muhuru-Bay. The United Nations Development Programs' concept of human poverty of 1965 was also explored and related to the enhancement of human development through provision of clean and safe water.

Data was obtained from field survey, secondary sources as well as PRA simple pair-wise ranking. For the field survey, a semi-structured questionnaire was used in Muhuru-Bay in four villages namely; Rabwao, Nyakiringoto, Bande and Olando. Sixty (60) respondents were randomly selected for interviewing. Eight key informants provided detailed information on key areas of investigation. This was complimented with in-depth key interviews as well as focus group discussion (FGD). In analyzing the field data, descriptive and inferential statistics was calculated using Statistical Package for Social Sciences (SPSS) program. This was then integrated with narratives and the results from PRA pair-wise ranking. Ground photographs were also captured to ascertain qualitative information from respondents. The graphical presentations of the frequency distribution in form of pie charts and bar graphs were made by the application of micro-soft excel (MS-Excel).

The general results across the four villages surveyed indicate that lack of rural water provision policy, poverty, inadequate sanitation facilities and cultural beliefs are some of the primary reasons for the persistent water problem in the area. Further results indicate that adoption of water security coping strategies was on the rise and that despite their high level of adoption, water per capita and sanitation conditions had not improved. Specifically, application of coping strategies had not necessarily increased amount of water required for most of the domestic activities. Hence water consumed falls below the global water per capita requirement. Consequently, the study found out that water for drinking was treated using both modern and traditional methods yet occurrence of water-borne diseases (cholera, bilharzias and typhoid) was common in the area. The Luo cultural values and resource scarcity were found to be some of the factors influencing patterns of water storage and treatment.

Based on the findings, a number of relevant recommendations are suggested. First, given the multifaceted nature of challenges facing rural water sector, the study proposes establishment of a Rural Water Development Authority (RUWADA) as an apex framework for rural water planning. The proposed policy framework would provide strategies and guidelines for domestic water access, utilization and management. A legal framework to protect source point water pollution is also a desirable component of the proposed policy. This is based on the fact that majority of the residents in the study area collect water from open lake and rivers. Secondly, the results suggest that water security is influenced by resource scarcity hence need to enhance access to water storage facilities affordably. Lastly, in order to mitigate against the negative effects of culture on domestic water management, the proposed policy framework (RUWADA) should consider integrating indigenous knowledge (IK) with modern domestic water management systems.

LIST OF ABBREVIATIONS

ADR	Area Development Report
ASAL	Arid and Semi-Arid Land
BWC	Bay Water Cooperative
CBO	Community Based Organization
CCA	Coping Cost Approach
CDC	Centre for Disease Control and Prevention
CMWS	Community Managed Water Supply
CPC	Community Project Cycle
CPR	Common Property Resource
DANIDA	Danish Development Assistance
DDC	District Development Committee
DDO	District Development Officer
DFID	Department for International Development
DOWAMS	Domestic Water Management Strategy
DPHO	District Public Health Officer
EEP	Environmental Education Program
FGD	Focus Group Discussion
GBV	Gender-Based Violence
GOK	Government of Kenya
HDI	Human Development Index
IKS	Indigenous Knowledge System
IPCC	Intergovernmental panel on Climate Change
KEBS	Kenya Bureau of Standards
LBDA	Lake Basin Development Authority
LAC	Latrine Awareness Campaign
LDC	Least Developed Countries
L.V.B	Lake Victoria Basin
MDDP	Migori District Development Plan
MDDSD	Migori District Disease Surveillance Department
MDGs	Millennium Development Goals
NGO	Non-Governmental Organization
NWSS	National Water Service Strategy
ODI	Overseas Development Institute
PRA	Participatory Rural Appraisal
RUWADA	Rural Water Development Authority
RWSI	Relative Water Stress Index
RUBAWACS	Rural-Based Water Coping Strategies
SAP	Structural Adjustment Program
SIDA	Swedish International Development Agency
SWS	Safe Water System
SPSS	Statistical Package for Social Sciences
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UN	United Nations
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WDC	Water Resource Users Development Cycle

TABLE OF CONTENTS

Declaration	ii
Dedication	iii
Acknowledgement	iv
Abstract	v
List of Abbreviations	vii
Table of Contents.....	ix
CHAPTER ONE	1
1.0 INTRODUCTION.....	1
1.1 Background Information.....	1
1.2 Statement of the Problem.....	3
1.3 Questions of the Study.....	5
1.4 Objectives of the study	5
1.5 Significance of the Study.....	6
CHAPTER TWO	7
2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK	7
2.1 Introduction.....	7
2.2 Kenya Rural Water Supply Program.....	7
2.3 Water, Sanitation and Human Health.....	8
2.4 Water Poverty and Property Rights.....	10
2.5 Methods of Water Treatment.....	11
2.6 Water Related Coping Behaviours.....	13
2.6 Water Related Coping Behaviours.....	14
2.7 Cost Implication of Water Security Coping Strategies	15
2.8 Summary of Literature.....	16
2.9 Theoretical Framework.....	17
2.9.1 Overview	17
2.9.2 Livelihoods Approach	18
2.9.3 Human Development Approach	20
2.9.4 Conceptual Framework	23
CHAPTER THREE	26

CHAPTER THREE	26
3.0 METHODOLOGY	26
3.1 Introduction.....	26
3.2 Description of the Study Area.....	26
3.4 Unit of Analysis	29
3.5 Population and Sampling.....	30
3.6 Data Collection.....	30
3.7 Data Analysis	32
3.8 Definition of Key Terms.....	32
3.9 Operationalization of Variables under Study.....	34
3.10 Challenges Faced During Field Work	35
CHAPTER FOUR	36
4.0 STUDY FINDINGS AND DISCUSSION	36
4.1 Introduction.....	36
4.2 Development of Water Security Coping Strategies in Migori.....	36
4.3 Background Information on Respondents	37
4.4 Why the Water Quality and Quantity Problem Persists	42
4.5 Domestic Water Requirement and Coping Strategies.....	47
4.6 Water Quality Coping Strategies (WQCS).....	54
4.7 Discussion of Key Findings.....	65
4.7.1 Persistence in Water Problem	65
4.7.2 Domestic Water Per Capita	71
4.7.3 Water Quality Coping Strategies and Human Health	73
CHAPTER FIVE	77
5.0 CONCLUSION AND RECOMMENDATIONS.....	77
5.1 Introduction.....	77
5.2 Research Conclusion	77
5.3 Recommendations	79
REFERENCES	83

Appendix 1: Questionnaire 1	89
Questionnaire 2: In-Depth Questionnaire (for key Informants)	93
Appendix 3 Sanitary, hygiene and wealth indicators Checklist	95
Appendix 4 Focus Group Discussion Questions	96
Appendix 5 List of the Key Informants	96
Appendix 6 Ranking Sanitation indicators using PRA Pair-wise rank	97
Appendix 7: Result of pair-wise ranking of sanitation indicators	98
Appendix 8 Matrix analysis for pair-wise ranking among the reasons for the persistence water problems in the four villages of Muhuru-Bay	99
Appendix 9 Summary of the proposed Apex Framework for Institutional coordination for Rural Domestic Water and Sanitation Provision	100
List of Tables	
Table 1: Percentage Distribution of Respondents According to the Village	30
Table 2: Percentage distribution of respondents according to their sources of water	40
Table 3: Percentage Distribution of Respondents According to their Reasons for the Persistence Water Problem in Muhuru-Bay	43
Table 4: Water Security Coping Strategies and Impact According to FGD Results	50
Table 5: Percentage Distribution of Respondents According to their Suggestions on ways of Improving Domestic Water Security	64
List of Figures	
Figure 1: Modified generic livelihood model	
Figure 2: Percentage Distribution of Respondents According to their Education	39
Figure 3: Percentage Distribution of Respondents According to their Domestic Water Consumption Category	48
Figure 4: Percentage Distribution of Respondents According to their Methods of Treating Water	57
List of Maps	
Map 1: Map of Kenya Showing Position of Migori District	28
Map 2: Map of Migori district showing its administrative boundaries	29
List of Photographs	
Plate 1: Photograph showing young children carrying out their domestic chores in Rabwao along the shores of Lake Victoria,	45

Plate 2 : Photograph showing a grass thatched house that are hindrance to water harvesting.	52
Plate 3: Photograph showing water harvesting facility.....	53
Plate 4 Photograph showing modern method of water storage	53
Plate 5: Photograph showing traditional pot water storage.....	53
Plate 6: Photograph showing water treatment using piece of cloth.....	56
Plate7: Photograph showing water boiling by use of solar panel heater.....	62
Plate8: Photograph showing water boiling using firewood.....	62
Case Studies	
case Study I: Traditional pot water purification and Coolant	59
Case study II: Bay Water Cooperative(BWC)	61

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The subject of water security and its role in Kenya's development space is a recurrent theme in any discourse on development of not only Kenyan society but the entire globe. Water is an undeniable right for all humans. Peoples' well-being is contingent upon equitable access to a safe, adequate and affordable water supply (Turton and Ohlson, 2000). In many parts of arid and semi-arid Africa, the shortage of water is already a critical limit to economic development. In fact water scarcity has been identified as a source of political instability (Wolf and Ross, 1992). There is also empirical evidence linking water shortages with diverse issues as food security, poverty alleviation, public health, and ecosystem protection (Agwata & Abwao, 2007).

In Lake Victoria Basin (L.V.B) for instance, the residents majorly depend on the lake for provision of both domestic water and livelihood activities (Douglas et.al, 2006). Specifically, reliability and sustainability of drinking water supplies and improved water management in human settlements reduces not only transmission of risks of water born diseases but also occurrence of food insecurity (Mireri et. al, 2007; Todaro and Smith, 2007; Krhoda, 1988). In order to achieve such situation, there is need to have functional water provision strategies which will lead to improved water per capita and sanitation.

In response to this water demand, the Kenyan government has made several attempts in ensuring that majority of its population access this life-sustaining item. To begin with, in 1963, the government launched Sessional paper No. 10 of 1965 titled: *African Socialism and its Application to planning in Kenya*. It was clear in this paper that the government was committed to ensuring that all citizens afford basic human needs including water. In pursuit of this vision the government has since engaged in various legal and policy reforms in water sector (Kenya, Republic 2000a). These policy and institutional framework reforms are aimed at improving water and sanitation as well as environmental management.

Ten years after the establishment of the Sessional paper No.10 of 1965, the government spelt out its plan for provision of potable water at a reasonable distance to all households by the year 2000. This strategy was outlined through the 1974-78

development plan (Kenya, Republic 1974). However, this strategy was thwarted in 1980s with advent of economic recession when the government begun experiencing severe budget constraints. It became clear that, on its own, it could not assure the citizens of adequate provision of clean water. Attention therefore turned to finding ways of involving other actors in the provision of water services. Such initiatives include the 1989-1993 government of Kenya and the UNICEF Plan of Operation that proposed the need to link the supply of water with the promotion of sanitation, both at rural household level and in urban planning (Kenya, Republic/UNICEF, 1991).

The publication of Sessional Paper No. 1 of 1999 on Water Resource Management was the first major initiative towards water commercialization. The overall goal of this national water development policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance (Kenya, Republic, 2000b). The aim here is to meet all competing users' needs in a sustainable, rational and economic way. For effective operationalization of the 1999 water policy and the Water Act of 2002, the government established National Water Service Strategy (NWSS) in 2003. This strategy focuses on poverty alleviation and improving quality of life at the same time promoting basic sanitation facilities particularly for the poor. The strategy postulated sanitation accessibility at 77.5 per cent in the urban setting and 72.5 per cent in the rural setting by 2015 (Kenya, Republic, 2004: SIDA/DANIDA, 2004: Kenya, Republic, 2002).

The establishment of the Water Service Trust Fund (WSTF) strategic plan 2008-2012 as a water funding framework for both rural and urban setting is also viewed as a strategy towards attainment of water security status. This framework has also been described as a measure for reducing burden of water collection from mainly women and girls who suffer the consequences of trekking long distances and vulnerability to gender-based violence (GBV) (Daily Nation, Wednesday, 8th, 2009). According to the Kenyan Ministry of Water and Irrigation, WSTF aims at mobilizing resources and building institutional capacity so as to achieve water supply and sanitation systems that are sustainable.

In addition to this financial arrangement, the government through the Ministry of Water and Irrigation has also established rural-based capacity building initiatives aimed at increasing local community participation in water and sanitation decision making. Such institutions include the Community Project Cycles (CPC), Water Resource Users Development Cycle (WDC) and the Water, Sanitation and Hygiene

(WASH). While WASH project concentrates on promoting sanitation activities in ASAL districts, CPC focuses on quality control and good water governance in rural areas (Daily Nation, 8th April, 2009).

Though water reforms in Kenya demonstrates improvement in water governance, the bulky of its strategies still emphasizes water commercialization. However, this model of water utilization and management is an urban phenomenon and one wonders whether the rural population can ever attain water security status under such model of resource allocation. It is against this background that this study sought to find out the potential presented by rural-based water security coping strategies (RUBAWACS) in tackling domestic water challenges in Muhuru-Bay.

1.2 Statement of the Problem

Three issues have been a challenge to water and sanitation among the rural population in Kenya. The first one is associated with ill health emanating from lack of clean and safe water. Secondly, lack of alternative means of ensuring adequate water per capita as a result of decline in government expenditure on rural basic service provision since 1980s. This was as a result of adopting the Structural Adjustment Programs (SAPs) (Ackello-Ogutu and Onjala, 2003). The suffering of women as they walk long distances searching for water is also critical challenge to the development of rural areas.

In Kenya, large proportion of its population continues to suffer water insecurity mainly manifested through water related illness, and high mortality rate (Kenya, Republic, 2008). More devastating is the fact that the poor populace suffers more and faces this crisis on a daily basis particularly in rural areas (Mohamed, 1971). For instance, the health statistics in the country has ranked Nyanza Province top in water-borne and related diseases. In the month of February, 2009, it was reported that, 369 incidences of cholera were recorded while 16 people lost lives as a result of poor sanitation (Daily Nation, March, 17th, 2009). In the era of rapid environmental change this remains unresolved challenge affecting not only peoples' health, and productivity but also their ability to withstand and recover from water-borne diseases.

Poor access to adequate water in rural areas is partly attributed to the fact that majority of road network and water supply infrastructure are dilapidated. In some places the establishment of community managed water facilities has faced several challenges ranging from inability of the local community to maintain water facilities,

poor coordination of resources as well as harsh climatic conditions. These deprive the local community easy access to water compared to their urban population. In fact empirical evidence shows that only 23 percent of rural population spends up to 5 minutes to access potable water compared to 80 percent in the urban areas. The situation is even worse in Nyanza Province where majority of population (60%) spend at least 1 hour carrying water (Kenya, Republic, 2001).

The District Development Plan 2008-2012 indicate that in Migori District 90 percent of households lack access to clean and safe water (Kenya, Republic, 2009). This condition not only threatens achievement of the socio-economic pillars of the Kenyan Vision 2030, but also the people's living standards and dignity. Water security shortcomings also affect women disproportionately as indicated by rising cases of miscarriages and back pain (WHO, 1997). The Lake Basin water security status is also characterized by high levels of stress. It is approximated that the area suffers 5% and 2% severe and moderate water stress respectively (Douglas et al, 2006). The question that remains elusive is, are there options for the local community to reduce risks associated with water insecurity and how effective are these strategies in addressing the challenges of water per capita and human health?

Nonetheless, coping strategies in rural areas such as Muhuru-Bay have continued to grow despite the severity of challenges they face. Harvey and Reed (2006) argues that efforts in improving domestic water supply should be directed at household level because community-based water projects are not necessarily panacea of water security. However, such rural-based water security coping strategies (RUBAWACS) that include use of herbs, water preservation and use of traditional pots for storing water are also faced with myriad of challenges ranging from logistical to institutional.

A move towards domestic water management initiatives envisaged in Kenyan vision 2030 has been seen as a way to address the shortfalls in rural infrastructure services including water provision. Despite this plan, application and effectiveness of RUBAWACS is still limited. The problem lays on the fact that favourable policy environment for these coping strategies do not fully exist. This is in spite of the government efforts to establish community-based water security institutions such as Community Project Cycles (CPC). Inadequate information on strengths and weaknesses of RUBAWACS is also lacking to inform policy making processes in the rural water sector.

In view of this, studies have been done in Arid and Semi-arid (ASAL) region of Kenya investigating coping strategies in regard to natural resources such as water. In spite of such efforts, there exists limited knowledge on why the problem of water scarcity has persisted in such areas. Gaps, challenges as well as opportunities presented by the informal rural-based water security coping strategies (RUBAWACS) in promoting domestic water security and good human health are neither well understood nor documented. It was on this realization that this study was designed to shed light on this issue using the case of Muhuru-Bay.

1.3 Questions of the Study

This study was set to answer the question; to what extent does rural-based water coping strategies (RUBAWACS) provide alternative for domestic water security in Muhuru-Bay?

The specific study questions are:

1. What are the reasons for the persistent water problem in Muhuru-Bay?
2. To what extent does rural-based water security coping strategy contribute to domestic water requirement?
3. How does the local community respond to the water quality challenges and how effective are these strategies in promoting better human health?

1.4 Objectives of the study

The overall objective of this study was to investigate the potential impacts of rural-based water security coping strategies (RUBAWACS) in addressing the challenges of water security in Muhuru-Bay.

The specific objectives are:

1. To identify reasons for the persistent water problem in Muhuru-Bay.
2. To establish the extent to which rural-based water security coping strategies contribute to domestic water requirement.
3. To find out how the local community respond to the challenges presented by poor water quality and effectiveness of these strategies in promoting better human health.

1.5 Significance of the Study

The question of water security around Lake Victoria Basin has been addressed through different studies. However, most of these studies have mainly focused on water resource pollution negating the water poverty situation (Kenya, Republic 2007). With increasing water crisis, and the unprecedented rise in water borne infections, many communities are devising ways of reducing the consequences of water inadequacy and contamination. One such mechanism is the rural-based water security coping strategies (RUBAWACS). The pertinent issue is whether these strategies are sustainable and what should be done to enhance their effectiveness in promoting household water security. This study therefore was designed to investigate the effects of rural-based water coping strategies (RUBAWACS) on domestic water per capita and sanitation.

These coping strategies are viewed as a way of improving peoples' living standards. At a household level RUBAWACS has the potential to contribute to proper hygiene, sanitation and poverty alleviation. At macro level, it can contribute to sustainable rural water resource utilization and management as part of ecologically and socially sound environment. In this context therefore the development of an appropriate approach to domestic water provision will depend upon the realization that sustainable water supply is determined by home-based coping activities (RUBAWACS) other than the traditional methods such as the community managed water projects. This is because community managed projects have been seen as lacking institutional capacity and ineffective in empowering the local community in resource stewardship and ownership.

Other than its potential contribution to the global debate on water insecurity and response mechanisms, findings in this study may provide evidence for informing planning process that is essential in developing policies, plans, strategies, programs and projects aimed at sustaining water security in rural areas. The development of an apex-rural water provision framework that takes into consideration the socio-cultural and spatial diversities and identities of the study area was the ultimate goal of this study.

