International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 6 Issue 9, September 2019

ISSN: 2394-4404

Water-User Preference Influencing Household Water Availability In Obunga Informal Settlement Of Kisumu City, Kenya

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Abstract: ***Approximately 80% of the estimated 844 million people without access to a basic water service live in rural areas and urban slums particularly in sub-Saharan Africa. This is in disregard of the fact that access to water service increased from 81% to 89% during the last one and half decades. In Kenya, majority of urban dwellers live in water stress informal settlements. Theorists and scholars have linked availability of domestic water with water user preferences or practices, although the same has not been documented among households living in informal settlements in Kisumu. The purpose of the study was to investigate water user preferences influencing household water availability in Obunga informal settlement of Kisumu City, Kenya. Specific objectives were to investigate the effects of the preferences for water use in gardens, laundry and toilets, washing, direct heating system, drinking, cooking, and personal washing, on the frequency, quantity, and reliability of water supply among households in the slums. The study adopted Ex post facto research design on a target population of 2,507 households from the four administrative units in Obunga informal settlement, whereby through stratified sampling technique 331 respondents were sampled using questionnaire administration. Purposive sampling method was used to select 3 key informants for key informant interview using interview guides. Qualitative data was analyzed through thematic analysis, while descriptive statistics and chi square test were used to analyse quantitative data on study variables by the use of statistical packages for social sciences (SPSS). The study found that most households in Obunga informal settlement have poor water-user preference, although majority of them have moderate availability of water. The findings also showed that households with good availability of water have poor water user preference while those with poor availability have good water user preferences. Differences in household water user preferences ($\chi 2o = 58.450 > \chi 2c\ (4, .05) = 9.488$) were found to be too large to be explained by chance: hence the alternate hypothesis that household water-user preference in the slums is dependent on the availability of water was rejected. It is therefore concluded that availability of water is not related to household water-user preference, and that household water-user preference gets poorer as the availability improves. The study recommends that households in the slums should be sensitized to improve their attitudes towards use of clean water so as to enhance availability of the commodity.***

Keywords: ***Water-user preference; Availability of water; Households; Informal settlements; Obunga informal settlement; Frequency of water supply; Quantity of water supply***

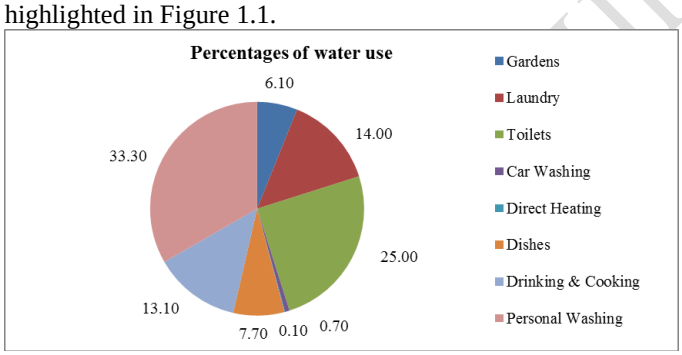
I. INTRODUCTION

The fact that water is a finite resource yet a human right cannot be gainsaid. The importance of water to human beings necessitated the target task of the Millennium Development Goal (MDG) 7 (c) aimed at halving the number of the population with no access to safe drinking water by the year 2015 (Clasen, 2012; Shaheed, Orgill, Montgomery, Jeuland & Brownd, 2014; UN, 2016). Implementation of this target improved the proportion of people with access to basic

ISSN: 2394-4404

drinking water from 81% to 89% between 2000 and 2015 (UN- Water, 2015; UNICEF, 2015). However, this improvement did not take sufficient consideration to water safety (Clasen, 2012; Bain et al, 2012), which became a key element of the target task for water supply in the Sustainable Development Goals (SDG 6). According to the United Nations Resolution 64/292: "The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (Shaheed et al, 2014; UN, 2010). Therefore, SDG 6.1 call for full coverage of safely managed drinking water by 2030. However, about 844 million people on Earth do still not have access to basic water supplies and 79% of them live in informal settlements and rural areas (WHO, 2017). At the same time, 2.1 billion people have no safely managed drinking water supply system service. This implies that 14.9% of the urban- and 45.2% of the rural population has improved water services (WHO & UNICEF, 2017). Water is therefore considered an infinite resource to be used with sufficient decorum. However, water-user preferences in most areas particularly in informal settlements where acute stress of the commodity id often experienced in seem to have attracted limited attention.

