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An Investigation into Domestic Water Consumption Patterns in Iten Town, Kenya

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Abstract

Scarcity of freshwater has become one of the major challenges facing urban areas. With ever-increasing urban population, the demand for water has gone up with little or no expansion of the existing water supply systems to match the growing demand. In that regard, this study sought to investigate domestic water consumption patterns in Iten Town, Kenya in a bid to understand more about urban freshwater scarcity. The study employed a descriptive survey design incorporating both quantitative and qualitative approaches. Structured questionnaires were distributed to 200 randomly selected households. The findings revealed that the per capita domestic water demand in Iten town stands at 44 litres, which was comparatively lower than the recommended WHO standard of 50 litres. Piped water was the main source of water (51.3%) with approximately 21-40 liters used per day (l/p/d) in laundry. At 64 l/p/d, findings revealed that households with fewer members used more water per person per day on average than, for example, a 8 member household that used 27 l/p/d. This study recommends practice of "7 R's" approach as a guide in reducing the consumption of fresh water resources.

Key Words: Water Use, Consumption Pattern, Domestic, Iten Town

INTRODUCTION

Globally, water crisis referring to scarcity of freshwater resources has become one of the major challenges due to population explosion, climate change and economic growth; (Vörösmarty *et al*., 2000; Rogers, 2008). According to UN estimates, the current world population is estimated at 7.2 billion, and is projected to reach 9.6 billion people in 2050, thus placing considerable pressure on water resources (Gerland *et al*., 2014). It is estimated that by 2025, 67% of the global population will be water stressed thus affecting access to water by many people (Gilland, 2002). It is worth noting however that although water is an abundant and renewable natural resource covering two thirds of the planet, a very small proportion of this is effectively available for human use. Consequently, scarcity of this commodity is unfortunately expected.

The urban and domestic users significantly drive the exploitation of global fresh water resources. Households, particularly in cities, contribute the greatest proportion of drinking water consumers. Households therefore, are the key drivers underlying the overexploitation of renewable freshwater resources together with the watersheds in their hinterlands and are, subsequently, a great influence on the fresh water balance.

Due to multiple factors, such as climate change, increased rates of urbanization and population growth particularly in urban areas, it is expected that water stress will significantly increase worldwide by the middle of this century and particularly in Africa, Asia, Australia, New Zealand, and

Southern Europe, as well as in Latin and North America (Vörösmarty *et al*., 2000).

Kenya, an African middle income developing country, also faces problems of water scarcity. With limited renewable water supply of 647 cubic meters per year, it is classified as water scarce country (Water Resources Management Authority, 2015). Future projections show that per capita available water will likely drop to 359 cubic meters per year by 2020 due to population growth (Kenya Anti-Corruption Commission, 2011). According to the Joint Monitoring Programme's 2012 report, access to safe water supplies throughout Kenya is 59%. The situation is even worse in urban areas.

Although access to safe water in urban areas is estimated at 55%, the overall coverage has been declining in terms of quantity, quality, reliability and access (Water Services Regulatory Board, 2016). Consequently, more and more people in Kenya's urban areas face challenges of accessing adequate and safe water supply. This is compounded with a general limited development of new water systems mainly due to the high capital costs involved and, of course, the high rates of urban population increase.

Iten Town, the County Headquarters of Elgeyo Marakwet County, is experiencing water scarcity. With the advent of devolution, there has been rapid increase in population migrating into the town and also an increased rate of development. The Town currently has a population of 8,655 people an increase from 7562 in 2012 prior to devolution. It is projected that the town's population will hit 13,611 by the year 2035 County Government of Elgeyo Marakwet (CGEM, 2013). This portends an increased urban water demand, despite the existing efforts to increase supply. Out of the contention that households play a critical role in reducing overall water demand, the present study therefore sought to investigate water consumption patterns in Iten town with the aim of shedding light on the key drivers influencing household water consumption. The main objective of this study therefore, is to establish the quantities of water consumed, main sources of water and household water expenditures and to determine effect of household characteristics on domestic water use patterns.