CHAPTER TWO

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This section presents a critical review of relevant literature placing rural water security in its historical context nationally and in the perspective of coping strategies in the region. Key issues of water security covered include: rural water supply, water and human health, water poverty and property rights, water treatment and also water-related coping behaviours. Review of literature on cost implication related to water security coping strategies (RUBAWACS) is also part of this chapter. The final part gives the theoretical and conceptual frameworks on which the study is based.

2.2 Kenya Rural Water Supply Program

Since 1970, the Government of Kenya has been involved in a program to bring water to all its population (Dworkin, 1980). Although the investment has been high, the results have been disappointing. Despite this poor performance in water sector, the government is still committed to the long term goal of universal supply, but recognizes that competing demands may now require a review of the long term objectives for water development. At the time of its inception, Kenyan water supply systems were made to cover large area. The aim of such complex system was to supply water to individual families through metered private connections; because Kenyan communities are dispersed, long distribution lines were used.

This visionary plan by the government was down turned by the economic recession of 1980s after the adoption of the structural adjustment programs. Factors attributed to this failure include; problems of design, construction and maintenance, making them unreliable and unaffordable. Maintenance problems were mainly due to low government funding levels. This has led to total failure in rural water systems.

In 1990s the government revisited water sector by establishing Sessional paper No.1 of 1999. This plan together with the 2002 Water Act as already mentioned in this paper focused attention on urban water provision. This radical shift in planning process may be viewed as a *slap* against the rural population due to its commercialization nature. The rural dwellers find this challenging due to a number of

factors such as lack of reliable income and poorly adjudicated land that is required for water development. Though donors have responded to this challenge by providing funds to rural self-help systems through NGOs such as CARE-Kenya, the success of these projects is also questionable bearing in mind the debate over '*whose reality counts*' by development scholars such as Robert Chambers (2007).

This withstanding, Dworkins' (1980) recommended for adequate donor-led funding and selection of appropriate technology in effort to improve water supply in rural areas. However, this strategy also raises concerns as far as implementation of the water projects is concerned. It is important to emphasize the fact that implementation of such proposals may be hindered by the disconnection between the local community and the donors. Of course weak institutional arrangement and lack of full participation by the local community in designing donor-led water systems are milestones.

The current study thus partially explores why water problem has remained an impediment to rural development even though the 1980 plan by the government was such ambitious in revitalizing rural water supply. Considering the deteriorated political and economic environments in the past two decades, performance in service delivery has insofar declined. Dworkins' prediction of the failure in rural water supply in his evaluation report to the international development community back in 1980s may be re-affirmed in the present study.

2.3 Water, Sanitation and Human Health

Given the importance of the disease burden related to water supply, sanitation and hygiene, it is imperative that further investigations be made to improve our knowledge about the relative importance of pathways of transmission. A survey conducted by Oduor and Slayter (2007) in South Kamwango village, Migori District, revealed that morbidity and mortality were the most serious household problems facing the residents. The study that mainly employed household survey also found out that most of the common diseases were related to lack of safe water. Women were found to be responsible for domestic chores including water collection and that income was not sufficient to sustain family livelihood such as water purification. Though the ecological and methodological similarities exist in both the previous and present study, the current study analyses water security as a household driver of living

conditions of both men and women as opposed to the previous design that focused on women population.

Considering the socio-cultural characteristics (men are mainly owners of property including land) of the Luo people, it would not be exhaustive to examine water security issues in reference to women alone because of two reasons; First, water resources occur on land and its enhancement depends on the right over land which in most parts of the study area men usually exercise exclusive rights over it. Secondly, though women in most African families are bestowed with responsibilities of collecting water for domestic purpose, it is in the view of the present study that risks associated with water scarcity affects both men and women hence analysis of the problem should be inclusive.

Douglas et. al (2006) through the use of Relative Water Stress Index (RWSI) in investigating water stress within the Lake Victoria Basin(L.V.B) found out that even though there are seasonal wet and dry periods, water stress is low for 90% of the population within the L.V.B. Despite this result, the study found out that 80% of the densely populated districts along the lake had poor access to safe water whereas only 25% of these districts were shown to have access to sanitation. The same study indicate that the districts reporting cholera cases for the period 1997-2001 were shown to have moderate to high risk virtually due to poor access to both safe water and sanitation.

Domestic water management is crucial in areas that are out of the national water provision grid such as Muhuru-Bay. Therefore, application of purely scientific techniques as demonstrated by Douglas et.al (2006) may be limited in methodology and interpretation of the outcomes. For instance, examination of a social process such as the strategies for water security may not be measurable by conventional instruments. Instead, carrying out triangulation by examining peoples' perceptions as well as measuring variables such as water per capita may yield interesting results. It was on this realization that this study was designed to apply simple pair-wise ranking as an instrument that could allow the local people identify their own problems and generate solutions. Direct observation with the aim of understanding water-man interaction was also applied more so to add value to the previous study by Douglas et al (2006).

2.4 Water Poverty and Property Rights

In Kenya water interaction occur at both the household and community level. At the household level water interaction concern water demand, supply and allocation. How much water is needed? Who fetches it? What is it used for? All these questions drive us to the understanding of the relationship between water security and human poverty. Swallow and Were (2006) conducted a survey of poverty and property rights in the Nyando basin of western Kenya, an area dominated by mostly Luo, Kipsigis and Ogiek communities. The study that was carried out in 2004-2005 conducted intensive survey of 14 villages distributed across the basin that covers 12 districts. The use of 39 sample households that used an unprotected communal spring as their primary source of water were reported using an average of 16.6 hours per week during the dry season and 6.5 hours per week during the rainy season to collect water from spring. Also, the study revealed that 25 respondents out of the 30 sample agreed that improved water supply reduced incidences of waterborne diseases. The question of who owns water sources and land was elusive in this study.

However, the overwhelming response on the usefulness of water supply may not be necessarily as a result of its improvement in supply; other intervening factors may have led to the observed improvement. For instance favourable ecological systems in the rift valley that is characterized by agro-ecological zone I and II could be one of the factors responsible for improved agricultural productivity. Muhuru-Bay is influenced by a number of geographical and cultural factors making it unsuitable for agricultural production. Also the incidences of diseases and reduction in its prevalence among the communities in the larger Nyando zone would be different compared to findings from the present study. Spread of water-borne diseases is largely influenced by pattern of water use and sanitation. However, the intensity of diseases such as cholera, dysentery, bilharzia and typhoid can as well be enhanced by epidemiological factors. For instance flood occurrence is specific to lowland areas compared to the rift valley hence the latter is less vulnerable to water-borne infections.

A similar study was conducted in Kericho and Nyando. The *safe guard household survey* by Onyango et al (2008) revealed that though women are considered as the main collectors of water, they are limited when it comes to controlling water facilities and land. The study that sampled 14 villages using the multi-stage sampling technique found out that 77 percent of the 150 households indicated that women are the main water collectors. Only 18 percent of the respondents had water within their

homesteads hence majority of water collectors have to travel to the nearest stream. In their efforts to avert the risks associated with water, the study found out that residents of Nyando and Kericho have to collect water for drinking from the rivers early morning before it is contaminated by people and livestock.

Similar arguments can be made concerning the power relation between men and women. In regard to water allocation and development there is a lot to be desired because as much as the women are bestowed with responsibility of providing domestic water in most parts of the lake basin, men seem to have control over land resources needed for its enhancement. Therefore, it is the men who can make decisions about what can or cannot happen on the land. This implies that the men appear to take leadership of the water projects while the women just enjoy the benefits of improved water supply. Whereas the water security may underlie the link between poverty and property rights, it remains a question as to whether coping strategies have significant impacts as far as water per capita and human health is concerned particularly among the rural dwellers.

Therefore, it was in the view of this study that a critical analysis of domestic water use pattern and the coping strategies could be done with a focus at household level as opposed to community and property rights. This study therefore expands on earlier studies by Onyango et al (2008) with more emphasis on relationship between domestic water use pattern and activities considered to promote peoples' wellbeing and productivity.

2.5 Methods of Water Treatment

For thousands of years, people have treated their drinking waters by various means to remove particles of solid matter, reduce health risks and improve aesthetic qualities such as appearance, odour, colour and tastes. Center for Disease Control and Prevention (CDC, 2007) conducted a survey in Upper Nyando District on adoptability of modern water treatment methods. The study found out that 47.9 % of households relied on surface sources of water such as rivers and ponds for drinking. The same study indicates that 99.7% of the respondents were reported storing water in the homes. Whereas majority (66.6%) of the respondents interviewed claimed to be treating water, those who applied the safe water system (SWS-chlorine) were slightly below average (43%).

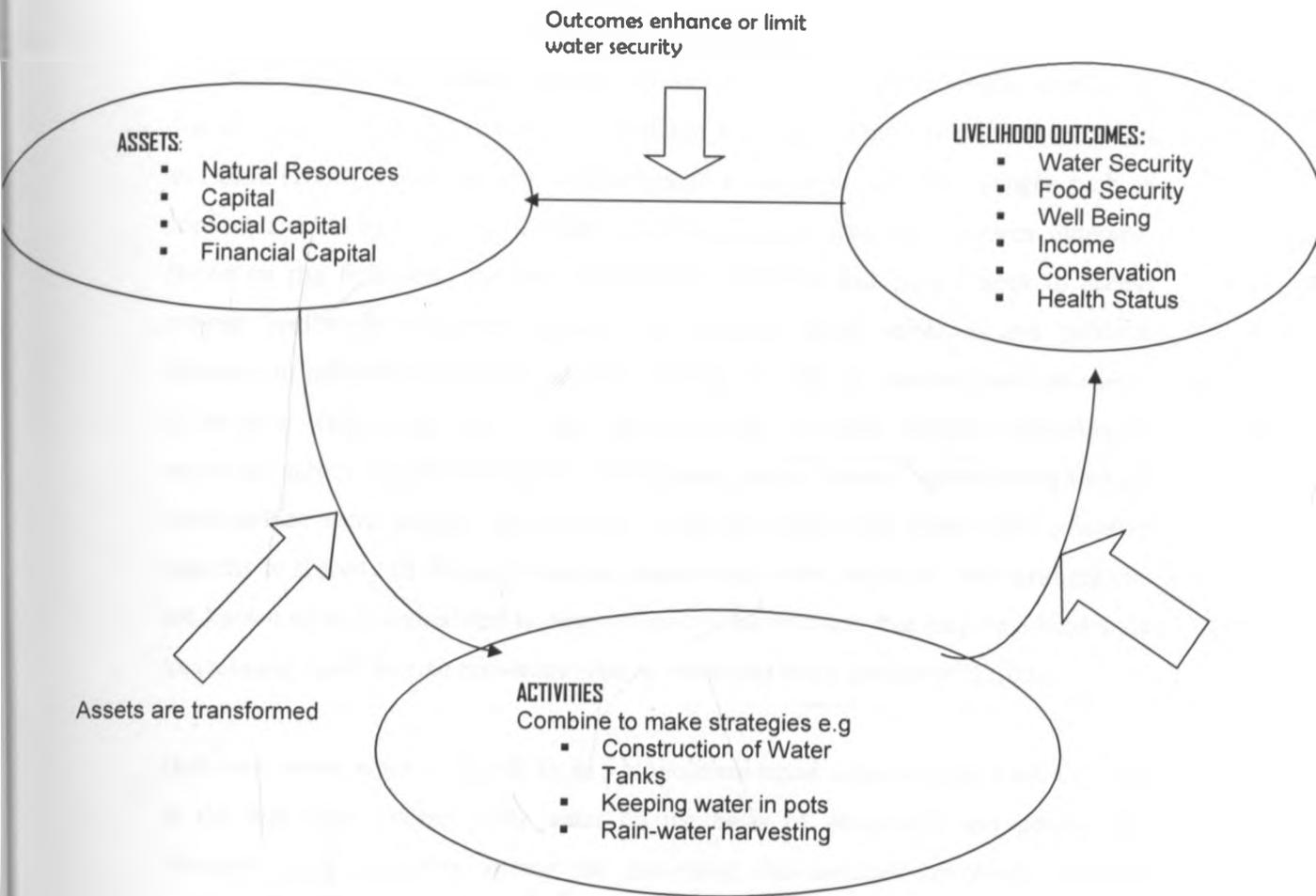
Treatment of water in rural areas is an interesting area worthy investigation due to the question; how safe is the treated water? Tracking the process of treatment reveals that the materials used for treating water and the subsequent post-treatment storage facilities are below the standards hence the likelihood of re-contaminating it. Storage of water could also attract investigation to understand whether the stored water is sufficiently enough to sustain a household particularly during dry season. This incapability of the rural dwellers to store adequate water is in most cases hampered by numerous factors including low income.

The CDC results may form good base-line information for determining whether or not the people of Upper Nyando stores adequate water. But then the need to understand the level at which the treatment of water subscribes to the WHO or Kenya Bureau of Standards (KEBS) may need critical analysis of the domestic water management. Beside this, the present study also goes beyond assessing storage to investigate how water is distributed to various household activities such as sanitation and hygiene, bathing, drinking and even for productive activities such as garden-irrigation.

Makusta, Kilungu and Ogutu (2001) conducted a study in western Kenya to assess the challenges impeding the implementation of the point-of-use water quality intervention by CARE-Kenya. The study revealed adoption rate of 33.5% among the respondents for using modern method for water treatment while 18.5% of the residents for clay pots modified for safe water storage. The base-line survey that selected households in 24 villages and interviewed household heads revealed that majority (90%) of respondents reported boiling as their primary water treatment method.

As much as this result may reflect experiences of the majority of people along the lake basin, it would be important to emphasize that boiling water alone does not necessarily remove pathogens and even chemical elements from water. This evaluation study by CARE-Kenya does not really inform on the dynamics involved in water management at household level. Such results may need to be evaluated because the characteristic of the population studied tend to exhibit weak economic status hence unlikely to maintain regular and effective water treatment. To bridge this gap the present study expands the previous research to investigate patterns of water use, identify the various coping strategies and the extent to which these coping strategies mitigate against the possible consequences of water scarcity and contamination on water per capita and human health respectively.

Fig 1. Modified Generic Livelihood Model



Sources; Modified, ODI

2.6 Water Related Coping Behaviours

Considering water insecurity as a form of vulnerability in the broad sense of livelihood shocks and trends, individuals and households consequently respond in different ways. A study conducted in Kajiado and Narok Districts of Kenya by Siri and Lind (2008) found out that, adjustment to multiple shocks and changes such as conflict and drought are intrinsically political process that have uneven outcome. Based on the fieldwork, the two case studies revealed that people seek to access coping livelihood adjustment options by forming social relations and political alliances to influence collective decision making as well as securing material means of survival. Interesting part of the previous study is that, unequal allocation of resources across regions, and poor development policy biased against marginalized communities were singled out as some of the processes that affect local adaptive capacity to scarcity of resources such as pasture and water. Arid and semi-arid regions are known to be marginalized in terms of poor infrastructure that may be a hindrance to accessing basic human resources such as water and even sanitation facilities.

However, when water is viewed from a biopolitical stand, communities seem to differ in the way they interact with water on the basis of geography and geopolitics. Whereas water allocation among the pastoralist communities surrounds livestock watering, the management of water along the lake where the present study was conducted is more domestic. For instance, in Muhuru-Bay water management and decision making surrounds sanitation, drinking, and cooking. In this viewpoint therefore, the present research may provide clues about the cultural generalizability of water security fit.

In addition to water politics, hydrological variability and extremes have also been demonstrated to be significantly related to water insecurity. According to Nidhi (2007) global warming will require significant adaptation particularly by countries that lack the infrastructure and institutions to store, manage, distribute and deliver their water resources. Nidhi postulates that such communities tend to have more limited adaptive capacities and are more dependent on climate sensitive resources, such as local water and food supplies.

Although hydrological variability is more general than coping strategies, it similarly involves resource endowment and environmental perception and is likely to be dependent on characteristics such as area infrastructure, water provision logistics and

sanitation facilities. In a situation of climate volatility, supply of and control over water is made further acute – climate governs the weather, weather dictates water distribution and water distribution controls life. Therefore the present study goes beyond this water politics by focusing on adoption patterns of coping strategies and the extent to which this can address the phenomenon of water insecurity at a household level.

2.7 Cost Implication of Water Security Coping Strategies

Literature related to economics of water and sanitation intervention including costs, cost-effectiveness, willingness to pay and cost-of-illness reveals that there are several opportunities for private sector participation in provision of water and sanitation services. The question is, are there differences between and within households in respect to cost of water and sanitation with reference to developing countries? A household survey of 20 randomly selected rural communities in Volta Basin of Ghana reveals that the rural dwellers could be paying as much as the urban water consumers for unimproved water supply. The findings further reveal that the rural consumers have the ability to pay but this is largely influenced by perceptions. The study that was conducted by Osei-Asare (2004) shows that forms of coping strategies in rural areas include opportunity cost and some amount of financial outlay.

Using the coping cost approach technique (CCA) to analyze his data, Osei-Sare established that costs of coping with water insecurity are higher in dry season and for forest ecology households. Though this study provides analytical insights that can be useful in household resource allocation, the application of cost-effectiveness model in drawing lessons from environmental economics has been criticized by many scholars (Fewtrell and Bartram, 2001). Such criticism argues that the approach is greatly hampered by lack of consistent record keeping among rural population. The present study therefore makes methodological contribution by allowing the voices of the local community through a number of approaches including PRA pair-wise ranking.

Aside from this finding, Berman (1982) cited in Fewtrell and Bartram (2001) points out that cost-effectiveness comparisons tend to undervalue interventions that provide important outcomes other than the one being considered, and are thus particularly inappropriate where programmes produce a broad mix of benefits such as water and sanitation interventions. This therefore imply that analysis related to water supply and sanitation projects should include measurements of direct economic benefits ,

such as increased time availability when water is conveniently located, commercial benefits as related to infrastructural improvement and health benefits. The health benefits may be both direct in terms of avoided medical expenses and indirect in terms of productivity gains due to reduced morbidity.

Though such a study along the lake basin in Kenya could yield comparable results, the household economics of the coping strategies was beyond the scope of the present study due to anticipated methodological limitations. For instance a question such as, what do water and sanitation facilities cost in different setting may not have been exhaustive in the present study due to inadequate primary data. It is rarely in the practice of the rural populace as pointed out earlier to find consistent data on income, expenditure and even inventory of sanitation related facilities hence difficult to implement a cost-effective study.

However, one positive feature of the current work is that it examined domestic water use patterns rather than view of water in general terms as occurs in many studies including the previous one from the Coastal region of Ghana.

2.8 Summary of Literature

In the literature presented, a variety of socio-economic, political, cultural and geographical factors influence water security and development of coping strategies (Dworkin, 1980; Oduor and Slayter, 2007; Douglas et al, 2006; Swallow and Were, 2006; CDC, 2007; Onyango et al, 2008; Makutsa et al, 2006; Siri and Lind, 2008 and Osei-Sare, 2004). Specific themes that have been explored include rural water programs, water poverty and health as well as coping strategies in response to water scarcity. This study extends research in the field of water and development by exploring relationship between the informal water security coping strategies (RUBAWACS) and water per capita as well as sanitation. Although majority of literature cites areas that share geographical similarities with the present study area, there is a considerable cultural variation on the dimension of water security and sanitation. In response to this variation, the present study extended approach to include pair-wise ranking; a technique that allowed the participants to visualize issues under study.

