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Assessment of Water Shortages and Coping Measures at Household Level in the Informal Settlements of Eldoret Municipality, Uasin Gishu County, Kenya

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***Abstract*:** *The struggle for water and its resources have progressively increased over periods of time. This is majorly attributed to the fact that the resource, as vital as it is, faces excessive extraction resulting from rapid population growth as well as urbanization and industrialization trends. The main aim of the study was to examine water shortage and coping measures at household level in informal settlements in Eldoret Municipality. To achieve the objectives of the research, guiding research questions were employed which investigated the availability of water, causes of water shortages, impacts of water shortages, and coping measures by the stakeholders to ensure water availability. The research was guided by integrated water Resource Management approach (IWRM). This approach is based on the perception of water as an integral part of ecosystem, natural resource, social and economical good. The study indicated that most of the households depend on piped water from Municipal (80%), while 10% got water from the boreholes, other depend on rain harvesting and from water kiosks. The cause of water shortage in Eldoret was high population, low pressure, overexploitation of catchment sources and climate change among other environmental factors. The study found out that water shortage had both negative and positive effects on households. The study recommended on Water officers to involve the community to aid in water maintenance, development programmes and water provision projects. The local authority should liaise with nongovernmental organization such as World Bank, World vision who has capacity to source funding for water rehabilitation services. The households should embrace maximum use of roof water during rainy season and sink more boreholes.*

Key Words: *Household, water shortage, water availability, coping measures*

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I. Introduction

Water is vital for human, animal and plant life. The United Nations Water Conference Action Plan recognized water as a right, declaring that all people have a right to have access to safe drinking water (Hardberger, 2005; UN-WDPAC, 2010). It is estimated that at least 1.1 Billion people, which represent 17% of the global population lack access to improved water. In urban areas, those living in informal settlement often lack access to adequate supply of water supply and sanitation (WHO/UNICEF, 2005)

Water shortage is a severe and growing global challenge. Over the last 50 years, water withdrawals have tripled due to economic development and rapid population growth, placing serious pressure on the planet's water systems. Agriculture remains the most significant consumer of water, accounting for approximately 75% of all global water use (Mcgee, 2011)

A large world's poorest citizens living in developing countries lacked access to water by 2000 and 1.6 billion people who had access to water did not have sufficient water (WHO/UNICEF JMP2000). This contributed to about 3900 deaths of children every day and over two million people every year due to water borne diseases (Hardberger, 2005). WHO/UNICEF (JMP) (2010) reports that, 87% of the world population mostly from developed countries uses water from safe sources of water for drinking. However, 884 million people in the world still do not get their drinking water from safe sources, specifically in developing countries, such as in Africa and Southern Asia. The World Water Council (WWC, 2012) noted that the world's population tripled in the 20th century, the use of the world water resources has grown six-fold, coupled with industrialization and urbanization.

Water in the Sub-Sahara region is not only scarce but also of exceptionally of poor quality. Due to pollution as well as unreliable supply and sanitation infrastructure, only a small percentage of what little water is available can be used for human consumption. Almost half of all Africans suffer from water-borne diseases,

with cholera and infant diarrhea, the most frequently occurring sicknesses. Most of the countries with the lowest levels of sanitation are located in sub-Saharan Africa, where 45% of the population resorts to using shared or dangerously inadequate facilities – with little progress in the area recorded to date.

Eastern Africa's renewable freshwater resources amount to 187 km³ per year; this is only 4.7 per cent of Africa's total, yet the sub-region is home to 19% of the region's population (AEO, 2013). This imbalance is set to worsen in the next two decades due to an increase in human and animal population increase.

Kenya is recognized by the United Nation Environment Programme (UNEP) as a water scarce nation, whose average supplies of available freshwater is 647m3 per capita, which is below the 1,000m3 per capita per year recommended by United Nation (Republic of Kenya, 1997). Furthermore, Kenya ranks 21st for the worst levels of access to water in the world, compared to its neighbors in the region, Uganda and Tanzania at 2940m3 and 2696m3 respectively (UN-WWAP, 2006), and about 41% of the people do not have access to clean water causing about 10% of deaths (KCBS, 2009).

Rapid urbanization amid of economic hardship in Kenya has resulted in an increased proportion of people living in absolute poverty in urban. In many urban areas, the shortage of water has been amplified by the government's lack of investment in water. Most of the urban poor Kenyans only have access to polluted water, which has caused cholera epidemics and multiple other diseases that affect health and livelihoods.

Access to safe water supplies throughout Kenya is 59% and access to improved sanitation is 32%. There is still an unmet need in rural and urban areas for both water and sanitation. Kenya faces challenges in water provision with erratic weather patterns in the past few years causing droughts and water shortages. Kenya also has a limited renewable water supply and is classified as a water scarce country. Urban migration contributes to challenges in sanitation, as people crowd into cities and urban growth is unregulated (Mahiri, 2011)

Clean water has become increasingly scarce with population increase in Eldoret. This has become a limiting factor to sustainable development. Little appreciation and understanding of the role of water in an economy has contributed to poor funding for water resources management and development. As a result, institutions responsible for implementing water resources management have weakened. Without a strategy to deal with this situation in Eldoret, rapid urbanization and population growth means worse conditions for millions of residents, especially the poorest in informal settlement.

1.2 Statement of the problem

Poor water availability and accessibility has been major concern in Eldoret town. Majority of the population in informal settlements rely on small scale businesses to earn a living. These livelihoods are highly dependent upon water at the most basic level such as drinking cooking and hygiene

According to Cheserek *et al* (2012), the town faces acute shortage of water due to increasing population and there have been rationing to ensure that everybody gets water. Chebara dam in Elgeyo Marakwet County currently serves Eldoret town and its outskirts with a production of 36,400 cubic metres per day contrary to the towns' demand of forty-six thousand cubic meters per day.

The illegal status of the slum areas in the town has hindered the expansion of municipal services to serve them. This has resulted to the poor being denied access to safe drinking water and proper sanitation. Therefore, there is a need to assess water sources, its availability, and efforts put forward at household level to manage the scarce resource in the informal settlements in Eldoret Municipality.

