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Demographic Characteristics of Households and House Ownership Status Influence on Water Demand in Ruiru Municipality, Kiambu County, Kenya

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Abstract: The study evaluate demographic characteristics and their influence on household daily per capita water demand and also analyze how property (housing) type/size influences water demand in Ruiru Municipality, Kenya. Cross-sectional data were obtained from 210 households using both closed and opened ended questionnaire and an in-house observation guide across the three income areas of Ruiru Municipality, Kenya. The obtained data was statistically analysed using descriptive statistics, step-wise regression model and analysis of variance (ANOVA). The results showed that household size, age of household head and price policy of water (43.7%), household size (29.7%) and household size and price policy of water (21.4%) were the predictors of household daily per capita water demand for low, middle and high income areas respectively. Household daily per capita water demand across the three income areas was not associated with house type/size at significant of $p>0.05$. The findings indicate that water is not used efficiently in the municipality. The findings strengthen the need for stringent measures to attain sustainable urban household water demand management and water institutional capacity should be given special attention. The study recommends for policy implication based on an integrated watershed management (IWRM) approaches which involve a combination of immediate replacement of water used amenities for high water efficient types; water pricing that reflects the economic level of the areas to encourage efficient use; water amenities on the different markets should display water efficiency label that can communicate to buyer; promotion of educational and sensitization programs that encourage households and house owners to adopt water conservation technologies like rain water harvesting, household level treatment of wastewater for flushing toilet.

Key words: Household Demographic · Daily per Capita Water Demand · Ruiru Municipality Kenya and step-wise regression mo

INTRODUCTION

The importance of water to all aspects of life cannot be overstated. It is an essential commodity for all living beings: for direct consumption to sustain life and health, for indirect consumption through water required to grow food, fodder, fibres and for maintenance of the wide range of ecosystem services needed to support, sustain economic and social activities [1].

Water for various uses must not be of same quality standard [2]. For example, water for flushing toilet can be recycle water from bath. Household water requirement drinking need to be of higher quality standard and reliability; which in turn leads to higher costs for treatment. However, securing adequate amount of water for daily use by households in both urban and rural areas in developed and developing countries is a major challenge for all governments [3-6]. Various factors have been attributed to the current shortfall in water supply. For example, there are issues of spatial distribution of rainfall in space and time, poor water resource management coupled with population growth and urbanization according to [5, 6, 7].

Also, [8] used ordinary least-squares (OLS) regression model to confirm reported decline in water demand in North America. The following were attributed to the reduction in household daily per capita water demand; reduction in household size, water efficient amenities adapted by households, spatial distribution of rainfall and household ownership influence use decision making. On the contrary, there is a growing demand for water to meet urban household needs in developing

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countries noted by [9]. This in part due to human population growth, mismanagement of water resources, growth in urbanization and housing facilities; a situation to be worsened by growing climate change especially in developing countries like Africa and Asia. The world population at December 2012 stands at 7 billion and Africa is a home to around 900 million people, a number that has been projected to grow to 1.2 billion by 2025 and to 2 billion by 2050 by [10]. With a population growth rate of more than 2% for most countries, the continent of Africa has the fastest growing population in the world with high youthful population [6]. For example, the three fastest population regions include Eastern Africa, Middle Africa and Western Africa and will grow unusually compared to every other region through 2100, even though total fertility will be close to replacement by 2050 [10].

At the moment, about 40% of Africa's populations are reported lives in cities and urban communities. This is expected to increase due to the fast growing rate in rural-urban migration reaching 50% by the year 2020 [3]; [11]. For instance, Uganda has national population of 34.1 million at a growth rate of 3.2 and urban population of 5.0 million persons in 2012. Its urbanization rate was estimated at 5.6% per annum coupled with high fertility rate according to Uganda Bureau of Statistics [12]. While Ghana population as of December 2012 was 24,420,123 and its capital Accra has 2,025,637 urban populations growing at the rate 2.8% according to [13]. This was projected to increase to 6,300,000 people by the year 2030.

