DETERMINANTS OF ADOPTION OF HOUSEHOLD DRINKING WATER TREATMENT METHODS IN WINAM DIVISION, KISUMU EAST DISTRICT, KENYA

BY

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DECLARATION

This research project report is my original work and has not been presented to any other university for any award.

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DEDICATION

This research project is dedicated to all members of my family for their love and support.

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LIST OF ABBREVIATIONS AND ACRONYMS

AWD	- Acute Watery Diarrhoea
DALYs	- Disability Adjusted-Life Years
DPHO	- District Public Health Officer
DV	- Dependent Variable
EV	- Extraneous Variable
GV	- Guideline Values
HWT	- Household Water Treatment
HWTS	- Household Water Treatment and Safe Storage
IDRC	- International Development Research Center
IV	- Independent Variable
KNHPC	- Kenya National Housing and Population Census
MCI	- Millennium Cities Initiative
MDGs	- Millennium Development Goals
MPHAS	- Ministry of Public Health and Sanitation
MV	- Moderating Variable
NGOs	- Non-Governmental Organizations
OR	- Odds Ratio
PHC	- Primary Health Care
POU	- Point of Use
RADWQ	- Rapid Assessment of Drinking Water Quality
SODIS	- Solar Disinfection
UNICEF	- United Nations Children's Fund

ABSTRACT

This research project report is about the study of determinants of adoption of household drinking water treatment methods in Winam Division, Kisumu East District, Kenya. In many parts of the developing world, drinking water is collected from unsafe surface sources outside the home and is then held in household storage vessels. Drinking water may be contaminated at the source or during storage. Strategies to reduce waterborne disease transmission must safeguard against both events. Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. In Kenya, diarrhoeal diseases are among the top ten (10) causes of morbidity and mortality. Diarrhoea is ranked number three (3) in most rural public health facilities. According to the Ministry of Health (MOH) National Health Sector Strategic Plan (2005 – 2010), treating water at the household level has been shown to be one of the most effective and cost-effective means of preventing waterborne disease in development and emergency settings. Promoting household water treatment and safe storage (HWTS) helps vulnerable populations to take charge of their own water security by providing them with the knowledge and tools to treat their own drinking water. The purpose of the study was to investigate determinants of adoption of household drinking water treatment methods in Winam division, Kisumu East district, Kenya. The objectives of the study were to: - Investigate the extent to which household socio-economic status determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District; Examine how knowledge on household drinking water treatment methods determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District; Determine the extent to which accessibility to household drinking water treatment methods determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District; and Assess how source of household drinking water determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District. The study employed a descriptive survey study design, using both quantitative and qualitative techniques of data collection; the quantitative technique answered occurrence, while the qualitative technique sought to answer the "why?" aspect of the study. The quantitative technique involved the use of questionnaires while the qualitative technique involved the use of key informant interviews (KIIs). The study used a sample size of 384 households. The researcher employed multi stage random sampling to arrive at the sample size. Quantitative data was analyzed using descriptive statistics, including frequency tables and cross tabulations. Statistical Package for Social Scientists (SPSS) software version 17.0 was used to aid the analysis of the quantitative data. Qualitative data was grouped into respective themes and described in verbatim to enhance deeper understanding of the description of the quantitative data, guided by the study objectives and questions. From the discussions on the findings, the study concluded that household socio-economic status, knowledge on household drinking water treatment methods, accessibility to household drinking water treatment methods and household drinking water source determined adoption of household drinking water treatment methods. The study report recommends that health promoters should design messages focusing on risks of not treating drinking water and the benefits of treating drinking water. Public health workers should also train community health workers on effective delivery of messages on household drinking water treatment methods and design a sustainable public campaign strategy to ensure sustained adoption of household drinking water treatment methods. Suggestions for further studies are: (1) Sustainability of adoption of water treatment methods and (2) Health seeking behaviour for drinking water treatment.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In many parts of the developing world, drinking water is collected from unsafe surface sources outside the home and is then held in household storage vessels. Drinking water may be contaminated at the source or during storage. Strategies to reduce waterborne disease transmission must safeguard against both events. Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. The importance of water for health and development has been reflected in the outcomes of a series of international policy forums such as the Alma-Ata Primary Health Care Declaration (WHO, 1978), the World Water Conference in Mardelplata, Argentina (WHO, 1977), the Millennium Development Goals (WHO, 2000) and the Johannesburg World Summit for Sustainable Development in (WSFSD, 2002). The UN General Assembly declared the period from 2005 – 2015 on the International Decade for Action, "Water for Life" (WHO, 2005). Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrhoeal disease annually, causing 1.8 million deaths, mostly among children under 5 years of age (WHO, 2005). Although clean water is a human right, 1.1 billion people still do not have access to safe drinking water (WHO, 2006). About 1.8 million people die from diarrhoeal illnesses every year. These illnesses are mainly due to a lack of safe drinking water, which can be enhanced by adoption of water treatment methods (WHO, 2007).

In 1990, more than 1 billion people depended on rivers, streams, or other unsafe surface sources for drinking water. In many developing countries, even municipal piped well water is unsafe, because of inadequately maintained pipes, low pressure, intermittent delivery, lack of chlorination, and clandestine connections. For example, Vibrio cholerae was repeatedly isolated from un-chlorinated municipal water systems in Peru that caused large epidemics of cholera. In Guayaquil, Ecuador, even central chlorination of the municipal water system was insufficient to maintain adequate free chlorine residuals at peripheral distribution sites, and drinking unboiled municipal water remained a primary source of cholera (Renton, 1999).

Outbreaks of acute watery diarrhoea (AWD) add to the disease burden and require costly diversion of scarce health and other resources to minimize fatalities. Diseases associated with contaminated water also exact a heavy economic load in the developing countries, both on the public health care system for treatment and on persons affected for transport to clinics, medicines and lost productivity. They also adversely impact school attendance and performance, particularly for girls and young women who must care for and assume the duties of ill parents and siblings (UNICEF, 2008).

As part of its Millennium Development Goals, the United Nations expressed its commitment by 2015 to reduce by one half the people without sustainable access to safe drinking water. Current estimates are that there are still 1.1 billion people without this access (WHO/UNICEF, 2006). Considerable progress is being made in expanding the coverage of "improved water supplies" such as protected wells and springs, boreholes and household connections. However, results from a recent assessment in six pilot countries, found that 31% of drinking water samples from boreholes exceeded WHO guideline values (GV) and national drinking water standards in the pilot countries for faecal contamination, the leading source of infection and disease (RADWQ, 2006).

According to Wright (2004), a large body of research worldwide has shown that even drinking water which is safe at the source is subject to frequent and extensive faecal contamination during collection, storage and use in the home. Health benefits of safe drinking-water, especially in preventing diarrhoea, which kills 2.2 million annually, including 17% of children below 5 years of age in developing countries, will remain elusive for vast populations for years to come (WHO, 2008).

In the United States, 14 outbreaks of infectious etiology associated with drinking water were reported for the two year period 1997–1998 (WHO, 2004).

In France, water that did not meet microbiological standards was associated with an increased risk of gastroenteritis. In the Philippines, an odds ratio (OR) of 1.92 for diarrhoea was reported following consumption of water contaminated with high levels of *Escherichia coli* (a faecal indicator bacteria). Children with prolonged diarrheal illness (more than 14 days) were more likely to have drunk water from an unprotected water source (WHO, 2004).

In china, the total annual average water resource volume is estimated at approximately 2.8 trillion cubic meters, making China the fourth largest source for water in the world. Of the total national groundwater resources, only 63 percent are usable as drinking water without treatment, 17 percent can be used for drinking water after appropriate treatment, 12 percent are unsuitable for drinking water but can be used as industrial and agricultural water sources, and 8 percent can be used as industrial water only after special treatment (U.S Department of Commerce, 2005).

In Pakistan, the access to safe drinking water is estimated to be available to 23.5 percent of population in rural areas and 30 percent of population in urban areas, while every year 200,000 children die due to diarrheal diseases (UNICEF, 2005)

Thirty (30) studies from different countries including Bangladesh, Brazil, Chile, Guatemala, Kenya, Malaysia and Panama examined the impact of sanitation on disease transmission. Several of those studies isolated various faecal–oral/water-borne pathogens from the faeces of sick people and the transmission of such pathogens isolated from infected faeces to human hosts has been shown in numerous studies (Esrey et al. 1991).

In Burundi, an epidemiological investigation conducted to identify sources of infection and risk factors for cholera during an epidemic found that both bathing in the lake and drinking its water were independently related to illness; additionally, *Vibrio cholerae* was isolated from the lake water (WHO, 2004).

In Kenya, diarrhoeal diseases are among the top ten (10) causes of morbidity and mortality. Diarrhoea is ranked number three (3) in most rural public health facilities. Promoting household water treatment and safe storage (HWTS) helps vulnerable populations to take charge of their own water security by providing them with the knowledge and tools to treat their own drinking water (MOH, 2005).

In Kisumu, only 40% of residents have access to piped water. Many people collect contaminated water from shallow wells or surface sources. Waterborne diseases such as cholera, amoebas, e-coli and typhoid are among the leading causes of death in Kisumu, particularly among children (Millennium Cities Initiative, 2011). According to Kisumu East District Hospital surveillance reports (2011), 19% of children below five years admitted between January and May 2011 were treated for diarrhoea illnesses, while another 8.4% were treated as outpatients, mostly a result of water borne pathogens. Each year Nyanza Province experiences cholera outbreaks and Kisumu East District is usually one of the worst affected localities mainly due to low adoption of water treatment methods (Millennium Cities Initiative, 2011).

This research project therefore sought to investigate determinants of adoption of household drinking water treatment methods.

1.2 Statement of the Problem

More than one billion people lack access to potable drinking water worldwide (WHO, 2004). Inadequate access to safe water is a primary cause of the estimated two million child deaths from diarrhea that occur each year in poor countries (Zwane and Kremer, 2007). Low cost point-of-use (POU) safe water technologies have the potential to expand access to safe water among the world's poor and can substantially reduce diarrheal disease Nevertheless, there is limited adoption of the technologies in many parts of the developing world, even when widely available (Clasen *et al.,* 2006).

Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrheal disease annually, causing more than 1.5 million deaths, mostly among children below 5 years of age (WHO, 2005). Contaminated drinking water is also a major source of hepatitis, typhoid and opportunistic infections that attack the immuno-compromised, especially persons living with HIV/AIDS (UNICEF, 2008).

Results from a recent assessment in six pilot countries, found that 31% of drinking water samples from boreholes exceeded WHO guideline values (GV) and national drinking water standards in the pilot countries for faecal contamination, the leading source of infection and disease (RADWQ, 2006).

World Health Organization data on the burden of disease suggests that approximately 3.2% of deaths and 4.2% of disability adjusted-life years (DALYs) worldwide are attributable to unsafe water, sanitation and hygiene (WHO, 2004). This figure corresponds to 88% of diarrhoeal diseases worldwide which is considered to be the attributable fraction of diarrhoea due to unsafe water supply and sanitation plus the disease burden from trachoma, schistosomiasis, ascariasis, trichuriasis and hookworm disease. In the European region it is estimated that 120 million people do not have access to safe drinking water. Consumption of unsafe water continues to be one of the major causes of diarrhoeal disease deaths (WHO/UNICEF, 2006).

According to Wright et al. (2003), making water safe at the source, where it is collected, often does not lead to drinking water that is safe in the home due to recontamination between the source and the household (Wright *et al.*, 2003). Unfortunately, adoption of point of use technologies remains low among the global poor (Clasen *et al.*, 2006).

Sixty three (63%) households in Kenya get drinking water from unimproved sources. However, disparities exist by residence, with a higher proportion of urban households (91%) having an improved source of drinking water compared with rural households which stands at 54% (KDHS, 2009). Approximately 50% of preventable diseases in Kenya are water, sanitation and hygiene related (MOPHS, 2010).

In Kisumu, only 40% of residents have access to piped water. Many people collect contaminated water from shallow wells or surface sources. Waterborne diseases such as cholera, amoebas, e-coli and typhoid are among the leading causes of death in Kisumu, particularly among children (Millennium Cities Initiative, 2011). According to Kisumu East District Hospital surveillance reports (2011), 19% of children below five years admitted between January and May 2011 were treated for diarrhoea illnesses, while another 8.4% were treated as outpatients, mostly a result of water borne pathogens. Each year Nyanza Province experiences cholera outbreaks and Kisumu East District is usually one of the worst affected localities mainly due to low adoption of water treatment methods (Millennium Cities Initiative, 2011). It is against the backdrop of low adoption of household drinking water treatment methods that this study sought to investigate the determinants of adoption of household drinking water treatment methods in Winam Division, Kisumu East District.

1.3 Purpose of the Study

The purpose of this study was to investigate determinants of adoption of household drinking water treatment methods in Winam division, Kisumu East district, Kenya.

1.4 Objectives of the Study

The objectives of the study were to:

1. Investigate the extent to which household socio-economic status determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District
2. Examine how knowledge on household drinking water treatment methods determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District
3. Determine the extent to which accessibility to household drinking water treatment methods determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District
4. Assess how source of household drinking water determines adoption of household drinking water treatment methods in Winam Division, Kisumu East District

1.5 Research Questions

The study sought to answer following research questions:

1. To what extent does household socio-economic status determine adoption of household drinking water treatment methods in Winam Division, Kisumu East District?
2. How does knowledge on household drinking water treatment methods determine adoption of household drinking water treatment methods in Winam Division, Kisumu East District?
3. To what extent does accessibility to household drinking water treatment methods determine

adoption of household drinking water treatment methods in Winam Division, Kisumu East District?

4. How does source of household drinking water determine adoption of household drinking water treatment methods in Winam Division, Kisumu East District?

1.6 Significance of the Study

The burden of disease associated with unsafe drinking water is particularly trying, not only because it is borne most heavily by the poor, the very young and the immuno-deficient, but also because it is largely preventable (Hutton & Haller, 2004). At the same time, an increasing number of field trials have demonstrated that point-of-use treatment and safe storage of water in the home can be a cost-effective way to help vulnerable populations achieve the health benefits of safe water by taking charge of their own water security. This study is thus intended to bridge the gap of knowledge and information concerning household water treatment methods for prevention of water borne diseases.

It is hoped that the findings of this study will be of significance to different groups and organizations variously. The Ministry of Public Health and Sanitation may find the findings of the study relevant in so far as strategies for controlling and preventing water borne diseases are concerned. It is also hoped that the Ministry of Medical Services will find relevance in the findings of the study by virtue of the expected recommendations bordering around strategies of reducing the water borne disease burden. Non-governmental organizations, public and community health programmers may also benefit from the findings of this study owing to the expected evidence-based information that the study will generate. Winam Division community may also benefit from the information so generated, which is hoped will form a basis on which sound and evidence-based programming on water, sanitation and hygiene interventions would be anchored. It is also hoped that the study will benefit researchers and scholars in similar fields by virtue of the growth and expansion of the body of knowledge, which is key to research and scholarly work.

1.7 Basic Assumptions of the Study

The key assumptions of the study were as follows: - That the theory of the Health Belief Model and the conceptual framework were accurate reflections of the phenomenon studied; factors influencing adoption of domestic drinking water treatment methods for prevention of water borne diseases; that the relationships among concepts in the Theory were necessary, sufficient, and clear in so far as this study was concerned; that the research instruments were congruent with the study's conceptual framework; and that the findings of this study would be useful to programmers and policy makers in the formulation of water and sanitation interventions in Kisumu East District and other places with similar demographic and geographic characteristics.