2.9 Theoretical Framework

2.9.1 Overview

The livelihood approach advanced by Chambers and Conway (1992) provides useful insights into capabilities, assets and activities required for means of living. According to Ellis (2000:10) livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household.

In addition to assets and activities, and the factors that mediate access, livelihood considerations must take account of the outcomes of the interaction of these components. Livelihood outcomes would ideally be what people seek and strategize to achieve through their activities, albeit in practice the means or the choice of activities may be restricted or absent and the ends will not always be realized. Desired outcomes might include increases in income (monetary), food and water security, health, physical security, independence, knowledge, status, or time – the inverse of various poverty dimensions. The outcomes in turn will usually have a direct effect on the asset base and activities (and possibly on the access regimes), so in this sense there is a cyclical relationship between assets, activities and consumption outcomes.

Most livelihood models focus on the household as the most appropriate social group for the investigation of livelihoods, albeit external measures to manage risk may be social or public in nature. Household livelihoods are however founded on the aggregation and dynamics of its individual members, which suggests that to develop understanding of the pervasive features of rural households some account of the intra-household dynamics (e.g. by gender, age or status) are necessary. Definitions of households have conventionally emphasized co-residence, sharing the same meals - “*cooking from one pot*” - and undertaking joint or co-ordinated decision-making; and rural households have been regarded as the centre of rural social systems. Recent concepts of the household broaden the definition to allow for overlapping social groupings, including family or other members who may be physically dispersed but socially interdependent (ODI, 2000).

The present study takes the view that rural-based water coping strategies (RUBAWACS) among the rural populace can therefore be considered as one of the livelihood activities and a means through which households use to increase their capability to water security. It is postulated that by applying the various coping

strategies, water security is increased in the form of high water per capita and proper sanitation which in turn promote good human health.

Livelihood approaches are numerous and a detailed analysis of other livelihood activities is beyond the scope of this study. However for the purpose of achieving the set objectives in the present work, water-related coping strategies employed by a household were hypothesized as influencing household water security which greatly results into outcomes in form of high water per capita and good human health. The livelihood activities and outcome whether positive or negative affects and are also affected by fundamental human right to basic resources such as water hence the inclusion of human development approach of the 1960s as part of the present study.

2.9.2 Livelihoods Approach

According to Maxwell (1999) causes of poverty are strongly linked to limited or limiting asset bases as well as the inability of a household to access these resources. At the household level this includes deficits in: social capital such as ill health, transport facilities or physical isolation. Devereaux (1993) and Davies (1996) have made the distinction between *survival*, *coping*, *adaptive* and *accumulative* strategies. For the purpose of this study, coping strategies are emphasized as those that absorb the impact of an adverse shock by drawing down assets and reducing consumption for instance that of basic human needs such as water. In their household livelihood strategy classification, Siegel and Alwang (1999) considers coping as practices in anticipation of, and in response to, risky events and outcomes such as water related diseases resulting from inability of the poor to treat water or afford potable water.

Livelihood strategies are also defined as activities undertaken by the household to generate a living including provision of water at a proximal distance. This struggle to provide for basic needs may have both negative and positive repercussions that include competition against limited resources. Although these consequences have not been widely explored in the literature, it is easy to see the relationship between livelihood strategies and the condition of a household in terms of water per capita and sanitation. Other scholars such as Davies and Hossain, 1997; Ellis 2000; Scoons, 1998; Carney, 1998, have argued that there are benefits associated with livelihood strategies such as consumption smoothing, labour smoothing, risk spreading and generation of resources for investment as well as consumption.

Similar arguments have also asserted that livelihood processes comprise of relationship between assets (capital), activities (strategies, production) and outcomes (entitlements, consumptions, wellbeing, health, and conservation). These resources and activities are usually within a mediating environment (Overseas Development Institute, ODI, 2000). The external mediating environment (illustrated in Figure 1) directly influences the external workings of the assets-activities-outcomes relationship. It provides the context within which household decision-making processes unfold. The schematic diagram in Figure 1 indicate that access to household assets and the use to which they can be put, influences the pattern of strategy activities and their potential outcomes. The outcomes can occur in various forms including proper hygiene and increased allocation of water to both productive and consumable household activities.

In view of this relationship, it is important to note that, not only are livelihood strategies and options circumscribed by the availability and mix of household assets, but they are also dependent upon resources associated with the community or supra-community level. For instance, inadequacies or anomalies in prevailing social relations, institutions and governance at local levels may thus too play a contributory role in the causes of poverty (Scoons, 1998). This observation concurs with Harvey's (2006) arguments that popularity of community-managed water supplies (CMWS) among donors is not necessarily a panacea of water security as it is perceived due to institutional and poverty limitations. Harvey suggests that, if community water management systems are to be sustainable, they require institutional support, monitoring, participatory planning as well as capacity building and technical assistance. Finally, coping behavior-particularly in regard to seasonal variations in rainfall is a major area of concern for rural societies. A good deal has been written on how households cope with seasonal food shortages, in most part of Arid and Semi-arid zones of Kenya and the entire African continent.

According to Narayan (1997) six basic strategies form the axes of the rural dwellers' coping behaviour: piece work, petty business, changes in diet, fewer meals, and selling cattle. This body of research indicates that these strategies are undertaken in a predictable and logical sequence, starting with easily reversible strategies which do not erode the asset base of the household (e.g. reduced meal frequency) to less easily reversible and more erosive strategies (e.g. sale of cattle or land, and *in extremis* forced migration). Seasonal water problems are also of great concern in semi-arid and

Narayan (op. cit.) indicates that coping strategies almost invariably involve resorting to unprotected water sources such as ponds, rivers and uncovered dug wells, with consequent knock-on effects in terms of waterborne diseases such as diarrhoea and cholera.

2.9.3 Human Development Approach

Since its establishment in 1965 the United Nations Development Program (UNDP) has promoted an understanding of poverty that goes beyond the lack of income. The 1997 Human Development Report introduced the concept of human poverty that focuses on the denial of opportunities and choices most basic to human development, namely to lead a long, healthy, creative life and enjoy a decent standard of living, freedom, dignity, self-esteem and the respect of others. This understanding of poverty sees it as a process, not as a condition. And it sees the poorest people not as passive victims but as leading actors struggling against a process of impoverishment. Rather than focusing on poor people's weaknesses, the concept of human development focuses on their potential strengths and on the assets they need in order to move out of poverty (UNDP, 1999). In this context therefore development becomes the process of change that enables people to take charge of their own destinies to realize their full potential.

Kiros (1985) however argues that poverty when viewed in its absolute terms may include state of isolation both spatial and social and in terms of lack of access to among other basic things, services such as health, transport and water. This being the case therefore, development revolves around the most basic human requirements such water. This resource (water) thus becomes a priority for human fulfillment and achievement in all spheres of life including education, dignity and even human rights. Based on this premise, there are three main advantages associated with this development approach. First, United Nations Development Programme (UNDP) has supported the view of development from the perspective of expanding peoples' opportunities and increasing access to resources. The approach also requires expanding human capabilities through provision of basic services such as healthcare, water and sanitation. This therefore becomes an impetus for widening peoples' choices as well as raising their levels of wellbeing as emphasized by Amartya (1998). As a result of this, quality of life is improved thus better standards of living. Not to emphasize self esteem.

Second, UNDP approach departs from the traditional measure of development that emphasizes economic output by focusing on human development index (HDI) that is critical to human progress. According to UNDP (1998a) the traditional model ignores the political, social, and cultural factors which are important in human development. The process of empowering people and building confidence begins with realization that life is beyond wealth. People's beliefs, norms and values are fundamental in any development intervention. For instance, increasing access of water to households not only reduces physical burden on women but it is also an opportunity for raising their career achievement as well as their dignity.

Third, it is clear that, human development entails people taking their own decisions about their lives (Blackburn et.al, 2005). Indeed, the DFID (2001) asserts that the fulfillment of poor people's water-related needs is fundamental to the elimination of poverty. This demonstrates the centrality of water supply and sanitation to the exercise of people's human rights. It is important to emphasize the fact that analysis of development calls for an integrated understanding of the respective roles played by different institutions and their interactions. According to Amartya (1998), the process of human capability entails social, political, economic and community structures. In this context the fulfillment and harmonization of all these processes requires balanced philosophy such as the human development approach.

Based on the above propositions, we postulate how water poverty is likely to perform on a number of indicators. A well developed and evenly distributed water supplies system is said to have the capability of increasing water security and eliminating human poverty (Blackben and Bhanu, 1999). It has, however, been argued that unless the water provision mechanism is favorable, especially for the low-income households, water poverty is likely to remain a feature. This is because, the poor usually find it difficult to pay for water daily, and rarely have disposable income sufficient to maintain regular water purchasing from vendors.

Per capita water intake on the other hand is likely to increase only if water accessibility is high through gainful income. It has been argued that factors inhibiting per capita income growth are also likely to inhibit individuals' access to safe drinking water in the right quantity (Kirby, 2007). For example, it has been postulated that someone is considered poor if he/she lacks adequate water. The same Global Policy Forum Report says that, millions of people try to exist on 10 litres a day (2.6 gallons). Yet, the absolute daily minimum amount of water a person needs is 50 litres: five

litres for drinking, 20 litres for sanitation and hygiene, 15 for bathing and 10 for preparing food.

Kirby (2007) argues that water is power and those who control its flow in time and space can exercise this power in various ways. It is often claimed that clean water tend to gravitate towards the rich and waste water towards the poor (Nuttal, 2006). This being the case, we would anticipate that access to adequate safe water would be hindered by high levels of poverty among the residence of Muhuru-Bay and application of coping mechanisms could be predominant particularly among the poor. Furthermore, the adoption of a water source is likely to be influenced by spatial distribution of water facilities and in turn dictates quality of water hence status of human health. This is because the residents' dependency on limited source of water exposes them to dangers of contracting water-borne diseases such as cholera. Sanitation can also dramatically reduce the spread of worm infections, while the use of increased quantities of water for personal hygiene can reduce faeco-oral transmission and prevent diseases such as scabies and trachoma (WHO, 1997). Water used for food production also improves health, mainly by promoting proper nutrition hence people's ability to recover from these and other diseases.

Also, water and sanitation can contribute to human development in other ways. For example, better sanitation provides real personal benefits in the form of greater privacy, convenience, safety and dignity. These aspects are particularly important for women. Through such empowerment the local people particularly women are protected from vulnerability to physical harm and denied freedom (Amartya, 1998). Consequently, by increasing level of access to safe and adequate water there would be significant improvement in human development index (HDI) which goes hand in hand with principles of sustainable development.

The social pillar of sustainable development aims at improving the quality of life of people (McAllister, 1980). Thus increasing individuals' water per capita raises their capability hence leading to reduction of poverty in the society. In sustainable development, studies focusing on the sustainable livelihoods are justified on the basis that sustainable development implies increase in per capita income and distribution in the society as well as improving quality of life which eliminates poverty. Emile (1988) cited in Rees (1990) argues that eco-development ensures that vulnerable groups, especially the poorest of the rural and urban population are able to obtain basic needs and that they participate in all aspects of development process. This

participation space provided to the marginalized population, probably forms the medium of continuity for resource use; an indication of sustainable livelihood and development.

The above explanations are relevant to this study since they focus on the linkages between water security and poverty and sustainability of rural-based water coping strategies (RUBAWACS) within the framework of UNDP as stipulated in the 1997 concept of human poverty. The postulation is that water security goes beyond the physical collection from the sources to include livelihood strategies such as coping options. It also indicates that application of these coping activities proves relevant in fighting water stress shocks such as water-borne diseases. On the other hand, increasing water security would save on household time budget hence promote human productivity while at the same time reduce human suffering.

2.9.4 Conceptual Framework

The support for rural-based water security coping strategies (RUBAWACS) relies on the failure of public utilities. Supporters of RUBAWACS typically claim that the public utilities are inclined to be inefficient in ensuring adequate water per capita, and more spending on water treatment particularly among the poverty stricken populace in the rural areas. Poor sanitation, urban biased models of resource allocation and lack of local community representation in decision making are also some of the bottlenecks that befall this form of resource distribution. RUBAWACS, on the other hand would promote household water security by allowing participation of the local community in water provision initiatives as well as enabling households save time and income. Indeed, a World Bank report indicate that application of local knowledge can be useful in tackling rural poverty and promoting sustainable livelihood in Africa (Lane, 2008).

Based on the above proposition, we postulate how a RUBAWACS is likely to perform on a number of indicators. In regard to this, therefore water security is guided by coping strategies at a household level. These coping options in many traditional societies can be classified into two categories: We have those that are geared towards ensuring adequate water per capita such as increasing storage capacity, digging water from sand, missing meals, rainwater harvesting and withdrawing children from schools to form labour for water collection. Coping strategies intended to promote household hygiene and mitigate against the effects of poor water quality include;

storing water in traditional water pots for long period of time, use of herbs, decanting, fetching water very early in the morning from the lake and boiling water before use. Use of modern chemicals is also part of water treatment. All these strategies have the potential of improving domestic water security in rural areas.

Water problem is likely to be caused by a number of reasons. It has been argued that poverty stricken households develop a composite of activities as part of their livelihood. For example, it has been postulated that the rural dwellers withdraw children from schools to form cheap labour for domestic chores including water collection. In certain communities changing behavior to suit the inadequacy of water forms the basis of escape from water related challenges. Such behaviours may have implications on the abilities of households to maintain a pre-scribed water treatment procedure and subsequent storage environment. Though water problem in the study area can generally be viewed from the perspective of poverty, other factors are also anticipated to be contributing to the scenario of water insecurity.

Water per capita is likely to be influenced by adoption of operating RUBAWACS. In the case of Muhuru-Bay, one would anticipate a low water per capita by the residents due to various institutional and logistical factors. This is because RUBAWACS demands financial commitments in establishments of related facilities which also depend on the household income levels. A combination of logistical factors such as poor transport network and lack of resources for storing and harvesting water is likely to influence water per capita. While testing this variable it would be important to consider the cultural aspect of the community under study who mainly carry out their hygiene activities away from home. Washing clothes, bathing, washing utensils and even sometimes drinking of water is done along the river or lakeshore. Therefore in investigating this indicator of water security it would be prudent to focus on household water requirements as opposed to water per capita in its technical terms.

The process of adopting water quality coping strategies (WQCS) has a direct implication on sanitation hence human health. Ability to adopt a given coping strategy is seen as a way of reducing risks associated with water contamination. This in turn influences the choice of water source. Frequent outbreak of water-borne diseases can be attributed to lack of water supply infrastructure. This is because the literature reviewed indicates that majority of people in the rural areas draw water from running rivers that are without treatment mechanisms. In response to the water quality status, the community under study has evolved new ways of averting water contamination. But then, these water treatment strategies are likely to be influenced by other factors such as resource availability and cultural beliefs. For instance the hygiene standards of treatment facilities and the post-treatment storage environment may be critical in determining the effectiveness of any water treatment strategy.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This chapter describes the geographical profile of the study area and methodological approaches that were used in data collection and analysis. Specifically, it presents the sampling strategy and sampling size, sources of data, study population and unit of analysis as well as methods of data collection. Definition of study key terms, operationalization of the study variables and challenges encountered during field work also form part of this chapter.

3.2 Description of the Study Area

This study was carried out in Muhuru-Bay of Migori district, Nyanza province. It is located between latitude 0° degrees 40' and 0' south and longitude 34° and 34° degrees east (Kenya, Republic, 2009). It borders Rongo district to the North, Transmara district to the East, Kuria district and the Republic of Tanzania to the South, Homa-Bay to the North-West and, Lake Victoria and Suba district to the West. In terms of settlement, Migori is a multi- ethnic district with the dominant tribes being the Luo, Suba, Luhya, Kisii and Kuria. The district has an average population density of 291 persons per km^2 with Suba East Division recording the highest density of 596 persons per km^2 and Nyatike the lowest of 176 persons per km^2 (Kenya, Republic, 2009). Majority of the rural poor are found in the lower divisions of Nyatike, Karungu and Muhuru-Bay due to the relative marginalization of this region. Pockets of urban poor are found particularly in slum dwellings such as Oruba and Soweto in Migori town.

According to the 1999 population census the population of Migori District was 254,709. This figure is expected to grow at a rate of 3.1 per cent per annum (Kenya, Republic/Migori District Development Plan, 2009). The district's population is therefore projected to stand at 336,676 persons in 2008, 358,211 persons in 2010 and 381,123 persons by the year 2012. There were 56,680 households in 1999 which are expected to increase to 74,920 by 2008 and 84,811 households in 2012.

The altitude of Migori ranges from 1,135 metres at the shores of Lake Victoria in Muhuru-Bay, Nyatike and Karungu divisions to 1700 metres in Suba West with several undulating hills and plains stretching from 20 to 70 km along the lakeshore. The 475km² of Lake Victoria serves not only as a source of fresh water fish but also as a potential tourist attraction.

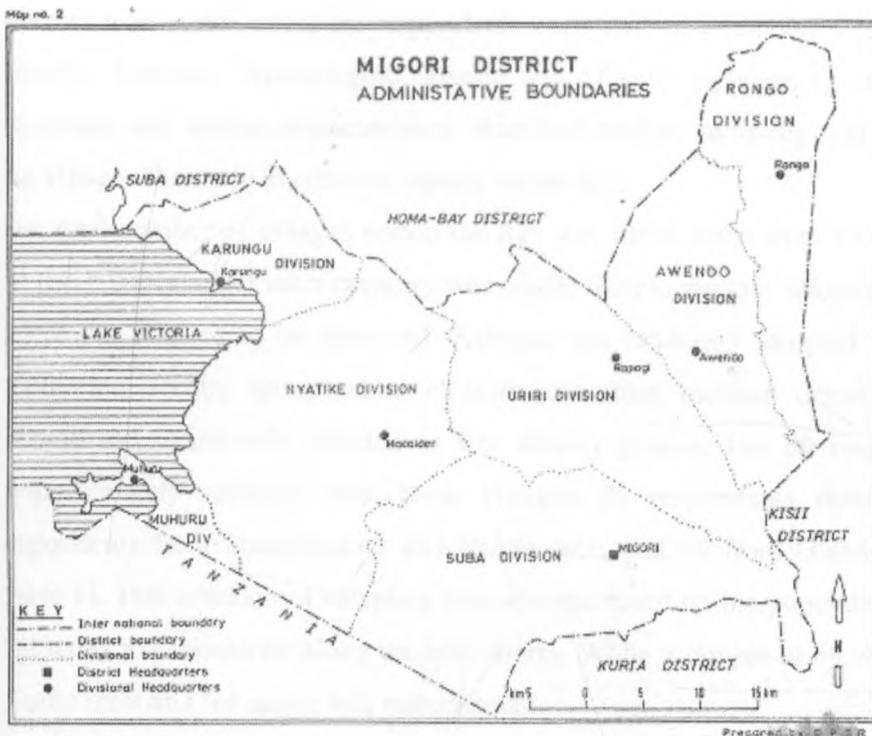
Rainfall patterns in the district vary, ranging from 700 mm to 1800 mm annually, with the short rains occurring between March and May, while the long rains fall during the October-December period. Climate is of a mild inland equatorial type, modified by relief, altitude and proximity to the lake. It favours the cultivation of cotton, maize and a variety of other food crops. Nyatike, Karungu and Muhuru-Bay divisions have comparatively harsher climatic conditions than Suba East and Suba West. These lakeshore divisions experience unreliable and poorly distributed rainfall. Temperatures show mean minimum of 17⁰ C and maximum of 20⁰ C, with high humidity and a potential evaporation of 1800 to 2000 mm per year. This influences water levels in water bodies hence affecting its availability for domestic purposes.