1.4 Research Objectives

The general objective of this study was to assess water shortage and management at household level in Eldoret town as a basis of suggesting measures towards solving the problems identified

Specific objectives will be:

(i) To asses water availability in informal settlement of Eldoret town
(ii) To investigate factors that causes water shortage in the study area.
(iii) To evaluate the implication of water shortages to livelihoods in the informal settlement
(iv) To determine the measures that stakeholders adopt to cope with water shortages in Eldoret town

1.5 Theoretical Framework

This research was based on Integrated Water Resource Management (IWRM) approach. This approach expresses the idea that water resources should be managed in a holistic way coordinating and integrating all aspects and functions of water extraction, water control and water-related service delivery so as to bring sustainable and equitable benefit to those entire dependent on the resource (EC, 1998)

The overall objective for water management, which adopts integrated approaches, is to satisfy the freshwater needs of all countries for their sustainable development. Integrated water resources management is based on the

perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization.

IWRM aims to promote more equitable access to water resources and the benefits that are derived from water in order to tackle poverty. Secondly, IWRM aims to ensure that scarce water is used efficiently and for the greatest benefit of the greatest number of people. Thirdly, IWRM aims to coordinate the planning of projects and activities that have both a direct and an indirect impact on water resources. Finally, IWRM aims to achieve more sustainable utilization of water, including for a better environment. The goal of sustainability is to be achieved through coordination, equity and efficiency.

The integration approach has to incorporate policy options that recognize importance of water, develop national water policies and to base the demand for and allocation of water resources on equity and efficient use. An integrated water resources management (IWRM), if implemented, must consider the strengthening of human resources development in terms of awareness creation programs, training of water managers, the development of new institutions that will serve and match this goal, effective information management, environment and development (Fulazzaky, 2014)

1.12 Definition of operation terms

Households: composed of the husband, wife, children and other member of the extended family living together in the compound and drawing and using water.

Water accessibility: refers to the physical distance, time taken to and from the household to draw water from water sources

Water availability this refers to having portable and quality water sources available for human consumption.

Water quality refers to the biological, physical and chemical characteristics of water.

Per capita water quantity refers to a specific measure of amount of water required per household.

Water quantity: Is the amount of water available at the source sufficient to meet the needs of the people for consumption and development

Water shortage- lack of sufficient water for domestic use

Coping measures- action taken by people in common to sustain water availability and accessibility

II. Literature Review

2.1 Introduction

The review of literature on relevant studies was done under the following categories: Types of water sources and their availability and accessibility, causes of water shortages, impact of water availability and accessibility at the household level, and water shortage coping mechanisms.

2.2 Availability and accessibility of water

The availability and accessibility of water is the key in development thought and practice. Shisanya (2005) notes that water resources are integral part of an ecosystem, a social and an economic good. Water can be found from natural sources like surface water, ground water and rain water; all require proper treatment for safe human consumption. Asare (2004) claimed that, water should be available, accessible, safe and usable. It is a resource that has to be managed and used sustainably.

Wambui & Ngindu (2007) in a study on quality of water used by slum dwellers in Kenya found out that most people (89%) said they used shallow wells as the major source of domestic water, whereas 2% said they used water from deep wells and the rest said they used tap water from the municipal council. The shallow wells often had no concrete slab and often the aperture was not covered at all or was poorly covered with a loose lid that was not lockable, whereas the deep wells had a piped system.

Those who used deep wells were mainly the more affluent people in the community who often owned the plot in which the well was situated. Tap water was mainly from water kiosks where water was being sold to the slum residents. Respondents who did not use the tap water said that the water from water kiosks was expensive and unaffordable to be used for domestic purposes. Problems of unreliability were mentioned as hindering use of tap water from the kiosks as some respondents said that sometimes the kiosk near their house could remain closed for a whole day or more. Some of the respondents reported that the nearest water kiosk was too far from their homes.

2.2.1 Water Sources, Availability and Accessibility Situation in Kenya

Kenya has been recognized by (UNEP) as a water scarce nation. The fresh water potential of Kenya of 647m3 per capita, has been declining since 2002 and it is projected that by 2025, it will be 235m3 (Republic of Kenya, 2007). National Water Policy, Paper No.1 of 1999, states that majority of Kenyans, 40% in urban areas

and 60% in rural areas of Kenya do not access any form of water sources such as boreholes and tap water (Republic of Kenya, 1999).

Despite the efforts to avail water to the citizens at affordable price, a significant number of people still pay high prices (TISDA Kenya, 2011). Distance affects accessibility of water; according to UNICEF (2002; 2006), for water sources to be accessible, it has to be at a distance of 1 km within reach. The Government of Kenya aims to reduce the distance travelled by women and girls in rural areas in collecting water to 2km by 2015; it aims at reaching 90% water access coverage in urban areas and 70% in rural areas, because most people in rural areas travel about 2- 4 km to access water sources. A study conducted by Moraa (2010) indicates that Kenya was not likely to achieve the MDG target of halving the proportion of people without access to water by 2015 and the vision 2030; water for all by 2030, may not be realized. This study looked at water sources within the study area in relation to the distance travelled by communities to access of water from their households.

WASREB (2009) estimates that in 2006-2007, only 37% of Kenyans had access to sufficient and safe drinking water close to their homes at an affordable price. The 2007 Citizen Report Card survey showed that users of water kiosks in cities fetch water 4-6 times per day; this meant that a poor household spent 112 minutes per day to fetch water at normal times, and as much as 200 minutes per day during times of scarce water sources.

Kalunda (2008) conducted a research on factors influencing accessibility to water supply in semi and arid areas in Mutito division, Kitui County, Kenya. The study found out that female headed households are poor than male headed households, due to their inability to access water. This study explained accessibility of water sources focusing more on factors influencing accessibility of water in households.