Kenya, on the other hand, has a total area of 582,646 Km^2. Over 80% of Kenya's land area is semi-arid and only 20% is arable land. Kenya's capital city, Nairobi is centrally located in the country and covers an area of 684 Km^2 and holds a population of 3.3 million people. Like many other developing countries in Africa, Kenya is experiencing rapid urbanization growth [14]. Nairobi population is projected to grow to 10.8 million by 2022 and 14.3 million by the year 2030 [15]. Due to the rapid urbanization, coupled with the population growth, it is estimated that by 2030, Kenya will be 61.5% predominantly urbanized. The rapid urbanization and population growth also generates a lot of opportunities and challenges such as water shortage, economy, social and environmental. [4], using contingency tables that generated frequencies and percentages to assess institutional aspect of Ruiru management and posit that institutional structure failed to sustainably manage water. Furthermore, [16] yet conducted another study in Ethiopia on factors influencing household water source choice decisions making using descriptive statistics and Logistic regression analyses model. The study concluded that primary employment of the head; expenditure, age and sex of the household head were predictors of water source for household.

Thus in Ruiru Municipality, the high rate of residential housing facilities to accommodate the growing human population means more demand for water is required by households. However, there are no adequate measures put in place to improve water use practices. Can the expanding urban area be matched without adequate water? The study hypotheses that 'demographic characteristics of the three income areas of the Ruiru Municipality have similar influence on household daily per capita water demand'. Also there is no significant relationship between household level of daily per capita water demand and house type/ number of room occupy. The need for better understanding of these household demography characteristics and house occupancy on daily per capita water demand of households in the municipality of Ruiru was the purpose of the study to contribute toward an efficient use of water as indicate by the IWRM principle. This is vital if Kenya is to meet the Millennium Development Goals (MDGs) by reducing the percentage of people without sustainable access to water at an affordable rate, safe to drink and proper sanitation for improved health benefits by 2015 [7].

MATERIALS AND METHODS

The Study Area: The study was carried out in Ruiru Municipality of Kiambu County, within in the Central Kenya. It lies between Latitudes 3°53' and 1°45' South of Equator and Longitudes 36°35' and 37°25' east. It lies approximately 1550m above sea level. The area is generally slopes from the northwest to southeast. To the North-West the town's topography is largely steep and separated by Makuyu and Ruiru rivers. However, these areas offer good locations for farming and also housing development. The area between the Biashara ward and Majengo estate is trough shaped and liable to floods during heavy rains Ruiru Municipal Physical Development Plan [15] and [17]. The areas south of Nairobi-Thika road are generally flat and offer good location for industrial development.

The municipality is located on the Thika-Nairobi Super High and expanding fast leading to increase water demand. It is located 15 kilometres to the northeast of Nairobi and less than 3 kilometres from the Nairobi city boundary [15]. Ruiru Municipality is a satellite town of the rapidly expanding Nairobi Metropolitan area. Locally, it borders Juja sub location to the north, Machakos County to the East, Nairobi city to the south and

Kiambu County to the west. It is accessible by either railway or highway and the entire municipality cover 292 Km^2 [15].

Population: Ruiru Municipality population stood at 109,574 people or 34,274 [18] Based on Nairobi's growth rate of 7.3%, the current population of the municipality is estimated to be between 165,000 and 180,000 residents [17]. Within the municipality, population density varies for instance; there is high population density in Biashara while the lower parts are sparsely populated.

Social-Economic Activities: The central business 'Biashara ward is the main commercial hub with the main activities of services including banks such as National Bank of Kenya, Equity Bank of Kenya, Commercial Bank of Kenya, Family Bank and PostBank, petrol stations, insurance and professional services, cafes and restaurants, the bus park and several shops for retail and wholesale purposes. Informal sector operators (food, vegetables, household ware, second hand/new clothes), are located around the bus park and on the main streets of the centre. The area is also known for the production of cash crops like coffee and sisal but the sisal processing came to halt [17]. The municipality is well-covered with industries such as Spinners & Spinners Limited, Brookside Dairy Limited, Devki Steel Mills and Bogani Industries. It also has the following educational institutions the Main and Ruiru Campus of Kenyatta University and other middle-level colleges with the Ministry of Higher Education. Examples of these include Compuera College, Royal College of Science and Technology and Nairobi Institute of Business Studies Branch.