According to Ho *et al*., (2001, cited in Ongere, Otor and Afullo, 2017); and Istifanus (2017) point out that for effective and wise water-use, households should use water in strict proportions of: gardens (6.10%), laundry (14.00%), toilets (25.00%), car washing (0.70%), direct heating system (0.10%), dishes (7.70%), drinking and cooking (13.10%), and personal washing (33.30%). These ratios have been adopted and recommended by the United Nations as ideal ratios for wise-water-use all over the world (UN, 2009). The ratios are highlighted in Figure 1.1.



Source: The UN-WWAP (2009) recommendations for domestic water use

Figure 1.1: Domestic water use

It is estimated that a person needs 50 to 100 litres of water per day to meet physiological and hygienic needs (Rumalongo, Nathengwe & Musyoki, 2017; UN Human Rights, 2016; WHO, 2003). People facing a limit of 20 litres per capita per day will therefore be exposed to a high level of health concerns. Rural as well as slum residents usually live in worse economic conditions than urban ones and this affects the volume of water use (Bain, Wright, Christenson and Bartram, 2014; WHO, 2013). However, it remains unclear how residents in such areas prefer to use the scarce water at their disposal.

Domestic water use refers to the amount of water taken for a given task or for the production of a given quantity of some product and it includes drinking water, cooking water, laundry, gardening, car-washing and bathing among others (Mohammed and Sanaullah, 2017; Olufayokemi, 2017; Shan, Yang, Perren and Zhang, 2015). According to Hoekstra (2006), water can be used renewably and non-renewably. In psychology, preferences could be conceived as an individual's attitude towards a set of objects, typically reflected in an explicit decision-making process (Dietrich and List, 2012; Lichtenstein & Slovic, 2006). In this study, preference refers to a tendency of household water-users to choose one use of water as opposed to the other, and allocating to use water for particular purposes as opposed to others.

In urban areas of Kenya, access to water services is highly unequal as well. The densely populated low-income urban areas, many of which are large unplanned informal settlements, remain underserved. There are a number of reasons leading to utility developers' abstention from investments in low-income urban areas: uncertainties regarding land ownership (Siakilo, 2014), the view that utilities development in low-income urban areas is commercially unattractive (Werchota, 2013), or the perception that informal areas have infrastructural problems that are too difficult to be managed (Siakilo, 2014; Werchota, 2013). It is estimated that the coverage of formalized water supply services to informal settlements in Kenya are often as low as 20% (Republic of Kenya, 2012). The Water Services Regulatory Board (WSRB, 2013) stated that the inequality in urban water provision in Kenya has its roots in poor planning, presence of informal settlements, networked designs favoring high-end users, design demand structures and supply *vs.* demand management.

The renewable freshwater resources of *Kenya* are estimated at 20.2 km^3 per *year*, which corresponds to 647 m^3 per capita and *year*. The total *yearly water* withdrawal is estimated to be over 2.7 km^3, or less than 14% of resources. However, *water* resources *availability* varies significantly in time and between regions. The WASREB (2018) estimates that out of the 21 million people living in service areas of the 88 regulated utilities, more than eight million people are living in more than 2,000 urban low income areas and a majority of these still depend on informal services that do not comply with the normative content of the human right to water. Kisumu, the third largest city in Kenya, is situated in the western region of the country, within Kisumu County. The city has a population of approximately 420,000 people (Republic of Kenya 2018). Over the years, Kisumu has experienced a growth in its population, with a resultant growth of informal settlements that are situated close to the city centre. Of the cities in Kenya, Kisumu is estimated to have one of the highest proportions of residents living in informal settlements estimated at 47% (NCPD 2018). These settlements are led by Obunga informal settlement and include Bandani, Nyalenda A, Nyalenda B, Manyatta A, Manyatta B, Manyatta Arab, Kaloleni and Kibos.

According to Blaustein (2010), over 60% of households in Kisumu do not have access to fresh water, and about 53% of the households lack adequate water supplies. About 62.3% of the water sources are not sustainable, and the quality of water is generally poor and not suitable for household use (Afullo & Danga, 2010). Studies (Odhiambo, 2016; Simiyu, Cairncross & Swilling, 2019) that have been carried out in

Obunga informal settlement have revealed that essential services like water and sanitation are significantly inadequate. However, as UN (2007), UNESCO (2006), and several other authors indicate, water security is the responsibility of both the user and the provider. In view of this, it was imperative to investigate the effect of household water user preferences on the availability of safe water for domestic use.