2.2.2 Water policy in Kenya

The 1974 Kenya Water Act underwent major revisions in 1999 and 2002, which mainly focused on the decentralization of water services and separating water policy formulation from regulation and services provision. Additionally, the 2002 National Water Policy defined the government's role as regulatory and delegated water service provision to the private sector, municipalities and communities. In spite of this decentralization and separation, the roles of the different actors (e.g., communities, non-governmental organizations, and private sector) involved in the water sector (users, managers, suppliers, conservationists) remain a challenge to the realization of the goal of Kenya's water policy because they are ambiguous and often conflicting. Whereas participation of all stakeholders in decision-making processes is encouraged and emphasized, few attempts have been made to incorporate ethics into water use and management.

The rights of people to access water and control their environment have not been incorporated into the country's water policy.

The U.S Agency for International Development, the World Bank and the World Health Organization recommend the "basic water requirement" BWR (include drinking and sanitation needs) in the range from 20 to 40 l/p/c/d (Zhang, 1999). Gleick in 1996 estimated the basic water requirement at 50 l/p/c/d for meeting four household basic needs: drinking, sanitation, bathing and cooking.

The basic water requirement is enough to keep our alive and healthy. Now many of people choose to purchase some liquid drinking water as bottled water, juices, milk, and soft drinks. Although many of us purchase the bottled drinking water, the household water consumption is till greater than the basic water requirement.

2.2.2.1 Water Act (Cap 372) 2002

An Act of Parliament to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services; to repeal the Water Act (Cap. 372) and certain provisions of the Local Government Act; and for related purposes..

The Act aims at improving the living standards of people by ensuring proper access to water services. It provides for the management and development of water resources and water supply and sewerage development, with the objective of conserving, protecting available water resources and allocate in a suitable and economic manner as well as supplying water in sufficient quantities to meet the various water needs while ensuring safe disposal of water.

This Act therefore clearly outlines methods and ways of ensuring that water is availed to all and its provision is ensured and managed adequately and sustainably

2.4 Impact of Water Accessibility on Livelihoods and Poverty

Poor water availability and accessibility is being recognized in many countries, as the lack of access to adequate quantities of water for human and environmental uses (White, 2012). According to UNDP (2006),

inaccessibility of water will be the defining condition of life for many in the new century; images of shrinking lakes and disappearing rivers and increased competition for scarce water resource driving conflicts within communities and causing water wars between countries, for example water conflicts in Isiolo and Baring counties in Kenya, where pastoralists keep fighting over scarce water resources.

Hardberger (2005) stated that water is necessary for the survival of all life, yet over one billion of the world's population does not access sources of clean water for drinking. Annan (2001) noted that access to safe water is a basic human right, which remains out of reach of many, especially in rural areas. United Nations (UN) (2005) notes that, 1000m3 per capita is the accepted general indicator of water scarcity; the approximate minimum necessary for an adequate quality of life in a moderately developed country. A country whose renewable fresh water availability annually per capita exceeds about 1,700 m3 will suffer local water problems. When it falls below 1000m3 per person per year, a country suffers from chronic water problems and below 500m3 per person per year; a country suffers from absolute scarcity. Therefore, the water resources have to be monitored for the well-being of human population, sustainable livelihoods and poverty reduction.

Ali (2012) conducted a study on adequate water supply as a rural poverty reduction strategy in developing countries, the study concluded that water is fundamental to health, survival and livelihoods; it is an economic, social, cultural and environmental good; a basic need and a human right. The study looked at water availability and accessibility in terms of quantity and quality and the relationship with improved health, livelihoods and poverty eradication in the study area.

Tezera (2011) studied Water supply and sanitation development; impacts of poor accessibility of potable water supply and basic sanitation in Soddo District, Gurage Zone, Ethiopia. It found that water accessibility impacts positively on sanitation and health, the economic, social and environmental condition of the area. The study linked water accessibility with health and poverty reduction in the study area.

Komenan (2010) studied water security and the poor, from rural areas in Cote d'Ivoire, to promote better understanding of water as a key factor in development and poverty eradication in the study area. This study explained the influence of water availability and accessibility on livelihood of people in Sankuri Division.

Porsani (2010) conducted a study on understanding the impact of water access for livelihoods in rural Sahel covering two villages. The study exposed ways through which water has been accessed and managed as well as identified factors promoting and hindering the sustainability of water management scheme. The study explained how water access is key to sustainable livelihoods and poverty eradication.

Hope *et al*. (2003) investigated the role of improved domestic water supply on livelihoods and poverty reduction in Limpopo province, South Africa and results showed that access to water offered opportunities to the poor to build healthy, secure and sustainable livelihood. The study explained water availability and accessibility as a catalyst for sustainable livelihood and poverty reduction which in most cases ignored as an indicator of poverty, development and sustainable livelihoods.

2.4.1 Implication of Poor Water Accessibility on Livelihoods and Poverty

The implications of poor water availability and accessibility are described by White and Bradley (2001) in terms of Health, Livelihood and Environmental.

2.4.1.1 Health Consequences

Every person needs a minimum level of water a day, these ranges between 15-50 litres per person per day. Every year approximately 3.4 million people die due to water-borne diseases such as diarrhea, the major cause for mortality among young children (McLennan, 2000; WHO/UNICEF)(JMP) 2007). Howard and Bartram (2003) classify four categories of diseases that relate to water; water-borne diseases caused by use of contaminated water such as diarrhea, typhoid and dysentery. Water-washed diseases caused by insufficient quantity of water for personal hygiene (faecal-oral transmission) such as diarrhea, trachoma, typhoid and skin. Water-based diseases transmitted through an aquatic host, like schistosomiasis and water-related diseases transmitted through insect vectors such as malaria.

2.4.1.2 Livelihood Consequences

Water shortage has severe implication on livelihoods and development contributing to poverty. Poor health arising from the use of unsafe water means that those affected may not be able to work. Women spend most of their time on fetching water; hence have less time for other tasks such as household duties and economic activities, resulting in a lower household income. Also, children have to help out on some of the tasks, causing them to miss out on their school education (WHO, 2003). These are indicators of poverty, arising due to poor water accessibility.