METHODOLOGY

Study Area

The study area which is Iten town is located in Elgeyo-Marakwet County at an elevation of 2,400 meters above sea level. It is located within coordinates 00°40'23'' N and 35°30'30'' E and it lies approximately 32 km North East of Eldoret Town. During the rainy season, temperatures can reach a low of 15°C and a high of 23°C during the dry season. The town is usually cold during the rainy season. It receives between 1200 mm and 1500 mm of rainfall per annum. Long rains fall between the months of March and July while the short rains fall between August and November (CGEM, 2013). With regard to drainage, the geographical position of Iten town is rather unique. Due to its elevation, Iten is one of the highest points that also forms a water divide separating Lake Victoria and Rift Valley Drainage Basins which lie opposite to each other. This means that most rivers adjacent to Iten town flows away from it and no major river flows towards it. This compounds the water supply challenges facing the town.

Research Design

The study adopted a descriptive survey design. Survey research is a type of study that involves the collection of data from a sample of elements drawn from a given population through the use of a questionnaire (Visser *et al*., 2000). Descriptive survey is used to obtain information describing particular aspects about a variable from selected sample of the population and their views are taken to represent those of the entire population (Fraenkel *et al*., 2012). This was thought appropriate since the study was interested in describing circumstances around which Iten households consume fresh water available to them.

Population Size

Iten Town is one of the fast growing towns in Kenya. The population as per the Elgeyo Marakwet County Integrated Development

Plan (CIDP) is 8,657 and households are 1,996. The major drivers of population growth in the town are largely natural internal growth and immigration, especially by county government employees, businessmen, tourists and athletes.

Sample Size and Sampling Procedures

The sample size was determined using the formula by Mugenda and Mugenda (2003), who guided that a sample size of 10% of the population size is adequate if the target population is less than 10,000. Therefore 10% of the population size is 200 households i.e.10% *1996= 199.6 where it is rounded up to 200. Stratified sampling technique was employed in the study where population was divided into five sections of settlements comprising of Central Business District (CBD), low, medium, high density and peri-urban. Items were selected proportionately from each section according to household population to constitute a sample. Household heads were drawn from the strata (Table 1).

Table 1. Sampled Households in Iten Town

Zone	Estates	Households
CBD	Milimani	40
Low Density	Koisungur, High Altitude (16 in each)	32
Medium Density	Lilies, Kariobangi (20 in each)	40
High Density	Kapsio	40
Peri-urban	Chebokokwa, Kamariny, Mindililwo (16 in each)	48
Total		200

Data Collection Techniques and Instruments

Three main data collection techniques and instruments were employed in this study. These are survey, interviews and direct observation techniques with questionnaires, key informant interview schedules and observation schedules respectively being the instruments employed for data collection.

Questionnaires are research tools through which people are asked to respond to the same set of questions in a given order. This allows the researcher to have direct contact with respondents (Creswell, 2003). The main information the questionnaire sought to elicit included quantities of water consumed, household water uses and effects of household characteristics on water use patterns. The total amount of water used in a household was determined by counting the number of Jerri cans used in the home after noting down their volume. The total volume was then computed.

Key informant interview was undertaken to collect water supply information from Iten Tambach Water and Sewerage Company-ITWASCO since it is privileged with information on water supply and consumption in the study area. Direct observation schedule on the other hand was used to collect information on the main sources and uses of water since it provided broad impression of issues being observed.

Validity and Reliability of Instruments

Validity is the accuracy and truthfulness of scientific findings while reliability relates to the consistency of a measure (Heale and Twycross, 2015). The researcher validated the data collection instrument (questionnaire) by subjecting it to a rigorous scrutiny by researchers and subsequently pre-testing in a pilot study prior to the main study.

Data Analysis

The data gathered was both quantitative and quantitative in nature. The returned questionnaires were checked for consistency and completeness. Thereafter, they were coded and analyzed using descriptive statistics by use of the Statistical Package for Social Sciences (SPSS) software (version 21). Categorical variables such as household size and occupation are presented using frequency tables.