STATEMENT OF THE PROBLEM

According to the UN, Kenya's per capita water supply stands at 696 cm^3 per year against a population of about 46 million. This is far below the internationally recommended benchmark of 1,000 cm^3 per capita a year. It has been indicated that over 60% of households in Kisumu do not have access to fresh water, and about 53% of the households lack adequate water supplies. In Obunga informal settlement of Kisumu City, less that 10% of residents are connected to piped water and majority of them rely on alternative sources of which about 62.3% of them are not sustainable, safe and unimproved. Whereas water resources cannot be expanded, the key to water security remains in the efficient wise water-use. It was therefore critical to analyse whether water user preference is dependent on availability of water in Obunga informal settlement. This study therefore tested two hypotheses:

- ✓ Ha_2. Household water-user preference is dependent on availability of water in Obunga informal settlement.
- ✓ Ha_3. Household water-user preference is dependent on quality of water in Obunga informal settlement.

II. LITERATURE REVIEW

Literature on water availability to households in low-income areas such as informal settlements has been adequately documented. However, focus on how availability of water depends on household water user preferences seems to have been neglected. Turrini (2013) investigated whether and how the supply of household-specific information affects household perceptions about the safety of their own drinking water in Cambodia. Results suggested that perceptions play an important role in the demand for water treatment products and in the willingness of households to engage in time-consuming and costly behaviors to ensure that their water is safe. Similarly, Hanasaki et al (2019) assessed the status of the current access to and the perceived water quality in villages with various types of water supply in central Kazakhstan. The results revealed that even though villagers were provided with tap water, significant numbers used alternative sources due to doubts regarding the tap water quality and use of other sources out of habit as well as availability of cheaper or free sources. In another study, Grafton, Ward, To and Kompas (2011) utilised household survey data for 10 countries to quantify and test the importance of price and non price factors on residential water demand. Results showed that the average volumetric price of water is an important predictor of differences in residential consumption in models that include household characteristics, water-saving devices, attitudinal characteristics and environmental concerns as explanatory variables. In another study, Mohammed and Sanaullah (2017) analysed the domestic water sources, consumption and factors influencing water consumption in Kandahar city, Afghanistan. They revealed that major components of water consumption included washing clothes, taking bath, sanitation and kitchen in that order.

Regionally, Kidanie (2015) assessed the current status of the water supply system in slum areas of Addis Ababa and to research how they are supported by the existing water sector policies. The results of a survey found that 62% of the households do not have a piped connection and that their main water sources are public taps (29%), vendors (12%), kiosks (4%) and the balance (17%) get water from unimproved water sources. The service that majority of the households receive is highly interrupted and the availability of water is on average 5 days per month with an average duration of 5.2 hours per day. Olufayokemi (2017) analysed the sources of water supply and household water consumption pattern in Lokoja metropolis of Nigeria. The study revealed that the largest percentage of total water consumption was used for washing clothes.

In Kenya, Cherunya et al (2015) compared user perceptions and preferences on water-service provision options, particularly the viability of decentralized models, such as the Safe Water Enterprise (SWE), as sustainable safe drinking water sources. Results showed that among a number of water-service provision options available, the majority of households regularly sourced their domestic water from more than one source. A majority of households perceived their water sources to be unsafe to drink. For this reason, drinking water was mainly chlorinated or boiled. Similarly, Koech (2016) assessed the magnitude of household water demand, key factors influencing the magnitude of water demand and distribution and the effectiveness of the current water use management strategies in Nyangores sub-catchment, Kenya. Results indicate that income, household size and distance from homesteads to water sources are major determinants of domestic water demand. Wagner, Cook and Kimuyu (2018) explored the preferences of households demand for water in rural Kenya with regard to relative importance of price, distance and quality in households' choice of use. It found that households are sensitive to the price and proximity in choosing among sources, but are not sensitive to other source qualities including taste, color, health risk, availability, and risk of conflict.