2.4.1.3 Environmental Consequences

Competition over resources leads to the depletion of freshwater resources increasing the chances of conflicts to arise. Omosa (2005) stated that conflicts over water are not new to pastoralists' communities, during

periods of severe drought. Also, low-income groups do not have the same means as higher-income groups and are therefore forced to obtain water from contaminated sources. They also lack sanitation facilities contributing further to the contamination of such water sources, causing water related health problems.

2.5 Coping Strategies at household level

Ahile *et al* (2015) conducted a research on Residents Coping Strategies with Water scarcity in Nigeria. Their finding showed that water shortage is not unique to Nigeria but exist in most African and Asian countries. Hence people device strategies to cope with the situation. The results reveal that 30.2% of the respondents usually dredge dry hand-dug wells to get water. This strategy is used mainly in the dry season. Ocheri et al (2010) observed that shallow wells in Makurdi town in Nigeria are full to the brim during the rainy season and could be fetched without the use of ropes and buckets. The wells however, dry up as the dry season sets in, forcing people to dig further to get water that will serve them for a while. The findings also show that 26.3% of the respondents store water in big containers to cope with scarcity. This strategy is adopted both in dry and rainy season. The water is supplied mainly by Tankers and Vendors. This invariably affects the income of most household heads.

Mahiri (2012) studied water management at households in Kibera slums; the study found out that Household water treatment methods (HWT) are important in areas where connections to infrastructure are not possible. Most slums areas in Kenya have been considered as illegal settlement and therefore services are no provided by government. Solar water disinfection is simple and affordable household water treatment technique which depends on solar energy. It involves filling water bottle and expose to the sun for six hours in clear sky or two days in a cloudy sky. The findings showed that 52% of the house households adopted the SODIS as their treatment option. This study therefore aim at investigation other coping measures adapted by households in the informal settlement.From the review of literature above, it is clear that treating water at household level is very important aspect of coping with water shortage and quality. It is recognized as bringing health benefits, especially reducing diseases. Provision of clean and safe water is desirable long term solution.

III. Research Methodology

This study employed descriptive survey design that provides qualitative and quantitative data that appropriately describe the water shortage issues in Eldoret Municipality. The design allowed the use of questionnaires for household, and an observation checklist to study the variables. The design was appropriate to the study because it helped to obtain information on the water shortage, water quality, availability and accessibility issues as in its natural settings and allow valid general conclusions from the facts discovered about its relation to livelihoods at household level.

3.3 Study area

The study was conducted in Eldoret Town, situated about 320 km north-west of the Kenyan capital, Nairobi. It lies at an altitude of about 1200 m above sea level with approximately latitude 0°31‟North and Longitude 35°16‟East and situated in Eldoret Municipal area which shares 3 districts, namely Eldoret East, Eldoret West and Wareng. It has urban and rural setting with cosmopolitan populace.

3.4 Target Population

The target population in this study comprised of heads of household father mother or guardian from the selected households in Langas and Munyaka Slum. A total of 5 Key informants from sectors that directly deal with water management was be included in the study to supplement and compliment the information gathered from the households.

3.7 Research tools and instruments of data collection

The researcher used questionnaires, interview schedules, observations and existing information as the main tools for data collection. The selections of these tools were guided by the nature of the data to be collected as well as the objectives of the study and time limits. The study utilized primary data generated from questionnaire, interviews, schedules, and focused group discussion guide (FGDs).

IV. Data Analysis, Interpretation And Presentation

4.1 Water availability in Eldoret Municipality

In the study, the first objective was to assess the water availability in Eldoret municipality. According to ELDOWAS Company the main source of water serving Eldoret currently is Chebara Dam, Kaptagat Catchment Forest and Sossiani River. The main water supplier in Eldoret is Eldoret Water and Sanitation Company (ELDOWAS) which provides piped water for domestic and industrial uses. ELDOWAS is a private company that was incorporated on 23rd September 1997 in accordance with the companies Act 486 of the laws of Kenya. Operations of the company commenced on 1st July 1998.

The figure 5 below illustrates the proportions of the respondents who use the different sources of water in the research area, 80% have piped water services, 10% from boreholes and, 8 % obtain the water from vendors kiosks, while 2% get their daily water from rainfall by harvesting during rainy season and storing in large water containers

The percentage of respondents that depend on untapped water is lower compared to those that have tapped/ piped water source despite that the water is often not available. The piped water is either provided by the municipal council through the Eldoret water and sewerage company (ELDOWAS) or is personally installed from other sources (boreholes). With 95.2% have their water supplied by the municipal council while 4.8% get it supplied in their systems by other providers. The respondents who relied on the municipal council for water supply have it available in the taps for few days per week.

The analysis shows that most respondents depend on municipal council for water supply but the water availability on the taps is very limited.

The respondents have water available in the systems/tap between mostly in the evenings and early in the mornings. This implies that they must put adaptive measures into place to ensure they have water for consumption available. The respondents depending on the municipal council for water supply spend considerable amounts of money as charges for the water. Most of them pay for water monthly, 66.1% have the charges included in the rent. With 14.8% spend 500 Ksh per month on water, 3.2% pay 700 Ksh per month, 3.2% spend 300 Ksh per month, 3.0% spend 150 shillings/month and the other 9.7% spend varied amounts.

4.5 Causes of water shortages in Eldoret Town

The second objective of the study was to identify the causes of water shortage in Eldoret town. It is evident that households in informal settlement experience water shortages.

95% of the respondents agree that there is water shortage, while 5% did not experience water shortages

From the above figure shows the comparison of two informal settlements and the extent to which they experience the water shortages. Langas is the most hit with 95% this is due to high population compared to Munyaka with 83% of the population experiencing water shortages.

The possible causes were varied depending on the responses by different respondents.