RESULTS AND DISCUSSION

The summary of the socio demographic characteristics of the respondent in the study area are as presented in Tables 2a and 2b.

Table 2a. Frequency Results for Household Characteristics of Sampled Households

Characteristics	Description	% of Sample
Gender	Males	37.1
	Females	62.9
Household head	Males	70.8
	Females	16.4
	Eldest child	4
	Grandparent	0.5
	Others	8.3
Household size	1-2 members	27.8
	3-4 members	35.9
	5-6 members	25.2
	7-8 member	11.1
Education level	None	1
	Primary	15
	Secondary	34.5
	College	33
	University	16.5

From the study it was found out that (62.9%) of the respondents were females while 37.1% males. The high number of female respondents can be attributed to the fact that a good number of female adults especially those with young children prefer spending their free time at home as opposed to their male counterparts. However, more than half of the households are headed by males (70.8%) with only 16.4% headed by females. The remaining 12.8% represent households headed by eldest child, grandparents and others (consists of a group of athletes and students living together). This shows that most families are patriarch in nature as is the case in many African cultures.

With regard to household size, 63.7% of the households have between 1 and 4 members (1 member= 8.6%, 2 member=19.2%, 3 member = 17.2% and 4 member household = 18.7%) while those with between 5 and 8 members were 36.7%. This means that most of the households in the study area have less than five members in their households. This has a negative impact on water consumption since small households consume more water on average than large households (Table 2b).

The study further revealed that in the study area, respondents who never went to school are 1%. Those with primary education were 15%, while 34.5% had secondary education. Respondents who studied up to college were 33% and those who managed university education were 16.5%. This means that most of the residents are literate and thus are in a better position to make informed choices regarding water consumption.

The study further established that more than half of the respondents (53.2%) were business people and government employees (Table 3). The rest are farmers (12.6%), housewives (9.5%), students (6.8%), athletes (3.2%), casual labourers (0.5%) and those employed with private sector (14.2%).

Table 3. Frequency Results for Occupation of Respondents in the Study Area

Characteristics	Description	% of Sample
Occupation	Private business	27.4
	Private sector employee	14.2
	Farmer	12.6
	Government employee	25.8
	Housewife	9.5
	Student	6.8
	Athlete	3.2
	Others i.e. Casual labourer	0.5

Per Capita Household Water Consumption

The amount of water used per household per day was determined by dividing total water consumed in the household between the numbers of persons living in it. It was found out that the average water consumed by the residents in the study area is 44 litres (Table 4).

The study further revealed that there is a correlation between the household size and the amount of water consumed. A single occupant in a house uses an average of 64 litres per day, two members in a household uses an average of 61 litres. For those households with eight members, the average amount of water consumed per person per day is 27 litres.

Most authors propose a minimum of between 20 to 100 litres of water per capita per day for domestic use. The World Health Organization/UNICEF Joint Monitoring Programme, for instance argues that the availability of at least 20 litres per person per day from a source within one kilometer of the users dwelling is regarded as a reasonable access (WHO and UNICEF, 2000; UNDP, 2006). WHO (2010) on the other hand recommends 50 Litres per person per day (l/p/d) as a basic water requirement to ensure meeting the most basic needs without raising any health concerns. Howard and Bartram (2003) recommend 100 litres for all household needs. As such, there is no agreed fixed quantity of what constitutes the amount of water per person that is essential to satisfy human health and enable a high quality of life for all (Chenoweth, 2008).

Table 4. Average Household Water Consumption

No. of household members	Ave. water consumed per day (Litres)	Frequency
1	64	14
2	61	36
3	48	26
4	43	30
5	37	20
6	36	18
7	32	7
8	27	13
Average per capita water consumption: 44 litres		

Respondents' Uses of Water

In the study area the common uses of water are; drinking, cooking, showering or bathing, cleaning the house, washing clothes, washing utensils, watering animals and gardening. Table 5 presents the average amount per use in litres.