1.8 Limitations of the Study

The limitation for this study had to do with the extent to which the findings of this study can be generalized beyond the study area. Furthermore, the number of cases sampled was too limited for broad generalizations for instance cutting across the country, besides the fact that the study area may not necessarily exhibit similar demographic and geographical characteristics with other parts of the country. Further empirical evaluations, however, were recommended to replicate the findings in different contexts and surroundings.

1.9 Delimitations of the Study

This study was intended to investigate determinants of adoption of household drinking water treatment methods with particular focus on the influence of household water treatment on prevention of water borne diseases in Winam Division, Kisumu East. The respondents were female household heads or responsible adults of either gender in the absence of female household heads within the sampled households. The female household heads was preferred because of the special gender role women play in fetching and preparing drinking water in most households.

1.10 Definition of Significant Terms used in the Study

Socio-economic Status: This means family size, gender dimensions, education and income levels.

Accessibility to Water Treatment Methods: This refers to the availability and ability to use household drinking water treatment methods

Awareness of Water Treatment Methods: This refers to possession of information on household drinking water treatment methods.

Adoption of water treatment methods: This means taking up and practicing ways of making drinking water at household level safe to drink

Water Treatment: This refers to the process of making water safe for drinking. It may include boiling, filtering or adding sterilizing chemicals such as chlorine

Household: For the purpose of this study, a household was defined as a person or a group of persons, related or unrelated, who live together and who share a common source of food

1.11 Organization of the Study

This research Proposal was organized into three chapters. Chapter one covers the introduction to the study, the problem statement, research purpose, objectives and questions, as well as limitations of the study. The second chapter looks at the literature review, which highlights water treatment and how they influence occurrence of water borne diseases. It also looked at the theoretical framework, the perceived conceptual framework and the summary of literature reviewed. Chapter three describes the research methodology, which includes the research design, target population, sampling methodology, sample size, data collection methods, reliability and validity of research instruments, data collection procedures, as well as data processing, analysis and presentation. Chapter four presents the research findings which have been discussed under thematic sub-sections in line with the study objectives, and includes Household knowledge on drinking water treatment methods and adoption of household drinking water treatment methods; Accessibility to household drinking water treatment methods and adoption of household drinking water treatment methods; and Source of household drinking water on adoption of household drinking water treatment methods. Chapter five outlines a summary of findings, conclusions, recommendations and contribution to body of knowledge.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature related to the study, based on the following thematic areas: the Concept of Household Drinking Water Treatment; Household socio-economic status and adoption of household drinking water treatment methods; Household knowledge on drinking water treatment methods and adoption of household drinking water treatment methods; Accessibility to household drinking water treatment methods and adoption of household drinking water treatment methods; and Source of household drinking water on adoption of household drinking water treatment methods.

2.2 The Concept of Household Drinking Water Treatment

In many parts of the developing world, drinking water is collected from unsafe surface sources outside the home and is then held in household storage vessels. Drinking water may be contaminated at the source or during storage. Strategies to reduce waterborne disease transmission must safeguard against both events. Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. The importance of water for health and development has been reflected in the outcomes of a series of international policy forums such as the Alma-Ata Primary Health Care Declaration (WHO, 1978), the World Water Conference in Mardelplata, Argentina (WHO, 1977), the Millennium Development Goals (WHO, 2000) and the Johannesburg World Summit for Sustainable Development in (WSFSD, 2002).

The UN General Assembly declared the period from 2005 – 2015 on the International Decade for Action, "Water for Life" (WHO, 2005). Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrhoeal disease annually, causing 1.8 million deaths, mostly among children under 5 years of age (WHO, 2005). Although clean water is a human right, 1.1 billion people still do not have access to safe drinking water (WHO, 2006). About 1.8 million people die from diarrhoeal illnesses every year (WHO, 2007). These illnesses are mainly due to a lack of safe drinking water, sanitation and hygiene. This means many deaths can be avoided and living conditions improved by enabling access to safe drinking water.

Simple and inexpensive technologies exist for treating drinking water in the home and storing it in safe containers. A growing body of research suggests that household water treatment and safe storage dramatically improve microbial water quality; significantly reduce the incidence of diarrhea; are highly cost-effective; and can be focused to make health improvements among the most vulnerable populations. Household water treatment (HWT) technologies typically fall in five main categories: chlorination (adding chlorine in liquid or tablet form to drinking water) flocculation/disinfection – adding powder or tablets to coagulate and flocculate sediments in water followed by a time release of disinfectant; filtration; solar disinfection -- exposing water in clear plastic bottles to sunlight for a day; and boiling. Reaching the vulnerable, however, implies much more than developing affordable products and technologies for household water treatment and safe storage (HWTS). Research has shown that even when products and technologies are available to improve the quality of water sources, people do not immediately seek and use these technologies in a consistent way. Identifying and implementing successful approaches to increase uptake of water treatment products on a sustainable basis are essential for this intervention to achieve widespread and long-term success (WHO, 2007).

Treating water at the household level has been shown to be one of the most effective and cost-effective means of preventing waterborne disease in development and emergency settings. Promoting household water treatment and safe storage helps vulnerable populations to take charge of their own water security by providing them with the knowledge and tools to treat their own drinking water. Because it prevents recontamination of water in the home, treating water at the household level is more effective than conventional improvements in water supplies in ensuring the microbiological quality of drinking water at the point of consumption (Sobsey 2002).

2.3 Household Socio-Economic Status and Adoption of Household Drinking Water Treatment Methods

The cost of many Household Water Treatment Systems (HWTS), while low from a global north perspective, is still a major investment for someone earning \$1 – \$2/day. For the poor, a critical factor in the affordability of a HWTS system may be the availability of credit or microfinance. Experience in several countries has shown that the availability of credit and microfinance stimulates the market for HWTS. Nonetheless, if poor people are already paying for water, sometimes at a price much higher than those receiving piped supplies, a HWTS system will not likely be their first need (Murcott, 2006).

One surprising finding of a recent study in Nepal was that although it had been presumed that microfinance institutions (MFIs) preferred not to lend for non-income-generating activities such as HWTS products, after interviews with several MFI and microfinance NGOs, it was discovered that the lack of money to lend was the main barrier (Frey et al, 2006).

In Madagascar a study by Rheingans & Dreibelbis (2007) found significantly lower levels of dilute sodium hypochlorite solution awareness among less advantaged groups, including those with lower levels of education, minority ethnic status, residence in rural areas, longer distances to health clinics and aged less than 23 years. Population characteristics associated with less use of the product included low socioeconomic status, low level of education, minority ethnic status and residence in rural areas.

In Bangladesh, investigators found that the successful introduction of household drinking water treatment methods such as solar disinfection was mainly dependent on environmental factors, water sources in use, occupation of household and season, as well as strong intra-familial and gender-related factors (Hobbins, Maeusezahl & Tanner, 2000).

2.4 Knowledge of Water Treatment Methods and Adoption of Household Drinking Water Treatment Methods

Water projects in the developing world have suffered from poor performance due, in part, to a lack of consumer adoption of water infrastructure and/or new HWTS products. Consumer knowledge of HWTS is viewed as a key barrier to sustained use of improved water 21 sources and products, and thus local consumer choice research has emerged as a critical element of successful HWTS interventions (Okioga, 2007).

According to a study by McGourty (2006) on the potential of household water treatment for users of hand dug wells in Busia, Uganda, most attributes of good quality water are associated with the aesthetic qualities. This makes it difficult to convince people that the water is not safe for drinking. The results from the membrane filtration served as a useful didactic instrument to demonstrate contamination. Methods of water treatment known other than boiling were filtration through cloth or leaving the water to stand/settle for a few hours. These methods were only used if there was sediment or colour in the water. When households were asked why they were not using water guard, they said they didn't know where to get it, how much it was or what it did.

The temporal adoption of hygiene measures can be illustrated by the study by Ahmed et al. (1993). This group compared cleanliness and diarrhoea levels in villages with and without hygiene education interventions. Higher adoption rates of the intervention were associated with a better cleanliness state, which was paralleled by a decrease in diarrhoea and malnutrition rates. These differences were found to increase over time as more villagers adopted the intervention.

Boiling is believed to be the most common means of treating water practiced at the household level, and the only HWTS method that has unquestionably reached scale in certain countries Household surveys in Peru found 51% of householders claiming to boil their water before use (Nawaz et al., 2001). If practiced correctly, boiling is also one of the most effective, killing or inactivating all classes of waterborne pathogens, including bacterial spores and protozoan cysts that have shown resistance to chemical disinfection and viruses that are too small to be mechanically removed by microfiltration (Block, 2001). In Peru, 20% of householders boiled their drinking-water even without knowing that it was eliminating waterborne pathogens (Nawaz et al., 2001).

2.5 Accessibility to Household Drinking Water Treatment Methods and Adoption of Household Drinking Water Treatment Methods

Drinking water must be microbiologically safe, free from toxic or harmful chemicals or substances, and comparatively free of physical compounds that affect the aesthetics of water, including turbidity, color, and taste-producing substances. While most efficient water treatment plants are able to achieve and provide these standards to their users, it is hard to meet such standards in cases where the piped supply is unavailable or where the piped network is contaminated. Household Water Treatment and Safe Storage (HWTS) systems were developed to provide a first or extra barrier of protection to ensure safe drinking water quality. They have gained increasing recognition as well as been implemented in the developing world for as many as 15 years. The idea is simple- to treat water at the point of use, preferably using effective but low-cost treatment technologies that could be developed using locally available raw materials. Ever since, HWTS technologies such as flocculation, filtration, chlorination and solar disinfection (SODIS) have been instrumental in treating water at the point of use (Sobsey, 2002).

There is significant evidence to suggest that HWTS have been successful in improving the drinking water quality and preventing diarrheal disease (Fewtrell, 2005). However, there has also been conflicting evidence from double-blinded studies that question HWTS efficacy (Schmidt, 2008).

Development and applications of HWTS as a solution for contaminated drinking water in developing countries existed prior to the 1990s. Pioneering work included the studies and implementation programs of the Centers for Disease Control / Pan American Health Organization (household chlorination), the Swiss Technical Institute-EAWAG (SODIS), Potters for Peace-Nicaragua (ceramic filtration), University of Calgary (Biosand), Proctor and Gamble (PUR) and others (Murcott, 2006).

Different major HWTS technologies are in use to various extents worldwide. These include safe storage, boiling, household chlorination, solar disinfection, two different types of ceramic filters – candle filters and pot filters, bio-sand filters and combined systems, including coagulation & chlorine disinfection and filtration & disinfection (WHO, 2004). In the Bolivarian Republic of Venezuela, a company has been distributing sodium dichloroisocyanurate (NaDCC) tablets since 1996, marketing three sizes of tablets (for treating 1, 5 and 20 litres) and achieving aggregate sales during the ensuing decade sufficient to treat approximately 400 million litres (approximately 60 million litres in 2006). While this company works with the Bolivarian Republic of Venezuela Ministry of Health, UNICEF and NGOs, sales are mainly targeted to higher socioeconomic classes, which pay the full cost of the product (US$ 1.22, US$ 1.27 and US$ 1.59 per pack for 30 tablets for the three sizes, respectively). The initial product launch included mass media (television, radio, newspaper, magazines, billboards) and distribution of samples and literature at stores, toll booths, government agencies and local NGOs. Currently, advertising continues in catalogues, point-of-use displays and leaflets distributed in subways. While the company continues to collaborate with the government and NGOs, mainly in disaster response, sales are chiefly to the middle class and in urban settings (Hobbins, 2004).

According to WHO (2009), an Irish company's sales of NaDCC tablets to households and agencies in Tanzania and Kenya increased significantly in recent years largely due to use of commercial marketing through mass media. The most substantial growth exceeded 150 million tablets in 2007, enough to treat more than 2.86 billion litres of water. A study by Clasen & Boisson (2006) in Dominican Republic found that a significant number of households took untreated water because the ceramic water filters took long to filter water and could therefore not filter enough water for the household members.

Lack of safe water creates a tremendous burden of diarrheal disease and other debilitating, life-threatening illnesses for people in the developing world. Point-of-use (POU) water treatment technology has emerged as an approach that empowers people and communities without access to safe water to improve water quality by treating it in the home. Several POU technologies are available, but, except for boiling, none have achieved sustained, large-scale use. Sustained use is essential if household water treatment technology (HWT) is to provide continued protection, but it is difficult to achieve. The most effective, widely promoted and used POU HWTs are critically examined according to specified criteria for performance and sustainability. Ceramic and bio-sand household water filters are identified as most effective according to the evaluation criteria applied and as having the greatest potential to become widely used and sustainable for improving household water quality to reduce waterborne disease and death (Sobsey et al., 2008)

2.6 Household Water Source and Adoption of Household Drinking Water Treatment Methods

There is a clear awareness about the importance of drinking from a clean source. People generally consider tap water to be of higher quality than water for local wells. Additional factors that influence water source selection are source proximity, source ownership, and affordability. Efforts to encourage use of piped water sources need to address these barriers rather than promote tap water use based on health messages alone (WHO, 2008).

Water and public health professionals do not think in terms of a single public health barrier to microbiologically contaminated drinking water, but of a "multiple barriers approach." Barriers that protect microbiological water quality can occur in each of these stages: watershed (source) protection, treatment (centralized and decentralized), piped distribution, non-piped, community and household distribution, safe storage and safe storage in reservoirs (WHO, 2004).

Securing the microbial safety of drinking water supplies is based on the use of multiple barriers, from catchment to consumer, to prevent the contamination of drinking water and to reduce contamination to levels not injurious to health. Safety is increased if multiple barriers are in place, including protection of water resources, proper selection and operation of a series of treatment steps and management of distribution systems, piped or otherwise (WHO, 2004).

The drinking water source or water exiting a treatment plant may provide a safe and potentially disinfected supply, but water may become re-contaminated through distribution and storage, if it is touched by unclean hands, dirty cups or dippers or if it is held in contaminated or uncovered storage vessels. Safe household water management means maintaining or improving the microbiological quality of the water through collecting, distributing/transporting and storing in the home. In this context, HWTS offers a new protection barrier (WHO, 2004).

In the United States, for example, 14 outbreaks of infectious etiology associated with drinking water were reported for the two year period 1997–1998. In developing countries, it is not only water contaminated at source or during distribution that is an issue, but water stored within the home which may also become contaminated. In France, water that did not meet microbiological standards was associated with an increased risk of gastroenteritis (WHO, 2004).

In china, the total annual average water resource volume is estimated at approximately 2.8 trillion cubic meters, making China the fourth largest source for water in the world. Of the total national groundwater resources, only 63 percent are usable as drinking water without treatment, 17 percent can be used for drinking water after appropriate treatment, 12 percent are unsuitable for drinking water but can be used as industrial and agricultural water sources, and 8 percent can be used as industrial water only after special treatment (U.S Department of Commerce, 2005).

A study carried out in Epworth Township and Hopley farm two peri-urban settlements in Harare, Zimbabwe revealed that water sources are either open unprotected or protected self-dug shallow wells. Most people in this area cannot afford to treat their water and report regular health problems related to the stomach and diarrhoea. Especially weak people (children, older people and the sick people) suffer from the water situation. The rainy season stretches from December to March. Unprotected wells are the most common source of water in Epworth, while most households in Hopley farm obtain their water from public taps. Most of the households in both locations did not carry out any treatment of their water. Bacteriological analysis of water samples collected during this study revealed the presence of coliforms in water, an indication that water used in these two commu-nities was contaminated. Diarrhoea was reported to have affected about 20% of the households (Sobsey et al., 2008).