Map 1: Map of Kenya Showing Position of Migori District



Source: Ministry of National Planning and Vision 2030: Migori District Development Office (2009)

Map 2: Map of Migori district showing its administrative boundaries



Source: Ministry of National Planning, Development and Vision 2030: Migori District Development Office (2009)

3.3 Research Design

The study was conducted using survey design. In this case data was collected using a semi-structured questionnaire. This was complimented by focus group discussions (FGD) and key-informant interviews. Participatory rural appraisal simple pair-wise ranking and ground photograph also formed part of data collection and recording processes respectively.

3.4 Unit of Analysis

The study focused on household heads. The heads were chosen because in most cases they are responsible for ensuring provision of basic human needs such as water. Though women and girls, among the Suba-Luo people are known to spent most of their time searching for water, it is generally observed that the shocks of water insecurity affects all population hence this study selected both men and women for interviews.

3.5 Population and Sampling

The study sampled 60 respondents. To ensure that respondents of all socio-economic statuses were represented, the respondents were randomly sampled from four villages namely; Rabwao, Nyakiringoto, Bande and Olando representing different socio-economic and spatial characteristics. Stratified random sampling was used to select the villages for study in order to capture variability.

The total number of villages within the Bay was listed down from where a listing of all the villages under each category was made. Simple random sampling was used to select the villages to be surveyed. Rabwao was randomly sampled from the high population density group while Nyakiringoto from medium density. Bande and Olando were randomly selected as low density groups. The 60 respondents were proportionately sampled from these villages; 20 respondents from Rabwao, 15 respondents from Nyakiringoto and Bande each, and 10 from Olando village (See Table 1). This criterion of sampling was adopted based on the population distribution that tends to concentrate along the lake shores. While a sample of 60 was chosen due to time limit and for easier data management.

Table 1: Percentage Distribution of Respondents According to the Village

Village	Frequency	Percent
Rabwao	20	33.3
Nyakiringoto	15	25
Bande	15	25
Olando	10	16.7
Total	60	100

Source: Field data, 2009

3.6 Data Collection

A semi-structured questionnaire was developed to collect information on variables which include, water problem, coping strategies, domestic water requirement as well as household sanitation. This was mainly intended to gauge respondents' feelings and

response on water availability, quality and potential of the rural-based water security coping strategies as an alternative means of promoting household water security.

For key informants, an in-depth schedule was used to interrogate the existing water policies and practices with a focus on rural areas. Eight key informants were interviewed. Two of them were drawn from community based organizations (CBOs) and the area Chief. The rest were from the Ministries of Water and Irrigation, Public Health inspectorate and Planning, National Development and Vision 2030. This was necessary for collection of specific information on rural water sub-sector. House visits and ground photographs were also conducted to verify qualitative information from the respondents.

This was supplemented by a focus group discussion (FGD) that drew participants from the local administration, and Non-Governmental Organizations (NGOs) operating in the field of livelihood. Representative from a women-based association concerned with promotion of sanitation and hygiene also formed part of the FGD group. Secondary data was obtained from such sources as books, articles, development reports, and thematic maps mainly to assess the current status of water facilities, water quality and water-borne disease surveillance. Review of such data was useful in cross-checking and authenticating the primary data.

Participatory Rural Appraisal; simple pair-wise ranking

A simple pair-wise ranking was also used in collecting data qualitatively. Ranking means placing something in order. This method was useful as it provided an opportunity to learn from the community about their categories, criteria, choices and priorities in respect to sanitation facilities and areas of water challenges.

Luigi Cavestro (2003) defines pair-wise ranking as a PRA method that helps villagers to set priorities (i.e. problems, needs, actions, etc.). Ranking was undertaken by involving eight household heads, two from each one of the villages under investigation; Olando, Bande, Nyakiringoto and Rabwao. This was aimed at exploring their diverse perception on the reasons for the persistence water problem and also how they valued sanitation facilities in the order of importance. Gender factor was considered by including four women out of the eight participants. The participants were then asked why they felt certain factors were more to blame for the existing water challenge. The order of preference among sanitation facilities was also ranked.

Matrix ranking criteria was then constructed in rows and items lined in columns. This was then deduced for further critical analysis.

3.7 Data Analysis

In analyzing the data from the questionnaire, descriptive and inferential statistics was used. Both descriptive and inferential statistics was calculated by the use of a computer with aid of Statistical Package for Social Sciences (SPSS) program. Descriptive statistics perform the first function of the measurable characteristics. As summarizing measures, they condensed raw data into forms which made it easier in sampling the analysis. The main descriptive analyses methods applied were the frequency distributions and percentiles.

Mean was used to get the mean age of respondents, average distance to the nearest water source and the average time taken in collecting water during both dry and wet season. MS Excel was used to give graphical representation of the frequency distribution in form of pie charts and bar graphs. This was supplemented with results from the simple pair-wise ranking particularly on questions regarding water problem and sanitation facilities. Narratives captured during household visits and interpretation of ground photographs on water storage activities and water use patterns were also integrated into the descriptive data to form themes along the study objectives.

3.8 Definition of Key Terms

Water Security: According to the Participatory Poverty Assessment Report of 1995(Kenya, Republic 1995) there exists strong link between poverty and lack of access to quality water. For instance, a poor person is sometimes defined as someone lacking access to potable water. The United Nations (Kirby, 2007) asserts that anyone living on less than 50 litres of water is considered poor. In relation to this, studies have shown that over 70 per cent of the urban population living in slum settlements with poor or no water supply services suffer water-borne diseases (Mireri, 2007).

Water Accessibility: UN-HABITAT (2003) defines water access as a situation where water is within reasonable proximity, safe for consumption and sufficient to meet people's needs. This may be influenced by income levels as well as distance covered from household to water source. This study assumes that constraints to water access can be mitigated by adopting appropriate coping strategies.

Rural-Based Water Security Coping Strategies (RUBAWACS): Coping strategies refers to livelihood activities that absorb the impact of an adverse shock by drawing down assets and reducing consumption. In their household livelihood strategy classification, Siegel and Alwang (1999) considers coping as practices in anticipation of, and in response to risky events and outcomes such as water-borne diseases resulting from inability of the poor to treat water or afford potable water from protected sources. For the purpose of this study, coping strategies have been classified into two categories: those related to water intake per capita (quantity) and those that relate to water treatment at household level (quality). The various water treatment strategies provides clue on how different households manage domestic water and sanitation.

Sanitation: In this study, sanitation refers a situation in which one is capable of managing the negative effects of water related illness such as diarrhoea and other intestinal worms: diseases that occur as a result of consuming contaminated water. Sanitation is key indicator since increased access to water through coping strategies can promote personal hygiene thus reduce transmission of water-borne diseases that threaten human health.

Water Facility: According to the Migori District Development Plan 2008-2012, a water facility is a physical establishment or arrangement made to provide alternative source of water for the majority of population living in rural areas without piped water systems. This definition is important to this study in that, the number and condition of the facility determines exposure of households to risks of water contamination and scarcity. The study was expected to establish the availability and operational status of these facilities that are usually maintained by the government, the community or Non-governmental organizations (NGOs). Their conditions also influence water scarcity respond strategies.

Income Level: In this study it refers to the average number of residents earning in the categories of below KSh. 500, between KSh. 1000-1500 and the category earning above KSh. 2000 per months. The category of those households without reliable source of income was also part of income analysis.

Water Source: Refers to places from which people acquire domestic water. In this study the hypothetical sources include; lake, rivers, boreholes, well, dams and roof catchments.

3.9 Operationalization of Variables under Study

Water Problem: Refers to a situation in which the access, availability and safety of water resource is not adequately addressed and therefore the consumers of the resource (water) are subjected to the consequences of scarcity, uncertainty and unsafety for a long period of time. According to study findings from western Kenya, population surrounded by Lake Victoria suffers 5% severe water stress and 2% moderate water stress (Douglas et.al, 2006).

This variable was therefore important for this study because the reasons for the persistence water problem as per the respondents' perception were discussed as factors that affect water security. Water insecurity is complex scenario and its persistence may be explained by examining these factors.

Water per Capita/Requirement: Refers to the amount of water an individual is expected to take per day. The UN outlines that the absolute daily minimum amount of water a person needs is 50 litres and distributed as follows: five litres for drinking, 20 litres for sanitation and hygiene, 15 for bathing and 10 for preparing food. Water intake that is below the UN mark is a good indicator of poverty as illustrated by inability to prepare meals and practice proper hygiene.

Since the culture of the population under study restricts them to performing most of the sanitation activities at either riverside or lakeshore, it becomes difficult to estimate water per capita in its technical terms. Therefore this study focused on household water requirement and how the available water is allocated among the different activities including, sanitation, hygiene drinking, clothing, and bathing. Allocation of domestic water among these activities was analyzed in reference to the United Nations water per capita requirement. To ascertain whether the coping strategies have had an impact on domestic water requirement, we analyzed the respondents' perception and general observation through checklist to confirm presence or absence of water storage facilities that also provided clues on quantity of water a household could store.

Water Quality Coping Strategy (WQCS): Water quality refers to the degree to which water is suitable for both human and animal consumption (WHO, 2003). Polluted water is hardly of any use for most purposes. It cannot be utilized for drinking because of its inherent health risk (Goel, 2006). World Health Organization has laid down drinking water standards which are considered international standards.

Kenyan water quality standard is stipulated by the Kenya Bureau of Standards (KEBS).

For the purpose of this study water quality coping strategy (WQCS) refers to the activities, behaviours and substances used by the rural community to mitigate against the negative effects of contaminated water. Colour, taste and turbidity were also standard measures for quality water among the community under this study. WQCS as a variable was useful in that, the percentage frequency of responses according to experiences of water treatment represented a mechanism for averting water-borne diseases hence promoting good human health. The different methods of water quality coping strategies were also investigated in order to gain insight into the role of local knowledge in reducing impacts of poor water quality.

Human Health: World Health Organization (WHO, 1997) defines health as a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity. Peoples' quality of life is better when they have access to adequate supply of water. This is central to overall human development and to the reduction of poverty (WHO, 1997). This variable was important to this study because percentage proportion of respondents who treat water were expected to have reduced risk of being infected with water-borne diseases such as cholera, typhoid, dysentery and bilharzia that are common in areas with the problem of water scarcity. According to WHO (1997) these diseases are usually caused by the ingestion of water contaminated by human faeces or urine containing pathogenic bacteria or viruses.

3.10 Challenges Faced During Field Work

There were a number of challenges experienced in carrying out this study. First, poor record of water quality monitoring at the district level affected our data need. We had to rely on secondary data for reviewing water quality status. Secondly, lack of institutionalization of water security coping strategies (RUBAWACS) made it difficult to assess the various water treatment activities and outcomes. In this case large part of our analysis is based on peoples' perceptions. Lastly, poor transport network and scattered households of the study area made the field work appear cumbersome. This had logistical implication on the application of participatory rural appraisal (PRA) in its complete form. In which case we had to select only eight participants for the simple pair-wise ranking exercise.

CHAPTER FOUR

4.0 STUDY FINDINGS AND DISCUSSION

4.1 Introduction

In this chapter various issues relevant to the study objectives and questions are presented and discussed. They include the development of water security coping strategies and its effects on water per capita and household sanitation in Muhuru-Bay. In this section results of data analysis are presented in forms of grouped frequency distribution and percentiles, which are in tabular form and explained. Charts have also been used to present results. Finally, this chapter discusses findings of the study.

4.2 Development of Water Security Coping Strategies in Migori

Development of rural water facilities can be traced back in 1970s when the Kenyan government invested in establishment of dams, boreholes and shallow wells. In western region, Lake Basin Development Authority (LBDA) was given mandate to develop these water facilities. The main aim of this initiative was to promote water and food security in areas that were considered arid and semi-arid (ASAL) (Dworkin, 1980). Initially these water facilities were maintained by the Kenyan government through the district development committee (DDC) budget. The technical support in form of maintenance and water treatment was mainly provided by the LBDA. With introduction of structural adjustment program (SAP) in 1980s, and the subsequent adoption of cost-sharing approach, the provision of basic human needs such as water became burdensome to both the state and the local community.

These facilities were then abandoned. According to the Migori District Development Plan (Kenya, Republic 2009), most water facilities in large parts of the district are non-operational due to several factors including inability of the local community to pay for their maintenance. As a result of this down-fall in rural water facilities, coping behavior in respect to water provision changed. Indeed this study has revealed that many people in Muhuru-Bay have devised ways and means of managing domestic water through several strategies. For instance 68 percent of those interviewed claimed to have acquired home-based water storage facilities in anticipation of water scarcity. More interesting finding indicate that a section of the local community have resorted to coping activities rather than depending on the government to provide water treatment materials. This was quite evident due to the fact that 80 percent of the

respondents indicated that they treat domestic water before drinking. Emergence of these domestic water management initiatives have had mixed results on the household water per capita and sanitation.

4.3 Background Information on Respondents

Sex and Age of the Respondents

Domestic water management can be influenced by gender dynamics. In most cases households with less empowered women are likely to suffer consequences of water scarcity. This is mainly due to poor tasks distribution that tend to overburden women and skewed mode of property ownership particularly in culturally embedded society such as western Kenya. This study identified household as the unit of analysis. The focus having been on household heads the findings indicated that 52% of those interviewed were male while the remaining (48%) were female. Gender disparity in the responses was noted.

The gender disparity could be explained by various factors. For instance, most households visited reported that women had travelled long distance to collect water and some had left for other livelihood activities such as small-scale businesses. Even households that were headed by women, they could only be traced along river side or lake shore as they went on with sanitation activities. This finding implies that women's role in household decision making regarding water for sanitation and other basic activities remain critical but elusive. In the view of this finding it is imperative that any water provision strategy requires consideration of gender analysis factor due to its role in domestic water management.

On the other hand, age can be an important indicator of water security. Areas without proper water provision systems can be straining particularly to the elderly population hence detrimental to their health. Significant proportion (47%) of respondents was aged 64 years. The mean age of respondents was 50 years (33%) while the median age was 58 years. An ageing population may also find it difficult to observe sanitation standards and water required to sustain both basic and productive household activities. However, it is important to emphasize that age alone may not necessarily be a measure of sanitation. But this could give us a clue on the role played by other socio-economic factors such as education level and the number of dependants being supported by such a household.

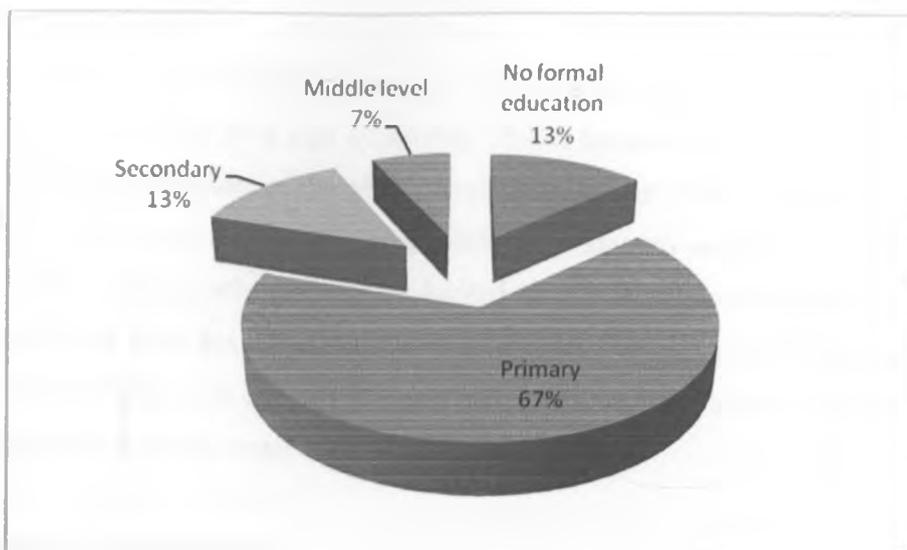
Education and Occupation of the Respondents

The level of education of respondents may influence decision making regarding domestic water management, sanitation awareness and also environmental management. Respondents were asked to state the highest level of education attained. One in eight (13.3%) of the total respondents had received no formal education, while majority (67%) had only completed some form of primary school education. Eight out of 60 respondents had received secondary education; only seven percent had some post-school qualifications (See Fig 2). As can be expected, there were gender differences in terms of the level of education attained.

Female respondents were more likely to be less educated than their male counterparts-more than a fifth (22%) of women had no formal education as compared to fourteen per cent of men. At the other end of the scale, men were twice as likely (10%) to have a post-school qualification as women (5%). In most cases finding such as this may suggest that in the absence of efforts to raise literacy level, cultural beliefs and traditional practices take precedence against conventional lifestyle.

For instance, the peoples' perception and attitudes of the concept of sanitation and care for the ecological environment may be elusive. Moreover, the low level of womens' educational attainment may have negative outcome on domestic water management because of their central role as water collectors in the study area. Population with such characteristics also tends to be less receptive to public health education programs that could be useful in reducing risks associated with poor hygiene.

Fig 1: Percentage Distribution of Respondents According to their Education



Source: Field data, 2009

With regard to employment, respondents were asked about their current employment status. Almost a third (35%) of all the respondents claimed that they were running small-scale businesses. Common businesses according to the respondents include, sale of fish, cereals, paraffin, firewood, livestock and water vending. A half (50%) of the respondents were occupied with subsistence farming (cultivating millet, sorghum, cassava and tobacco). Four percent of the respondents interviewed were engaged in fishing while two out of 60 respondents were found to be housewives (not occupied with any income generating activity). One respondent claimed to have no occupation while a village elder was also interviewed. Two percent of the respondents were found to be veterinary herbalists. Most of these categories represent less economically gainful occupations. Yet the ability of a household to maintain proper sanitation and hygiene requires not only financial input but also development of reasonable capacity for domestic water storage.

To begin exploring the extent of poverty in study area, the respondents were asked whether they have any regular income and by how much they earn per months. When asked about their approximate household monthly income, two out of seven (16%) respondents were unable to approximate their monthly income. While 28(47%) respondents claimed to have had irregular source of income, 8 percent earned less than Kshs. 500 per months. The study revealed that two percent of the respondents lived in households with income of between Kshs.1500-2000. At the same time only

a sixth (17%) of the respondents approximated their monthly income to be slightly above Kshs. 2000.

A number of households that survive on less than a dollar per day as indicated by the above finding can be a sign of poverty. This is because such families are more likely not only to fall short of the global water requirement (50L/person/day), but are also vulnerable to water-borne disease infections due to unaffordable medical bills. However, this conclusion may be limited in at least one consideration. That income level alone does not influence access to water in absolute terms. Instead condition of public utilities such as road network and water supply systems are also intervening factors in regard to water supply.