Locally in Kisumu, Simiyu, Cairncross and Swilling (2019) explored living conditions and deprivations in informal settlements of Kisumu, Kenya. Results indicate that deprivation is widespread at the individual and housing unit level. Approximately, only 8% of the compounds had water connections and households in the rest of the compounds depended on nearby water points, to which they mostly walked for less than 5min, paying on average KES 3 for a 20-l jerry can. Studies done in Obunga informal settlement also revealed lack of adequate essential services in the area of sanitation and water. Odhiambo (2016) examined the state of sanitation conditions and the existing sanitation infrastructure in Obunga. Findings indicated that factors like overcrowding, lack of proper sanitation facilities, mismanagement and lack of toilet waste disposal were on the forefront of major causes of poor sanitation. In another study, Ongere, et al (2017)

examined the effect of water-user preference on the sustainable supply of safe water in Obunga informal settlement. It was found that households in Obunga informal settlement have poor water-user preference, and that household water-user preference in the slums is dependent on the sustainable supply.

The reviewed studies have dwelt at large on the status of water availability to households in informal settlements as well rural areas. It is clear that households living in these two areas classified as low-income areas do face water stress. However, most of the studies have not assessed the water-user preferences of the households: this could be a critical factor determining availability of water for domestic use. Moreover, information with regard to whether households' water-user preferences in Obunga informal settlement are dependent on availability of water has not been documented.

III. RESEARCH DESIGN AND METHODOLOGY

A. RESEARCH DESIGN

An Ex post facto research design a kind of "experiment" in which a researcher, rather than administering a treatment, examines the results of a naturalistically occurring treatment after that treatment has occurred, was adopted. This is a pseudo (or false) experimental research designs where a researcher, rather than conducting an experiment, substitutes the experiment with a naturally occurring condition after the condition has already occurred, and then relate this after-the-fact-treatment to an outcome (Oso & Onen, 2008). The design was deemed suitable because the elements of household water-user preference which the study investigated had already occurred and were only being studied as an after the fact. Hence Ex post facto was the ideal design.

B. STUDY AREA

The study was conducted in Obunga informal settlement in Kisumu Municipality between the months of March and July, 2012. Administratively the slums are in Kanyakwar Sub-location, in East Kisumu Location, in Winam Division of Kisumu Central Constituency, Kisumu West sub-county, in Kisumu County. The slums can be located by GPS on coordinates listed on table 3.1.

Area	Gps co-ordinate	Co-ordinates	Co-ordinates	Co-ordinates	Co-ordinates
Obunga Central	Longitude	34.759 E	34.764 E	34.7662 E	34.7667 E
	Latitude	-0.079 S	-0.08 S	-0.0781 S	-0.0799 S
Obunga Kamakowa	Longitude	34.765 E	34.759 E	34.772 E	34.771 E
	latitude	-0.078 S	-0.077 S	-0.076 S	-0.075 S
Obunga Sega sega	Longitude	34.7662 E	34.7667 E	34.775 E	34.775 E
	latitude	-0.0781 S	-0.0799 S	-0.071 S	-0.072 S
Obunga Kasarani	Longitude	34.759 E	34.765 E	34.775 E	34.775 E
	latitude	-0.077 S	-0.0738 S	-0.069 S	-0.072 S

Note: E = Eastings, S= Southings.
Source: KNBS data, 2012
Table 3.1: Obunga informal settlement Gps Co-ordinates

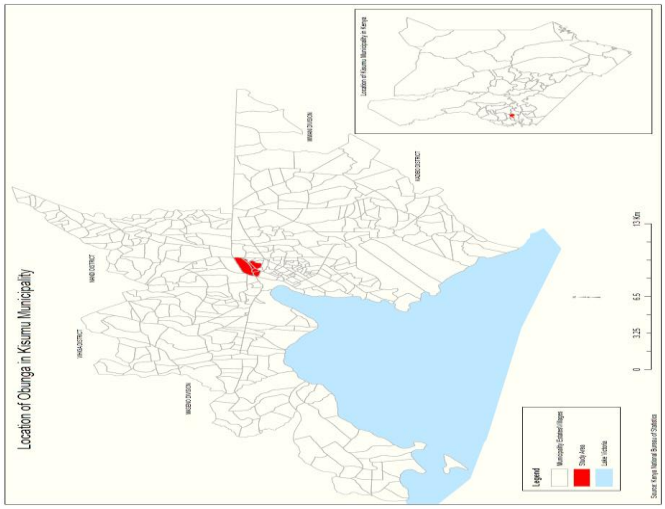


Figure 2: Obunga Central, Obunga Kamakowa, Obunga Sega sega, and Obunga Kasarani, distributed as indicated in Table 3.2

Administrative areas	Households	Male	Female	Total
Obunga Central	766	1324	1248	2572
Obunga Kamakowa	645	1070	952	2022
Obunga Kasarani	573	1044	978	2022
Obunga Sega sega	523	837	758	1595
Total	2507	4275	3936	8211

Source: KNBS data, 2009
Table 3.2: Population description of Obunga informal settlement by administrative units

C. SAMPLE SIZE AND SAMPLING PROCEDURE

The study obtained the sample size through the following sampling procedure.

a. SAMPLE SIZE

The sample size comprised 331 households in Obunga informal settlement. The sample was determined according to Amin's (2005) table of samples, as shown below, and was distributed among the 4 administrative units in the slums as shown in Table 3.1.