Kenya is limited by an annual renewable fresh water supply of only 647 cubic meters per capita, and is classified as a water scarce country. 16.8 million people in Kenya do not have access to potable water. Only 57 percent of the rural population has access to an improved drinking water source, and the time-intensive pursuit of water collection often prevents women from taking up income generating activities, or in the case of girls, prevents them from attending school (Water.org, 2011).

Improvements in source water quality generally depend on expensive, long-term, centralized projects, such as construction of wells, water treatment plants, and water distribution systems. During WHO's Drinking Water Supply and Sanitation decade 1981 to 1990, an effort was made to increase access to potable water in developing countries but was nearly outstripped by population expansion and migration from rural to urban areas. Safe drinking water for all remains an elusive and expensive goal (Fewtrellet al, 2005).

Providing safe, reliable, piped-in water to every household is an important goal that yields optimal health gains, while also contributing to Millennium Development Goal targets. However, these investments in water supply infrastructure are expensive and implemented in a longer timeframe. Meanwhile, simple and inexpensive techniques exist for treating drinking water in the home and storing it in safe containers. These household water treatment and safe storage interventions (HWTS) can be implemented rapidly, with typical reductions of diarrhoea from 30-50% (Fewtrellet al., 2005)

A large proportion of the world's people do not have access to improved or microbiologically safe sources of water for drinking and other essential purposes (WHO/UNICEF, 2000). Diarrhoeal diseases kill an estimated 1.8 million people each year. Among children under five years in developing countries, diarrhoea accounts for 17% of all deaths (WHO, 2005). Unhygienic handling of water during transport or within the home can contaminate previously safe water. A high percentage of people could therefore benefit from effective household water treatment and safe storage practices. Such household-level interventions can be very effective in preventing disease if they are used correctly and consistently (WHO/UNICEF, 2008).

The burden of disease associated with unsafe drinking water is particularly trying, not only because it is borne most heavily by the poor, the very young and the immuno-deficient, but also because it is largely preventable. Providing reliable piped-in water must remain a priority, given its high return not only in health gains but also in economic productivity and overall human wellbeing At the same time, an increasing number of field trials have demonstrated that point-of-use treatment and safe storage of water in the home can be a cost-effective way to help vulnerable populations achieve the health benefits of safe water by taking charge of their own water security (Hutton & Haller, 2004).

The vast majority of diarrhoeal disease in the world (88%) is attributable to unsafe water, sanitation and hygiene (WHO, 2004). Although it is accepted that diarrhoeal disease is a huge problem worldwide, obtaining reliable data on the extent of diarrhoeal illness and the extent to which this illness is water-borne disease, is difficult. A recent estimate suggested that residents of developed countries experience 1 episode of diarrhoeal illness every 2 years, whilst residents of developing nations may experience between 5 and 20 episodes per year. With a current global population 6.5 billion individuals this adds up to 5-60 billion gastroenteritis cases annually. Diarrhoeal diseases, because they limit normal consumption of food and adsorption of nutrients can also cause malnutrition, leading to impaired physical growth and cognitive development, reduced resistance to infection and potentially long-term gastrointestinal disorders (Anon, 2002).

Increasing access to improved drinking water is one of the Millennium Development Goals that Kenya along with other nations worldwide has adopted (WHO and UNICEF, 2005). The source of drinking water is an indicator of whether it is suitable for drinking. Sources that are likely to provide water suitable for drinking are identified as improved sources. They include a piped source within the dwelling or plot, public tap, tube well or borehole, protected well or spring, and rainwater. Lack of ready access to a water source may limit the quantity of suitable drinking water that is available to a household. Even if the water is obtained from an improved source, moreover, water that must be fetched from a source that is not immediately accessible to the household may be contaminated during transport or storage. Another factor in considering the accessibility of water sources is that the burden of going for water often falls disproportionately on female members of the household. Home water treatment can be effective in improving the quality of household drinking water (KDHS, 2009). A study by Moser, Heri & Mosler (2005) in Nepal found that a significant number of people did not adopt use of solar disinfection for treatment of drinking water due to lack of time, cold or rainy weather period, among other reasons.

According to KDHS Report (2009), three out of five households in Kenya (63%) get drinking water from an improved source. However, disparities exist by residence, with a higher proportion of urban households (91%) having an improved source of drinking water compared with rural households (54%). Among the improved sources, piped water into the plot accounts for the highest proportion (15%) of households, but mainly in urban areas (33%), while the most common improved category for rural households is a protected dug well (12%).

More than one-third of Kenyan households get their drinking water from a non-improved sources, mainly surface water from lakes, streams, and rivers (24% of households). Although only 6% of urban households use non-improved sources for drinking water, the proportion is far higher for rural households, which stands at 46% (KDHS, 2009).

Dehydration caused by severe diarrhoea is a major cause of morbidity and mortality among young children, although the condition can be easily treated with oral rehydration therapy (ORT). Exposure to diarrhoea-causing agents is frequently related to the use of contaminated water and to unhygienic practices in food preparation and disposal of excreta (KDHS, 2008)

According to the Ministry of Public Health and Sanitation (2010), approximately 80% of hospital attendance in Kenya is due to preventable diseases. About 50% of these diseases are water, sanitation and hygiene related. In Kenya the status of Environmental Sanitation has been declining. Due to the rapid increase in population, in both rural and urban areas, there are high population density "hotspots" with deplorable living conditions with poor sanitary conditions and special conditions of poverty.

2.7 The Theoretical Framework

This study is based on the Theory of Health Belief Model (HBM). The HBM is a psychological model that attempts to explain and predict health behaviors. This is done by focusing on the attitudes and beliefs of individuals. The HBM was first developed in the 1950s by social psychologists Hochbaum, Rosenstock and Kegels working in the U.S. Public Health

Services. The model was developed in response to the failure of a free tuberculosis (TB) health screening program. Since then, the HBM has been adapted to explore a variety of long- and short-term health behaviors, including sexual risk behaviors and the transmission of HIV/AIDS (Glanz, Rimer & Lewis, 2002).

The theory postulated that: A person believes that his or her health is in jeopardy; The person perceives the "potential seriousness" of the condition in terms of pain or discomfort, time lost from work, economic difficulties, or other outcomes; On assessing the circumstances, the person believes that benefits stemming from the recommended behaviour outweigh the costs and inconvenience and that they are indeed possible and within his or her grasp; and The person receives a "cue to action" or a precipitating force that makes the person feel the need to take action (Glanz, Rimer & Lewis, 2002).

The Health Belief Model relates largely to the cognitive factors predisposing a person to a health behaviour, concluding with a belief in one's self-efficacy for the behaviour. A systematic, quantitative review of studies that had applied the Health Belief Model among adults into the late 1980s found it lacking in consistent predictive power for many behaviours, probably because its scope is limited to predisposing factors (Harrison, Mullen, and Green, 1992)

2.8. The Conceptual Framework

The study was guided by the following conceptual framework:

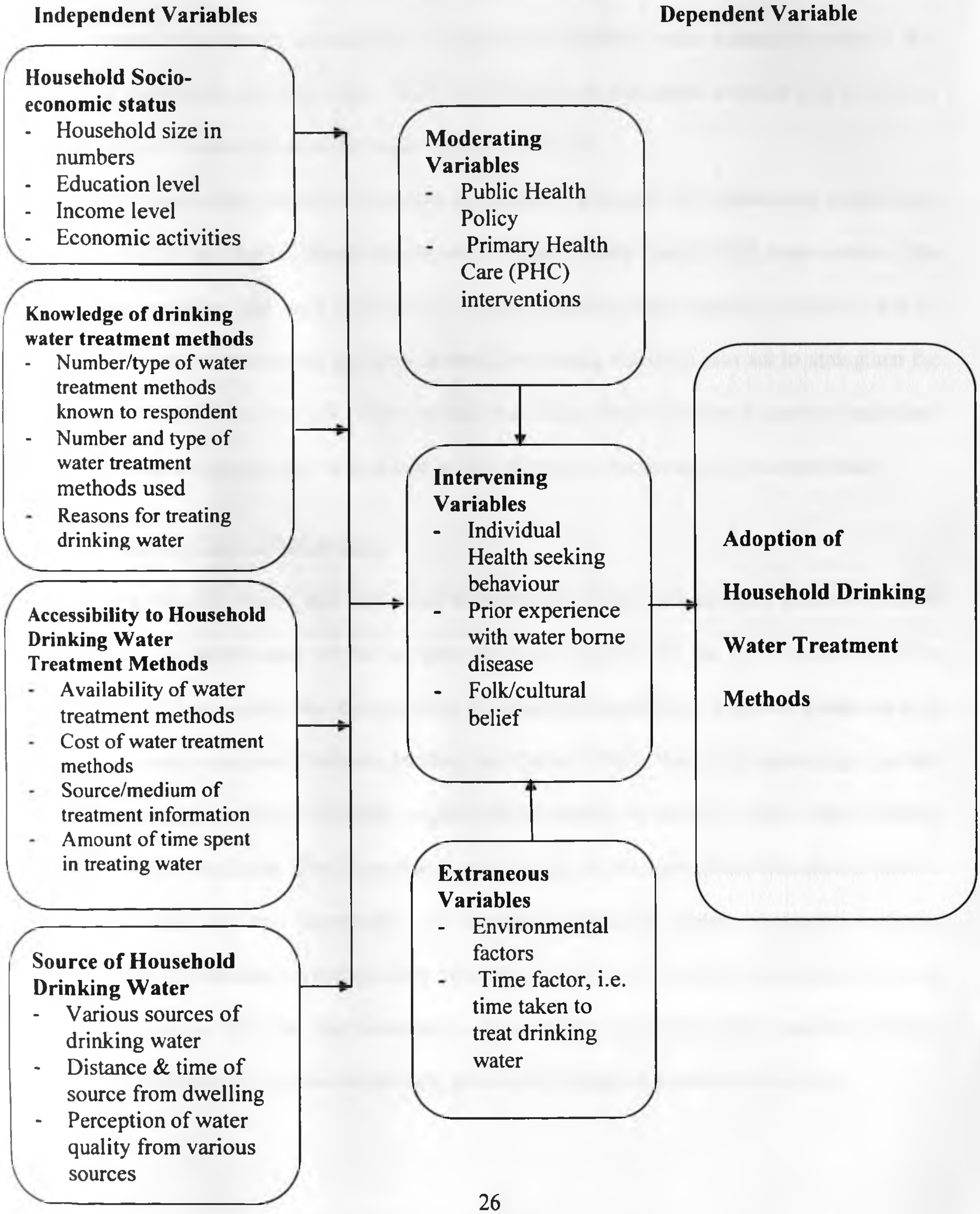

Fig 2.1: Conceptual Framework

The independent variables (IV) are the determinants of adoption of household drinking water treatment methods. They include household socio-economic status, knowledge of drinking water treatment methods, accessibility to household drinking water treatment methods and source of household drinking water. The IVs influence the dependent variable (DV), which is the adoption of household drinking water treatment methods.

The moderating variables that were perceived to influence the relationship between the IV and the DV are Public Health Policy and Primary Health Care (PHC) Interventions. The extraneous variables that were perceived to remotely influence the interaction between the IV and the DV are environmental and time factors. Intervening variables also act to strengthen the influence of the IV on the DV. They include Individual health seeking behaviour individual health seeking behaviour, prior experience with water borne disease and folk/cultural belief

2.9 Existing Gaps in Knowledge

Whereas the theory has been used to explore a variety of long and short-term health behaviors, the maintenance of the adopted practice required for the new behaviour to be sustained and incorporated into the repertoire of behaviours available to a person at any one time is not adequately explored (Harrison, Mullen, and Green, 1992). This is the knowledge gap that this study sought to address. The study explored determinants of adoption of household drinking water treatment methods. The determinants as outlined in the conceptual framework include Socio-economic factors, knowledge of household drinking water treatment methods, accessibility to household drinking water treatment methods, and source of household drinking water, interweave with the four constructs of the HBM; perceived threat and net benefits; perceived susceptibility; perceived severity, perceived benefits, and perceived barriers.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research design, target population, sampling design, data collection methods, procedures, reliability and validity of data collection instruments, data analysis procedures, time schedule and budget.

3.2 Research Design

According to Kothari (2004), research design is the arrangement of conditions for collection and analysis of data with an aim of combining relevance to the research purpose with economy in procedure. This study will employ a descriptive survey design which involves both quantitative and qualitative approaches. The descriptive survey was suitable for this study as it is an efficient way of collecting information from a large number of respondents and appropriate for a wide range of information (Mugenda, 2003). The quantitative technique answered occurrence, while the qualitative technique sought to answer the "why?" aspect of the study. The quantitative technique involved the use of questionnaires while the qualitative technique involved the use of key informant interview (KII).

3.3 Target Population

The study was conducted in Winam Division, Kisumu East District, Kisumu County. The Division had twelve administrative locations and 36 sub-locations. The twelve locations comprised the following: West Kolwa, Central Kolwa, East Kolwa, Kondele, Township, Miwani, East Kajulu, West Kajulu, East Kisumu, North Kisumu, Central Kisumu, South West Kisumu. According to the Kenya National Housing and Population Census report (KNHPC, 2009), Winam Division had a total human population of 412,323, with a population density of 1046 persons per square kilometer. This population occupied an area of 394.4 square kilometers. The target population for this study was 102,508 households. The table below shows the population distribution of households by administrative locations/units for Winam Division:

Table 3.1: Distribution of households by administrative locations for Winam Division

Location	Households
Township	10,162
Kondele	21,419
Kolwa Central	7,611
Kolwa West	24,439
Kolwa East	4,603
Kisumu South West	4,958
Kisumu Central	3,773
Kisumu East	10,211
Kisumu North	3,896
Kajulu East	3,245
Kajulu West	6,206
Miwani	1,985
Total	**102,508**

Source: National Central Bureau of Statistics, Kisumu East District.

3.4 Sample Size and Sample Selection

According to Babbie and Maxfield (1995), sampling is a method of selecting some part of a group to represent the entire population. Strydom and Venter (2002), on their part refer to sampling as "taking a portion of that population or universe and considering it representative of that population or universe". This section outlines the sample size and sampling techniques used.

3.4.1 The Sample Size

The sample size for the study was 384 households, distributed proportionately on the basis of populations of sampled sub-locations. This sample was drawn from a population of 102,508 households that make Winam division. The sample size was arrived at using a formula by Fisher et al. (1995). The derivation of this sample size is thus given below: -

Using simple random sampling,

$$N= \frac{Z^2pq}{d^2}$$

Where **n** is the desired sample size for a target population more than 10,000

Z is the standard normal deviate at the required confidence level (95% for the study), Z = 1.96

d is the level of statistical significance set (5% in this case)

p is the proportion in the target population estimated to have characteristics being measured (50%)

q is 1-p

$$\text{Therefore } n = \frac{1.96^2 \times 0.5 \times 0.5}{(0.05)^2}$$

$$= 384$$

Source: Fisher et al. (1995)

3.4.2 Sampling Techniques

Multi-stage random sampling method was used to sample the households. Mugenda (2008) describes multi-stage sampling as a complex form of sampling in which instead of using the entire selected cluster, the researcher randomly selects element from each cluster at different stages. This method of sampling is preferred by the researcher because sampling the entire division would be prohibitively expensive and time consuming.