Other Characteristics

Regarding the source of drinking water the study was split into four possible sources; lake, river, dam, shallow wells and borehole. The survey findings showed that a third (33%) of the respondents collected their water from the nearest river. This was followed by shallow well (32%) and lake (25%). The proportion of those who collected water from the dam and borehole were 7% and 3% respectively as shown in Table 2. When asked whether they had experienced any form of water pollution; 97 percent of the respondents claimed to have taken contaminated water. Characteristics of contaminated water according to the respondents ranged from brown, dark, green to funny smell. Occurrence of salty water was also reported by some respondents particularly those residing in upper part of the lake (Bande and Olando).

Table 2: Percentage Distribution of Respondents According to their Sources of Water

Point of water access	Frequency	Percent
River	20	33.3
Lake	15	25
Dam	4	6.7
Shallow well	19	31.7
Borehole	2	3.3
Total	60	100

Source: Field data, 2009

General observation in the study area showed that residents tend to collect water from the streams and lake even when such sources are far away from a homestead. Sources such as dams and borehole are mainly seasonal hence less preferred by the respondents. This finding imply that source of water can define the status of water quality as well as the coping strategies employed by a household.

But the case of Muhuru-Bay is unique because they prefer collecting water from natural sources irregardless of their quality status. This gives insight in understanding the role of socio-cultural characteristics in resource use and management (i.e. environmental perception). Of course the observed social groupings among women folk as they trekked to access water may imply that sources of water have functions beyond water collection. This gives us insight on the role social capital can play in rural development in the context of water as an engine of community development.

The survey findings showed that the residents of the study area spend an average of 3 hours to access water during dry season while 2 hours in the wet season. Though the amount of time taken to fill the 20-litre jerrican varied with the source of water, generally the average time was 5 minutes and 15 minutes in wet and dry season respectively. Since the dry season was longer than the wet one, the respondents felt that the 2 kilometre average distance travelled to water point was straining.

In regard to household sanitation indicators, the respondents were asked to indicate whether they owned the various items known to be hygiene measures against water-borne-disease outbreak. The indicators under study included; compost pit, pit latrine, water storage tank, water treatment substances, utensil rack, chlorine tablets, firewood and disinfectants. A vast majority (70%) of respondents were found to be missing pit latrine. Only two (3%) respondents were found to be in possession of a larger water storage tank while 60% could not afford modern water treatment substances.

It was also found out that 70% of the respondents had constructed a compost pit while 32 out of 60 respondents had erected an out-door utensil rack. At the same time majority (93%) of the respondents could not afford disinfectant of any kind. While these hygiene indicators are basic requirement for mitigating against conditions considered favourable for the survival of water-borne pathogens, the finding show that residents of study area are inadequately prepared to protect their domestic water against contamination.

When these sanitation facilities were subjected to pair-wise ranking by the PRA participants, the result to a larger extent disagreed with interview findings. For instance the need to have utensil rack was ranked high compared to those who owned the facility. The same ranking process indicated that the respondents had least regard for pit latrine (see Appendix 2). During the ranking exercise women were more concerned about availability of utensil racks, disinfectants and latrines as opposed to their male counterparts who considered firewood and water tank more useful.

When asked why they preferred their choices, interestingly both men and women participants in the PRA exercise claimed that all these facilities were important for protecting their children against *diep* (local name for diarrhoea). This finding may suggest that though sanitation facilities are viewed differently by men and women, some common level of understanding of their role in reducing water-borne infections exist. Probably the question of affordability could also explain the slight variation in preference of these facilities between men and women. Indeed poverty and lack of sanitation facilities were cited as some of the reasons that have led to the persistence water problem in the study area (see Table 3).

4.4 Why the Water Quality and Quantity Problem Persists

Water problem is an important indicator in assessing water security. From the in-depth interviews there was a consensus that water scarcity is a major challenge to development of the study area. The challenges according to the District Water Officer-Migori manifest itself in terms of quality and quantity. The public health officials (DPHO) largely attributed the water problem to poor pit latrine coverage, poor sanitation, poverty as well as poor coordination of financial resources to maintain regular water treatment. It further emerged from the focus group discussion (FGD) that unless checked the high level of surface water pollution from faecal matters was a real threat to the districts' population particularly children under the age of 5 years. This category of population is more vulnerable to diarrhoeal, cholera, bilharzia, typhoid and dysentery infections due to their low immunity.

Next, semi-structured interviews were conducted to gauge peoples' perception on reasons for the persistent water problem in the area. Different reasons were presented by respondents. One fourth (25%) of the respondents stated that lack of national policy on rural water provision was the major challenge to water security in the study area. Poverty was rated second (23%) while 12 percent of the respondents claimed

that unfavourable climatic condition was factor contributing to water insecurity. A further investigation into poverty issue during an in-depth interview with District Development Officer (DDO) revealed that poverty occurs in various forms. For instance government financial inability to initiate and support water supply systems, low income per capita among the local community and the inability of the residents to own and contribute towards community water projects.

Inadequate sanitation facilities coverage (10%) and socio-cultural beliefs (5%) were also cited as challenges to water quality in the study area (see Table 3). Findings from the respondents residing along the lake shores (Rabwao and Nyakiringoto) attributed the problem to lack of sanitation facilities such as pit latrines and bathrooms to the frequent outbreak of cholera, bilharzia and typhoid. Eight percent of all the respondents argued that the failure of rural water facilities and mismanagement of the rural water funds were the major reasons for the absence of a reliable water supply system.

Table 3: Percentage Distribution of Respondents According to their Reasons for the Persistence Water Problem in Muhuru-Bay

Responses	Frequency	Percentage
Lack of national policy for rural water provision	15	25
Unfavorable climatic conditions and drought	7	11.7
Poverty	14	23.3
Lack of sanitation facilities such as pit latrines,	6	10
Lake pollution	2	3.3
Poor drainage and sloppy landscape	1	1.7
Not sure	2	3.3
Excessive deforestation	2	3.3
Very deep water table	1	1.7
Poor farming methods	2	3.3
Cultural beliefs that water is God given hence clean	3	5
Limited water sources and failure of rural water facilities	5	8.3
Total	60	100

Source: Field data, 2009

The findings suggest that the problem of water per capita and contamination is multifaceted. Therefore for a successful water security intervention there is dire need to consider all these factors that range from institutional structures, logistical challenges to national pattern of resource allocation.

In an attempt to shed more light on the interaction between water and the physical environment, a focus group discussion (FGD) was organized.

The FGD findings revealed that laundry work was carried out at the lake shore and river side (See Plate 1) and yet these are the main source of water for the majority of the residents in the area. General observation indicated that due to unavailability of alternative sources of water at close range, women and children had to trek long distance to the lake so as to perform their household sanitation activities. Incidences of meeting a woman carrying clothes, utensils, and other household items is common in the study area. The local community refers to this as ‘*distance washing*’. One of the women found washing utensils at the lake shore had this to say:

.....we do all our kitchen activities here at the lake because we have no tap water...we also know that this water is polluted but the government has not provided us with chemicals to treat it? When I wake up in the morning the first thing is to carry my children's cloth and utensils for washing at the lake, then we collect water at the same time for drinking and cooking. We cannot even bath our children at home because to get enough water we have to walk from Nyakiringoto up to the lake (from Nyakiringoto to the lake shore is approximately 3.5 Kilometers) (Personal interview, Akinyi; Nyakiringoto resident, July, 2009)'

Carrying out laundry activities at the lake that also forms source of drinking water for the residents is obviously a hazardous activity. This is due to the fact that there are no arrangements in place to disinfect the water before it is collected for domestic purposes. This finding shows that water contamination is a daily phenomenon in the study area and that it translates into associated risks such as ill health.



Plate1: Photograph showing young children carrying out their domestic chores in Rabwao along the shores of Lake Victoria, Kenya: The Lake supports livelihood activities including drinking water for the residents. (Photograph taken 11; 00 am July, 2009)

From the above photograph it is clear that household activities are done along the lake shore. Collection of domestic water from the same source without treatment can be risky to the residents. However, the study found no evidence to link source water pollution and outbreak of water born diseases.

Results from the in-depth interviews with District Water Officer(DWO) further indicate that water problems in Muhuru-Bay is mainly natural due to aridity and the nature of hydro-geological setting which affects water table. This condition according to the DWO may require heavy investment in drilling to access clean water and yet the government reduced the expenditure on water provision. Such water development strategies were found to be underutilized. For instance the respondents from Orlando village attributed the abandonment of boreholes to the nature of underground water that was salty.

A part from these findings, the study also revealed that residents (Orlando and Bande) in areas where boreholes and dams dominate seem to have developed negative attitude towards these facilities. The negative attitude towards borehole water had affected their effectiveness. To reaffirm this, we had to interview one resident of the

study area who was reported to have declined use of borehole water; he had this to say.....

since we were borne, we have been drinking the water from Ongoche river without any problem, when the government brought this Bomba (borehole) our children started being sick.... the government may have put fertility drugs in this water to reduce our birthrate.....I and my family have never used this water and will never....(Personal interview , Abich; Olando resident, 2009).

In view of this narrative from Abich(a resident from Olando village), one can conclude that though the borehole water is salty hence unsuitable for drinking directly, the case presented here looks critical as far as peoples' perception is concerned. The introduction of the borehole by the LBDA and the subsequent treatment may have been perceived by the local community as conspiracy by the government to achieve other objectives other than the intended one. This implies that community entry skills for a development work are important when dealing with culturally embedded society particularly in rural areas.

In order to ascertain differences in perception of people on the issue of water problem, we had to apply pair-wise ranking. The finding shows that, though most items considered to be the cause of water problem generated similar results with the findings from questionnaire interviews, some level of contradiction was noted in respect to pair-wise ranking approach. For instance, whereas lack of sanitation facilities was considered an impediment to water security (see Table 3), the same item was ranked last on pair-wise ranking.

The PRA participants also disregarded poor farming and deforestation as factors leading to the water problem. Poverty and persistence drought however maintained high scores in both methods; probably an indication that the two factors have direct impact on the lives of the residents. The difference in the result may be explained on the basis of methodology applied. Whereas, semi-structured interviews may have restricted the respondents, PRA pair-wise ranking approach assisted the local community visualize the relationship between different phenomena such as drought and lack of water and also poverty. This finding implies that to understand social processes such as water poverty future researches need to consider demystifying certain concepts by allowing the subject of study conceptualize the relationship in the

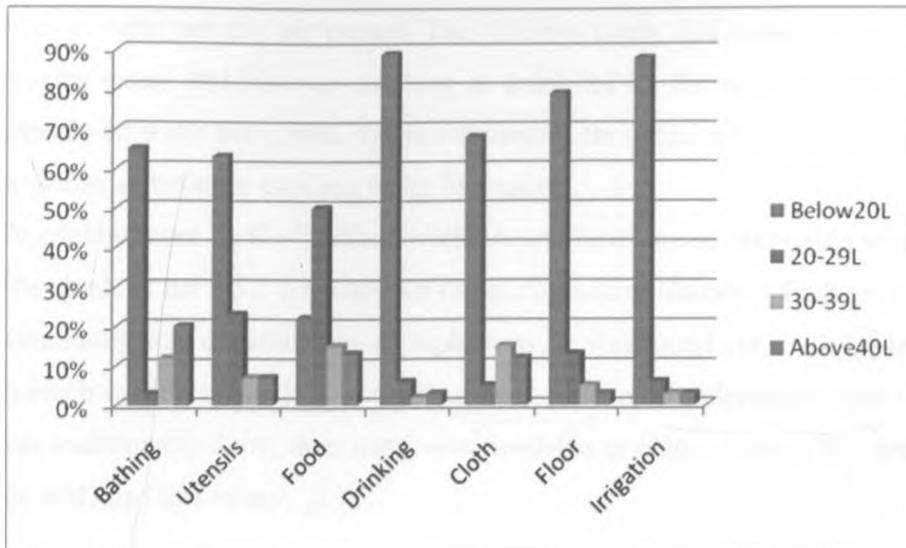
physical world; PRA approach therefore becomes a useful tool due to its power in allowing visualization of issues under study.

4.5 Domestic Water Requirement and Coping Strategies

Water per capita is yet another indicator for assessing water security. This is based on the fact that water sufficiency affects not only sanitation activities but also productive engagements such as kitchen irrigation. Issues investigated include, adoption of coping strategies, and distribution of water for various activities. Rating of water quantity as a result of water security coping activities was also part of this study. The study therefore sought to answer the question, to what extent does coping strategies increase the amount of water available for domestic activities. Household water related activities under investigation were; bathing, cooking, washing clothes, resurfacing floor and drinking?

To answer this question, domestic water consumption categorization was developed as follows; (below 20) L, (20-29) L, (30-39)L, (Above 40)L. Respondents were then asked to state in which category they belonged in terms of water consumption. It emerged that a vast majority (89%) of respondents consumed less than 20 litres of water for drinking per person per day. Large number of respondents were found spending at most 20 litres of water for resurfacing floor (79%), bathing (65%), washing cloth (68%), and cooking food (22%) (See Fig 3). Though most water related activities are carried out at the riverside or lake shore, the drinking and cooking water still fell below the global benchmark. This implies that despite efforts by the local community to compensate for livelihood activities by combining domestic tasks, water poverty is still day-to-day phenomenon.

Fig 2: Percentage Distribution of Respondents According to their Domestic Water Consumption Category



Source: Fied data, 2009

In order to introspect the respondents' feeling a bout water adequacy in relation to coping strategies they were asked to rate as either *very adequate*, *adequate*, *inadequate* or *very inadequate*. The survey revealed that quantity of water available was very inadequate(33.3%) while 35.9 percent respondents still felt that the water at their household was inadequate. On the other part of the scale, 23.1 percent of respondents claimed that water available for them was moderately adequate to support most household duties. 5.1 percent of respondents claimed that water available was very inadequate while 2.6 percent felt that water was suffeciently available. The even distribution of the response across the scale show that water security is relative and is dependent on a number of factors. Adoption of coping strategies such as storage tanks is largely influenced by availability of financial resources.

An evaluation of water intake against the United Nations water per capita requirement indicate that in all domestic water uses, households that responded to this question were exposed to water poverty conditions. The survey analysis result showed that water for bathing, drinking and food fall below the global requirements by 70%, 90%, 52% respectively. The study findings further indicate that water for sanitation activities such as washing utensils, cleaning hands deviated from the United Nations requirement by 80 percent. This overwhelming result shows that water security involves more than physical vailability of the resource to include livelihood meliu

such as coping behaviours, activities and even logistical arrangements. Interestingly, households with water storage tanks still were found to be surviving on less than 50 litres of water per day per person. This findings imply that coping behaviours such as *missing meals* and *distance washing* as exhibited by the respondents have negative impacts on water per capita. Yet this strategies are perceived by the respondents to be activities suitable for tackling water insecurity!

To explore more on the livelihood behaviours, focus group discussion was conducted. The result of the FGD contradicted the questionnaire interview findings that the local community was experiencing water scarcity. It was found out that people had access to much water and that if domestic activities were to be undertaken along the lake as it was traditionally done, then water was available in plenty. One of the participants in the FGD had this to say....

Water is available in this area except during dry season. Water along the lake is too plenty; the only problem we have is to carry the water to our homes for cooking. During day-time we have no water problem because the kiosk owners use lake water to prepare meals for us and you don't need to go home so as to have food for you... .. (FGD, Participant; Lwero, Olando resident, July 2009)

Interesting result from the FGD participants revealed that the local community had responded diversely to conditions of water scarcity during the dry season. Some of these coping strategies related to water quantity as generated by the FGD participants are presented in Table 4;

Table 4: Water Security Coping Strategies and Impact According to FGD Results

Types of water security coping strategies	Coping activities	Impacts on water per capita/requirement
Water rationing	Water for drinking only used during night meals	Number of meals per day reduced
Water hording	Water in bucket kept away from children	Children unable to drink water during the day
Water recycling	Water used for washing utensils kept for other uses such as mopping	At least water for washing hands available though not clean
Water mixing	Water from the borehole and dam mixed to reduce saltiness	Washing clothes made easier
Distance washing and cleaning	All kitchen sanitation activities done along the river side or lake shores: For example, washing utensils/watering livestock/washing clothes/children bathing	Reduces burden of water collection among women and young children
Domestic water conservation and preservation	Those households with water tanks store water during rainy season for over six months	Increase in water availability during dry season.

Source: Field data, 2009

The evolution of new terms in domestic water management gives a clue on how a society's intellectual assets can be harnessed for livelihood and development. This may also imply that water problem is real and that respond mechanisms vary from household to the other.

In an attempt to find out from respondents how they managed water situation, the respondents were asked whether they devised ways of storing water during dry season. Majority (61.7%) of respondents were found to be storing water. A further investigation into the nature and process of coping strategies revealed that ordinary jericans(28%) were predominantly used for storing water while 21 percent of the respondents stored water in super drums. Other significant water storage facilities were water tanks (5%), *sufurias* (8%), super drums and jericans (10%), and buckets (18%). The respondents were also found to be storing water in traditional pots (10%). As indicated by the finding, many respondents lack adequate water storage facilities thus unprepared to tackle the problem of water scarcity. This also has direct implications on water per capita as well as sanitation practices that majorly depend on availability of adequate water. Household time budget is also affected. For instance the much time spend drawing water negatively affects utilization and management of other livelihood activities.

Availability of water storage facilities is not absolutely indicator of water security. The capacity of a water storage facility is vital as it may determine the ability of a household to avert impacts of prolonged dry season. Therefore, the survey further sought to establish the capacity of the water storage facilities among the respondents who possessed them. Respondents who devised ways of managing domestic water through water storage facilities were asked to state amount of water the facility stored. Though 39% of the respondents indicated that the capacity of the water storage is above 200 litres, still majority (61%) of the respondents were unable to store water above 200 litres. This shows that anticipation for risks associated with water scarcity are weak hence unable to mitigate against occurrence of such natural events. This finding was strengthened by sentiments that were made by one of the respondents. She had this to say;

.....During rainy season we can collect much water but where can we store the water? My house has only small jericans and a pot that carries little water for a day, every day we have to go and fetch water from river Ongoche. Whenever I try to collect water from my grass-thatched house the water is black. We need support to install the big plastic tanks in our homes to collect water even though it is dirty... (Personal interview, Mrs Ariya; resident of Bande, 2009) (See Plate 2).



Plate 2 and 3: Photograph showing Mr. Ariyas' homestead in Olando village in Migori District and a water harvesting facility in a neighbouring homestead. Most low income households along the shores of Lake Victoria are incapable of harvesting water due to poor housing structures (Photograph taken 12; 00 Noon, July, 2009).

In the view of this finding, one can conclude that water requirement at household level is hampered by a number of factors including lack of harvesting and storage facilities.

To gain more insight on the disparities in resource endowment we identified two cases with different water storage capacity. The result from direct observation indicate that installation of large home-based water storage tanks were more prevalent among average and high income earners. The same households were also found diversifying sources of water by constructing home-based shallow wells even in some few cases installing septic tanks (see plates 4). This was evident following expression of one of the respondents with successful domestic water management systems. He had this to say;

...People in this area lack the knowledge, skills and finances to establish water tanks in their homes... ..you can see this is dry season but my tank is full of water, we have 3 of these plastic tanks each carrying 2500 litres of water. The residents should be educated on how to harvest water, be empowered financially, and be supplied with larger water tanks so as to secure water for dry season. If this is done then the water can be used for sanitation and even irrigating vegetables... .. (Personal interview, Okoth, resident of Olando, 2009).