Among the uses, watering animals, gardening and washing clothes consumed the greatest quantities of water (20-40 litres per day) while water for drinking, cooking and washing utensils consumed the least quantities (less than 10 litres per day). Drinking water per person was found to be

between one and two (1-2) litres. However, Chenoweth (2008) disputes that, 5 litres is required for drinking in tropical climates. Drinking of less water can be attributed to the cold weather experienced in the area.

Water used for bathing was found to be between 11 and 20 litres. However, according to WHO (2013), 30 liters per day per person is required for personal washing. Use of less water can be attributed to shortage of water in the area which has compelled residents to use minimal water while taking a bath or a shower.

Table 5. Average Amount of Water Per Use

Uses of water	Average amount per use Per day (Litres)
Drinking	1-2
Cooking	5-10
Showering/bathing	11-20
Cleaning house	11-20
Washing clothes	21-40
Washing Utensils	6-10
Watering animals	21-40
Gardening	21-40

Main Sources of Water

Having established the quantities consumed by the respondents and the main consumptive uses, this study sought to establish the main sources of these fresh water. The findings revealed that the main sources of water for the residents of Iten town are piped water (51.3%), combination of piped water and well (24.1%), well (10.6%) and communal water kiosk (5%). The least used sources of water on the other hand are spring, combination of roof catchment and water vendors and combination of piped water and roof catchment (all not more than 1%).

It can be deduced from the findings that despite the main source of water being piped water, the supply of water from the area service provider is not enough. This has compelled the area residents to use other sources of water such as wells.

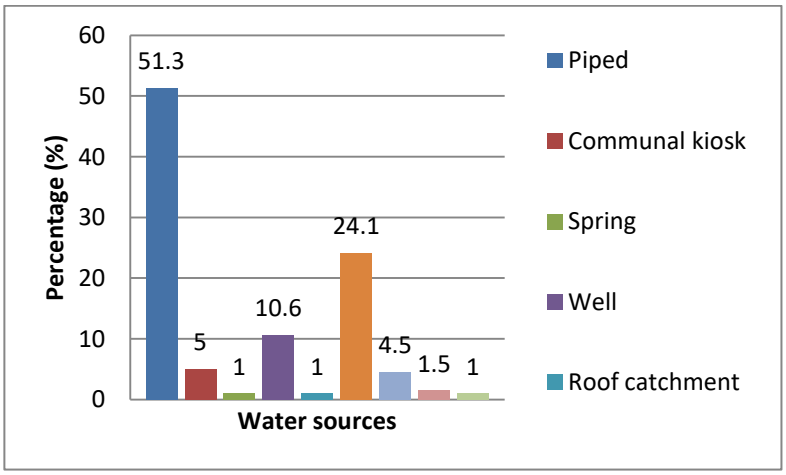

Figure 1. Sources of Water

Figure 1 shows the main water sources in the study area. The blue dots represent a borehole, a dam and water kiosks. The yellow dotted lines indicate the existing water distribution network.

Most of the respondents reported that the water from ITWASCO Company is potable. Respondents who use both well and piped water reported using water from the well when there is water rationing. Water from roof catchment is available only during rainy season making it unreliable; spring water is also unreliable because the distance is more than one kilometer for most of the respondents, while water from the well has not been treated. However, it was found out that many households in the study area rely on more than one source to satisfy their water needs, often using different sources for different types of uses. For instance, water used for washing clothes might come from a well while the water used for drinking and cooking is obtained from the area water service provider i.e. water kiosk.