According to Mugenda (2008), 30% sample size is sufficient to represent a population to be used in a social science research. Accordingly, 30% of the 12 (twelve) locations in Winam Division (3.6) locations, hence 4 locations were sampled. The four locations were randomly selected using a raffle method containing names of the 12 locations. This resulted in Kolwa Central, Kolwa East, Kondele and Kisumu Central were selected as summarized in table 3.2:

Table 3.2: Random multi-stage sampling of households by locations

Location	30% randomly selected locations	Number of households	Sample Size proportionate to number of households
Township			
Kondele	Kondele	21,419	143.7
Kolwa Central	Kolwa Central	7,611	51.1
Kolwa West		24,439	163.9
Kolwa East	Kolwa West		
Kisumu South West			
Kisumu Central	Kisumu Central	3773	25.3
Kisumu East			
Kisumu North			
Kajulu East			
Kajulu West			
Miwani			
Total		**57242**	**384**

Source of Data: Kenya National Housing and Population Census Report (2009)

In choosing the first location to start the research, the researcher used the raffle method. This was repeated to sequence all the other locations. To choose the first household to begin from, the researchers proceeded to the central point of the location and spin a pen. The first household in the direction the tip of the pen pointed was be the first household to begin the interview. This process was repeated in the other locations.

3.5 Research Instruments

Data was collected through the use of household questionnaires and key informant interview schedule. The household questionnaire was organized into four sections. Section one collected data on Household socio-economic status while section two sought to obtain information on objective two, knowledge of household drinking water treatment methods. Section three had questions on objective three, accessibility to household drinking water treatment methods, while section four had questions on source of household drinking water. The key informant interview questions were addressed to the district public health officer (DPHO), and asked questions on household drinking water treatment methods in Winam Division.

3.5.1 Pilot Testing of the Instrument

A pilot testing of the household questionnaire was conducted in 38 (10%) purposively sampled households in East Kaila location in Maseno Division, Kisumu West District. According to Mugenda and Mugenda (1999), pilot testing is used to refine the research instrument. The pilot study was conducted outside the study area to avoid validity threats to the findings. The questionnaires in the pilot testing were administered by research assistants under the supervision of the researcher. The pilot testing sampling used the same procedure described in the sampling techniques above.

3.5.2 Validity of the Instruments

Reliability and validity refer to the quality and trustworthiness of data (Mugenda, 2008). Reliability is a measure of the degree to which a research instrument yields consistent results, while validity refers to the accuracy and meaningfulness of inferences which are based on the results of such instruments (Mugenda and Mugenda, 1999). Accordingly, the researcher maximized the validity and reliability by collecting data using properly constructed tools, appropriate data collection procedures, and sampling techniques that not only targeted the right population but also yielded accurate data. Other measures included peer and expert review of the instruments and pilot testing which facilitated necessary adjustments to the instruments.

3.5.3 Reliability of the Research Instrument

Reliability is a measure of the degree to which research instrument yields consistent results or data after repeated trials. The reliability of the instrument was tested using split-half method to calculate correlation of odd and even items separately and using r-function of Spearman Brown prophecy formulae. In this study, the questions in the instrument were separated into two halves, using the odd numbered questions for one set and the even-numbered questions for the other. Each of the two sets of questions were treated separately and scored accordingly. The two sets were then correlated to undertake an estimate of reliability. To adjust the correlation coefficient obtained between the two halves, the following formula known as the spearman-Brown formula was applied:

$$\text{Reliability} = \frac{\text{2x Corr Between the even halfs}}{\text{1+ Corr Between the odd halfs}}$$

$$R = \frac{2r}{r + 1}$$

r is a quantitative measure of reliability on a scale of 0-1, such that as r tends to 1, the stronger the reliability and vice versa. For this study, reliability of 0.5 or more is acceptable (Salemi, 2008).

3.6 Data Collection Procedures

The researcher obtained the necessary authorization and introductory letter from the University of Nairobi and sought permit allowing him to conduct the research from the National Council of Science and Technology. The researcher also presented himself to the District Commissioner and the District Public Health Officer, Kisumu East District, to obtain the necessary authority to conduct research. After this, the researcher conduct a two day training and induction of 6 research assistants who then proceeded to collect data from the sampled households in Winam Division, Kisumu East District. The training included the following: - understanding the questionnaire, household sampling, interview skills, data collection, data recording and ethical considerations.

3.7 Data Analysis Techniques

According to Kothari (2009), data analysis describes the computation of certain measures along with searching patterns of relationships that exist among data groups. Data cleaning will be undertaken to ensure completeness and consistency. Descriptive statistics, including frequencies and percentages were calculated for quantitative data. Multivariate statistics (cross tabulation) were done to determine the relative influence of the independent variables on adoption of household drinking water treatment methods. Statistical Package for Social Science (S.P.S.S) version 17.0 was used to aid the quantitative analysis. The outcome variables were then compared to the socio demographic characteristics of the sample. The data was presented in tables. Qualitative data was be grouped into respective themes and used to enhance deeper understanding of the description of the quantitative data, guided by the study objectives and questions.

3.8 Ethical Considerations

Ethical research practices were observed throughout the study. This included seeking consent from the interviewees before commencing data collection, assurance of confidentiality of information obtained from the interviewees as well as providing appropriate information regarding the importance and significance of the study. The researcher also obtained permit from the National Council for Science and Technology.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the research findings which have been discussed under thematic sub-sections in line with the study objectives. The sub-sections include: response rate of the study, demographic characteristics of respondents, Household knowledge on drinking water treatment methods and adoption of household drinking water treatment methods; Accessibility to household drinking water treatment methods and adoption of household drinking water treatment methods; and Source of household drinking water on adoption of household drinking water treatment methods.

4.2 Questionnaire Return Rate

This section presents the questionnaire return rate for the different categories of respondents that were targeted during the study. Quantitative primary data was sourced through administration of household questionnaires with female or any other available responsible adults in the absence of female respondents. Out of the 384 respondents targeted, 346 (90.1%) responses were obtained. The other 9.9% did not respond due to various commitments. Nachmias and Nachmias (2005) posited that a response rate of 75% is acceptable for academic surveys. The response rate was considered above average. The researcher made a decision to analyze the data based on this response rate as it was considered to depict a true picture of the study variables interacting with the population with minimal non response error.

An in-depth interview schedule targeting the District Public Health Officer who was a key informant was used to elicit detailed qualitative information relating to determinants of adoption of household drinking water treatment methods. There was 100% response rate for the key informant interview. The in-depth interview responses, opinions, insights and discussions are based on this category of respondents.

4.3 Demographic Characteristics of Respondents

This section describes the demographic characteristics of the respondents involved in the study. The demographic characteristics included, gender, age, marital status, and education.

4.3.1 Gender of Respondents

The study sought to establish the distribution of respondents by gender. This was necessary in providing the background for the analysis of determinants of adoption of household drinking water treatment methods. Respondents were asked to state their gender. The results are presented in table 4.1:

Table 4.1: Distribution of Respondents by Gender

Gender	Frequency	Percent (%)
Male	89	25.7
Female	257	74.3
Total	**346**	**100.0**

Out of the 346 majority of respondents interviewed, 257 (74.3%) were female while 89 (25.7%) were male. This indicates that in most households, more women are involved with household drinking water treatment processes. The finding can be compared to similar findings of a study by UNICEF (2006) among various countries involved in UNICEF Joint Monitoring Programme for Water Supply and Sanitation, which found that that women shoulder the bulk of the water collecting responsibility when drinking water is not available on premises. The study by UNICEF found that women are more than twice as likely as men to go and fetch drinking water.

4.3.2: Age Distribution of Respondents

The study sought to describe the age distribution of respondents. This was necessary for the researcher to have an appropriate background understanding of this demographic feature among the respondents and how they relate with adoption of household drinking water treatment. The respondents were asked to state their ages, and the findings have been presented in table 4.2:

Table 4.2: Distribution of Respondents by Age

Age Bracket	Frequency	Percent (%)
Below 18 Years	15	4.3%
19 - 24 Years	159	46.0%
25 - 35 Years	52	15.0%
36 -45 Years	71	20.5%
Above 45 Years	42	12.1%
Non Response	7	2.0%
Total	**346**	**100.0%**

In terms of age, 15 (4.3%) respondents were below 18 years, 159 (46%) were between 19-24 years, 52 (15%) were between 25-35 years, 71 (20.5%) were between 36-45 years while 42 (12.1%) were above 45 years. None responses for this category were 7 (2%). These findings indicate that the majority of those involved in water treatment are between ages 19 to 24 years. The findings are congruent with similar findings by UNICEF (2006) among various countries involved in UNICEF Joint Monitoring Programme for Water Supply and Sanitation, which suggested that children (boys and girls) play a relatively small role in water collection, with 11% of households reporting that children were the main water haulers.

4.3.3: Marital Status of Respondents

It was important to establish the marital status of respondents to understand the demographic background specific to marital status. Respondents were asked to state their marital status. Table 4.3 below presents the responses:

Table 4.3: Marital Status of Respondents

Marital Status	Frequency	Percentage
Single	78	22.5
Married	268	77.5
Total	**346**	**100.0**

In terms of marital status, 78 (22.5%) were single while 268 (77.5%) respondents were married. The finding indicates that majority of respondents, that is 77.5%, involved with drinking water treatment were married as compared to 22.5% who were single. This finding indicates that marital status influences involvement in household drinking water treatment.

4.4 Household Socio-Economic Status and Adoption of Drinking Water Treatment Methods

The study sought to investigate household socio-economic status with a view to establishing how this relates with adoption of household drinking water treatment methods. To accomplish this, the study investigated household size, education level, and economic activities.

4.4.1 Household Size and Adoption of Drinking Water Treatment Methods

The study sought to establish the various household sizes and thus investigate the extent to which household size determines adoption of household drinking water treatment methods. In order to determine the household size, respondents who participated in the survey were asked to state the number of persons that live in their households. This is illustrated by 4.4:

Table 4.4: Household Size and Adoption of Drinking Water Treatment Methods

Household Size	Frequency	Percent
1 – 5	235	67.9%
6 – 10	100	28.9%
Above 10	5	1.4%
Non Response	6	1.7%
Total	**346**	**100%**

Out of 346 respondents interviewed, 235 (67.9%) had between 1 and 5 persons living in their households, 100 (28.9%) had between 6 and 10 persons, 5 (1.4%) had above ten persons while 6 (1.7%) did not respond to this question. This finding shows that the majority of respondents, i.e. 67.9%, had between 1 and five persons living in their households. The mean number of persons per household was found to be 5. This analysis was further subjected to cross-tabulation to establish the relationship between household size and adoption of household drinking water treatment methods. The relationship herein is illustrated by table 4.5:

Table 4.5: Household Size and Drinking water Treatment Method Used

Household Size	Drinking water Treatment Method Used in Household			
	Boiling	**Add purifiers**	**None**	**Total**
1 – 5	50.0%	50.0%		100.0%
6 – 10	6.7%	86.7%	6.7%	100.0%
Above 10	50.0%	16.7%	33.3%	100.0%
Total	**24.5%**	**61.2%**	**14.3%**	**100.0%**

From the cross tabulation above, 50% of households with between 1 and five persons boiled their drinking water while the other 50% added purifiers to treat their drinking water. For those households with between 6 and 10 persons, 86.7% added purifiers to drinking water, 6.7% boiled their water while 6.7% did not treat their water at all. 50% of households with over ten persons boiled their drinking water, 16.7% added purifiers while 33.3% did not treat their water. This finding established that majority of households with between 6 and 10 (86.7%) persons added purifiers to treat their drinking water. It also established that the category of households with more than 10 persons had the highest proportion of households that did not treat their drinking water, at 33.3%. This finding could be attributable to the fact that the bigger the household size, the less the likelihood for the household to treat drinking water, possibly because of the time and cost involved. Overall, the study established that the majority of households, i.e. 61.2%, treated their drinking water by adding purifiers. Out of households who participated in the study, 24.5% boiled their drinking water while 14.3% did not treat their drinking water. This finding validates empirical findings by Hobbins, Maeusezahl & Tanner (2004) on Home-based Drinking Water Purification in the pluri-national State of Bolivia, who argued that use of solar disinfection was positively associated with family size.

4.4.2 Education Level and Adoption of Drinking Water Treatment Methods

Level of education is necessary in understanding the adoption of household drinking water treatment methods. This study sought to establish the highest education levels of the respondents with a view to determining how this influences adoption of household drinking water treatment methods. Respondents were thus asked to state their highest level of education completed. Table 4.6 shows the frequencies and percentages of the various education levels completed by the respondents:

Table 4.6: Highest Level of Education of Respondents

Level of Education Completed	Frequency	Percent
Primary	99	28.6%
Secondary	129	37.3%
A Level	23	6.6%
Tertiary/Middle level college	30	8.7%
University	16	4.6%
No response	49	14.2%
Total	**346**	**100.0%**

Table 4.6 shows that most of the respondents were literate with a majority 129 (37.3%) out of 346 (100%) having completed secondary education. This was followed by 99 (28.6%) who had completed primary education, 23 (6.6%) who had completed A level education, 30

(8.7%) who had completed Tertiary/Middle level college education and 16 (4.6%) who had completed university education. 49 (14.2%) did not respond to this question for personal reasons. These findings were subjected to further analysis using cross-tabulation to determine the relationship of this variable with the dependent variable. Table 4.7 shows the relationship:

Table 4.7: Education Level and Water Treatment Method Used

Highest Level of Education	Drinking water treatment method used in household			
	Boiling	**Add Purifiers**	**None**	**Total**
Primary	38.5%	53.8%	7.7%	100.0%
Secondary	38.9%	61.1%		100.0%
A Level		100.0%		100.0%
Tertiary/Middle level college		100.0%		100.0%
University			100.0%	100.0%
Total	**29.3%**	**63.4%**	**7.3%**	**100.0%**

From the cross tabulation, the researcher found that 53.8% of those who completed primary education treated their drinking water by adding purifiers, 38.5% of them boiled their drinking water while 7.7% of them did not treat their drinking water at all. For respondents who had completed secondary education, 38.9% boiled their drinking water while 61.1% added purifiers to treat their drinking water. 100% of those who had completed both A level education and Tertiary/Middle level Colleges added purifiers to treat their drinking water. A worrying finding is that those who had completed university education did not treat their water at all. From the analysis, it is clear that most respondents, i.e. 63.4%, added purifiers to treat their drinking water vis avis 29.3% and 7.3% of the respondents who boiled their drinking water and did not treat drinking water respectively. These findings imply that education levels determine adoption of household drinking water treatment methods. The findings have established a definite household drinking water treatment adoption pattern comparable to the findings of an empirical study by Rheingans & Dreibelbis (2007) , which established population characteristics associated with less use of dilute sodium hypochlorite solution to include low socioeconomic status, low level of education, minority ethnic status and residence in rural areas in Madagascar.