Population	Obunga Central	Obunga Kamakowa	Obunga Kasarani	Obunga Segasega	Total
Households	766	645	573	523	2,507
Sample	101	85	76	69	331

Table 3.3: Distribution of households in the four administrative units in Obunga informal settlement

Amin (2005) recommends a sample of 331 for a population of 2,507, at 0.05 level of confidence and 5.0% margin of error. These were the same conditions which the researcher used on the study. Guided by the Table, this study selected 331 households from the 2,507 households in the 4 administrative units in the slums.

Purposive sampling was used to select the Key Informants that the researcher deemed suitable for the study. This technique was used to select only those respondents that the

researcher was interested in and wanted to include in the study because of their typicality (Oso and Onen, 2008).

D. DATA COLLECTION METHODS

a. INSTRUMENT FOR DATA COLLECTION

Questionnaires and interview guides were used for data collection in this study. Questionnaires were used to collect data from the sampled 331 respondents of the study because the sample size was quite large, and given the time constraints, questionnaires were the ideal tool for collecting data. They (questionnaires) are deemed suitable in that they have the benefit of being self administered, anonymity and standardization of

b. RELIABILITY AND VALIDITY OF INSTRUMENTS

Reliability is a measure of the degree to which a research instrument yields consistent results after a repeated trial (Amin, 2005). Test – Retest method was used to measure reliability of the questionnaires and a correlation of 0.1 was obtained, by testing the same examinees/subjects twice (through a pilot study) with the same test/scale and then correlating the results, signifying that the instrument coefficient was stable. This means that the study instruments were capable of yielding consistent responses from the selected respondents. To ensure instrument validity, the data collection questionnaire was appraised by two independent experts, one from Kenyatta University (from the Department of Environmental Sciences) and the other from Masaai Mara University, School of Tourism and Natural resources Management. The ratings of the two supervisors were then compared and the necessary adjustments made. To enhance the validity of the instruments, a pilot study was carried out in Nyawita slums, a nearby slum to the study area. (Refer to figure 3.3 for the map of Obunga informal settlement), an area whose population shares similar characteristics to the area of study.

c. DATA ANALYSIS

Data analysis was done by the help of statistical packages for social sciences (SPSS). Chi-square was used to compare the differences between water securities of households as a result of different household water-user preferences. To test the hypotheses, the responses of each respondent on each item of the study objective was assessed and scored on a 1 – 5 points depending on the response. The minimum and maximum scores for each objective were divided into equal interval of three, for good, moderate and poor, as shown in Table 3.5. The scores were interpreted as summarized in Table 3.5.

Element of Water Security	Score – Code		
	Good = 3	Moderate = 2	Poor = 1
Availability of water	10-12	6-9	3-5
Household water-user preference	39-54	24-38	9-23

Table 3.5: Scoring, coding and interpretation of data

IV. RESULTS

A. HOUSEHOLD WATER-USER PREFERENCE AND AVAILABILITY OF WATER

The main objective of this study was to establish the relationship between household water-user preference and availability of water in Obunga informal settlement. The level of availability of water was compared against the status of household water-user preference for each household to determine the actual number of households in the slums that have poor, moderate and good availability of water, against the poor, moderate and good household water-user preference. The results are summarized in Table 4.1.

Levels of Availability of Water and Households Distribution		Household water-user preference			
		Poor	Moderate	Good	Total
Poor	Frequency	19	20	32	71
	Percent	7.4	7.8	12.6	28
Moderate	Frequency	48	33	48	129
	Percent	18.9	13	19	50.8
Good	Frequency	37	11	6	54
	Percent	14.6	4.3	2.4	21.2
	Total	104	64	86	254
		40.9	25.1	34	100.0

Table 4.1: Household water-user preference and availability of water in Obunga informal settlement

The table shows that majority (50.8%) of households in the slums have moderate availability of water while about 21.2% of the households have good availability of water. Another 28% of the households have poor availability of water. The table further shows that most (14.6%) of the households with good availability of water have poor household water-user preference and that only 2.4% of the households with good availability of water have good household water-user preference. But significant proportions (12.6%) of households with poor availability of water have good household water-user preference. This scenario suggests that availability of water is not related to household water-user preference, and that household water-user preference gets poorer as the availability improves.