Water Supply Infrastructure: The Athi Water Services Board (AWSB) has licensed the Ruiru-Juja Water and Sanitation Company (RUJWASCO) to operate and maintain the water supply and sanitation facilities within the municipality. But this is only meeting 14% of the water demand for the municipality. The high demand for water led to privately owned borehole operation and shallow wells proliferation within the Ruiru Municipality, predominantly in the densely populated areas that do not have connections to piped water [16, 17.

Research Methodology: The study used descriptive approach which involved utilization of mixed methodologies that combine qualitative and quantitative method. A cross-sectional household level demographic characteristic data was collected across three income areas of Ruiru Municipality using both closed and open ended questionnaire and in-house observation guide. A total of 210 households were drawn from across Wataalam and Githambaya Area 'B' areas classified as low income areas; Murera/Mugutha areas observed as middle income and Gitongora/Kihunguro in Ruiru East noted as the high income areas within the municipality according to [16] and the municipal officials consulted prior to the study. The selections of the wards were based on their demographic characteristics. This is to help determine how their demographic characteristics influence household daily per capita water demand across the three income areas. Sample sizes of 70 households were chosen for each income areas based on proposal guideline provided by [19]. It states that study seeking to compare the differences between the strata should adapt equal proportion in selecting its sample size. Equal sample size from each stratum would be more efficient even if the strata are different in size [19]. Thus, the low income area (Githambaya 35 and Wataalam 35), middle (Murera 37 and Mugutha 33) and high (Gitongora 35 and Kihunguro 35) income areas sampled size 210 households respectively. Also [20] posit that ideal sample to consider for step-wise regression analysis should not fall below 150 if appropriate and accurate result is desire.

Prior to the main research, a pilot survey was done in order to pre-assess the various instruments (questionnaires and in-house observation guide). After the pilot assessment, various items in the research instruments that were unreliable as well as redundant were done away with and a final form of the research instruments prepared for the main research.

In order to thoroughly comprehensive the household daily per capita water demand management properly, both published and unpublished literatures were used concerning demographic characteristics influencing household daily per capita water demand management principles. This enables the researcher to arrive at reliable and accurate interpretation of results by triangulating the findings with previous ones. The data were then analysed using statistical tools such as step-wise regression model where the model was able to eliminate variables that failed to influence the dependent variable household daily per capita water demand and however gave the percentage those that influence contribute to predict the dependent variable household daily per capita water demand. On the other hand ANOVA was tested at the significant level of $p < 0.05$ to determine how housing occupy by households across the income areas influence their household daily per capita water demand. The findings were then interpreted and presented in cross-tabulation,

frequencies and percentages from which inferential were drawn. The findings were validated and confirmed with similar empirical works for accuracy and reliability of results.

Step-Wise Regression Model: There are various ways to determine the predictor variables of household daily per capita water demand. But for study like this we need to be exact on how much each independent variable is contributing to predict the dependent variable to inform decision making process. Therefore, step-wise regression was deemed fitting for the study since it always results in the most parsimonious model. This could be important if you wanted to know the minimum number of variables and their percentages contribute to predict the criterion variable [20]. This was done following the guideline provided by [20] for analysis of the kind. Thus, the analysis formula:

$$Q = f(X_1, X_2, \ldots, X_n) + u,$$

where, Q—is the dependent variables for the household daily per capita water demand and use. In this study Q is an average monthly household daily water demand (use).
f (.)—signifies the function of explanatory independent variables: household demographic characteristics such as gender, marital status, education, occupation, income, age, household size and cost of water.
u—is the stochastic error term. In this study it is held constant. For each of the three income areas, full logarithmic model were developed as:

$$\ln Q = b_0 + b_1 \ln X_1 + \ldots + b_n \ln X_n + u.$$

This allows the interpretation of the results as per each income area through data split option in the model. By the nature of the step-wise regression model, independent variables which do not contribute significantly in explaining (predicting) the dependent variable were eliminated. This was done by reporting the R Square (R^2), which is the square of the measure of correlation and indicates the proportion of the variance in the criterion variable which was accounted for by our model based on guideline provided by [20]. The beta results were reported to enable prediction to be made about future water demand or saving through technologies adoption by household to manage water sustainably. Thus, beta is measured in units of standard deviation. For instance, a beta value of 2.5 indicates that a change of one standard deviation in the predictor variable will result in a change of 2.5 standard deviations in the criterion variable. The higher the beta value the greater the impact of the predictor variable on the criterion variable.