4.4.3 Occupation and Adoption of Drinking Water Treatment Methods

In order to determine the main occupation of the household heads, respondents were asked to state the main occupation of the household head. This was useful in establishing how household socio-economic status determines adoption of household drinking water treatment methods. Table 4.8 shows the various occupations for household heads:

Table 4.8: Main Occupation of Household Heads

Main Occupation of household	Frequency	Percent (%)
Farming	19	5.5%
Home maker	21	6.1%
Family business	84	24.3%
Own business	123	35.5%
Formal/paid employment	84	24.3%
Other	15	4.3%
Total	**346**	**100.0%**

Out of 346 respondents who participated in the study, majority 123 (35.5%) stated that their household heads were engaged in own business, 19 (5.5%) farmers, 21 (6.1%) home makers, 84 (24.3%) were engaged in family business, 84 (24.3%) in formal employment and 15

(4.3%) were engaged in other occupations. This implies that majority of the households are engaged in business as their main means of livelihood. These findings were subjected to further analysis by way of cross tabulation as shown in table 4.9:

Table 4.9: Occupation of Household Head & Water Treatment Method Used

Main Occupation	**Drinking water treatment method used in household**			
	Boiling	**Add Purifiers**	**None**	**Total**
Farming	50.0%	50.0%		100.0%
Home maker		100.0%		100.0%
Family business		100.0%		100.0%
Own business	30.0%	40.0%	30.0%	100.0%
Formal employment	22.2%	66.7%	11.1%	100.0%
Other	100.0%			100.0%
Total	**24.5%**	**61.2%**	**14.3%**	**100.0%**

From the cross tabulation, 50% of households whose heads were farmers boiled their drinking water while the other 50% in this category added purifiers to their drinking water. 100% of households whose heads were home makers, engaged in family business and other occupation added purifiers to treat their drinking water. For households whose heads were engaged in own business, 30% of them boiled their drinking water, 40% added purifiers to their drinking water and 30% did not treat their drinking water. 22.2% of households with heads in formal employment boiled their drinking water, 66.7% added purifiers while 11.1% did not treat their drinking water. This finding drew parallels between 100% of households whose heads were home makers, engaged in family business and other occupation, who treated drinking water, and those who were engaged in own business and formal employment, where 30% and 11.1% did not treat their drinking water respectively, and thus established that occupation determines adoption of household drinking water treatment methods. This finding validates similar findings by Hobbins, Maeusezahl & Tanner (2000) in Bangladesh, where they found that the successful introduction of household drinking water treatment methods such as solar disinfection was mainly dependent on environmental factors, water sources in use, occupation of household and season, as well as strong intra-familial and gender-related factors.

4.4.4 Income Level and Adoption of Drinking Water Treatment Methods

The study sought to determine household income levels with a view to establishing the relationship with adoption of household drinking water treatment methods. To determine this, respondents were asked to state their average household income in terms of Kenya shillings. Table 4.10 illustrates the findings:

Table 4.10: Household Income

Average Household Income	Frequency	Percent
Below Ksh. 5000	180	52.0%
Ksh. 5000 - Ksh. 15,000	127	36.%
Above Ksh. 15,000	35	10.%
No Response	4	1.%
Total	**346**	**100.%**

Of the 346 households which participated in the study, 180 (52%) earned below Ksh 5,000, 127 (36.7%) earned between Ksh 5,000 and Ksh 15,000, while 35 (10.1%) earned above Ksh 15,000. there were 4 (1.2%) non-responses. This implies that majority of households, i.e. 52% earned below Ksh 5,000, followed closely by those earning between Ksh 5,000 and Ksh

15,000 indicating that population studied was largely poor. This could have a ramification on adoption of household drinking water treatment methods. These findings were further subjected to cross tabulation analysis, as shown in table 4.11:

Table 4.11: Average Household Income and Water Treatment Method Used

Average Income	Drinking water treatment method used in household			
	Boiling	**Add Purifiers**	**None**	**Total**
Below Ksh. 5000	18.5%	55.6%	25.9%	100.0%
Ksh. 5000 - Ksh. 15,000	35.3%	64.7%		100.0%
Above Ksh. 15,000		100.0%		100.0%
Total	**22.9%**	**62.5%**	**14.6%**	**100.0%**

From the cross tabulation, 18.5% of households earning below Ksh 5,000 boiled their drinking water, 55.6% added purifiers while 25.9% did not treat their drinking water. In the category of households earning between Ksh 5,000 and Ksh 15,000, 35.3% boiled their drinking water while 64.7% added purifiers to their drinking water. 100% of those earning above Ksh. 15,000 treated their drinking water by adding purifiers. Overall, the findings indicate that majority of households (62.5%) treated their drinking water by adding purifiers as compared to 22.9% which boiled their drinking water and 14.6% which did not treat their drinking water. These findings imply that majority of those who did not treat their water from this category (25.9%) were the poorest, earning below Ksh. 5,000, as compared to the relatively more economically endowed households (earning above Ksh. 15,000), where 100% treated their drinking water. It therefore follows that household income levels determines adoption of household drinking water treatment methods. This finding resonates with similar findings by UNICEF (2006) on Safe Water, which found that companies working with the Bolivarian

Republic of Venezuela Ministry of Health mainly targeted higher socioeconomic classes, which pay the full cost of water treatment products.

4.4.5 Economic Activity and Adoption of Drinking Water Treatment Methods

In order to determine the economic activities for households, respondents were asked to list economic activities that their household members were engaged in and determine how this relates with adoption of drinking water treatment. The findings are summarized in table 4.12:

Table 4.12: Economic Activities for Household Members

Economic Activity	Frequency	Percent
Formal Employment	10	2.9%
Not employed	82	23.7%
Business	248	71.7%
Farming/Agriculture	2	0.6%
System	4	1.2%
Total	**346**	**100.0%**

From the 346 households which participated in the study, it was established that 10 (2.9%) engaged in formal employment, 82 (23.7%) were not employed, 248 (71.7%) engaged in business, while 2 (0.6%) were engaged in Agriculture. These findings revealed that the majority of households, i.e. 71.7%, engaged in business, while the least segment were engaged in farming/agricultural activities. The findings were subjected to further analysis through cross tabulation to establish the relationship of the variable with the dependent variable. Table 4.13 shows the results of the cross tabulation:

Table 4.13: Economic Activity and Drinking Water Treatment Method Used

Economic Activity	Drinking water treatment method used in Household			
	Boiling	**Add Purifiers**	**None**	**Total**
Formal Employment		100.0%		100.0%
Not employed	22.2%	66.7%	11.1%	100.0%
Business	27.0%	56.8%	16.2%	100.0%
Total	**25.0%**	**60.4%**	**14.6%**	**100.0%**

The cross tabulation above shows that 100% of those in formal employment treated their drinking water by adding purifiers. For those not employed, 22.2% treated their drinking water through boiling, while 11.1% did not treat their drinking water. 27% of households engaged in business boiled their drinking water, 56.8% added purifiers to treat their drinking water while 16.2% did not treat their drinking water. From the findings, it can be deduced that those in formal employment have an appropriate health seeking behaviour, since 100% of them treat their drinking water. It can also be deduced that some of those not employed and those engaged in business have other concerns more pressing than the need to treat water, as evidenced by 11.1% and 16.2% of those that did not treat their water respectively. This socio-economic factor is thus a determinant of adoption of household drinking water treatment methods. The findings of this study confirm similar findings by Rheingans & Dreibelbis (2007) on awareness in water treatment in Madagascar, which established that population characteristics associated with less use of drinking water treatment products, included low socioeconomic status.

4.5 Knowledge of Drinking Water Treatment Methods and Adoption of Household Drinking Water Treatment Methods

To determine the extent of household knowledge on drinking water treatment methods, respondents were asked questions relating to the number/types of household drinking water treatment methods known to them, used and the reasons for treating their drinking water. This was important to enable the researcher to determine the influence of this variable on the dependent variable.

4.5.1 Awareness and Adoption of Drinking Water Treatment Methods

Awareness as a factor was important to this study since it provided an assessment of the households' awareness of drinking water treatment methods and how this relates with adoption of household drinking water treatment methods. To establish this, respondents were asked to state the methods of household drinking water treatment that they were aware of. Table 4.14 presents the findings for this question:

Table 4.14: Household Awareness on Water Treatment Methods

Treatment Method	Frequency	Percent (%)
Boiling	118	34.0%
Decanting	24	7.0%
Add purifiers/Chemicals	170	49.0%
Sieving	28	8.0%
Non-response	6	2.0%
Total	**346**	**100.0%**

From the presentation on table 4.14, 118 (34%) of the 346 (100%) respondents interviewed reported being aware of boiling as a drinking water treatment method, 24 (7%) were aware of decanting, 170 (49%) were aware of adding purifiers/chemicals, while 28 (8%) were aware of sieving. 6 (2%) did not respond to this question. These findings indicated that the majority of respondents (49%) were aware of adding purifiers/chemicals to treat their drinking water. The method that respondents were least aware of was sieving (8%). These findings were further subjected to cross tabulation analysis to determine the relationship with adoption of household drinking water treatment methods. Table 4.15 presets the findings:

Table 4.15: Drinking Water Treatment Method Awareness and Used

Known Treatment Method	Drinking water treatment method used in household				
	Boiling	**Add Purifiers**	**Sieving**	**None**	**Total**
Boiling	35.3%	47.1%		17.6%	100.0%
Decanting		100.0%			100.0%
Add purifiers/Chemicals		94.7%		5.3%	100.0%
Sieving			100.0%		100.0%
Total	**21.4%**	**62.5%**	**3.6%**	**12.5%**	**100.0%**

The cross tabulation above shows that 35.3% of respondents who were aware of boiling as method for treating household drinking water boiled their drinking water, 47.1% added purifiers/chemicals while 17.6% did not use any water treatment method. 100% of those who were aware of decanting treated their drinking water by adding purifiers. 94.7% of respondents aware of chemicals/adding treated their drinking water by adding purifiers, while 5.3% of households in this category did not treat their drinking water at all. 100% of respondents who were aware of sieving as a method of household drinking water treatment treated their drinking water b sieving. These findings established a trend whereby respondent adopted drinking water treatment methods that they were aware of, as evidenced by 100% of those who were aware of sieving and adding purifiers respectively. This finding implies that awareness of household drinking water treatment method determines adoption of household drinking water treatment method. Further, these findings validate findings of a similar study by Rheingans & Dreibelbis (2007) on awareness and use of drinking water treatment products in Madagascar, which found that households who reported having heard of the drinking water treatment products reported relative high adoption rates.

4.5.2 Household Drinking Water Treatment Methods Used

The study sought to establish the number and types of household drinking water treatment methods used by households. This was important for the researcher as it constituted the dependent variable and would give an indication of adoption rates for various water treatment methods. To achieve establish this, respondents were asked to state drinking water treatment methods used in their households. Table 4.16 below presents the findings:

Table 4.16: Household drinking Water Treatment Methods Used

Water Treatment Method used	Frequency	Percent (%)
Boiling	78	22.5%
Add purifiers/Chemicals	217	62.7%
Sieving	3	0.9%
Other	48	13.9%
Total	**346**	**100.%**

From table 4.16, three water treatment methods, i.e. boiling, adding purifiers/chemicals and sieving are used by 295 (86.1%) households. Other treatment methods are used by 48 (13.9%) households. From the findings, majority 217 (62.7%) households reported adding purifiers/chemicals to treat their drinking water, followed by 78 (22.5%) households who boiled their drinking water, and 3 (0.9%) households who reported to be treating their drinking water through sieving, while 48 (13.9%) reported using other methods to treat their drinking water. From these findings, it is clear that the treatment method most adopted by households was adding purifiers/chemicals while the method least adopted by households was sieving. From these findings, it could be deduced that majority of households probably find it easy, affordable, effective and convenient to treat their drinking water by adding purifiers/chemicals as opposed to a small minority of 0.9% of households used sieving as a drinking water treatment method. These findings contradicted findings of household surveys in Peru where Nawaz et al., (2001) found that boiling was the most common means of treating water at the household level, with 51% of householders claiming to boil their water before use.

4.5.3 Reasons for Treating Household Drinking Water

Many households treat drinking water for various reasons. The study sought to establish the reasons behind treating drinking water. To determine this, respondents were asked to state the benefits that they draw from treating their drinking water. Table 4.17 presents their responses:

Table 4.17: Benefits of Treating Household Drinking Water

Benefits of treating water	Frequency	Percent
Purify and make it safe for drinking	52	15.0%
Kill/eliminate germs	272	78.6%
Don't Know	22	6.4%
Total	**346**	**100.0%**

Table 4.17 shows that majority of households, that is 272 (78.6%) treated their drinking water to kill/eliminate germs. 52 (15%) households treated their water to purify and make it safe for drinking while 22 (6.4%) households did not know why they were treating their drinking water. The first and second reasons combined give a high proportion of households (93.6%) that treated drinking water for the right reasons. This finding implies a health seeking behaviour for the households, and therefore the likelihood of sustainable adoption of household drinking water treatment methods. It could therefore be deduced that perceive of treating drinking water determines adoption of household drinking water treatment methods. This study lends credence to findings of a study by Block (2001) on water treatment, which suggested that boiling, if practiced correctly, is one of the most effective, killing or inactivating all classes of waterborne pathogens, including bacterial spores and protozoan cysts. It also finds congruence in findings of a study by Nawaz et al. (2001) on Health Risk Behaviour and Health Perception in Peru, which found that 20% of householders boiled their drinking-water even without knowing that it was eliminating waterborne pathogens. These findings were further subjected to cross tabulation analysis as presented in table 4.18:

Table 4.18: **Benefits Drawn From Treating Drinking Water and Method Used**

Benefits of Treating Water	Drinking water treatment method used				
	Boiling	**Add Purifiers**	**Sieving**	**None**	**Total**
Making it safe for drinking	50.0%	50.0%			100.0%
Kill/eliminate germs	20.5%	68.2%	2.3%	9.1%	100.0%
Don't Know				100.0%	100.0%
Total	**22.6%**	**62.3%**	**1.9%**	**13.2%**	**100.0%**

From the cross tabulation, 50% of households that treated their drinking water to make it safe for drinking boiled the drinking water, while 50% added purifiers/chemicals. For the category of those who treated their drinking water to kill/eliminate germs, 20% treated their drinking water by boiling, 68.2% added purifiers, 2.3% sieved, while 9.1% did not treat their drinking water. 100% of those who did not know reasons for treating drinking water did not treat their drinking water. This finding implies that knowledge of reasons for treating drinking water determines adoption of household drinking water treatment methods. These findings validate findings of a study by Block (2001) on Water Treatment, who suggested that boiling drinking water is effective for killing or inactivating all classes of waterborne pathogens.