Table 5: ***Causes of water shortages***

Causes	Percentage
High population	40 %
Low water pressure at source	33%
Overexploitation at Source (excessive abstraction)	15%
Illegal connections	7%
Environmental factors e.g. climate change	5%
Total	**100%**

From the table above, 40% base the water short to high population hence an increase in demand for the scarce resource, 33% said it was due to low water pressure and 15% argued that shortages were due to reduced water levels at the sources (water catchment points). Reduced water levels at the sources, was also reported to cause of water crisis from the analysis. The water source points e.g., boreholes and wells, have been degraded due to lack of proper management and conservation and over exploitation leading to low levels of water available for consumption. High population was the major cause of water shortages since the increase in the water demand only translates to reduced levels of the resource and thus not always available due to rapid water withdrawal. From the analysis low water pressure caused water shortages since the water has very little force to move up the water table and higher distances. Due to this, at times the water force is very minimal for the water to move up the system translating to no water in the pipes and taps until the pressure is higher when the water level goes up. This may take longer especially during the dry seasons resulting to prolonged lack of water in the system and may require electricity to pump up the water. From the research, illegal water collection points where some households were obtaining water from were identified. This caused water shortage because much water was lost due to the leakages. Figure 8 below shows an illegal water collection point in Langas estate. The

main pipes has been disconnected and water accessed from that point reducing the chance of getting to the intended point. Due these illegal water interruptions; there is a lot of leakage and wastage that leads to water shortages. The respondents confirmed the high cases of illegal water connections and interference of water system which resulted to reduced water in the system. This has resulted to the households spending more on water than they should, impacting negatively on the economic status of Eldoret's informal settlement. Among the respondents', 5% attributed the water crisis to degradation of the catchment areas; majority said that climate change has resulted in reduced precipitation. Degradation of the water catchment areas in Eldoret is said to be the main environmental factor leading to reduced water supply. Lack of protection and conservation of water source points has resulted to reduced water levels available for use. Most of the water catchments are located far from urban areas and their management depends on the local area water management team at the source. The water sources i.e. wells and boreholes located in Eldoret's informal settlement are either well protected or poorly protected and managed. This has resulted to pollution of the water which causes low quality, water supply for consumption since the water for consumption is not always available.

4.6 Implication of water shortages in the informal settlement

Water shortages have the capability of having a negative impact on the achievement of all the Millennium Development Goals (MDGs). Globally, more people now live in urban centres than in rural areas and the trend is expected to continue, putting pressure on provision of water (UN-water, 2011). From the study a number of negative and positive impacts of water shortages in informal settlement were identified

4.6.1 Health

Water shortages have directly and indirectly led to the increase in water borne diseases in the settlement. Failure by relevant stakeholders in addressing the water supply situation has led to the slums facing a huge health crisis. According to residents, there have been cases of cholera and typhoid in the study area, more people falling victim to diseases such as diarrhoea after consuming water from unprotected sources. It has also forced some residents to end up using unprotected water sources to carry out their day to day household chores. Few residents stated that they have had some water borne diseases after consuming water after the resumption of water supplies.

The rate of water-borne diseases increases significantly during periods of water shortages as people fail to follow basic sanitation rules such as boiling water. Few residents stated that they were using some chemicals to treat the water that they received. Also most residents stated that they did not boil water before consumption. This could be as a result of residents assuming that the water that they receive was safe to drink. A study by Mahiri (2012) found out that 80% of the households reported cases of water born disease in Kibera slums, particularly because of inadequate water supply.

4.6.2 Sanitation

From the findings, it had become more difficult for residents to use the toilet as there would be no water to flush during water shortages. The failure to have reliable water supply had forced resident to find alternative means of relieving themselves most of which were unhygienic places, which increased the risk of spreading water borne diseases. The water shortages had also impacted negatively on the keeping of personal hygiene. Most people in the area now forewent some basic chores such as bathing and washing clothes due to water shortages. Water rationing compromised personal hygiene as that person would be prone to water related diseases. In areas that constantly have water shortages people prioritize important aspects such as cooking and neglect essential aspects such as bathing.

4.6.3 Gender

Water shortages have the capability of derailing the achievement of Millennium Development Goal 3 as the water shortages have increased the productive roles of women in Eldoret's informal settlement as it has been mostly women who are responsible for fetching water. It has in fact seemed that they have reinforced the stereo types that fetching water is a duty for a woman or girl. This has resulted in the women and girls facing long queues waiting to get water during water rationing days. This disparity had been due to the fact that it was mostly women who were around at home for most of the time hence the duty to fetch water has rested with them.

4.6.4 Conflicts over Water Resources

According to residents, water shortage has sometimes led to conflicts during the height of the water rationing between residents to secure water. Shared boreholes became property that was administered by the local Residents within the estate. It was the mandate of the Residents association to ensure that the boreholes were protected from vandalism and abuse. It became also the mandate of the Residents to ensure that order and

sanity prevailed in the Boreholes. This was after the realization that water had become a source of conflict between residents who had previously shared the borehole.

4.6.5 Economic Effects

Water shortages also affected the economic sector as it greatly affected economic activities in the area. For those that decided to embark on agricultural activities they faced several challenges such as an unfavorable climatic condition and the water shortages that followed. Car washing and construction are the main economic activities taking place in the informal settlement. Langas is high density suburbs that have informal businesses that thrive within it. Most of them strived on local resources to survive. They are largely businesses that are run by people who live in the area. They service the needs of the community. One such sector is car washing which depended on water.

The water shortages have unfortunately led to the decline in business ventures for most youths in the area who viewed construction as a means of employment. However it becomes a major problem for them when they cannot utilize their skill due to the water shortages. As a result most of them remain unemployed as the industries are not employing anyone as they are also downscaling. So as a result most youths end up engaging in illegal dealings and social vices as they seek way of earning and sustaining a livelihood.