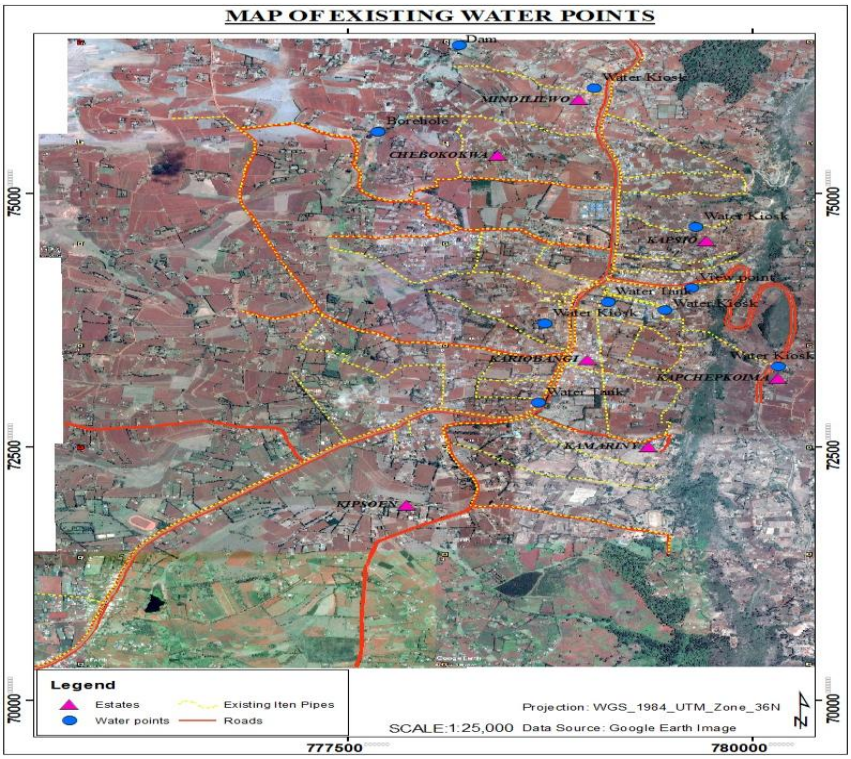

Figure 2. Main Water Points

Effects of Household Factors on Water Consumption

A number of household factors affect water consumption, including presence of a garden. Most households with gardens water them during the dry season, hence having an impact on the overall amount of water used in the household. Some of the crops planted in gardens are vegetables, fruits and flowers.

Presence of a Garden and Water Consumption

It was found out that households with gardens consume more water than those who do not have (Table 3.4). However, those households without gardens are more (65%) than those who have (35%) as shown in Figure 3.

Table 6 suggests an insignificant positive correlation between households that have a garden and consumption of water (r=0.081; sig. 0.357). A positive correlation indicates that an increase in the number of household with gardens leads to an increase in the amount of water consumed, thus implying a direct relationship between the two variables. It can be deduced therefore that, despite the number of households with gardens being less than a half (35%), it has an impact on the overall water consumption in the study area.

Table 6. Correlation between Gardening and Water Consumption

Correlations	
Presence of a garden & Amount of water per day	
Pearson correlation (r)	0.081
Significance (2 tailed)	0.357

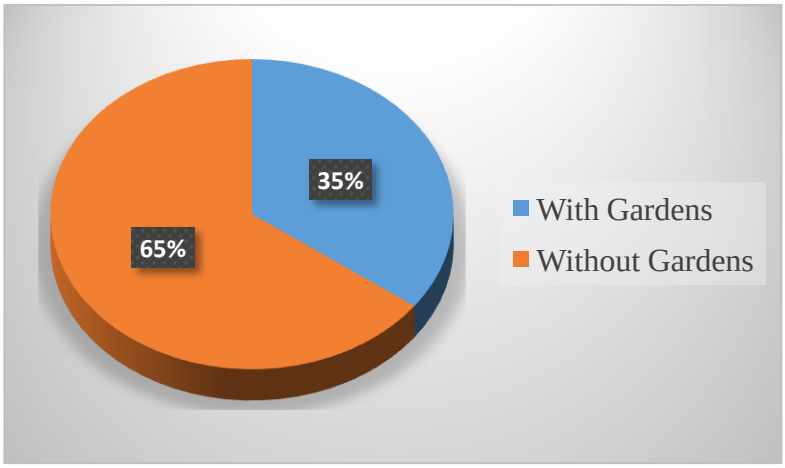

Figure 3. Percentage of Households with Gardens

Plate 1a shows some of the plants grown in a garden in Kapsio Estate. In the garden there are flowers, traditional vegetables black night shade (*managu)* and straw berry plants that need watering during dry periods. Plate 1b shows a garden of vegetables in Lilies Estate. At the middle of the photograph is a drum which is used to store water for watering the vegetables.