Furthermore, the ANOVA report generated by the step-wise regression model, determined the variance accounted for by the independent variables. In step-wise regressions analysis (model) do not directly manipulate the independent variables but instead just measure the naturally occurring levels of the variables and see if this helps us predict the score on the dependent variable (or criterion variable) [19]. Thus, ANOVA is actually a rather specific and restricted example of the general approach adopted in multiple regressions [20, 21]. It provides justification for the step-wise regression results obtained. At this point it is worth noting that household size is a common predictor variable in three areas. Though, other variables were uniquely predictor of daily per capita water demand of households within the three income areas of Ruiru Municipality.

Also, the study used step-wise regression technique because it allows the model to decrease drastically the total number of independent variables assumed to have influenced the daily per capita household water demand. The final result will depend substantially on the significant parameters left and the percentage influence they contribute to the dependent variable (household daily per capita water demand) according to [19, 21].

More so, according to [20], one-way between-groups ANOVA is used when you have one independent (grouping) variable with three or more levels (groups) in this case the property (house) type and size (number of rooms) in the low income, middle and high income areas and one dependent continuous variable which is the households' daily per capita water demand. The 'one-way' part of the title indicates there is only one independent variable and 'between-groups' means that you have different participants in each of the groups. Hence, to determine whether there was a relationship between households' daily per capita water demand and property type/size across the three income areas of Ruiru Municipality one way ANOVA performed.

RESULT AND DISCUSSION

Results of Households Demographic Characteristics: Table 1.0 shows the household demographic characteristics of the three income areas. The results indicate that, across the 210 households respondents surveyed in the low, middle and high income areas, there were 64.3%, 57.1% and 61.3% female respondents than male respondents in the low, middle and high income

Table 1.0: Households Demographic Characteristics

N=210		Low Income Area, N=70	Middle Income Area, N=70	High Income Area, N=70
Gender (%)	Male	35.7	42.9	38.6
	Female	64.3	57.1	61.4
Marital status (%)	Married	75.7	71.4	68.6
	Single parent	10.0	5.7	0.0
	Single	14.3	22.9	31.4
Education (%)	None	2.9	1.4	1.4
	Primary	30.0	4.3	15.7
	Secondary	45.7	40.0	32.9
	Tertiary	21.4	52.9	50.0
	Informal Training	0.0	1.4	0.0
Occupation (%)	Salaried	2.9	24.3	21.4
	Self employed	54.3	50.0	41.4
	Unemployed	8.6	14.3	24.3
	Manual worker	34.2	11.4	12.8
Income (Kshs.)	10,000 and below	34.3	4.3	2.9
	10,001-20,0000	45.7	28.6	21.4
	20,001-30,000	14.3	21.4	22.9
	30,001-40,000	1.4	25.4	18.6
	40,001-50,000	2.9	11.4	18.6
	50,001-60,000	1.4	4.3	2.9
	60,001-70,000	0.0	2.9	1.4
	70,001-80,000	0.0	1.4	5.7
	80,001-90,000	0.0	0.0	1.4
	90,00- 100,000	0.0	0.0	4.3
Age (years)	25 and below	15.7	14.3	11.4
	26-35	40.0	28.6	31.4
	36-45	34.3	34.3	31.4
	46-55	7.1	15.7	17.1
	56-65	1.4	4.3	4.3
	66 and above	1.4	2.9	4.3
Household Size (%)	1	8.6	1.4	1.4
	2	7.1	2.9	1.4
	3	22.9	5.7	5.7
	4	27.1	21.4	12.9
	5	34.3	40.0	55.7
	6+	0	28.7	22.9