4.6 Accessibility to Household Drinking Water Treatment Methods and Adoption of Drinking Water Treatment Methods

To determine the extent to which accessibility to household drinking water treatment methods determines adoption of household drinking water treatment methods, the study sought to investigate availability of drinking water treatment methods, cost of water treatment, source of information on water treatment and amount of time spent in treating water. The findings are discussed in the following sub-themes:

4.6.1 Availability of Water Treatment Methods

The study sought to investigate the availability of household drinking water treatment methods. This was critical in helping the researcher to examine the extent to which this determined adoption of household drinking water treatment methods. Respondents were asked to state which drinking water treatment methods were available for their households. Table 4.19 presents findings from the responses:

Table 4.19: Water Treatment Methods Available for Households

Accessible Treatment Method	Frequency	Percent
Boiling	125	36.1%
Decanting	7	2.0%
Add purifiers/Chemicals	167	48.3%
Sieving	3	0.9%
Other	44	12.7%
Total	**346**	**100.0%**

From table 4.19, boiling was available to 125 (36.1%) households, decanting available to 7 (2%), adding purifiers/chemicals was available to 167 (48.3%) households, sieving available to 3 (0.9%) households, while 44 (12.7%) accessed other methods of drinking water treatment. The findings indicate that adding purifiers/chemicals was available to majority of households, i.e. 48.3%, while sieving was available to minority of households, i.e. 0.9%. These findings were further subjected to cross tabulation analysis to establish how availability of household drinking water treatment methods determines adoption of household drinking water treatment methods. Table 4.20 presents the findings of the cross tabulation:

Table 4.20: Water Treatment Methods Available and Used

Accessible water treatment methods	Drinking water treatment method used in household				
	Boiling	**Add Purifier**	**Sieving**	**None**	**Total**
Boiling	60.0%	40.0%			100 %
Decanting		100.0%			100 %
Add Purifiers/Chemicals		96.3%		3.7%	100 %
Sieving			100.0%		100 %
Other				100.0%	100 %
Total	**21.4%**	**62.5%**	**3.6%**	**12.5%**	**100 %**

The cross tabulation shows that 60% of households to which boiling was available as a method of drinking water treatment actually boiled their drinking water while 40% added purifiers. For the category of households to which decanting method was available ended up adding purifiers to their drinking water. 96.3% of households to which adding purifiers/chemicals was available added purifiers to their drinking water while 3.3% did not treat their drinking water. Moreover, 100% of households to which sieving method was available actually sieved their water, while 100% of households to whom other methods of water treatment were available did not treat their drinking water. These findings indicate that despite other drinking water treatment methods being available to households, most households preferred to add purifiers to treat their drinking water. Reasons for this preference could range from user friendliness, efficacy, and other reasons of convenience with regard to the option of adding purifiers/chemicals. These findings indicate that accessibility to household drinking water treatment methods determine adoption of household drinking water treatment methods. The findings corroborate similar findings of a study by WHO (2004) scaling up water treatment among low-income populations, which found that different major HWTS technologies, including safe storage, boiling, chlorination, solar disinfection and different types of ceramic filters, bio-sand filters and combined systems, including coagulation & chlorine disinfection and filtration & disinfection among other methods, were in use to various extents worldwide.

4.6.2 Cost of Water Treatment Methods

It was critical to establish the cost of various drinking water treatment methods in order to examine how this determines adoption of household drinking water treatment methods. To determine this, respondents were asked to state how much in terms of Kenya shillings they spent per day to treat their household drinking water. Table 4.21 presets the findings of this question:

Table 4.21: Money Used to Treat Drinking Water for Household

Money Used	Frequency	Percent
Between Ksh. 1 to Ksh. 15	78	22.5%
Between Ksh. 15 to Ksh. 30	178	51.4%
Between Ksh. 30 to Ksh. 50	27	7.8%
Don't Know	59	17.1%
No Response	4	1.2%
Total	**346**	**100.0%**

Out of the 346 households interviewed and responses presented in table 4.17, it was found that 78 (22.5%) spent between Ksh. 1 and Ksh. 15, while the majority of households 178 (51.4%) spent between Ksh. 15 and Ksh. 30, and 27 (7.8%) spent between Ksh. 30 and Ksh. 50 per day to treat their drinking water. 59 (17.1%) households did not know how much they spent to treat their drinking water per day, while 4 respondents did not respond to the question. Considering that this study has established that majority of households have modest economic status, the cost of treating drinking water as presented herein could be out of reach for a significant segment of households with minimal earnings. These findings validate similar findings of a study by Hobbins (2004) on Home-based drinking water purification through sunlight in Bolivia, which found that companies working with the Bolivarian Republic of Venezuela Ministry of Health, UNICEF and NGOs, sales were mainly targeted to higher socioeconomic classes, which pay the full cost of the product, thus influencing adoption of household drinking water treatment methods. These findings were further subjected to cross tabulation analysis to ascertain the extent to which the cost of treating drinking water determines adoption of household drinking water treatment methods. Table 4.22 presents the findings:

Table 4.22: Cost of Treating Drinking Water and Treatment Method Used

Money Used	**Drinking water treatment method Used**			
	Boiling	Add purifiers	None	Total
Between Ksh. 1 to Ksh. 15	14.3%	85.7%		100.0%
Between Ksh. 15 to Ksh. 30	14.3%	85.7%		100.0%
Between Ksh. 30 to Ksh. 50	80.0%	20.0%		100.0%
Don't Know	22.2%		77.8%	100.0%
Total	**22.4%**	**63.3%**	**14.3%**	**100.0%**

From the cross tabulation, 85.7% of households which spent between Ksh 1 and Ksh. 15 added purifiers to treat drinking water while 14.3% of households in this category boiled their drinking water. Households which spent between Ksh. 15 and Ksh. 30 exhibited similar water treatment trends as the first category. 80% of households that spent between Ksh. 30 and Ksh. 50 boiled their drinking water while 20% added purifiers. For households that did not know how much they spent in treating their drinking water, 22.2% boiled their drinking water while 77.8% did not treat their drinking water. From the findings, it is apparent that the boiling as a method of treating water is expensive, since the majority who boiled their drinking water spent between Ksh. 30 and Ksh. 50. The findings also indicate that the drinking water treatment of method adding purifiers was more affordable, with majority households (85.7%) using the method spending between Ksh. 1 and Ksh. 30 per day to treat their drinking water. These findings indicate that the cost of treating drinking water determines adoption of household drinking water treatment methods. The findings corroborate findings of a similar study by Hobbins (2004) on Home-based drinking water purification through sunlight in Bolivia, which found that companies working with the Bolivarian Republic of Venezuela Ministry of Health, UNICEF and NGOs targeted their sales mainly to higher socioeconomic classes, hence determining adoption of drinking water treatment methods.

4.6.3 Source of Water Treatment Information

The study sought to investigate the various sources of information for household drinking water treatment and how they relate to adoption of household drinking water treatment methods. Respondents were asked to state the source of information for their drinking water treatment methods. Table 4.23 shows the findings in response to the question:

Table 4.23: **Source of Information on Drinking Water Treatment Methods**

Source of Information	Frequency	Percent
From health workers	31	9.0%
From friends/relatives	37	10.7%
From mass media	200	57.8%
From social gatherings	50	14.5%
From school/college	23	6.6%
Other	1	0.3%
No Response	4	1.2%
Total	**346**	**100.0%**

Out of the 346 respondents interviewed, 31 (9%) obtained information of drinking water treatment from health workers, 39 (10.7%) from friends/relatives, 200 (57.8%) from mass media, 50 (14.5%) from social gatherings, 23 (6.6%) from schools/colleges, while 1 (0.3%) obtained the information from other sources. 4 (1.2%) respondents did not respond to this question. These findings indicate that the majority of households, i.e. 57.8%, obtained information on household drinking water treatment from mass media, thus suggesting that mass media is an effective means of disseminating information on water treatment. Social gatherings and friends/relatives follow in sequence in terms of effective media of such information dissemination. These findings were also subjected to cross tabulation analysis. Table 4.24 presents the findings:

Table 4.24: Source of Information on Drinking Water Treatment and Treatment Method Used

Source of Knowledge	Drinking water treatment method used in household			
	Boiling	**Add Purifiers**	**None**	**Total**
Health workers	66.7%	33.3%		100.0%
Friends/relatives		100.0%		100.0%
Mass media	29.2%	70.8%		100.0%
Social gathering	20.0%	20.0%	60.0%	100.0%
School/college	20.0%	60.0%	20.0%	100.0%
Total	**24.0%**	**62.0%**	**14.0%**	**100.0%**

Table 4.24 shows that 66.7% of households who obtained information on drinking water treatment methods from health workers boiled their drinking water while 33.3% added purifiers to treat their drinking water. This indicates that health workers promote and focus more on boiling water as a household drinking water treatment method. 100% of households that obtained information on drinking water treatment from friends/relatives added purifiers to treat their drinking water. This indicates that the friends/relatives also added purifiers. 29.2% of households that obtained the information from mass media boiled their drinking water while 70.8% added purifiers. This indicates that mass media promote the method of adding purifiers more than other methods. 20% of households that obtained information on drinking water treatment from social gatherings boiled their drinking water, 20% added purifier while 60% did not treat their water. The high percentage of households that did not treat their drinking water from this category indicates that social gatherings are an ineffective way of disseminating

information on drinking water treatment. Finally, 20% of households that obtained information on drinking water treatment from schools/colleges boiled their drinking water, 60% added purifiers while 20% did not treat their drinking water. This is an indication that schools/colleges are also not very effective media for disseminating information on household drinking water treatment. Overall, these findings indicate that source of information on drinking water treatment methods determine adoption of household drinking water treatment methods. These findings corroborate findings of a similar study by WHO (2009) on scaling up household water treatment among low-income populations, which found that an Irish company's sales of NaDCC tablets to households and agencies in Tanzania and Kenya increased significantly in recent years largely due to use of commercial marketing through mass media. The most substantial growth exceeded 150 million tablets in 2007, enough to treat more than 2.86 billion litres of water.

4.6.4 Time Taken to Treat Household Drinking Water

The researcher found it important to investigate the amount of time spent to treat drinking water and how this relates with adoption of household drinking water treatment methods. Respondents were asked to state how much time it took them to treat drinking water for their households. Table 4.25 presents the findings:

Table 4.25: Time Taken to Treat Drinking Water for Households

Time	Frequency	Percent
0 - 30 minutes	200	57.8%
30 minutes - 1 hour	70	20.2%
Beyond 1 hour	20	5.8%
Don't know	52	15.0%
Non Response	4	1.2%
Total	**346**	**100.0%**

Out of the 346 households interviewed, majority of the households, that is, 200 (57.8%) took between 0 and 30 minutes to treat their drinking water, 70 (20.2%) took between 30 minutes and 1 hour to treat their drinking water, 20 (5.8%) spent beyond 1 hour to treat their drinking water, while 52 (15%) did not know how much time it took them to treat their drinking water. 4 (1.2%) respondents did not respond to this question. These findings were further subjected to cross tabulation analysis as shown in table 4.26:

Table 4.26: Time Taken to Treat Drinking Water and Treatment Method Used

Time Taken	**Drinking water treatment method Used**			
	Boiling	Add Purifiers	None	Total
0 - 30 minutes	32.3%	67.7%		100.0%
30 minutes - 1 hour		100.0%		100.0%
Beyond 1 hour	33.3%	66.7%		100.0%
Don't know		12.5%	87.5%	100.0%
Total	**22.4%**	**63.3%**	**14.3%**	**100.0%**

The cross tabulation shows that 32.3% of households that spent between 0 and 30 minutes to treat drinking water boiled their drinking water while 67.7% added purifiers. This implies that more households preferred to add purifiers to their drinking water, since it took less time to treat drinking water by adding purifiers than it took to boil. 100% of households that spent between 30 minutes and 1 hour to treat drinking water added purifiers, indicating that they found it more convenient to treat their drinking water by adding purifiers. 33.3% of households that spent more than 1 hour to treat their drinking water boiled their drinking water, while 66.7% added purifiers. This finding indicate that more households preferred to treat their drinking water by adding purifiers, probably because it took relative less time. For those who did not know how much time it took them to treat their drinking water, 12.5% added purifiers while 87.5% did not treat their drinking water. These findings indicate that time taken to treat drinking water determines adoption of household drinking water treatment methods, and validates findings by a study by Clasen & Boisson (2006) on water quality improvement for prevention of diarrhoea in Dominican Republic, which found that a significant number of households took untreated water because the ceramic water filters took long to filter water and could therefore not filter enough water for the household members.

4.7 Source of Household Drinking Water Treatment Methods and Adoption of Household Drinking Water Treatment Methods

The study sought to examine the extent to which household drinking water source determines adoption of household drinking water treatment methods. To examine this, the researcher asked questions regarding various sources of drinking water, distance and time taken to fetch water from dwelling units as well as perception of water quality from various sources, and how these relate with adoption of household drinking water treatment methods.

4.7.1 Source of Household Drinking Water:

The study sought to establish the various sources of drinking water for the households. Respondents were asked to state the main source of their household drinking water. Table 4.27 presents the responses and findings:

Table 4.27: Main Source of Water for Members of Household

Source of Water	Frequency	Percent
Piped into dwelling	4	1.2%
Piped into yard/plot	28	8.1%
Public tap	288	83.2%
Open well in dwelling/yard/plot	8	2.3%
Open public well	5	1.4%
Protected well in dwelling/ yard/plot	5	1.4%
Water vendors delivered in Jerri cans	4	1.2%
Non Response	4	1.2%
Total	**346**	**100.0%**

From the table, 4 (1.2%) had their dinking water piped into building, 28 (8.1%) had their drinking water piped into yard, 288 (83.2%) obtained their drinking water from public taps, 8 (2.3%) obtained their water from open well in dwelling/yard/plot, 5 (1.4%) obtained their drinking water from open public well, 5 (1.4%) from protected well in dwelling/ yard/plot, while

4 (1.2%) from water vendors delivered in Jerri cans. 4 (1.2%) respondents did not respond to the question. These findings were further subjected to cross tabulation analysis as shown in table 4.28:

Table 4.28: Source of Drinking Water & Treatment Method Used

Main Source of Water	Drinking Water Treatment Method Used			
	Boiling	**Add Purifiers**	**None**	**Total**
Piped into dwelling		100.0%		100.0%
Piped into yard/plot	20.0%	80.0%		100.0%
Public tap	21.6%	62.2%	16.2%	100.0%
Open well in dwelling/yard/plot	50.0%	50.0%		100.0%
Open public well		100.0%		100.0%
Protected well in dwelling/ yard/plot			100.0%	100.0%
Water vendors delivered in Jerri cans	50.0%	50.0%		100.0%
Total	**22.4%**	**63.3%**	**14.3%**	**100.0%**

From the cross tabulation, 100% of households which had drinking water piped into dwelling treated their drinking water by adding purifiers. This indicates that 100% of those households distrust the safety of the drinking, hence the need to add purifiers. 20% of households that had water piped into their yard/plot treated their drinking by boiling while 80% added purifiers. It could be deduced that majority of households in this category find it more convenient to treat drinking water by adding purifiers. 21.6% of households that obtain their drinking water from public taps treated the drinking water by boiling, 62.2% added purifiers while 16.2% did not treat their water. This could imply that the majority of households in this category (62.2%) find it more convenient and effective to treat their drinking water by adding purifiers while the other minority probably felt that the water was safe for drinking, hence finding no need to treat it. 50% of households that obtained their drinking water from open well in dwelling/yard/plot treated the water by boiling while 50% added purifiers. The fact that all the households in this category treated their drinking water suggests that they distrusted the safety of the source of water. This could also be said of households that obtained their drinking water from open public wells, since 100% of them treated their drinking water. To the contrary, 100% of households that obtained their drinking water from protected well in dwelling/yard/plot did not treat their drinking water. This could imply that they trust the safety of the source of their drinking water. 50% of households that obtained their drinking water from vendors delivered in jerry cans treated their drinking water by boiling while the other 50% added purifiers. The fact that all the households treated their drinking water indicates that they did not trust the safety of the source of water. These findings indicate that source of household drinking water determines adoption of household drinking water treatment methods, and they corroborate similar findings of the Kenya Demographic and Health Survey (2009) on various health indicatiors, which found home water treatment to be effective in improving the quality of household drinking water.

4.7.2 Distance from Household Drinking Water Source

Distance from water source was an important factor in the study. Respondents were asked to state the distance of source of drinking water from their households. Table 4.29 presents the findings:

Table 4.29: **Distance from Source of Drinking Water to Household**

Distance	Frequency	Percent
0 - 200 meters	220	63.6%
200 - 500 meters	122	35.3%
Missing in System	4	1.2%
Total	**346**	**100.0%**

From table 4.29, majority of households, that is 220 (63.6%) reported distance from drinking water source between 0 and 200 meters, while 122 (35.3%) reported distance between 200 and 500 meters. 4 (1.2%) respondents did not respond to the question. These findings indicate that majority of households have fairly near distances from drinking water source as compared to 35.3% whose distances from drinking water source are relatively located further from their households. The cross tabulation analysis below presents a deeper analysis.