4.6.6 Urban Agriculture

Most residents in Langas and Munyaka were engaged in farming vegetables such as tomatoes kales, and carrots, most of these products were consumed at household level. The water shortages have affected urban agricultural activities, lowering their production. Most of the vegetables are very nutritious hence they were vital in improving the health of the residents. Most residents also stated that they usually sold surplus produce to street vendors in the area. In a way the produce was aiding the women in gaining extra money for their personal and household use. This was however affected by the water shortages which rendered some of their activities impossible. The water shortages also affected the production of seedlings that were being produced by women in Langas. However, she complained that since the introduction of water rationing she has reduced production.

4.6.7 Positive Effects

Water shortages created business for some entrepreneurs. Some unemployed youths were now selling water containers in the slums. These containers were mostly being sold by women. This sort of business has become a source of livelihood for these women. However, it has to be noted that these women do not exclusively deal in water containers as most are into vegetable selling.

Youths were now being contracted by people who were extending their houses to fetch water from the boreholes. It was observed that youths had formed a group that deals in ferrying water for those that are constructing. It can be said that the water shortages have in a way created employment for these youths though its sustainability is questioned.

Selling of water had also become a major source of income for some residents. Youths had taken it to themselves to sell water to those that do not have. A 20 litres bucket of water costs between Kshs 20 depending on the situation. This had become a source of living for most of the unemployed youths in the high density.

The water shortages have had a huge impact in the lives of people in Eldoret at large. Though the extent of the impact has not been as disastrous as that in and other town the effects have nonetheless been felt. Mostly the effect has been felt at household level and in individual capacity. The impact has also been severely felt in the high density suburbs than in low density suburbs. Also in the high density suburbs the effects have been generally severe in Langas compare to Munyaka.

4.7 Stakeholders Adaptations to Water shortage in Eldoret municipality

The fourth objective of the study was to analyze the coping strategies by the stakeholders to ensure regular water availability. There is evidence that water shortage in Eldoret is associated with increase in population that does not go together with improvement of available water infrastructure. This is partly an indication of lack of effective urban planning measures. It is argued that 40 to 80 per cent of the urban population in Eldoret resides in unplanned settlements, which also lack essential municipal services. This means that many residents are forced to search for alternative sources of water which is not safe for drinking. The respondents have adapted to water shortage by buying storage containers, regulating the amount of water used in the households, reusing water in the homes e. g water used for laundry is reused to flush toilets. Most (97%) have adapted to water shortages by buying water containers for storage purposes. The other 3% agreed they regulated the available water during use to prevent unnecessary wastage. From the analysis, Eldoret residents have adapted to water shortages fetching and storing in water containers to ensure availability for use when required.

The study found that water shortages in the informal settlement had forced the community to seek for alternative ways of having clean and safe water. In other words, inadequacy in the quality and quantity of water for each of its intended purposes created different coping responses. The major coping mechanisms included; use of water from wells and boreholes, rainwater harvesting as mentioned by respondent; changes in water consumption pattern as mentioned by respondents and purchasing water from vendors and neighbours connected tap as mentioned by respondents. All these mechanisms enabled households to cope with water shortages situation.

4.7.1: Sinking more Boreholes

Water shortage has caused the residents in the study area opt for water from local wells and boreholes. Most households use water from wells and boreholes to supplement ELDOWAS Company's piped water which is inadequate. The water drawn from the wells and boreholes are for laundry and bathing and very rarely for cooking purposes due to the fact that it is less clean and safe to drink

This study observed that households generally categorize water into two; water for their personal consumption (more safe) and water for other uses(less safe). Regardless of poor quality of water from boreholes and shallow wells, some of residents use that water for domestic consumption. Residents in those areas rely much on boreholes, shallow wells that are mainly used during water deprivation days and during ELDOWAS taps breakdown. Equally important, the study showed that most residences have embarked on construction of boreholes and wells around their homes as a strategy to address the problem of water shortage and reduce water related costs. However, water from these sources is not safe for human health. Findings indicate that constructed boreholes and wells especially in informal settlements refute coexistence of onsite sanitation and use of ground water for domestic purpose, thus, calling for need of an adequate lateral separation between the pit latrine and the wells to reduce chances of faecal contamination of ground water. Many people in different parts of the informal settlement have been affected by water related diseases such as cholera, typhoid and diarrhoea because of using contaminated water from boreholes and wells. These people are also at increased risk of dying from waterborne diseases. The observation is comparable to that of Cheserek (2009) who observed that many households in Eldoret municipality get water from Kiosks and wells. Residents pay charges, and the price per bucket differs from place to place and from season to season. Most wells are owned by individuals, Community Based Organizations (CBOs) and Non-Governmental Organizations (NGOs).

4.7.2 Rainwater Harvesting

The most significant mechanism used by households in Eldoret municipality to get water is through rainfall harvesting. Rainwater harvesting is collected from rooftops through drains or gutters into storage containers like drums and surface tanks, and other storage facilities. During rainfall seasons households in the study streets harvest water and store in different storage containers. Rainwater harvesting plays great role in water supply provisioning in the study area despite the fact that there are fewer initiatives to bring in modern technologies in rainwater harvesting. Poor technology plays a great role in functioning of rainwater supply in the study area. Nevertheless, the great challenge facing the households is inadequate storage facilities.

4.7.3 Purchasing Water from Vendors

Since ELDOWAS does not provide water to all citizens; small-scale independent water providers provide water to residents in the Eldoret municipality. The private commercial sectors play a major role in water distribution. It was observed in the study area that households bought water from street water vendors and from neighbors connected to ELDOWAS taps. Water vendors use handcarts and truck tankers to distribute water to households. Street water vendors that use handcarts were buying water from truck tankers services and from private built reservoirs. These street water vendors sell 20 litres containers at 20 kshs, this price goes up during dry seasons and during taps breakdown.

Individuals or collective organizations seek for alternative ways of obtaining water. Residents opt to buy water from water vendors who keep water in 5000 to 10000 litres reservoir on their plots. However, other residents obtain water from water vendors that use handcarts who are common providers of water in many parts of the informal settlement.