Field Survey, Author (2013)

areas respectively. Marital status indicates that 75.7%, 71.4% and 68.6% were married in the low and middle income areas whilst single parents were 10% and 5.7% for low and middle income areas. The study further captured 14.3%, 22.9% and 31.4% of the respondents reported as single in the low, middle and high income areas. More so, educational attainment were given as 2.9%, 1.4%, 1.4% (no formal education) for the low, middle and high areas; 30%, 4.3% and 15.7% attained primary level education (for the low, middle and high income area); secondary level 45.7%, 40% and 32.9% (for the low, middle and high income area) respectively; tertiary level 21.4%, 52.9% and 50% for the low, middle and high income areas. Occupation on the other hand indicate that 2.9%, 24.3% and 21.4% reported as government workers for the low, middle and high income areas; self-employed reported were 54.3%, 50% and 41.4% for the low, middle and high income areas; unemployed 8.6%, 14.3% and 24.3% for low, middle and high income areas; manual worker reported were 34.2%, 11.4% and 12.8% respectively for low, middle and high income areas. Furthermore, the study results indicate that 80% of low income area households had household expenditure less or equal to Kenya Shillings (Kshs.) 20, 000, middle income areas household expenditure between Kshs 10,000 to Kshs. 40,000 and high income areas household expenditures concentrated between Kshs. 10, 000 and Kshs. 50, 000. Age of respondents' revealed that over 80% of household's heads age fell above 26 years and below the age of 56 in the low income, middle income and high income areas.

While over 54%, 37% and 28.5% of the respondents in the low, high and middle income area between the ages of 25-45. It was further indicated that the mean household size for the low income area was 4 and 5 for both middle and high incomes.

The average monthly mean costs of household water were Kshs. 581.3, 1247.9 Kshs. and 1311.4 Kshs. respectively.

RESULT

Table 1.1 show the summary of the results of the step-wise regression model of the various explanatory independent variables that predict households' daily per capita water demand across the three income areas of Ruiru Municipality, Kenya. This was achieved through the hypothesis; "demographic characteristics have similar influence on household water demand in Ruiru Municipality". To test this hypothesis, the study used a data split in order to regress for each of the three areas of Ruiru Municipality. A step-wise multiple regression analysis was performed and seven household demographic attributes: gender, education, occupation, income (expenditure of household), age, household size and cost of water were considered while the dependent variable was measured in terms of per capita household water demand.

The results in Table 1.1 represent separate predictor variables of household daily per capita water demand in the three income areas with unique characteristics. Following the guideline provided by [20] in discussing the regression model, below are the results for household-level cross-sectional data:

For the low income area, the predictor variables in the model were household size, age and monthly cost of water (Table 1.1) while the following were eliminated gender, education, occupation and household expenditure (income). The value of the $R^2 = 43.7$ indicates that 43.7% of the variance in the dependent variable (household daily per-capita water demand) is explained by the model. The middle income area only had household size as the predictor variable which gave $R^2 = 29.7$. This indicates that 29.7% of the variance in the household daily per-capita water demand. The other six variables were eliminated by the model. On the other hand, the high income area predictor variables were household size and monthly cost of water which yielded $R^2 = 21.4$. This shows that 21.4% of the variation in the household daily per-capita water demand was explained by the model. At this point it is worth noting that household size is a common predictor variable in three areas. These results were validated through further analyses associated with the step-wise regression involving ANOVA findings. Thus the results in Table 1.2