Table 4.30: Distance from Source of Drinking Water and Treatment Method Used

Distance from source	Drinking water treatment method used in household			
	Boiling	**Add Purifiers**	**None**	**Total**
0 - 200 meters	30.0%	53.3%	16.7%	100.0%
200 - 500 meters	10.5%	78.9%	10.5%	100.0%
Total	**22.4%**	**63.3%**	**14.3%**	**100.0%**

From the cross tabulation, 30% of households whose source of drinking water was located between 0 and 200 meters boiled their drinking water, 53.3% added purifiers while 16.7% did not treat their drinking water. This finding indicates that fewer households in this category did not treat their drinking water, probably trusting the safety of their drinking water. On the other hand, 10.5% of households whose source of drinking water was located between 200 and 500 meters treated their drinking water by boiling, 78.9% added purifiers while 10.5% did not treat their drinking water. This finding indicates that more people in this category did not trust the safety of their drinking water, hence the need to treat, as compared to a small percentage (10.5%) of households which did not treat their drinking water, either because they trusted the water safety or did not care. These findings indicate that distance of drinking water from households determine adoption of household drinking water treatment methods. The findings are congruent with findings of Kenya Demographic and Health Survey (2009) to the effect that more than one-third of Kenyan households get their drinking water from distant and non-improved sources, hence necessitating the need to treat drinking water.

4.7.3 Time Taken to Fetch Water

The study sought to examine the time taken to fetch household drinking water, from the time one leaves the house in search of water, until he/she comes back with water. Respondents were asked to state how much time it took from the time of leaving the house to fetch water until returning to the house with water. Table 4.31 presents the findings:

Table 4.31: Time Taken from House to Source of Water and Back

Time	Frequency	Percent
0 - 30 minutes	309	89.3%
30 minutes - 1 hour	33	9.5%
Beyond one hour	4	1.2%
Total	**346**	**100.0%**

Out of the 346 respondents interviewed, 309 (89.3%) took between 0 and 30 minutes to fetch drinking water from source. This finding indicates that majority of households access drinking water from nearby sources. 33 (9.5%) take between 30 minutes and 1 hour to fetch drinking water from source, while 4 (1.2%) fetch took more than 1 hour to access drinking water from source. These findings imply that these households access drinking water from relatively far sources. The findings were further subjected to cross tabulation analysis to determine how they relate with adoption of household drinking water treatment methods. Table 4.32 below show the findings:

Table 4.32: Time Taken to Source of Water and Drinking Water Treatment Method Used

Time taken to fetch water	Drinking water treatment method Used			
	Boiling	**Add Purifiers**	**None**	**Total**
0 - 30 minutes	25.0%	59.1%	15.9%	100.0%
30 minutes - 1 hour		100.0%		100.0%
Total	**22.4%**	**63.3%**	**14.3%**	**100.0%**

Table 4.32 shows that 25% of households that took between 0 and 30 minutes to fetch drinking water boiled the drinking water, 59.1% added purifiers while 15.9% did not treat their drinking water. These findings imply that a significant proportion of households in this category which did not treat their drinking water were likely to be confident of the safety of the drinking water, probably due to the fact that they sourced the drinking water from close proximity. 100% of households that took more than 1 hour to fetch drinking water from source treated their drinking water by adding purifiers. This is an indication that the households took into consideration the relative longer amount of time that could have exposed the drinking water to

contamination, hence the need to treat the drinking water. These findings indicate that amount of time take to fetch household drinking water determines adoption of household drinking water treatment methods. The findings are congruent with findings of a study by Moser, Heri & Mosler (2005) on determinants of diffusion of solar disinfection in Bolivia, which found that a significant number of people did not adopt use of solar disinfection for treatment of drinking water due to lack of time, cold or rainy weather period, among other reasons.

4.7.4 Perception of Water Quality

The study sought to assess how perception of household drinking water source determines adoption of household drinking water treatment methods. Respondents were asked to state whether they thought their drinking water was safe for drinking. The responses are presented in table 4.33:

Table 4.33: Perception of Water Quality

Water Safety	Frequency	Percent
Yes	22	6.4%
No	64	18.5%
Don't know	260	75.1%
Total	**346**	**100.0%**

From table 4.28, 22 (6.4%) households believed that their drinking water was safe for drinking against 64 (18.5%) households that believed that their drinking water was safe for drinking. 260 (75.1%) did not know whether their water was safe for drinking or not. The findings were further subjected to cross tabulation analysis as shown in table 4.29:

Table 4.34: Drinking Water Safety and Drinking Water Treatment Method Used

Water safe for drinking	Drinking water treatment method used			
	Boiling	**Add Purifiers**	**None**	**Total**
Yes	8.3%	58.3%	33.3%	100.0%
No	36.0%	60.0%	4.0%	100.0%
Total	**27.0%**	**59.5%**	**13.5%**	**100.0%**

From the cross tabulation, 8.3% of households that perceived their drinking water to be safe treated their drinking water by boiling, 58.3% added purifiers while 33.3% did not treat the water. The significant high proportion of households that did not treat their drinking water could have been convinced that the water was safe and therefore did not require treatment. The other 66.7%, even though they perceived their drinking water to be safe for drinking, still treated the drinking water, most likely for precautionary purposes. 36% of households that did not perceive their drinking water to be safe for drinking boiled the water, 60% added purifiers while 4% did not treat the drinking water despite perceiving it unsafe for drinking. These findings indicate that water safety/quality perception determines adoption of household drinking water treatment methods. These findings validate findings of Kenya Demographic Health Survey (2009) on various health indicators, which found that more than one-third of Kenyan households get their drinking water from non-improved sources.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of findings, conclusions, recommendations and contribution to body of knowledge

5.2 Summary of Findings

The purpose of this study was to investigate the determinants of adoption of household drinking water treatment methods in Winam Division, Kisumu East District, Kenya. In order to determine the relationship between determinants of adoption of household drinking water treatment methods and the adoption of household drinking water treatment methods, data relating to household socio-economic status, knowledge on household drinking water treatment methods, accessibility to household drinking water treatment methods and household drinking water source, was collected. In-depth information concerning determinants of adoption of household drinking water treatment methods was also sourced from the District Public Health Officer. This data was subjected to preliminary analysis and summarized in form of frequency tables. The summaries were subjected to further cross tabulation analysis to test dependence or relationship between the independent variables and the dependent variable.

The first objective of the study was to investigate the extent to which household socio-economic status determines adoption of household drinking water treatment methods. In terms of household size, the study found that majority of households with between 6 and 10 (86.7%) persons added purifiers to treat their drinking water. It also established that the category of households with more than 10 persons had the highest proportion of households that did not treat their drinking water, at 33.3%. in terms of education level, the researcher found that 53.8% of those who completed primary education treated their drinking water by adding purifiers, 38.5% of them boiled their drinking water while 7.7% of them did not treat their drinking water at all. A worrying finding is that those who had completed university education did not treat their water at all. Regarding economic activities, the study found that 50% of households whose heads were farmers boiled their drinking water while the other 50% in this category added purifiers to their drinking water. 100% of households whose heads were home makers, engaged in family business and other occupation added purifiers to treat their drinking water. 22.2% of households with heads in formal employment boiled their drinking water, 66.7% added purifiers while 11.1% did not treat their drinking water. In terms of income levels, the study found that 25.9% of those earning below Ksh. 5,000 did not treat their drinking water while 100% of those earning above Ksh. 15,000 treated their drinking water. The study also found that those in formal employment have an appropriate health seeking behaviour, since 100% of them treat their drinking water.

Secondly, the study examined how household knowledge on drinking water treatment methods determined adoption of household drinking water treatment methods. In terms of awareness, the study found that majority of respondents (49%) were aware of adding purifiers/chemicals to treat their drinking water. The method that respondents were least aware of was sieving (8%). Other methods that respondents were aware of included boiling (34%) and decanting (24%). From the findings, majority 217 (62.7%) households reported adding purifiers/chemicals to treat their drinking water, followed by 78 (22.5%) households who boiled their drinking water, and 3 (0.9%) households who reported to be treating their drinking water through sieving, while 48 (13.9%) reported using other methods to treat their drinking water.

From these findings, it is clear that the treatment method most adopted by households was adding purifiers/chemicals while the method least adopted by households was sieving. The study established that respondents adopted drinking water treatment methods that they were aware of, for instance 100% of households that were aware of sieving and adding purifiers adopted the methods. In terms of reasons for treating drinking water, the study found that majority of households, that is 272 (78.6%) treated their drinking water to kill/eliminate germs, 52 (15%) households treated their water to purify and make it safe for drinking while 22 (6.4%) households did not know why they were treating their drinking water. The study established that household knowledge on drinking water treatment determined adoption of household drinking water treatment methods.

Thirdly, the study sought to determine the extent to which accessibility to household drinking water treatment methods determined adoption of household drinking water treatment methods. In terms of availability of treatment methods, the findings indicate that adding purifiers/chemicals was available to majority of households (48.3%) while sieving was available to minority of households (0.9%). Other methods available included boiling (36.1%), decanting (2%) and other methods (12%). These findings indicate that despite other drinking water treatment methods being available to households, most households (62.5%) adopted the method of adding purifiers to treat their drinking water. In terms of cost of treating water, the study found that 22.5% spent between Ksh. 1 and Ksh. 15, while the majority of households (51.4%) spent between Ksh. 15 and Ksh. 30, and 7.8% spent between Ksh. 30 and Ksh. 50 per day. 17.1% households did not know how much they spent. From the findings, it is apparent that boiling as a method of treating water is expensive, since the majority who boiled their drinking water spent between Ksh. 30 and Ksh. 50. The findings also indicate that the drinking water treatment of method adding purifiers was more affordable, with majority households (85.7%) using the method spending between Ksh. 1 and Ksh. 30 per day to treat their drinking water. These findings indicate that the cost of treating drinking water determines adoption of household drinking water treatment methods. Regarding information source, the study also found that 9% of households obtained information of drinking water treatment from health workers, 10.7% from friends/relatives, 57.8% from mass media, 14.5% from social gatherings, and 6.6% from schools/colleges, while 1 (0.3%) obtained the information from other sources. The findings indicate that source of information on drinking water treatment methods determine adoption of household drinking water treatment methods. In terms of time taken to treat drinking water, the study majority of the households, (57.8%) took between 0 and 30 minutes to treat their drinking water, 20.2% took between 30 minutes and 1 hour, 5.8% spent beyond 1 hour, while 15% did not know how much time it took them to treat their drinking water. The study findings indicate that time taken to treat drinking water determines adoption of household drinking water treatment methods

Finally, the study sought to assess how source of household drinking water determines adoption of household drinking water treatment methods. The study found that 1.2% had their dinking water piped into building, 8.1% had their drinking water piped into yard, 83.2% obtained their drinking water from public taps, 2.3% from open well in dwelling/yard/plot, 1.4% from open public well, 1.4% from protected well in dwelling/ yard/plot, while 1.2% obtained their drinking water from water vendors delivered in Jerri cans. The study established that 21.6% of households that obtained their drinking water from public taps treated the drinking water by boiling, 62.2% added purifiers while 16.2% did not treat their water The study findings indicate

Finally, regarding source of household drinking water, the study established that sources of drinking water, distance and time from dwelling, as well as perception on water quality from various sources determined adoption of household drinking water treatment methods.

5.4 Recommendations

Having considered the theoretical framework, conceptual framework as well as the literature review, the researcher has given the following recommendations:

1. Community health workers (CHWs) should broaden the scope of household drinking water treatment methods that they promote. This should be done factoring in specific needs of various socio-economic segments of communities.
2. CHWs should also focus more on the benefits of treating drinking water and the dangers of not treating drinking water. This is important considering the study findings to the effect that a significant proportion of households did not know why they were treating drinking water, leading to a similar proportion of households that did not treat drinking water.
3. Public Health Workers should focus on the effective strategies for delivery of information about household drinking water treatment. From the research findings, it is evident that people take the cue to act only if they are convinced that their health is in jeopardy. Messages on household drinking water treatment should thus focus on risks of not treating drinking water and the benefits of treating the water.
4. Public Health Workers should also focus on training community health workers on effective delivery of household drinking water treatment methods.
5. Finally, but not least, Public Health Workers should design a sustainable public campaign strategy to ensure sustained adoption of household drinking water treatment methods.

5.4.2 Suggestions for Further Research

Researchers should seek to conduct studies on the following areas:

1. Sustainability of adoption of water treatment methods.
2. Health seeking behaviour for drinking water treatment.

5.4.3 Contribution to Body of Knowledge

This study helped to shed light on various determinants of adoption of household drinking water treatment methods in Winam Division, Kisumu East District, Kenya. It has helped ascertain the different extents to which the various determinants influence the adoption of water treatment methods. Table 5.1 below illustrates the contribution to the body of knowledge:

Table 5.1: Study Contribution to the Body of Knowledge

Objective	Contribution to the body of knowledge
Investigate the extent to which household socio-economic status determines adoption of household drinking water treatment methods	Socio-economic factors such as age, marital status, education, income, occupation and economic activities determines adoption of household drinking water treatment methods
Examine how knowledge on household drinking water treatment methods determines adoption of household drinking water treatment methods	Knowledge on household drinking water treatment methods determines adoption of household drinking water treatment methods
Determine the extent to which accessibility to household drinking water treatment methods determines adoption of household drinking water treatment methods	Accessibility issues such as distance, cost, and time determine adoption of household drinking water treatment methods
Assess how source of household drinking water determines adoption of household drinking water treatment methods	Source of household drinking water determines adoption of household drinking water treatment methods

REFERENCES

Anon (2002). *Resolving the global burden of gastrointestinal illness: A Call to Action.* American Academy of Microbiology, Washington DC; 2002. http://www.asmusa. Org

Babbie, E. and Maxfield, M.G., (1995). *Research Methods for Criminal Justice and Criminology*. Boston.

Block SS (2001). Disinfection, sterilization and preservation, 5th ed. Philadelphia, PA, Lippincott Williams & Wilkins.

Clasen, T., I. Roberts, T. Rabie, W. Schmidt, and S. Cairncross (2006). *Interventions to Improve Water Quality for Preventing Diarrhoea (Review).* The Cochrane Library, 2006.

Conner, M. & Norman, P. (1996). *Predicting Health Behavior. Search and Practice with Social Cognition Models*. Open University Press: Ballmore: Buckingham; 1996.

Esrey, SA, Feachem RG, Hughes JM (1991). *Interventions for the control of diarrhoeal diseases among young children: improving water supplies and excreta disposal facilities. Bull. WHO* 64: 776-72.

Fewtrell, L., Kaufmann, R.B., Kay, D., Enanoria, W., Haller, L., & Colford, J.M. Water (2005). *Sanitation and Hygiene Interventions to Reduce Diarrhoea in Less Developed Countries.* A systematic review and meta-analysis. *Lancet Infectious Diseases.*2005; 5:42-52.

Fisher, A.A, Leing, E.J., Townsend, W.J. (1995). *Handbook for Family Planning Operations Research Design.* Second Edition, Population Council

Glanz, K., Rimer, B.K. & Lewis, F.M. (2002). *Health Behavior and Health Education. Theory, Research and Practice.* San Fransisco: Wiley & Sons; 2002.