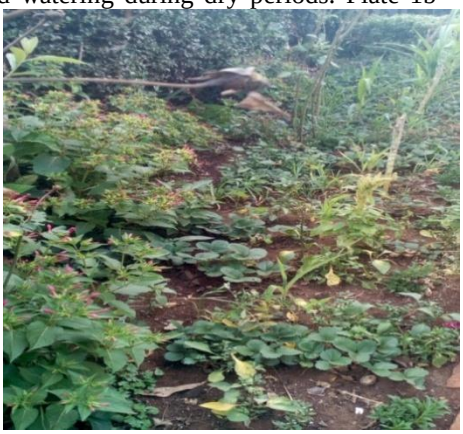

Plate 1a: A Garden of Flowers

Plate 1b: A Garden of Vegetables

To find out whether the practice of water conservation measures in the study area has an effect on water consumption patterns, the respondents were asked to identify which conservation measure is practiced in their households. The responses are as shown in Figure 4, 35.1% of the respondents reported reusing their water for instance water used to wash clothes is used to clean the house, while 16.4% reported using minimal water. These measures (Reduce: using minimal water and Reuse) form part of the 7 "R"s' approach. The rest (48.5%) do not practice any water conservation measure. This means that almost a half of the respondents use water without caution hence other measures of 7 "R"s' approach need to be practiced. The "7 R's" are words that start with letter 'r" that act as a guide in reducing the consumption of fresh water resources. This includes; 'Refuse': refusing to waste water, 'Respect': treating water with consideration, 'Repair': repairing of water supply infrastructure, 'Recycle': re-using water and creating something else with it i.e. wastewater is used to recharge underground aquifers, 'Rethink': redesign our way of living in order to reduce amount of waste water produced, 'Reduce' and 'Reuse' (El-Halwagi *et al.*, 2003; El-Haggar, 2010).

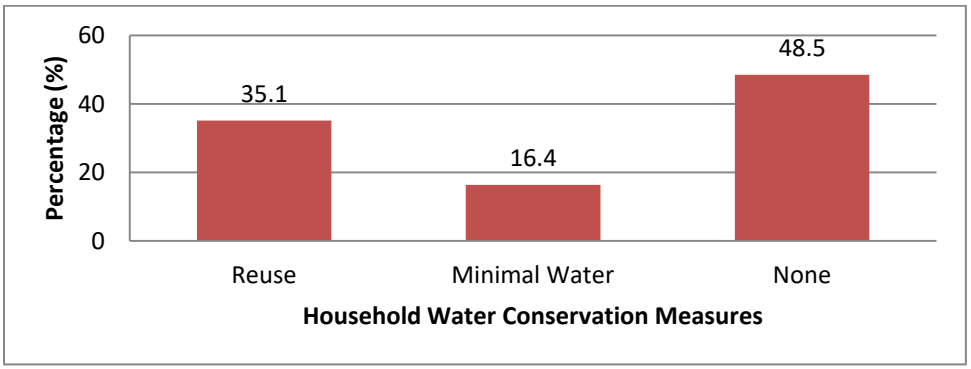

Figure 4. Household Water Conservation Measures

CONCLUSION

The study concludes that the average water consumed per person per day is 44 litres, which is lower than the recommended WHO standard of 50 litres of water. It's further concluded that households with many members use less water on average per person per day and vice versa. This could be as a result of economies of scale relating to the optimization of water realized in large households.

RECOMMENDATION

The study recommends the practice of "7 R's" lifestyle as one of the key strategies in reducing the consumption of fresh water resources. They are; 'Reduce', 'Reuse', 'Refuse', 'Respect', 'Repair', 'Recycle' and 'Rethink'. These are individual lifestyle changes that take management of water into consideration all year round.

The study further recommends the practice of drip irrigation in order to reduce the amount of water used in gardens, since it is less wasteful as opposed to manual irrigation which was found to be a common practice in the study area where buckets and watering cans are used.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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