Table 1.2: ANOVA Results of the Three Areas

Areas	Model		Sum of Squares	df	Mean Square	F	Sig.
Low Income	1	Regression	272.296	1	272.296	37.697	.000[a]
		Residual	491.189	68	7.223		
		Total	763.486	69			
	2	Regression	303.619	2	151.810	22.118	.000[b]
		Residual	459.866	67	6.864		
		Total	763.486	69			
	3	Regression	333.541	3	111.180	17.067	.000[c]
		Residual	429.945	66	6.514		
		Total	763.486	69			
Middle Income	1	Regression	1254.007	1	1254.007	28.752	.000[a]
		Residual	2965.764	68	43.614		
		Total	4219.771	69			
High Income	1	Regression	828.096	1	828.096	13.358	.001[a]
		Residual	4215.390	68	61.991		
		Total	5043.486	69			
	2	Regression	1077.217	2	538.608	9.098	.000[d]
		Residual	3966.269	67	59.198		
		Total	5043.486	69			

a. Predictors: (Constant), Household size

b. Predictors: (Constant), Household size, Age

c. Predictors: (Constant), Household size, Age, Monthly cost of water

d. Predictors: (Constant), Household size, Monthly cost of water

e. Dependent Variable: Household per capita water demand

Field Survey, Author (2013)

Table 1.3: Factors Affecting Household Water Demand

Ares	Variables		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Low Income	1	(Constant)	1.196	1.012		1.182	.241
		Household size	1.586	.258	.597	6.140	.000
	2	(Constant)	3.366	1.416		2.377	.020
		Household size	1.710	.258	.644	6.618	.000
		Age	-.076	.036	-.208	-2.136	.036
	3	(Constant)	3.220	1.381		2.332	.023
		Household size	1.555	.262	.585	5.932	.000
		Age	-.082	.035	-.224	-2.354	.022
		Monthly cost of water	.002	.001	.208	2.143	.036
Middle Income	1	(Constant)	-1.907	2.900		-.658	.513
		Household size	2.993	.558	.545	5.362	.000
High Income	1	(Constant)	-.926	4.168		-.222	.825
		Household size	2.968	.812	.405	3.655	.001
	2	(Constant)	-3.223	4.224		-.763	.448
		Household size	2.728	.802	.372	3.401	.001
		Monthly cost of water	.002	.001	.225	2.051	.044

Field Survey, Author (2013)

reveal that $F_{3,\ 66} = 17.067$, $P < 0.05$, $F_{1,\ 68} = 28.752$, $P < 0.05$ and $F_{2,\ 67} = 9.098$, $P < 0.05$ for the low, middle and high income areas respectively.

This signifies that there was significant difference in the means of the predictor variables for the low, middle and high income areas of Ruiru Municipality. However, this was not satisfactory to make a decision about the hypothesis "Demographic characteristics have similar influence on HHs water demand in Ruiru Municipality". Further interpretation base on the standardized and unstandardized coefficients in Table 1.3 was done to ascertain the contribution of each predictor variables to the prediction of the dependent variable.

A large value indicates that a unit change in this predictor variable has a large effect on the criterion variable. The *t* and Sig (p) values give a rough indication of the impact of each predictor variable – a big absolute *t* value and small *p* value suggests that a predictor variable is having a large impact on the dependent variable Pallant (2011).

Thus the results yielded different linear equations for the different areas. The equations for the low, middle and high income are listed below:

Low Income Area: Household daily per capita water demand = 1.555 × household size - .082 ×Age + .002 × monthly cost of water + 3.220

Middle Income Area: Household daily per capita water demand = 2.993 × household size - 1.907

High Income Area: Household daily per capita water demand = 2.728 × household size + .002 × monthly cost of water - 3.223

Using the linear representation from the three income areas together with the mean household size, mean age and mean monthly cost of water for three areas, it evident that the household daily per capita water demand (use) for the low, middle and high income areas are 272 litres, 580 litres and 613 litres respectively considering their mean monthly cost of at 581.3, 1247.9 Kshs. and 1311.4 Kshs. respectively. This was based on calculation of the current thrift of 1000 litres of water at the cost of 69 Kenya Shillings. This implies that the larger the household size, the higher its water demand. Also household water demand in the middle and high income areas is not price responsive as it takes positive sign contrary to Olmstead *et al*. [22]. Negative sign implies that water demand is responsive to price. This can be explained by the fact that almost all the water uses in the three income areas reflect the household demographic characteristics of using water to meet their basic necessity of living. Hence, the study concludes that there were significant differences in how the household demographic characteristics influenced household daily per capita water demand. Therefore the study rejects the hypothesis "demographic characteristics have similar influence on HHs water demand in Ruiru Municipality".