Harrison, J. A.; Mullen, P. D.; and Green, L. W. (1992). *A Meta-Analysis of Studies of the Health Belief Model.* Health Education Research 7:107–116.

Hobbins M (2004). Home-based drinking water purification through sunlight: From promotion to health effectiveness [PhD thesis]. Basel, University of Basel (http://pages.unibas.ch/diss/2006/DabsB_7569.pdf).

Hobbins M, Maeusezahl D, Tanner M (2000). Home-based drinking water purification: The SODIS Health Study / Assessment of the current setting in WPP. Basel, Swiss Tropical Institute; CARE-Bangladesh; DASCOH-Bangladesh; SDC-WPP Bangladesh (Report No. 4-7-2000).

Hutton, G. & Haller, L. (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level.* Available at http://www.who.int/water_sanitation_health/wsh0404.pdf.

Isaac, R (1999). *Analysis of river sand to remove intestinal protozoan parasites from contaminated drinking water.* University of Zimbabwe, Avondale, Harare; 1999.

Jalan, Jyotsna and E. Somanathan (2008). *The importance of being informed: Experimental evidence on demand for environmental quality.* Journal of Development Economics, 2008, 87, 14–28.

Jill, L., David, L., and Jeff, A (2009). *Information and Persuasion: Achieving Safe Water Behaviors in Kenya*

KDHS 2009: *Kenya Demographic Health Survey Report.* KDHS, Nairobi; 2009

Kosek, M., Bern, C. & Guerrant, R.L. (2003). *The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. Bull. WHO* 81, 197-204; 2004.

Kremer, M., E. Miguel, S. Mullainathan, C. and A. Zwane (2009). *Trickle Down: Chlorine Dispensers and Household Water Treatment*. Working Paper.

Madajewicz, M., A. et al (2007), *Can information alone change behavior? Response to arsenic contamination of groundwater in Bangladesh*. Journal of Development Economics, 2007, 84, 731–754.

Mark,S, Christine, S, Lisam, C, Joseph, B, and Mark Elliot (2008). *Point of Use Household Drinking Water Filtration: A Practical, Effective Solution for Providing Sustained Access to Safe Drinking Water in the Developing World*

MOH (2005): *2nd National Health Sector Strategic Plan (2005 – 2010)*

Moser S, Heri S, Mosler HJ (2005), Determinants of the diffusion of SODIS. A quantitative field study in Bolivia. Summary report. Dübendorf, EAWAG.

Mugenda, A.G, (2008): *Social Science Research Theory and Principles*. Nairobi: Applied Research & Training Services; 2008.

Mugenda, M.O and Mugenda, G.A (2003). *Research Methods: Quantitative and Qualitative Approach*. ACTS Press, Nairobi; 2003.

Mulligan, J., Fox-Rushby, J., Adam, T., Johns, B. & Mills A. (2005). *Unit Costs of Health Care Inputs in Low and Middle- Income Regions*. Disease Control Priorities Project Working Paper No. 9. September 2003, revised June, 2005. Geneva: The World Health Organization

Murcott S (2006). Implementation, critical factors and challenges to scale-up to HWTS systems. Background paper on household water treatment and safe storage (HWTS) for the e-conference on 12–22 May 2006, hosted by USAID/AED Hygiene Improvement Project (HIP) (http://www.hip.watsan.net/page/1738).

Nawaz H et al. (2001). Health risk behaviours and health perceptions in the Peruvian Amazon. American Journal of Tropical Medicine and Hygiene, 65(3):252–256.

Okioga, T. (2007). *Water Quality and Business Aspects of Sachet-Vended Water in Tamale, Ghana*. Massachusetts Institute of Technology.

Prüss-Üstün, A. & Corvalán, C. (2006). *Preventing disease through healthy environments: toward an estimate of the environmental burden of disease.* Geneva: The World Health Organization; 2006.

Rheingans R, Dreibelbis R (2007). Disparities in Sûr'Eau use and awareness: Results from the 2006 PSI TraCsurvey. Presentation at London School of Hygiene & Tropical Medicine, Fall 2007.

Ries AA, Vugia DJ, Beingolea L, et al. (1992). *Cholera in Piura, Peru: a modern urban epidemic.* J Infect Dis. 1992; 166: 1429-1433.

Stella, M (2006). *An Investigation into The Potential of Household Water Treatment for Users of Hand Dug Wells in Busia, Uganda.* Master's Thesis at Cranfield University at Silsoe; 2006.

Strydom, H and Venter, L., (2002): *Sampling and Sampling Methods*. In A.S. De Vos, H.E. Strydom& C.S.L Deport. (eds). *Research at Grassroots* (2nd ed), (pp 197-208). Pretoria: Van Schaik

Susan, M. (2006). *Implementation, Critical Factors and Challenges to Scale-Up of Household Drinking Water Treatment and Safe Storage Systems*. A paper presented at the Electronic Conference May 12-22, 2006 hosted by USAID / Hygiene Improvement Project (HIP)

Swerdlow DL, Mintz ED, Rodriguez M, et al. *Waterborne transmission of epidemic cholera* *in Trujillo, Peru: lessons for a continent at risk.* Lancet.1992; 340: 28-32.

Treatment Market in China. International Trade Administration, Washington, D.C.; 205

UNICEF and WHO (2008). *Progress on Drinking Water and Sanitation: Special Focus on Sanitation.* World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP). UNICEF, New York and WHO, Geneva, 2008

US Department of Commerce (2005). *Water Supply and Wastewater*

Weber T, Mintz E, Cafiizares R, et al. (1994). *Epidemic cholera in Ecuador: multidrug-resistance and transmission by water and seafood. Epidemiologic Infect.*

WHO (1977). *World Water Conference.* Mardelplata, Argentina: World Health Organization; 1977.

WHO (1978). *Primary Health Care Declaration.* Alma-Ata: World Health Organization; 1978.

WHO (1992). *The International Drinking Water Supply and Sanitation Decade.* End of Decade Review (as at December 1990). Geneva, Switzerland: World Health Organization; 1992. WHO/CWS/92.12.

WHO (1994). *Financial management of water supply and sanitation.* Geneva, World Health Organization.; 1994.

WHO (2000). *Millennium Development Goals.* Geneva, Switzerland: World Health Organization; 2000.

WHO (2004). *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributable to Selected Major Risk Factors.* Edited by Ezzati, M et al. Geneva, Switzerland: World Health Organization; 2004.

WHO (2004). *Guidelines for Drinking Water Quality.* Geneva, Switzerland: World Health Organization; 2004.

WHO (2004): *Report on Water, Sanitation and Health – Links to Health*. Geneva; 2004

WHO (2005). *International Decade for Action*; *Water for Life.* Geneva, Switzerland: World Health Organization; 2005.

WHO (2005). *World Health Report 2005*. Geneva: World Health Organization; 2005

WHO (2006). *Progress towards the Millennium Development Goals*. Geneva, UN Statistical Division; 2006

WHO (2007): *Combating Waterborne Disease at the Household Level.* Geneva; 2007

WHO/UNICEF 2004: *Joint Monitoring Programme Report for Water Supply and Sanitation 1990-2005*, New York: The United Nations; 2004.

Zwane, A. and Michael, K. (2007). *What Works in Fighting Diarrheal Diseases in Developing Countries? A Critical Review.* The World Bank Research Observer, 2007, 22, 1–14.

APPENDICES

Appendix i: Letter of Transmittal
P. O. BOX 19522 – 40123, KISUMU.

Dear Respondent,

Thank you for accepting to participate in this research project. My name is Richard Otieno. I am Master of Arts graduate student at the University of Nairobi. I am currently working on my Research project titled "Determinants of Adoption of Household Drinking Water Treatment Methods in Winam Division, Kisumu East District, Kenya".

Your household has been selected by chance from all households in this area. I would like to ask you some questions related to above mentioned study. The information you provide will be useful for finding out the status of adoption of water treatment methods in your community, and will be used to meet the academic objectives of the study and to inform future development programs in this area and other parts of Kenya.

Participation in the survey is voluntary. All the information you give will be kept confidential. The information will be used to prepare general reports, but will not include any specific names. There will be no way to identify that you are the one who gave this information. If you have any questions about the survey, you can contact the researcher through the following contact: 0721-712-883. Email Address: richardotieno@yahoo.com

Thank you.

Signature of interviewer: ____________________

Date: ____________________

Respondent agreed to be interviewed 1. YES 2. NO

Appendix ii: Household Questionnaire

Questionnaire Code: ☐

Section 1: Household Socio-Economic status

1. What is your gender? *(Please tick one)*

   ☐ Male

   ☐ Female

2. How old are you ☐ Years

3. What is your marital status? *(Please tick one)*

   ☐ Single

   ☐ Married

   ☐ Divorced

   ☐ Widowed /separated

   ☐ Other Specify ____________________

4. Have you ever attended school? *(Please tick one)*

   ☐ Yes

   ☐ No

5. If yes, what is the highest level of your education? (Please tick one)

   ☐ Primary school

   ☐ Secondary school

   ☐ A Level

   ☐ Tertiary/middle college

   ☐ University

   ☐ Other Specify ____________________

6. What is the main occupation of your household head? (Please tick one)

☐ Farming

☐ Home maker

☐ Family business

☐ Own business

☐ Formal/paid employment

☐ Other: specify ______________________________

7. How much income on average do you get in your household in Kenya Shillings per month?

(Tick one only)

☐ Below Ksh 5000 ☐ Ksh 5000 to Ksh 15,000 ☐ Above Ksh 15,000

8. How many people live in your household? __________

9. Please list economic activities that your household members are engaged in.

____

____

____

Section 2: Knowledge of Drinking Water Treatment Methods

10. Mention drinking water treatment methods that you are aware of.

☐ Boiling

☐ Decanting

☐ Add purifiers/chemicals, e.g. water guard, Purr

☐ Sieving

☐ Solar disinfection (SODIS)

☐ Add herbs

☐ Other (specify) ______________________________

11. Where did you obtain knowledge on drinking water treatment?

☐ From health workers

☐ From friends/relatives

☐ From mass media, i.e. radio, TV, newspapers

☐ From social gatherings, i.e. church, market

☐ From school/college

☐ Other: specify ____

12. Which drinking water treatment methods mentioned above do you use in your household, **in order of priority, i.e. 1, 2, 3, etc**?

☐ Boiling

☐ Decanting

☐ Add purifiers/chemicals, e.g. water guard, Purr

☐ Sieving

☐ Solar treatment

☐ Other ____

☐ None

13. What benefits do you draw from treating your drinking water?

☐ To purify and make it safe for drinking

☐ To make it sweet to drink

☐ To kill/eliminate germs

☐ Don't know

☐ Other (specify) ____

Section 3: Accessibility to Household Drinking Water Treatment Methods

14. Which household drinking water treatment methods are available/accessible for your household in order of priority?

- [ ] Boiling
- [ ] Decanting
- [ ] Add purifiers/chemicals, e.g. water guard, Purr
- [ ] Sieving
- [ ] Solar treatment
- [ ] Other ______________________________
- [ ] None

15. How much Kenya Shillings on average per day do you use to treat drinking water for your household?

- [ ] Between Ksh. 1 to Ksh. 15
- [ ] Between Ksh. 15 to Ksh. 30
- [ ] Between Ksh. 30 to Ksh. 50
- [ ] Above Ksh. 50
- [ ] Don't know

16. Where do you get information on drinking water treatment for your household?

- [ ] From health workers
- [ ] From friends/relatives
- [ ] From mass media, i.e. radio, TV, newspapers
- [ ] From social gatherings, i.e. church, market
- [ ] From school/college
- [ ] Other, (Specify): ______________________________

17. How much time does it take you to treat drinking water for your household?

- [ ] 0 – 30 minutes
- [ ] 30 minutes to 1 hour
- [ ] Beyond 1 hour
- [ ] Don't know

Section 4: Source of Household Drinking Water

18. What is the **one** main source of water for members of your household?

Tick **ONE answer only.**

- [ ] Piped into dwelling.
- [ ] Piped into yard / plot.
- [ ] Public tap.
- [ ] Open well in dwelling / yard / plot.
- [ ] Open public well.
- [ ] Protected well in dwelling / yard / plot.
- [ ] Protected public well.
- [ ] Spring / river / stream.
- [ ] Pond / lake / dam.
- [ ] Rainwater.
- [ ] Tanker truck.
- [ ] Bottled water.
- [ ] From water vendors delivered in Jerri cans
- [ ] Other.
- [ ] Don't know / no answer.

19. How far is the distance of source of drinking water from your household?

- [ ] 0 – 200 meters
- [ ] 200 – 500 meters
- [ ] 500 – 1000 meter
- [ ] Beyond 1 km

20. How much does it take you from the time you leave your house to fetch water until you come back with water?

- [ ] 0 – 30 minutes
- [ ] 30 minutes – 1 hour
- [ ] 1 hour – 2 hours
- [ ] Beyond 1 hour

21. In your view, is the water from the source above safe for drinking?

- [ ] Yes
- [ ] No
- [ ] Don't know

Thank you for participating in the study

Appendix iii: Key Informant Interview Schedule for District Public Health Officer

1. Which are the prevailing household drinking water treatment methods used in Winam Division?

___

___

___

2. In your view, which factors influence the adoption of the prevailing household drinking water treatment methods in Winam Division?

___

___

___

3. Which are the common water borne diseases affecting Winam Division?

___

___

___

4. Which household drinking water treatment methods are most adopted in Winam Division?

___

___

Thank you for participating in the survey.

Appendix iv: Schedule of Sampled Households

Location	Households	Cumulative Households	Sampled Households
Kondele	21,419	21,419	220
Kolwa Central	7,611	29,030	78
Kolwa East	4,603	33,633	47
Kisumu Central	3,773	37,406	39
Total	**37,406**		384

Table 3.4: Schedule of Sampled Households, adopted from Schmidt sampling methods (Schmidt, 2008)

Appendix v: Research Authorization

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telegrams: "SCIENCETECH", Nairobi
Telephone: 254-020-241349, 2213102
254-020-310571, 2213123
Fax: 254-020-2213215, 318245, 318249
When replying please quote

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: NCST/RRI/12/1/MED-011/128

Date: 9th August 2011

Richard Otieno
University of Nairobi
Kisumu Campus
P.O BOX 825-40100
KISUMU

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "***Determinants of adoption of household drinking water treatment methods in Winam Division,Kisumu East District,Kenya***" I am pleased to inform you that you have been authorized to undertake research **in Kisumu East District** for a period ending ***30th September 2011***

You are advised to report to **The District Commissioner, The District Medical Officer of Health & The District Education Officer of Kisumu East District** before embarking on the research project.

On completion of the research, you are expected to submit **one hard copy and one soft copy** of the research report/thesis to our office.

P.N. NYAKUNDI
FOR: SECRETARY/CEO

Copy to:

The District Commissioner
Kisumu East District

Appendix vi: Research Clearance Permit

CONDITIONS

1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed with-out prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

GPK6055(3m)10/2011

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

(CONDITIONS—see back page)

PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs/Miss/Institution
Richard Otieno
of (Address)University of Nairobi
P.O BOX 825, Kisumu
has been permitted to conduct research in
Location
Kisumu East District
Nyanza Province
on the topic: *Determinants of adoption of household drinking water treatment methods in Winam Division, Kisumu East District, Kenya*

for a period ending 30thSeptember2011

PAGE 3

Research Permit NO.*NCST/RRI/12/1/MED011/128*
Date of issue *9th August 2010*
Fee received *kshs. 1000*

Applicant's Signature

Secretary
National Council for Science and Technology