Plate 4 and 5: From left *Photograph showing Mr. Ben Okoth, a resident of Olando village demonstrating the success of his home-based water management systems and to the right is a photograph of water storage facility for a low income household. Households with high income are likely to escape water related risks by establishing large water tanks (Photographs taken 5; 00 PM, July 2009).*

The photographs on plate 4 and 5 give insight on how resource endowment can influence household water per capita. This finding implies that attainment of water security status is dependent up on not only income level but also material resources needed for capacity building. Financial ability of a household increases its potential for maintaining significant water storage capacity as evidenced in plate 4 compared to low income households (See Plate 5). Taken together these findings strongly support the view that resource endowment explains basic, unique characteristics of water security coping strategies.

An in-depth interview with a women representative indicated that the local community particularly women were exposed to much suffering. This is because most of their time was spend trekking to the lake for water and that water is inadequate to cater for all their sanitation requirements. The women leader had this to say during the interview;

.....women in this area are suffering because their husbands go fishing and they have to take care of children, cook food for the fisher-men, go wash utensils along the lake at the same time carry water for their husbandsthey cannot stop fetching water because they in fact need water most..... our girls have to wake-up earlier and

accompany their mothers to the lake to fetch water before they go school (Personal interview, Rodah Adhiambo, resident of Nyakiringoto, 2009).

This finding shows that women and children are more likely to suffer impacts of water scarcity than their men counterparts. General observation indicated that even in situation where the source of water is close to homesteads, men tend to observe the societal norms that domestic water management is women's role. It shows that for a successful water development intervention a household power relation analysis is critical. Probably empowering women may mean increasing domestic water per capita.

4.6 Water Quality Coping Strategies (WQCS)

Safe drinking water and sanitation contributes to survival, health and socio-economic development. Therefore, the quality of water in terms of the extent to which it meets international and national standards is important. This is because infections such as typhoid fever, bilharzia, cholera, diarrhoea and dysentery occur due to contact with contaminated water. In this regard, sources of water and its management at household level may determine quality of water consumed. The Kenyan government provides guidelines for safe water as protected spring, treated borehole, tap and protected well. In regard to domestic water, the United Nation recognizes certain water uses to be paramount to human health. These areas include; sanitation and hygiene, bathing, cooking food, and drinking.

Based on this fact, the survey sought to investigate the various water quality coping strategies and their effectiveness in promoting household sanitation. To begin exploring this, respondents were asked whether they treat water before drinking. Majority (80%) of respondents claimed that water was treated once collected from the river or lake. The survey also found out that 5 percent occasionally treated water while the remaining 15 percent were unable to treat water citing various reasons.

Insufficient firewood for boiling water and inadequate income were some of the reasons cited by respondents for not treating water. When further interviewed to state why they had no confidence in the modern water treatment chemicals, one of the respondents had this to say;

.....our water is very salty and with some green materials but even when we boil the water our children continues to fall sick....some of the materials (chlorine substances) from the shop also have funny smell and our children don't like themwe can't boil the water every day because this area has no firewood and paraffin is expensive to afford, so we just believe God will protect our children against illness..(Personal interview, Rose Ojuki, resident of Olando, 2009).

This finding gives insight into the understanding of culture and how it could influence domestic water management. In order to ascertain the contribution of cultural factors, an in-depth interview was conducted.

The interview with the District Public Health Officer confirmed this finding. The DPHO pointed out that the local community has not realized the relationship between water contamination and infection from water-borne diseases. It was also found out that boiling of water does not reach the benchmark of 100 degrees Celsius and that the high level of illiteracy among household heads who are mostly above 60 years old contributes to ineffectiveness of water treatment applications.

A case was cited in which members of a village in the study area complained to the health officials how the chemicals that had been distributed by UNICEF were negatively perceived by the local people. The local community had claimed that the water guard had funny smell and that it re-contaminated the domestic water further. As a result of this attitude most residents in the study area have resorted to filtering water using piece of cloth (See Plate 6), carrying out some form of boiling and keeping water in a traditional pot for at least three days before drinking.



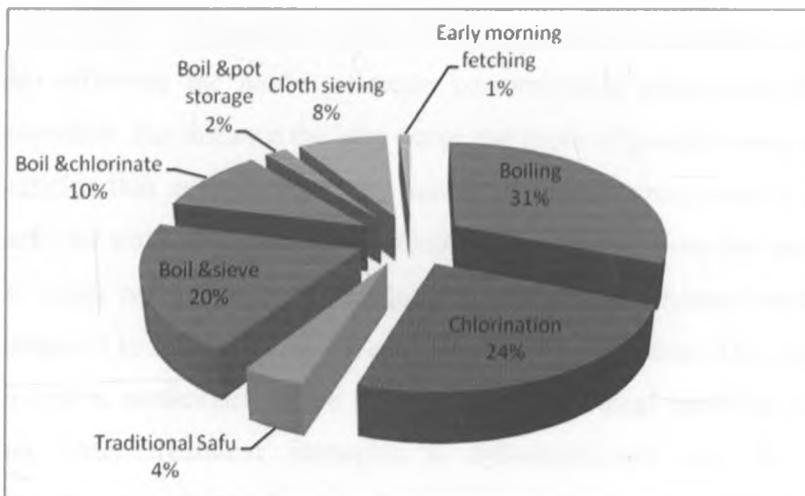
Plate 6: Photograph showing a woman sieving water into traditional pot by use of white piece of cloth. Most residents along the shores of Lake Victoria believe that sieving water is cheaper means of treating water (Photograph taken 5:00 pm, July, 2009)

Moreover FGD result indicated that water-borne diseases are prevalent among the residents, as much as various water treatment methods were employed. The District Development Officer also revealed that one major challenge in their efforts to raise living standards of the people in the study area was socio-cultural beliefs and attitudes among the residents. For instance in one of the surveyed villages it was clear that diseases were acts of nature and therefore a modern intervention could not be a solution. Review of the District Development Plan 2008-2012 had revealed that such beliefs required an integrated approach including efforts to transform the societal norms and beliefs.

Regarding the water quality coping strategies (WQCS), the respondents were asked to state their current water treatment methods. It emerged that boiling was significantly (31%) applied by the local community in treating water followed by chlorination (24%). One sixth (20%) of the respondents who treated water boiled and then sieved into a storage facility. Other methods applied in treating water for drinking included boiling and chlorination (10%), cloth sieving (8%), traditional *safu* (4%), boiling and storing in a traditional pot (2%) and early morning water fetching (1%) (See Fig 4). A combinational approach in water treatment may signify lack of full confidence in either of the methods applied.

An interesting finding indicated that respondents living close to the river believed that fetching water early in the morning was a remedy against pathogenic organisms that caused illness. Despite this finding, majority (80%) acknowledged the fact that treating water ex-situ could reduce prevalence of water-borne diseases. This finding was strengthened by the responses on whether the residents believed that treating water reduced chances of water-borne diseases. Results showed that 70 percent of the respondents agreed that treating water was a safety measure against diseases such as cholera, dysentery, bilharzia and typhoid that are common mainly among children under the age of five years.

Fig 3: Percentage Distribution of Respondents According to their Methods of Treating Water



Source: Field data, 2009

As much as the findings indicate that the respondents treat water, it is important to acknowledge the fact that the process of preparing water for human consumption is complex and that it is demanding in terms of skills, resource input. Post-treatment storage environment does also determine effectiveness of the water treatment strategies. If these considerations are not thought out, the likelihood of re-contamination is high.

Given the heterogeneity of the villages under study we also sought to find out alternative methods applied in water treatment. To begin exploring this, a question was posed during the FGD on ways practised by the local community in promoting sanitation, hygiene and reducing chances of water-related infections. The FGD

identified several methods applied by the community. The strategies that slightly varied within studied villages are summarized below;

Use of herbs(mti-mboga,and safu)

Hiding water from children

Exposing water to sun-light

Sieving water into the pot

Praying to God before drinking water

Fetching water early morning

Allowing water to settle after fetching

Locating specific points for fetching drinking water

The coping strategies were applied differently in relation to the surveyed villages. This can be explained in at least two ways; First, the different sources of water that also influence the nature of water contamination determines the mode of coping behaviour. For instance the lake water had more of green blooms and solid suspended particles that need decantation. Secondly, natural environment that either provides herbs for water treatment or not. General observation from the study area indicate that the upper part of the lake(Olando) is bushy and with home-based tree plantations as compared to Rabwao that has experienced deaforestation. This may influence coping strategies, particularly those that require use of local materials. This findings show that water treatment strategies is influenced not only by the socio-cultural characteristics of a society but also its physical environment.

Further investigation into the process of treating water by use of traditional pot revealed interesting result. The indigenous knowledge(IK) that governed this treatment approach was strongly supported by the respondents for being the only way they could ensure that water was clean. This interesting scenario was documented as illustrated in Case study I.

CASE STUDY I: TRADITIONAL POT WATER PURIFICATION AND COOLANT

According to Mama Ooko, one of the oldest women respondent we came across during our field work for this research, storage of water and purification by pot has been done since time immemorial. The genesis of pot making in African traditions can be as old as human civilization because pots were among the many items that were used in trade as well as prestige in African setting. In Luo culture *dapi*(pot) was mainly reserved for storing water for drinking. The belief among the Luo people is that the pot storage allows particles to settle hence removing the solids from water. According to mama Ooko it also removes any germs that could cause diseases to children. This is in line with conventional science which stipulate that it is advisable to store water and allow it to settle as it reduces levels of impurities by up to 50%. The people of Muhuru-Bay have remodified the process of pot storage to include sieving water using white linen. The water is then left for 2-3 days before it is consumed. Usually the pot is kept in dark room away from direct light and in a cool wet conditions probably to allow the process of cooling and purification. Indeed after hours or two days the water cools and looks transparent, an indication that turbidity level has decreased. The cooling can also be explained using scientific knowledge in which some pathogens get denatured under very cold conditions hence rendering them ineffecttive against living cells. The pots that are usually prepared by old women ,stores water between 20-40 litres and in many families the water is usually for the elderly people. The use of locally available materials makes this approach to water treatment affordable even though environmentally unfriendly due to the excess firewood needed during the preparation of pots. The high level of environmental degradation and deforestation associated with pots preparation has almost rendered this indigenous technology less applicable. Though it is not clear the extend to which pathogens are denatured by the pot, this method can be cost-effective and socially acceptable if integrated among other water treatment technologies in the study area.

Source: Field data, 2009

In the view of the above case study, it can be concluded that the local community have responded to water problem in various ways and that their indigenous knowledge(IK) plays key role in promoting some level of water treatment. The study also established that though many homes were observed owning traditional pots, when asked to state other ways in which they treated water, the result contradicted the general observation as only 11.5 percent claimed to be sieving water and storing into the pot. However, the scientific measurement of water quality parameters of the pot water was beyond the scope of this study. Thus there was no evidence to link pot storage and removal of pathogens and chemical substances.

But again the post-treatment storage environment is very critical in determining whether pot water is clean or not. The utopic belief by the elderly people that *pot water* is clean may need re-thinking particularly in regard to the post-treatment water storage environment. However, it would also be important to consider social axioms of a society that shapes behaviour and actions in a culture. In this view therefore one may conclude that infection from water-borne diseases may vary depending on individuals propensity to adapt to the local socio-cultural environment.

During the FGD, participants decried that even though many strategies were used in treating water, occurrence of water-borne diseases were common in the area. This implies that for an effective water treatment procedure, hygiene standards are mandatory.

In order to explore modernisation trends in water treatment, an in-depth interview with German based water project founder was conducted. During the interview it was established that the pilot project on water treatment by use of solar panel had been successful. The project that was initiated to promote food security and water treatment awareness was reported to be supporting more than 200 people including school going children. This success story was documented as shown in Case study II.

Case study II: Bay Water Cooperative(BWC)

The BWC was started in 2003 by a German group of volunteers with aim of promoting agricultural production and increasing access to clean drinking water as well as sensitizing the local community on the importance of treating water before drinking. The project that begun at a school center has extended to cover several households using German-made water solar heaters. The pannels that have the capacity of holding 40L of water at a time, can boil the same quantity of water within 30 minutes at mid-day and 50 minutes during morning and evening hours. Currently the water heater is serving a school with a population of 200 pupils and 15 staff. The preliminary survey findings by BWC after the establishment of the preject indicate that since its installation, the frequency of illness among the school pupils has greatly reduced. There are plans to increase the coverage of the facility and also develop more traditional pots to be used in storing water after boiling. The environmental and developmental impacts of the project have been felt by both the Shiners' school community as well the entire Muhuru village. Reduction in tree felling and increased school enrollment particularly girls are some of the impacts of the BWC project. The major challenge however, include lack of technical in-put especially on infrastructural development , monitoring and evaluation. Lack of water storage facilites has also been drawback to the project that aims at establishing a water plant that will promote small-scale irrigation to increase food security in the area.

Source: Field data, 2009

The water heater solar pannel facility is managed by a school community but the entire Muhuru village is a beneficiary. The solar pannel technology that has gained relatively wider usage in the area is illustrated below by one of its beneficiaries (see plate 7).



Plate7 and 8: From left photograph showing a teacher in a local school as she demonstrates the use of the water heater solar panel that is used for boiling drinking water in the school; On the right side of the photograph shows a woman boiling water using firewood. The German-based Bay Water Cooperative(BWC)project serves more than 200 pupils and the community (Photograph taken 12;00 noon, July 2009)

Comparing the water quality coping strategies among different households it was obvious that lack of material resources (firewood) influenced the process. For instance, observing a woman from a low income household as she boiled drinking water revealed that the process was less effective. World Health Organization(WHO) recommends that for an effective treatment, boiling should go up to 100⁰ C. But as the reader can see from the photograph shown in plate 8, the woman boiling water for drinking seem to be lacking adequate fuel. On the other hand, the photograph shown in plate 7, reveal that with availability of appropriate technology, water can be treated to some acceptable level for human consumption.

It is however important to emphasize that provision of treatment materials alone may not necessarily ensure availability of clean water as other factors may intervene. This findings show that rural societies are entangled in a myriad of challenges in achieving standards set for various living conditions such as water treatment procedures. Material resources, attitude and limited information include some of the macro-factors that determine how such population can carry out an effective treatment procedure to avert risks of infection from water-borne diseases. The findings also show that lack of basic sanitation knowledge among the rural population is one of the factors that aggravate risks associated with poor water quality.

Respondents' Opinion on Status of Water Projects

The community confidence in development of water projects is yet a nother indicator in measuring viability of any water provision strategy. Establishing machinery for complaint resolution is therefore important especially in the way a strategy should be designed not only as remedy to past mistakes but also as a way of increasing local community participation in decision making. In order to assess the respondents' opinion on the status of water projects by either government or Non-Governmental Organizations, the respondents were asked a number of questions. The survey sought to know the respondents assessment on the success or failure of water projects in the area.

The survey indicated that majority(83.4%) of the respondents felt that the water projects had not performed to their expectations while the rest claimed that all the water projects in the area have been successful. It can therefore be concluded that most respondents are dissatisfied with the water projects initiated by the government and NGOs. This finding can be strengthened by the earlier one in which the respondents attributed the persistence water problem to the failure of water projects mainly those that were established by the government through lake basin development authority(LBDA)(see Table 3).

Suggested Solution to Improving Domestic Water Security and Quality

Given the fact that majority(83.4%) of the respondents showed dissatisfaction with the water projects, the respondents were then asked to air their views on how best domestic water could be managed. The interest of the study in this section was for the purpose of generating views which would help in designing a domestic water management strategy(DOWAMS). Such a strategy would assit the local community attain water security status. Following the open nature of the question, their diverse responses have been categorized into much broader view. Table 5 gives the summaries.

Table 5: Percentage Distribution of Respondents According to their Suggestions on ways of Improving Domestic Water Security

Suggestions	Frequency	Percent
Reduction in prices of the plastic water storage tanks	19	31.6
Donor support for water source diversification	8	13.3
Establishment of home-based shallow wells in every home	1	1.7
Establishment of water treatment plant along the lake shore and river-side	4	6.7
Government supply of water tanks, jericans and super drums	1	1.7
Establishment of large traditional pots in every home for water storage and preservation	13	21.7
Toilet awareness campaign(TAC) to be carried out along the lake region	2	3.3
Environmental education on risks of lake water pollution	2	3.3
Increase access to water treatment materials including locally available herbs such as <i>mti-mboga</i> and <i>safu</i>	2	3.3
Enforce law against spraying chemicals in the lake by the fishermen	2	3.3
Provide technical skills and materials for rain water harvesting	4	6.7
Satisfied with water situation	2	3.3
	60	100

Source: Field data, 2009

The suggested solutions are an indication that the residents of Muhuru-Bay do have some level of understanding of how to tackle the problem of water quantity and quality. Though the survey results indicate that two respondents (3.3%) did not have recommendation, the greatest percentage(31.6%) are of the view that the prices of water storage tanks should be reduced to enable majority install them for water harvesting and storage. This was closely followed by the need to establish large traditional water pots(21.7%) in every home which is perceived by the local community to be serving multipurposes. Traditional pots serves as water storage facility as well as water purifier. Water source diversification(13.3%) and provision of

technical skills and materials for rain water harvesting(6.7%) were also among the suggestions made by the local community for improving domestic water security.

4.7 Discussion of Key Findings

The discussion of the key findings is based on the analysis of data from research questions and their corresponding objectives in the context of the study theoretical framework. The findings of the study makes three main contributions. First, it support the view that water scarcity is influenced by various logistical and institutional factors. Secondly, application of coping strategies does not necessarily increase water per capita. Lastly, water quality coping strategies(WQCS) are diverse and their impacts are yet to be felt. Further discussion based on research questions is thematically presented below.

4.7.1 Persistence in Water Problem

The first research question sought to identify the reasons for the persistence water problem. The study found out that a section of the community has been unable to improve water supply over time due to numerous challenges. These challenges include, policy gaps, poverty, inadequacy of sanitation facilities and cultural beliefs in form of attitudes and perceptions. These aspects are discussed below.

The first factor contributing to the persistent water problem in the study area was pointed out as lack of national policy on rural water provision and the failure of the rural water facilities. Such a concern is strengthened by the obvious lack of piped water systems in the rural areas of many developing countries. In Kenya the fall of free service in water provision was felt in early 1980s with adoption of the SAP packages. This finding attest to some of the challenges pointed out by the Kenyan government that one of the challenges facing water sector was institutional weaknesses (Kenya, Republic, 1999:8).

Though this seems genuine case presented by the government, the sessional paper No. 1 of 1999 on National Policy on Water Resources Management emphasizes the need to promote water commercialization. This model in water development skews against the rural population where the dilapidated infrastructure and inadequate technology reduces the chances of having a robust rural water supply system. There are success cases however in some countries south of the Sahara that have demonstrated achievement of Millenium Development Goals(MDGs) by strengthening rural water

provision. According to the World Bank report '*Attacking African Poverty*', the national rural water sector reforms in Ghana, the national sanitation program in Lesotho and sanitation program in South Africa have managed to achieve water coverage rate above the progress for sub-Saharan Africa (Lane, 2008).