4.7.4 Changes in Water Consumption Pattern

Since water supply cannot suffice the needs of the residents in the city and as the water is provided on user fee basis, households have come up with strict water budgeting strategy. This strategy is mostly applied to safe and clean water uses. Clean and safe water is mainly used for necessary household consumption such as drinking and cooking. Some of the uses which are not important such as washing clothes and mopping are skipped. The findings indicate that 34% of the respondents use little water especially on vital domestic uses such as drinking and cooking. Other domestic activities which need water such as washing clothes, mopping and

bathing are avoided during acute water shortages. Other domestic activities which need water were depending on water from boreholes and wells.

4.8 Role of ELDOWAS Company in mitigating water shortages in Eldoret Municipality

Eldoret water and Sanitation Company, ELDOWAS planned to construct a new dam at Kipkaren River at the beginning of 2014 in collaboration with the World Bank and the Lake Victoria north water services board which was is expected to cost Kshs. 546 million and produce an additional 10,000 cubic metres of water. This was to increase the capacity of water to the residents of the town and environs. It is revealed that the company is also committed in rehabilitating Kaptagat dam which will produce an additional 6000 cubic metres of water to the residents of the town. This is to cater for the demand of water that has continued to increase up to 450,000 cubic metres against current supply of 36,400 cubic metres daily.

Eldoret is served with three water sources, Chebara, Kaptagat and Sosiani using gravity to naturally pump the water thus not incurring huge power bills. The company has been forced to ration water in Eldoret town because of the high demand against low supply, but hoped that this would be a thing of the past when the two projects are completed. The company however lamented that there is high cases of vandalism of water metres and theft of water especially in informal settlement causing the company to incur losses in repairs. They have since resorted to using plastic water metres, which has reduced the theft of metres.

Data from ELDOWAS indicate a continuous reduction in water levels of their dams. This is caused by indiscriminate deforestation in water catchment areas. Further, the Water Company lacks financial resources to expand water distribution network to informal settlement and relies on dams with fixed capacities meaning it can only sustain a specific daily supply. According to the company the option of diversifying into underground water sources is not possible due to high salinity levels

V. Summary, Conclusion And Recommendations

5.1 Introduction

The study was to investigate the impacts of water shortage and coping measures at household level in the informal settlement of Eldoret municipality. The research aimed at establishing water availability in informal settlement of Eldoret town, investigating the causes of water shortage, evaluating the implications of water shortages to livelihoods in the informal settlement and determining the measures stakeholders adopt to cope with water shortages in Eldoret town at the informal settlements.

This study noted that the main source of water serving Eldoret is Chebara Dam, Kaptagat Catchment Forest and Sossiani River. The main sources of water for the households in Eldoret were; piped water from the municipal council, water from boreholes, shallow wells and rain water harvested during the rainy season.

Several factors were noted to be responsible for water shortages in the informal settlement. The increasing population which has led to low water levels due to the increase in demand has majorly contributed to the erratic supply. The increase in demand has resulted to rapid withdrawal of water thus overexploitation at the source points. This is hardly enough for the high population. Most water systems have not been adequately managed and maintained leading to loss of water due to frequent leakages. Other management related causes, attributable to variations in water supply, are leakages in the distribution network. The leakage occurs mainly due to corroded pipes in distribution network, damages caused during road widening and repair works and also use of poor quality pipes in majority of household connections.

Environmental factors leading to low water supplies are varied in the area. Degradation of the source points (8.3%) e.g. boreholes and wells due to lack of protection. Reduced precipitation: while16.7% said that reduced precipitation has resulted in low water supply. Supply capacity of surface sources like rivers and reservoirs decrease owing to uncertainty and fluctuations in rainfall/ precipitation in most of the country. The general neglect in conserving rainwater has resulted in waste of rainfall by way of run-off and evaporation.

Rapid water extraction: high number of the respondents agreed that reduced water supply is due to rapid water extraction at the source points and this has resulted in overexploitation of the available water. This is a major cause of reduced water quantity thus water shortages. Surface water pollution is another environmental factor that has resulted to reduced supply of drinking water in the area. This is from effluents discharged into the rivers and underground water making it unfit for human consumption. The contamination of water in many areas of the world is a major factor influencing drinking water supply. Drinking water apart from source level is also likely to get contaminated in the distribution network when sewage or other waste materials enter through broken or leaking pipes. In urban areas with inadequate sanitation system this becomes a major cause. Further, improper siting of water collection points particularly in low lying areas, unhygienic practice of collecting water by households, adversely affect water quantity and quality

From the findings water shortages had both negative and positive impacts to the residents of Eldoret Municipality. According to residents, there have been cases of cholera and typhoid in the study area, more people falling victim to diseases such as diarrhoea after consuming water from unprotected sources. It has also

forced some residents to end up using unprotected water sources to carry out their day to day household chores. Furthermore, the water shortages had also impacted negatively on the keeping of personal hygiene which can be a trigger to water related diseases

Water shortages have increased presumed cultural roles of women in Eldoret's informal settlement as it has been mostly women who are responsible for fetching water. Furthermore, water shortages has sometimes led to conflicts during the height of the water rationing since households sharing the boreholes had to ensure that the boreholes were protected from vandalism and abuse. Water shortages had also affected the economic sector as it greatly affected economic activities in the area. The shortages lead to the decline in business ventures for most youths in the settlements who view car washing and construction as a means of employment. Most youths end up engaging in illegal dealings and social vices for survival. The water shortages have also affected urban agricultural activities in the area such as market gardening. This was however affected by the water shortages which rendered some of their activities impossible.

Despite the negative impacts of water shortages, this has created businesses for some entrepreneurs. Some self-employed youths were now selling water containers in the slums. Youths were being contracted by people who were extending their houses to fetch water from the boreholes. Moreover, some use water tankers to deliver clean water to the residents.

Residents have developed adaptation strategies at household level to ensure regular water availability. UN-Water (2007) postulated that addressing water crisis requires an integrated and multi-dimensional approach. Managing water resources should aim at enhancing economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Thus the stake holder's involved in the mitigation process are the central government, local authority, nongovernmental organizations and the residents in the informal settlement. The study established that the households and stakeholders have adapted to water shortage to ensure water availability. From the analysis, Eldoret residents have adapted to water shortages by fetching and storing water in large containers to ensure availability for use when required, regulation of the available water, recycling and water harvesting during the rainy season to ensure availability after the rains.