The data in Table 4.2 were further tested using a Chi-square test to determine if there were significant differences in the frequencies between the categories indicated in the table. Data were used to test the hypothesis that household water-user preference in the slums is dependent on water availability. The results of the Chi-square test are summarized in Table 4.2.

Variable	N	Df	χ^2_c	χ^2_o	A	Decision
Household water-user preference and availability of water	254	4	9.488	58.450	.021	Reject Ha_2

Table 4.2: Chi-square analysis of water- user preference and availability of water

The information in Table 4.2 indicates that there is a significant difference in household water-user preference based on the status of the availability of water. The table shows that $\chi^2_o = 58.450 > \chi^2_{c\ (4,\ .05)} = 9.488$, which indicates that the differences in household water-user preferences are too large to be explained by chance. This led to the rejection of the alternative hypothesis Ha_2 that household water-user preference in the slums is dependent on the availability of water. The study, therefore, established that household water-

user preference in the slums is not dependent on the availability of water to households. Hence, it can be deduced from these results that household water-user preference is one of the factors causing water insecurity in the slums.

V. DISCUSSIONS

Water-user preferences among households in Obunga informal settlement are poor (Table 4.1). This implies that the way households use water in this area disregards recommendations by the UN (2009) for wise water-use. The households under study also seem use water contrary to proportions suggested by Istifanus (2017). This concurs with findings in Ongere, et al (2017) who also established that households in Obunga informal settlement have poor water-user preferences. This user behaviour revealed in Table 4.1 perhaps resonates with the households' perception that water sources in the information settlement are unsafe hence can be used without following strict procedures as revealed in Cherunya et al (2015).moreover, Wagner et al (2018) also found in another study done in Kenya that households, in the their preferences in using water, are not sensitive to other source qualities including taste, color, health risk, or availability. Contrary to expect ions, households in the area tend to use water in disregard to water pricing. This contradicts findings in Grafton et al (2011) which showed that the average volumetric price of water is an important predictor of differences in residential consumption. This insensitivity among households could perhaps be the reason behind unavailability of adequate safe water frequently faced by households in the informal settlements such as Obunga.

Additionally, the study reveals in Table 4.2 that household water-user preference in the slums is not dependent on the availability of water to households. Hence, it can be deduced from these results that household water-user preference is one of the factors causing water insecurity in the slums. They (households) tend to use water in undesirable proportions. This tends to contradict a study in Afghanistan by Mohammed and Sanaullah (2017) who found that major components of water consumption included washing clothes, taking bath, sanitation and kitchen in that order. Water-user preferences established in this study is also contrary to what Olufayokemi (2017) found in a study done in Nigeria that: the largest percentage of total water consumption was used for washing clothes. Findings in Table 4.2 also disagree with Ongere, et al (2017) who found that household water-user preference in the slums is dependent on the sustainable supply of water in the area (Obunga informal settlement). The findings in Table 4.2 may imply that water user preference depends on other factors such as pricing, distance to the source of water, attitude and size of the family. These were revealed in studies by Grafton et al (2011) and Hanasaki et al (2019).

VI. CONCLUSIONS

It is concluded that household water-user preference in Obunga informal settlement is poor. In this regard, water stress facing households in the slums is due to use of water in proportions that are not recommended. The study also concluded that household water-user preference is not dependent on the availability of water. The user preference depends on the family size, water pricing and attitude of the users among others.

VII. RECOMMENDATIONS

Availability of water should also be improved in Obunga informal settlement. In this regard, the households should be sensitized to use water in appropriate proportions geared towards saving the commodity for essential usage such drinking and cooking. This study also recommends adapt water recycling behaviour whereby reusing water for house cleaning and gardening would reduce wasteful behaviour of clean water. More water connections (infrastructure) should also be embarked on in Obunga informal settlement to ensure that water is made available to the residents.

ACKNOWLEDGEMENT

Finally, I wish to thank all the households, officials from Government Departments (KIWASCO and WASREB) who participated in this study to make it a success.

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