General observation in the study area, showed that rural water facility establishments were in non-operational status leaving the residents to rely on unreliable and highly polluted lake and river waters. Initiatives made by local NGOs have neither succeeded due to numerous factors including aridity and lack of technical input in siting water sources. Mireri (2007) argues that operation and maintenance of water supplies has recently become one of the major problems within water sector. The previous finding cites poor design, maintenance, and operation as primary challenges. This has had negative effects on performance of rural water facilities.

Onyango et al (2008) found out from Nyando basin that weak land adjudication in the zone was one of the policy issues affecting water security in the area. For instance all springs fall under private land and that there are no or limited public roads leading to the springs. Similar study by Were et al. (2006) indicated that most water projects around springs in Nyando basin rely on customary laws to secure rights to the springs. This policy gap in land adjudication influences household water security in many ways. For example the need to diversify water sources may be hampered by lack of well defined boundaries.

Secondly, the unique contribution of poverty to predicting water insecurity was distinctive to our understanding of the relationship between poverty and water scarcity. Interviews with residents of Muhuru-Bay revealed that poverty was one of the central reasons for the inability of the residents to tackle the problem of water quantity and quality. The constraints imposed by poverty were found to be;

- (i) inability to pay for the maintenance of water systems
- (ii) low income per capita

Constraints for the state to provide basic physical infrastructure such as proper water systems in rural areas were diverse. They include poor coordination of rural development funds and the poorly performing economies of rural population who mainly practice subsistence farming. Viewing provision of basic services, such as water and sanitation, as the duty of the state most African countries established large, centrally managed water supply programs (World Bank/Lane, 2008). These programs used conventional engineering solutions that resulted in infrastructure that were

beyond the people's capability to maintain. Maintenance was problematic because the governments funding was centralized. They provided water free of charge to people connected to the services. As the economies of many countries declined, however, budgets were reduced, water infrastructure fell into disrepair and users were unable or unwilling to maintain it themselves.

As a result, the poor rural population have suffered more of poor sanitation and inadequate water for both domestic and productive activities. Though the study area is potential in ground water, its exploitation is under utilised. Considering the fact that only 10 percent is the proportion of renewable ground water in Kenya, water problem could become a near disaster. Exploitation of ground water however would require heavy investment in water treatment but as the result indicate in Fig 4, only 31 percent boil water as a form of treatment; activity that is also hampered by factors such as inadequate fuel and unhygienic post-treatment storage environment.

Many of the respondents living along the shores of Lake Victoria, in the present study belong to the low income stratum. They are poor. Their socio-economic characteristics leads to this classification. For example over 13.3 percent had received no form of formal education, while majority(67%) had attained only primary education. Only a small proportion(7%) had received post-primary education. Even the sources of income reported by the respondents were pre-dominantly non-professional, characteristic of low income communities. The leading occupations included subsistence farming(50%), petty business(35%) and fishing(7%). There were also cases of non-occupation(2%). This findings concures with findings by World Vision(WV, 2009) in which absolute poverty in Migori was found to be at 78.5 percent as compared to 64.6% nationally. The same study found out that 97.7% of households were reported to have had at least one month of severe food shortage mainly attributed to inadequate rainfall. This results confirms the national argument that Lake Victoria Basin is one of the water-surplus area of Kenya yet it routinely suffers from extreme poverty(World Bank, 2004).

It is however important to emphasize that presence of water a lone is not necessarily indicator of development and social progress. This is because areas characterised by poor infrastructure have minimum chances of fully exploiting water resources because factors of production tend to be costly to gaurantee any gainful production. Also the pattern of national resource allocation and the nature of landscape may reduce possibilities of enhancing agricultural production even though water is available. In

this general notion of poverty as 'exclusion', accessibility to resource is important, not only for its role in facilitating regular and stable family livelihood but also for its role as part of the social capital(Mbaku, 2005; World Bank, 2002). This maintains the social relations forming the safety of poor people in many societies. Examining water security in the context of macro environment(national economy) it is obvious that poverty is accelerated by many other factors. For instance, Mbaku(2005) points out that the persistence economic downturn in African countries after so many years of independence is due either to policy mistakes made by well-intentioned leaders or unskilled and ill-informed bureaucrats and politicians. Mbaku underscores that for each African country's economy to operate effeciently and create wealth that is needed to confront poverty and deprivation, the economy not only has to have the necessary resources, but must be provided with the appropriate institutional environment. Though this argument may hold particularly in developing countries, more data may be needed to verify suggested relationship between poverty and water insecurity.

The last finding under the first research question to be discussed is that sanitation facilities and cultural embedment of the community is related the water insecurity.The residents' sanitation level is still poor as evidenced by lack of basic sanitation and hygiene facilities. The checklist result indicated that pit latrine coverage stood at only 31.7 percent, composit pit(30%), utensil rack coverage was 53.3 percent. A vast majority(93%) of the respondents did not have disinfectant materials in their homes while 85 percent were unable to purchase chlorine tablets known for killing pathogens that cause water-borne diseases.

The results agrees with the recent Area Development Report(World Vision /ADP, 2009) which found out that pit latrine coverage had not significantly improved since 74 percent of the households do not have latrines compared to 74.6 percent in 2004. According to the World Vision evaluation report the level of hygiene and sanitation practices has not improved over time because only 10 percent of the 120 household surveyed owned pit latrines(WV, 2009). If proper waste disposal is a remedy against water contamination then the residents of Muhuru-Bay are exposed to high risks of water-borne disease infections. Some reservations however must be noted concerning the conclusion about the sanitation facilities coverage. It should be emphasized that even though sanitation facilities are highly regarded as predictor of good

health(WHO, 1997), their presence may not necessarily point at this success due to non-point nature of water contamination.

Despite this argument, World Bank '*Living Standards Measurements Study*', reveals that 80 to 90 percent of the rural poor in developing countries have no sanitation facilities of any kind(Komives et al. 2001). In Muhuru-Bay this could be the case because many residents(47%) claimed to have no regular income. Even those with some level of income, were found to be surviving on less than a dollar a day. Douglas et al(2006) established that Migori District is one of the medium high risky areas in terms of sanitation and hygiene. The gist of Douglas et al findings observes that the geography of the area contributes significantly to low latrine coverage as evidenced by the frequent flooding that often sweeps away structures including the sanitation ones.

World Health Organization(2000) has also argued that factors inhibiting sanitation standards along the lake basin cannot only be limited to the household water management behaviour. WHO argues that ecological conditions in particular the growth of water hyacinth in lake Victoria that creates suitable conditions for the survival of *vibrio cholerae*(causative agent for cholera) also significantly encourages spread of water-borne infections.

The interpretation of sanitation and hygiene practices among the Luo culture may also be relevant to water insecurity. This stems from the peoples' perception of the concept of sanitation and hygiene. The importance of maintaining a clean environment particularly in the context of water quality is also unique among the Luo people. Although NGOs and government agencies have put in place relevant environmental education programs, the extent to which these programs are appreciated is still low. Various factors influence peoples' attitude of the importance of maintaining sanitation.

The study also found out that men-women power relation at household level is related not only to water collection but also to its allocation. General observation revealed that men were more pre-occupied with activities such as fishing that were more likely to generate income while women were left with responsibility of collecting water and doing laundry work for the family.

This result concurs with findings of Onyango et al(2008) in which 77% of the surveyed households indicated that women were most important water collectors. They also have an additional burden of having to carry out laundry work along river sides. The study shows that cultural norms of society can influence water security negatively as in this case the women who are the major collectors of water may be overwhelmed with more work to perform. The strict observation of some societal norms by mainly men can also be viewed retrogressive not only to the advancement of women but also general sustainability of water supply at household level.

Furthermore, the belief that water is 'God' given affects the reception of education on proper hygiene practices, so public health education has neither been well-understood nor appreciated by the general population. Consequently, lack of proper understanding of the concept of water treatment(most residents cannot relate treatment and killing microorganism hence boiling water does not go beyond 100 degrees celcius) reduces the effectiveness of the process.

This findings agrees with most previous studies in natural resource management. According to Hannigan(1995) the management of natural resources is affected by the intersecting and competing social and cultural definations and interests. The dynamics underlying this management, the priorities accorded to the environment vi-a-vis other concerns and the optimal means of mitigating environmental conditions are influenced by the attitudes, perceptions and interests of a given society. The residents of Muhuru-Bay and policy makers in water sector are therefore faced with the challenge of how to address these diversities among different members of the society. The finding that cultural beliefs is related to water insecurity could also be explained on the ground of this socio-cultural and environmental context.

Indeed this conclusion is consistent with sociological and humanistic development perspective regarding human interaction with resources (Amartya 1998). For instance Amartya observes that the issues of epidemiology and pollution are both environmental and socially influenced. Aside from public facilities(such as water sources and latrines), nature of community relationship can be very important in determining availability of human basic needs such as water. Of course, these conclusions are restricted in at least one respect; that they are relevant for the rural society context that still value traditional practices.

4.7.2 Domestic Water Per Capita

The second research question and objective two sought to find out how the rural-based water security coping strategies contributed to water per capita. The results showed that residents' water per capita is far below the global requirement of 50 litres per person per day. This is despite the fact that adoption of water security coping strategies (RUBAWACS) stands at 61.7 percent. When measured against the United Nations water per capita requirement, analysis of the survey found out that average water for sanitation, hygiene and other domestic activities deviated significantly from the global requirement.

Compared to the national water per capita projections (650m³ per person per year) this result reflects the water poverty scenario among majority of Kenyans. According to world Bank report (World Bank, 2004), Kenya has a limited fresh water endowment of just 650m³ per capita per year as compared to 1000m³ United Nations requirement. When compared regionally Kenya is categorized as water stress as opposed to Uganda with 2940 cubic metres and Tanzania (2696m³). Estimated demand for water in Kenya is 3150Mm³ per year and is projected to rise by 38% by 2010 and 76% by 2020 (World Bank, 2004).

Furthermore, the estimated water per capita is likely to decline to 235m³ in 2025 as the population reaches 60 million (NEMA, 2003). This implies that productivity in the most affected areas such as Lake Victoria Basin would decline leading to increase in the number of people suffering from human poverty. In contrast to this postulation, scientists suggest that total global precipitation (amount of condensable water particles in the atmosphere) is likely to increase during the next century though ununiformly

(Intergovernmental Panel on Climate Change (IPCC, 2007). Conversely the same report indicate that, global warming could further reduce water availability in those areas that already suffer from water stress or water scarcity. Domestic water for human survival activities could be significant as far as this postulation is concerned.

Water security measures the ability of a country to continue to function productively, both socially and economically. An investigation into how each household distributed water for various domestic activities generated an interesting results. All the basic sanitation activities consumes water in the category of less than 20 litres (see Fig 3). In most cases use of water for productive activities such as kitchen garden irrigation indicated no water use. Almost similar result was found through survey that was

conducted by Bay Water Cooperative(2009) which shows that only 25% of those interviewed were doing small-scale farming as their basic source of livelihood. Also this finding was supported by the present study showing that relationship between poor water systems and weak agricultural productivity(kitchen gardening) can explain broader impacts of water scarcity.

Conversely, a contradicting finding by Swallow and Were(2006) indicated that Nyando zone had adopted intensive agricultural activities such as livestock farming, tea seedlings and kitchen gardening as a result of improved water supply. The contradiction in the use of water from the two cases could be attributed to a number of factors. The ecological potential of land in the western rift valley as opposed to Muhuru-Bay that is ecologically unsuitable for crop and livestock production can best explain the difference in the result. Water utilization and management in the present study area is largely confined to domestic purposes. These findings together imply that water accessibility affects and is affected by the productive potential of an area hence both promoters and consumers of water must be developed concurrently.

In deed a recent World Vision study reveals that water access in Migori District is still low at only 25.2 percent as compared to the national access rate of 31.8%(World Vision, 2009). Of course, access to adequate water may determine whether a household collects sufficient water or not hence influence water per capita.

Another possible caveat of the study arises from the coping strategy issue. Because the study is largely survey, its findings can be interpreted in two ways. The survey established that majority(61.7%) of the respondents have responded to the water scarcity scenario. The response to water scarcity, however varied from household to the other. The capacity of the storage facility proved inadequate as indicated by the facilities that could mainly store 200 litres of water. Though some residents felt that coping strategies had improved their water requirement(3.3%), quite a number(35.9%) showed high level of dissatisfaction that water was not adequate to cater for all the domestic activities. Other external factors such as aridity may have also influenced the high level of dissatisfaction among the respondents. It easily could be claimed that the willingness of the community to respond to risks of water insecurity is hindered by inadequate financial resources.

An evaluation report by Word Vision argues that over the past five years(2004-2009) the water availability situation in Migori has not improved as the residents have to travel for an average of 2 hours to collect water during the dry season. Water inavailability is complex because it influences many human related processes including sanitation and childrens' ability particulary girls to attend schooling regularly. Response mechanisms adopted by the local community to reduce impacts of water scarcity was found to be insuffeciently adequate to maintain household sanitation and promote productive activities. The various coping behaviours adopted to increase water per capita seem to be less effective as evidenced by consumption of water below the global requirement.

The ineffectiveness of the water security coping strategies as evidenced in the study threatens response to harsh climatic conditions. According to the World Bank(2004) about 84% of Kenya consists of arid and semi-arid lands(ASALs). In this case therefore domestic water management strategy(DOWAMS) should recognize the external factors that influence water per capita in designing such a framework. Establishing an enabling environment for water abstraction and treatment may be a priority. This is based on the fact that acquistion of water storage facilities in the absence of adequate water sources may not necessarily ensure water security.

Considering the demonstrated efforts made by the local community to manage domestic water, it would be imperative to integrate and build on these traditional methods and assets. It is generally believed that stability in water per capita is dependent up on community empowerment through organized capacity building programs. Indeed the World Bank(Lane, 2008) argues that empowering the poor entails respecting their knowlodge, social structures, institutions, and leadership as well as paying attention to the women and the marginalised not vice versa.

4.7.3 Water Quality Coping Strategies and Human Health

The third and final research question was expected to investigate the various water quality coping strategies and their implication on human health. The result show that the local community treat water using different methods such as boiling, cloth sieving and chlorination. The survey findings also reveal that though the local community acknowledged the importance of treating water, the methods applied may not be effective in reducing water-borne disease prevalence.

The study found out that 31 percent of the respondents boil water whereas 24 percent apply chlorination, result that concurs with previous survey by the Bay Water Cooperative(BWC, 2009). BWC found out that 30 percent of those who claimed to be treating water put water through some form of boiling before drinking while the rest use chlorine for water treatment. This findings imply that the community under present study appreciate and practice some form of water treatment. The different approaches exhibited by the respondents in water treatment shows how the society is socio-culturally and economically differentiated.

A further investigation into storage of water after treating indicated that water is mainly sieved into a water pot and water collecting jerricans; a condition that could be increasing the chances of water re-contamination. The half-hazard process of treating water at household level seem to contravene the WHO water treatment procedures. According to Goel(2006) there are at least three stages in treating water for drinking, thus; pre-treatment, coagulation, flocculation, filtration and finally disinfection. Goel acknowledges that though storing water can provide more than 50% reduction in most pathogenic microorganisms in hours to few days, the practice should be carried out in contamination-free environment. Storing water in unclean pots by the local community therefore exposes them to risks of drinking re-contaminated water. This finding may provide a clue as to why the area records high cases of water-borne diseases despite evidence of water treatment among the local community.

On the other hand, filtering water using piece of cloth was also pre-dominantly applied as a way of treating drinking water. It is important to emphasize that filtering according WHO(1997) only removes particles of solid nature to reduce turbidity. The process neither kills pathogens nor removes excess chemical elements. WHO defines potable and drinking water as that which is free from pathogens and chemicals that are deleterious to human health. Therefore water drawn from boreholes, rivers and even the lake may need elaborate treatment procedures such as chlorination and softening.

According to the MOH Migori District Hospital, bilharzia, cholera and typhoid are the leading killer of mostly children under the age of five years in the area. This finding attest to the global water and sanitation assessment report that 2 million children die from sanitation related diseases every year in sub-Saharan Africa(UNICEF, 2000). The process of water treatment, post-treatment storage environment as well as

materials used for treating water may determine the water quality status. In some cases when modern chemicals are used still the question of procedure and skills in their application arises.

Sanitation and hygiene practices varied within households. For instance households with average and high income had stable counts of chlorine substances and demonstrated regular and procedural treatment of water. On the other hand, poorer families were found to be fatalistic about the relationship between water contamination and water-borne diseases.

Goel(2006) confirms this findings when he argues that water contamination may vary between adjacent households with the poorer having the greatest burden of infection. It was established that most low income earners could not afford any modern form of water treatment. Studies on the burden of disease confirms this finding by observing that contamination pathways include, contaminated food, person to person and lack of hygiene. Effectiveness of the treatment methods, the sources of water and the coverage of sanitation facilities such as pit latrines influences the status of water quality hence human health.

Adoption of modern methods of treating water is still low among the residents of Muhuru-Bay. Fig 4, indicate that only 24% of the respondents apply chlorine in treating water. The result is slightly below Makusta et al(2001) who found out that 33.5% of the respondents in western Kenya were chlorinating drinking water. The difference could be explained by a number of factors. For instance the transport network in Muhuru-Bay is dilapidated hence access to treatment materials may be limited. Future studies however should investigate whether these findings are valid for rural population in other parts of the country or whether they are unique to the communities along the lake basin.

In concurrence with the present study previous studies have indicated that , traditional water treatment methods are common among low income households. However, the environment under which the process occurs has a role to play in determining water quality (Mishara, 2006). Mishara(2006) found out that in Sri Lanka majority(70%) of households treated water using local methods yet prevalence of diarrhoeal cases were rising. This finding agrees with the present situation in which the last half of the year(2009) the study area has recorded 313 cases of diarrhoea. During the same period 20 children under the age of 5 years were suffering from dysentery. Bilharzia infection was also on the rise, with 15 cases being reported within the months of

January to June, 2009 (Migori District Disease Surveillance Division; MDDSD, 2009).

This chronic occurrence of water-borne infections imply that safety of water is not only limited to household water management but the wider environment. This finding is consistent with recent studies by World Vision which indicate that water from all the four major (river, lake, dam and shallow well) sources is of low quality with excess chemical elements, high turbidity, fluoride and had funny smell and taste (World Vision, 2009). Such water may need vigorous treatment. It is important to emphasize the fact that though contaminated water may not have short term health effects, accumulated consumption of the water could have serious long term impacts on human health.

In the view of this finding, one can conclude that the policy challenge here is how development of domestic water management strategies could balance conventional and traditional methods of treatment. This may be instrumental in increasing effectiveness of water treatment strategies in the rural areas. Our findings in water quality coping strategies (WQCS) domain are consistent with this body of knowledge and support our broader contention that coping strategies can be interpreted within the livelihood theoretical frameworks conventionally used for understanding access to resources and coping behaviours and processes (Ellis, 2000a; Carney, 1999).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study was set to investigate the impact of rural-based water security coping strategies (RUBAWACS) on domestic water per capita and household sanitation. The study was guided by the following questions; First, what are the reasons for the persistent water problem in Muhuru-Bay?. Secondly, to what extent does RUBAWACS contribute to domestic water per capita? Lastly, how does the local community respond to the water quality challenges such as ill health and how effective are these strategies in promoting sanitation? This chapter presents conclusion based on the analysis of study findings. The chapter winds up with policy recommendations for government and other water development partners and also recommendations for further research.