5.2 Conclusions and the Way Forward

The world contain sufficient clean water for ever one, however water is not equally distributed leading to insufficient access. Basing on the findings, it is evident that domestic water supply service in the city of Eldoret municipality is problematic since it does not meet the required community needs. The gap between water demand and supply is increasing at a higher rate than population growth- as income level of informal dwellers decreases the demand for better services increases. Water availability is shrinking due to competing demands. The problem is associated with deterioration of infrastructure system, lack of good governance, rapid population increase, poor revenue collection and illegal connection. People waste a lot of time looking for water whereas such time could have been used on other socio-economic activities. The situation is worse during break down of ELDOWAS taps and during dry season. It has also been leant that the residents in the city use water from wells and boreholes, rainwater, changes in water consumption pattern and purchasing water from vendors and neighbours connected to ELDOWAS tap as coping measures. It has been learned that a lot of water is lost in the way to the city. This is a manageable issue and local participation is very important to rectify the situation. We understand that pipes of water that pass through villages and urban streets and these can easily be protected by the local community and local government authorities. This could minimize problem of illegal water tapping. In line with this those involved in illegal water tapping should be punished by law.

Additionally, there is evidence that water shortage in Eldoret is associated with increase in population that does not go together with improvement of available water infrastructure. This is partly an indication of lack of effective urban planning measures. It is argued that 40 to 80 per cent of the urban population in Eldoret resides in unplanned settlements, which also lack essential municipal services. This means that many residents are forced to search for alternative sources of water which is not safe for drinking. It is fact that the majority of the residents use pit latrines as the main sanitary system and most of these underground sources of water are polluted. That is why the residents in the informal settlement are frequently subjected to number of waterborne diseases such as cholera, dysentery and typhoid (Cheserek et al, 2004). The government should improve the available water infrastructures and increase others so that our cities may become pleasant and health living places

According to ELDOWAS company, the challenge of servicing more people with limited water resources requires a critically reappraise of current perspective on urban water management. Water demand is growing due to population growth and rising incomes. Supply is shrinking due to competing water users, deteriorating water quality, and overexploitation. Uncertainty about future conditions is becoming more acute because of climate change and shifting economies. We need to reconsider water use practices and develop strategies that can respond to all these challenges simultaneously.

Findings show that residents use rainwater as an alternative during water shortage among the poor families. But this source is affected by seasonality of rain, pollution and lack of modern storage facilities. Further, residents collect the water and use it. They do not have proper water storages that could enable them to keep it longer. The government has to initiate programmes which will focus on awareness creation among the local community on the benefits and necessity of water harvesting, and efficient and effective ways of harvesting the rainwater. Local community should be trained on how to practice advanced methods of harvesting rainwater.

In a nutshell, water shortage is still a challenging issue in the informal settlement of Eldoret municipality as a number of residents are inadequately served with it. The demand for water for human consumption in the city is growing very fast. Lack of access to water has greater impact on the poor affecting their livelihoods and health. This can largely be avoided with better government strategies to enable the residents living in the city deal with the problem. Education on proper water sources conservation, water pipes conservation legislations and sanctions to those involved in illegal tapping of water, and creation of awareness of the city dwellers on how and why water should be conserved can serve the purpose

The study established that the respondents had coping measures to ensure that water is available despite the water shortage. This is possible mainly by its storage, regulating the use of the available water and water conservation techniques. Other sources of water supply include buying from water kiosks and vendors when the water is not available in the systems. Others depend on borehole water and shallow well which supplement the water supplied by the municipal council of Eldoret. This ensures that the daily activities that require water are not severely affected.

Eldoret water and Sanitation Company, ELDOWAS planned to construct a new dam at Kipkaren River in collaboration with the World Bank and the Lake Victoria north water services board which was expected to cost Kshs. 546 million and produce an additional 10,000 cubic metres of water. This was to increase the capacity of water to the residents of the town and environs. It is revealed that the company is also committed in rehabilitating Kaptagat dam which will produce an additional 6000 cubic metres of water to the residents of the town. This is to cater for the demand of water that has continued to increase up to 450,000 cubic metres against current supply of 36,400 cubic metres daily.

Eldoret is served with three water sources, Chebara, Kaptagat and Sosiani using gravity to naturally pump the water thus not incurring huge power bills. The company has been forced to ration water in Eldoret town because of the high demand against low supply; they have since resorted to using plastic water metres, which has reduced the theft of metres.

5.3 Recommendations

Based on the analysis of the study, the researcher wishes to make the following recommendations;

1. Water officers (from the Eldoret water and sewerage company) should involve the community to aid in water maintenance, development programmes and water provision projects. Members of the community should come up with other ideas to supplement the current water sources and make communal contribution to support that e.g. drilling more boreholes, wells and implementing any water conservation techniques that may be beneficial.
2. The local authority should liaise with non-governmental organizations such as World Bank, World vision who has capacity to source funding for water rehabilitation services.
3. Local government need to prioritize the completion of short term mitigation projects that have been implemented but not been completed. The government should organize more capacity building programmes for both water officers and the households to equip them with adequate skills and abilities to handle any issues that are related to water to enhance consistent supply.
4. The water officers should come up with strategies to deal with illegal connections that interfere with main water systems leaving them damaged and increased leakages by their prevention and penalizing those involved.
5. The households should embrace maximum use of roof water harvesting in most buildings so as to collect a lot of water during the rainy seasons.
6. The study mainly investigated the impacts of water shortage and coping measures at household level.

The researcher recommends further research on:

i) The impacts of reduced water supply on other areas in the country other than Eldoret municipality.
ii) The strategies being employed by the government to cope with the challenges caused water shortages in the informal settlement.
iii) A case study of an area that has sufficient water supply to identify the associated factors

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