5.2 Research Conclusion

Based on the research findings, we arrive at a number of conclusions. The first objective of this study was to identify some of the reasons for the persistent water problem. Analysis of the research findings has shown that lack of national policy for rural water supply, poverty, inadequate sanitation facilities and cultural beliefs are fundamental factors that influence water availability and quality. Indicators of policy gaps across the four villages surveyed were similar. Lack of rural water supply systems and missing guidelines on utilization and management of domestic water were also noted as policy gaps. Cultural factor manifested itself through attitude and societal norms that either deterred or promoted development of water provision initiatives.

The way poverty occurs in the area was systematic-low income per capita to maintain water facilities and lack of funds for installing large water storage facilities and the inability to cost-share operations of water supply schemes.

Though poverty was explained both at macro and micro level, household absolute poverty was evident and thus more related to water problem. At the broadest level, the results of this study indicate that reasons for the persistent water problem are multifaceted hence the study suggest a need for an integrated policy approach towards rural water provision. The proposed policy guideline should however consider spatial

diversities as well as identities in the light of socio-economic, cultural and environmental dynamics of the rural population.

The second objective was to establish how the rural-based water security coping strategies (RUBAWACS) contribute to domestic water requirements. Findings reveal that as much as the adoption rate for the RUBAWACS is high, the residents' water per capita is below the global requirement of 50 litres per person per day. The storage facilities are limited as to the amount of water they can store. This was evident by the low water storage capacity. As a result, water related activities and processes such as bathing, drinking, sanitation and hygiene are negatively affected. Coping strategies such as early morning water fetching and combination of activities were found to be less effective as far as water per capita is concerned. The findings suggest that water security cannot be examined only in terms of coping strategies. Instead external factors such as logistical arrangement contribute to its availability.

Lastly, this study was set to find out how the local community cope with the challenges presented by poor water quality and the effectiveness of the strategies in promoting sanitation. Based on the study analysis, it was found out that though the local community treated water using different methods, the process involved in treatment and the storage of water after treatment was still below the hygiene standards. Medical documentary review revealed that despite the high adoption rate of water treatment among residents, water-borne disease prevalence had not reduced.

This was tested by carrying out content analysis on morbidity reports for the last six months in 2009. Whereas the nature of pollution in the boreholes and lake required elaborate treatment methods such as flocculation, coagulation and filtration, the local community were found boiling and sieving water. These methods are considered less effective in killing pathogens and removing chemical elements that are responsible for microbiological contamination and water hardness respectively.

The role of cultural beliefs in water quality and sanitation perception was noted among respondents and it had a mixed result. Considering the role played by norms in rural societies it would be imperative to analyze social axioms (that defines peoples' behaviour in a cultural setting) in future researches and implementation of water development projects. This is based on belief that the concept of *water quality* is relative and the effects of water contamination may affect people differently depending on how one has adapted to a given culture.

Regarding the household water management strategies, the study found out that they were mainly practiced without any significant implication to water per capita and human health. Indeed our findings support a view in which livelihood strategies are not necessarily an apex of resource endowment but a means through which mostly the poor expresses their suffering albeit adequate to promote individual wellbeing or societal development(Ellis, 2000a).

In view of the general findings, it is imperative to note that combination of livelihood activities does affect effectiveness of any water provision strategy. It is also possible that some indicators could have different results were the study carried out in a society that has institutionalized water security coping strategies.

This is because, there is no single institutional panacea that will ensure adequate water provision anywhere in time and space. Rather, each strategy does face a set of challenges that are shaped by both internal as well as political, physical, economic and socio-cultural constraints of its operating environment. We therefore encourage further research as to how best the rural population can respond to the rising challenges of water insecurity.

5.3 Recommendations

It is evident from this study that water insecurity is still a challenge to human development in spite of coping strategies adopted by the residents of the study area. Improvement in water provision and in the right quality will therefore dependent on a number of factors ranging from policy matters, capacity building to advocacy and public health education. In this regard we suggest the following recommendations;

a) Policy Framework

In regard to policy gaps in the rural water provision, the government of Kenya in conjunction with other stakeholders may need to develop a policy framework to coordinate water provision in rural setting. Enhancing easy access to water utilization and management facilities is important. Such facilities include; storage facilities, treatment materials and water harvesting technologies.

In order to ensure smooth operation of the proposed policy guideline a legal framework may also be necessary. This will reduce cases of water pollution from point source. Since domestic water is determined by the quality status of rivers and lake, there is dire need to formulate a legal framework to regulate activities along the rivers and lake in the study area. However, such a proposal should be taken with

caution so as not to interfere with the community's socio-cultural systems of values and beliefs.

Integration of indigenous knowledge (IK) and modern systems can be a pre-requisite for the policy strategy. For instance the traditional science behind water storage pots could be harnessed and used to store water after boiling on solar panels that represent the modern trends. But then this will require the implementers to uphold the principles of sustainable development considering the fact that pot making process is energy demanding. Energy saving technologies could be used to avert the possible negative socio-economic and environmental externalities.

To avert the problem of failure in water projects there is need for an establishment of a Rural Water Development Authority (RUWADA) to oversee the planning process for water assessment, development and supply. The body that we propose to be autonomous will also involve working groups drawn from civil society and donor partners. The body could also mobilize resources and develop yardsticks for good practices in domestic water management with the view of promoting good water governance (See Appendix 9).

b) Capacity Building

Given the high level of water poverty in the study area a lot need to be done to effectively implement the existing or proposed policy and legislation. This include capacity building and requisite investment in water and sanitation service delivery. Based on the potential presented by the local initiatives in domestic water management, technological transfer and skill impartation is necessary in order to enhance proper water management practices.

Man power endowment in domestic water management is critical in planning for rural water provision. Emphasis should be focused on water governance as opposed to the traditional engineering water management model. Training of the local community on integrated water use is not only a necessary remedy against poor leadership but also means of empowering the local community in ownership of the development process. Cash transfer arrangements towards establishment of sanitation related facilities and water treatment plants are also necessary. Public utility development is the foremost step in enhancing water security. For instance protection of water points can reduce point source water pollution.

c) Advocacy and Public Health Education

In regard to advocacy and public health education, change of attitude and perception can be a remedy. However, for an effective change of mind and behaviour efforts to have accurate knowledge about the community is necessary. Understanding of social axioms of a society is needed for development process. It plays a major role in enabling policy makers develop programs that can easily be adopted by the consumers of the development process. In this view therefore the following measures can be undertaken;

First, there should be a concerted effort by the government and other partners to carry out an environmental education campaign (EEC) to sensitise the community on the relationship between hygiene and human health. A public health education program may achieve this by working with the local community particularly women to train them on practices of good hygiene using multi-media approaches.

Secondly, a latrine awareness campaign (LAC) may be useful in promoting sanitation standards. This will also require the training of trainers (TOT) in order to impart the sense of latrines in homes. With financial support to the local leaders, a model latrine may be established in a central place to serve as an example to the community. This may be useful in transforming peoples' perception and attitude towards new cultural practices such as ownership of latrines. To achieve this, linkages between the various sectors such as water, public health and development planning is necessary.

Though these recommendations are diverse in terms of approach and content, an ideal program for a domestic water security and sanitation may require a holistic approach so as to capture and harmonize different interests and needs of the society. This is based on the fact that whereas the respondents appreciated the connection between water treatment and reduction in water-borne diseases, the rate of infection from bilharzia, cholera, typhoid, diarrhoea and dysentery continues to rise as indicated by the morbidity records.

d) Recommended areas for Further Research

There were a number of unresolved issues emerging from the study that would suggest need for further research. First, future research question should focus on the role of gender in household decision making regarding water and sanitation due to the role played by women in domestic water management.

Second, the role of culture in water problem seem to have multifaceted dimensions hence the need to establish how cultural beliefs promote or deteriorate water situation.

Documentation of indigenous knowledge systems(IKS) may be necessary step for such study.

Lastly, future research should focus on economic analysis of coping strategies in order to inform decision makers about the household competing needs. The present study could not establish how the various coping strategies affect household budget. A cost-benefit study on coping strategies is therefore research gap.

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APPENDIX 1

QUESTIONNAIRE 1

My name is Francis Odari, a postgraduate student at the Institute for Development Studies (IDS), University of Nairobi. I am carrying out a study on ***RURAL-BASED WATER SECURITY COPING STRATEGIES: A case of Muhuru-Bay Migori District Western Kenya***. This study intends to examine the potential of rural-based water security coping strategies (RUBAWACS) in addressing domestic water challenges. Your patience in answering these questions is highly appreciated. Your responses will be treated confidential.

HOUSEHOLD QUESTIONNAIRE:

Date.....

Questionnaire

No.....

Village/Location/Sub-location.....

SECTION ONE

A. Background Information

Q. No.	QUESTION	OPTION	RESPONSES Tick (/)
1	Name of respondent(optional)		
2	Sex of respondent	a. Male	
		b.Female	
3	Age(Years)	a.Under 20	
		b.20-39	
		c.40-59	
		d.60+	
4	Marital status	a. Single	
		b.Married	
		c.Divorced	
		d.Widowed	
		e. Separated	
5	Main occupation	a. Small-scale business	
		b.Teaching	
		c.Fishing	
		d.Housewife	
		e.Small-scale farming	
		f.Others(Specify)	
6	Education Level	a. None	
		b.Primary	
		c.Secondary	

		d. Middle level college	
		e. Adult education	
		f. University	
7	What is your average income per month?	a. Below 1000 KSHs	
		b. 1000-2000 KSHs	
		c. Above 2000 KSHs (Specify)	
8	What is the size of your dependants?		

SECTION TWO

B. Water Accessibility

9	What is your main source of water?		
10	How much time do you spend to collect water during: i) Dry season? ii) Wet season?	a. Dry season	
		b. Wet season	
11	What amount of time do you take to fill the 20 litre jerrican during: i) Dry season ii) Wet season	a. Dry season	
		b. Wet season	
12	How far (in KMs) is your homestead to the nearest water source?		

C. Water problems, coping strategies and domestic water requirement

13	Do you experience water shortages?	a. Yes	
		b. No	
14	If yes to Q. 13, when are shortages acute?	a. During rainy season	
		b. During dry season	
		c. All seasons round the year	
15	What do you consider to be significant reason(s) for persistent water problems in this area?		
16	Do you device ways of storing water for your family during times of shortage?	a. Yes	
		b. No	
17	If yes to Q.16, what method do you use to		

	store water for future use?		
18	How much water in litres does the facility store?		
19	How would you rate the amount of water available since the adoption of the water storage facility stated in Q.17	a. Very adequate	
		b. Adequate	
		c. Moderate	
		d. Very inadequate	
		f. Inadequate	
20	How much water do you use for the various activities per day?	a. Bathing	
		b. Washing utensils	
		c. Cooking food	
		d. Drinking	
		e. Washing clothes	
		g. Resurfacing floor	
		h. Kitchen garden irrigation	
		i. Others (Briefly explain)	

D. Water quality coping strategies (WQCS) and human health

21	Are there times when water is not suitable for drinking?	a. Yes	
		b. No	
22	What characteristics is the water at such a time?	a. Brown	
		b. Dark	
		c. Colourless	
		d. Funny smell	
		e. Green	
		f. Others (Specify)	
23	Do you treat water for drinking at such a time?	a. Yes	
		b. No	
		c. Sometimes	
24	If Yes to Q. 23, how do you treat your water? (Briefly explain)		

25	How do you rate the quality of water after treatment?	a. Very clean	
		b. Moderately clean	
		c. Poor quality	
		d. Highly polluted	
26	Which facility do you use to store water after treatment?		
27	What other ways do you employ to make sure that domestic water is clean?		
28	Which area of water use do you consider treating most?	a. Water for drinking	
		b. Water for washing clothes	
		c. Water for cooking	
		e. Water for bathing	
		g. In all uses	
29	Has anyone in your family suffered from water related illness?	a. Yes	
		b. No	
30	If Yes to Q.29, what are some of the common diseases suffered?	a. Dysentery	
		b. Cholera	
		c. Bilharzia	
		d. Typhoid	
31	Do you think by treating water before drinking reduces chances of getting water borne diseases stated in Q.30?	a. Yes	
		b. No	

E. General Information

32	Are there any water project(s) initiated by the government or Non Governmental Organizations to supply water in the Division?	a. Yes	
		b. No	
33	Have the project(s) been successful?	a. Yes	
		b. No	
34	If No to Q.33, what do you think may have led to the failure of the water project (s)?	(Briefly explain)	
35	What do you think should be done to improve home-based water storage and treatment arrangements in this area?	(Briefly explain)	

Appendix 2

Questionnaire 2

IN-DEPTH QUESTIONNAIRE (for key Informants)

SECTION ONE: General Information

Study Topic: *RURAL-BASED WATER SECURITY COPING STRATEGIES: A Case of Muhuru-Bay Migori District Western Kenya*

Name of the Interviewer.....

Institution.....

Research Site.....

Location of the Interview.....

Date of Interview.....

1. Name of the Interviewee.....
(Optional)

2. Occupation.....

3. Marital Status.....
(Optional)

4. Age.....
.....

5. Sex.....
.....

SECTION TWO: *Water problems and Rural-Based Water Security Coping Strategies*

a) History of rural water facilities and water problems(Area chief/District Water Officer/ DDO)

1. Are there rural water facilities and if yes please give brief history of their establishment (what is their nature, when established, and the location)
2. What is the operational status of the stated water facilities?
3. According to you what are the main obstacles in current policies concerning public water supply?

4. What do you consider to be the most important changes to improve rural water supply strategies?

b) Water per capita/requirement (District Water Officer)

5. Who is responsible for water provision in Muhuru Division (State, private or community?)

6. What is the estimated ratio between household and water sources available for the rural population in Muhuru Division?

7. What is the current water per capita in Migori District

8. Do you think water per capita is adequate for the general purpose and sanitation?

9. How can the water provision and decision-making process be organized to ensure that the home-based water provision strategies get rightful opportunity in the supply system?

c) Water quality and human health (Area Chief/District Public Health Officer/ District Water Officer)

10. Does the Ministry of Water and Irrigation undertake regular water quality tests and monitoring? How often and which site in particular?

11. Are quality statistics available for the local community before and after treatment?

12. How often do you receive cases of water related diseases from Muhuru-Bay?

13. Which diseases are commonly reported in the area?

14. Do you recommend the use of local materials by the local community in treating water

15. How effective are these local substances in ensuring water quality?

d) Water Governance(Area Chief/Women-Group representative/DDO and District Water Officer)

16. What are the main achievements you have contributed in the planning and decision-making process to promote a better water provision system?

17. What are the most urgent improvements in the planning and decision-making process for effective coordination of resources meant for public water provision?

18. Which issues of leadership among different stakeholders are most urgent to coordinate in devising a better water provision strategy?

Thanks for taking your time and volunteering information

Appendix 3

Sanitary, hygiene and wealth indicators Checklist; Rabwao/Nyakiringoto/Olando/Bande

		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	Pit latrine																					
2	Composite pit																					
3	Water storage tank																					
4	Water treatment substances																					
5	Out-door utensil rack																					
6	Hand washing basin																					
7	Chlorine tablets																					
8	Firewood for boiling water																					
9	Waste disposal bag																					
10	Bathing trough																					
11	Disinfectant																					
12	Soap dish																					
13	Iron roofed house																					
14	Brick house																					
15	Grain store																					
16	Tobacco banner																					
17	Vegetable garden																					
18	Furniture																					
19	At least 3 houses																					
20	At least 3, 20L jericans																					

Appendix 4

Focus Group Discussion Questions

FGD Focus areas: Water problems/water per capita/water quality/human health

Institution: Institute for Development Studies, University of Nairobi

Interviewer.....

Site.....

Date.....

1. What do you consider to be the most urgent problems concerning public water supply?
2. What are, according to you the most important reasons for the problems that you have pointed out?
3. According to your opinion, how has the current water facilities (dam, lake, and borehole) contributed to availability of water?
4. Do you think water available is enough and clean to ensure normal household sanitation and other activities?
5. What do you consider to be the most important concerns that should guide the establishment of a good water provision strategy?
6. What is your assessment on the current water quality?
7. Do you think that most diseases are as a result of poor water quality?
8. Are there methods used locally to treat water? If yes, what are these methods and substances?
9. How do you assess the effectiveness of these water treatment substances on levels of water quality?
10. If you were given the powers to design a new strategy for water supply, decision making and implementation of domestic water security policies; what are the most significant changes you would propose?

APPENDIX 5

List of the Key Informants

Name	Designation	Site	Contact
Siso Lwero	Ex-Area Chief	Olando	+254 734756989
Jan Grenzebach	Bay Water Cooperative Director	Muhuru-Bay	+254 715433654
Philip Athero	District Water Field Technician	Migori
Julius Ongicho	District Water Officer	Migori	+254723477532
Mrs Abongo	Divisional Women Representative	Muhuru
Joash Nyangau	Clinical Officer	Muhuru
Tom	District Development Officer	Migori	+254 720927722
Chanzu	Deputy District Public Health Officer	Migori	+254 722569724

Appendix 6

Ranking the sanitation indicators in Olando, Bande, Nyakiringoto and Rabwao villages in Muhuru-Bay

Utensil rack									
Storage tank	Utensil rack								
Compost pit	Utensil rack	Tank							
Firewood	Utensil rack	Tank	Firewood						
Bathing trough	Utensil rack	Tank	Firewood	Trough					
Disinfectant	Utensil rack	Tank	Firewood	Trough	Disinfectant				
Chlorine tablets	Utensil rack	Tank	Firewood	Trough	Disinfectant	Chlorine tablets			
Pit latrine	Utensil rack	Tank	Firewood	Trough	Disinfectant	Chlorine tablets	Pit latrine		
Sanitation facilities	Utensil rack	Tank	Firewood	Trough	Disinfectant	Chlorine tablets	Pit latrine	Bathing trough	

Source: PRA, field data, 2009

Appendix 7

Result of pair-wise ranking of sanitation indicators

Sanitation indicators	Score	Rank
Utensil Rank	8	1
Storage tank	7	2
Compost pit	6	3
Firewood	5	4
Bathing trough	4	5
Disinfectant	3	6
Chlorine tablets	2	7
Pit latrines	1	8

Source: PRA field data, 2009

Appendix 8

Matrix analysis for pair-wise ranking among the reasons for the persistence water problems in the four villages of Muhuru-Bay

Factor	Drought	Policy	Poverty	Sanitation	Landscape	Deforestation	Culture	Farming	Rank
Persistence Drought		policy	Drought	Sanitation	Drought	Drought	Poverty	Drought	2
Lack of rural water policy			Policy	Sanitation	Policy	Policy	Sanitation	Policy	3
Poverty				Sanitation	Poverty	Sanitation	Sanitation	Poverty	1
Lack sanitation facilities					Sanitation	Culture	Sanitation	Farming	7
Landscape						Farming	Sanitation	Deforestation	8
Deforestation							Sanitation	Water table	5
Cultural belief								Culture	4
Poor farming									6

Source: PRA, Field data, 2009

Appendix 9

Summary of the proposed Apex Framework for Institutional coordination for Rural Domestic Water and Sanitation Provision