Housing and Water Demand Management: House ownership in Ruiru municipality was established and there were 7.1%, 81.4% and 71.4% house owners for the low, middle and high income areas respectively (Figure 1.0).

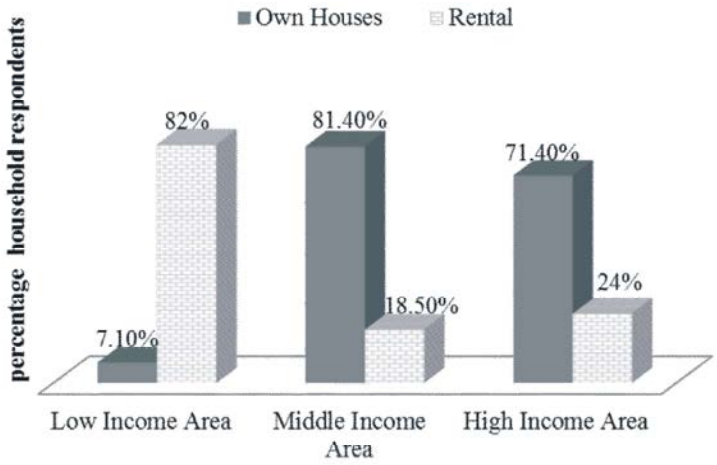

Fig. 1.0: House Ownership
Field Survey, Author (2013)

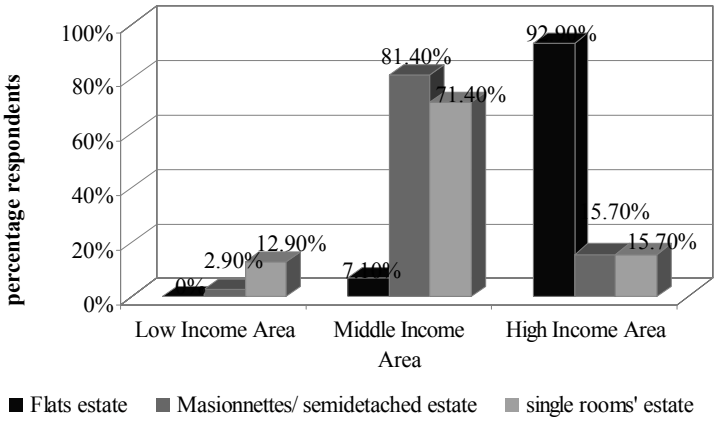

Fig. 1.1: Distribution of House Type Field Survey, Author (2013)

The results in Figure 1.0 indicate the 7.1%, 81.4% and 71.4% respectively of the low, middle and high income areas reported as owners of house they were living in during the study. The results show that in the low income area, 82% of the respondents reside in rental housing compared to the other two income areas. These residences are found around the factories and the market area low income area which is the business hub (*'Biashara'*) and thus convenient to them to engage in small scale businesses and labour work at the factories. The high percentage for the middle and high income however constitute high profile government and private sector employees who purchased land and constructed their own houses noted by [23]. When the respondent households were asked whether ownership influence decision making toward household water demand management practices leading to efficiency in water use, the results indicate that 97%, 91.4% and 74% respectively of the low, middle and high income areas reported yes. Adding it will afford the opportunity to take water use decision. This confirms an empirical work by [8]; [5] who established that:

> *The decision by a household to install appliances that use less water and optimise water utilization as well as rain harvesting facility is largely determine by the owner of the household and his understanding of water as a finite resource. Tenants are only staying for a period of time and cannot make any long term plan for sustainable household water use.*

House Type and Household Water Demand: The study determined the types of housing across the three areas of Ruiru Municipality and results are as in Figure 1.1.

Figure 1.1 results indicate that a majority of 92.9% respondents households sampled in the low income area lived in single rooms' estate as compared to 15.7% for

Table 1.4: Distribution of House size (Number of Rooms)

	Number of Rooms							
Locations	1	2	3	4	5	6	7	N=70
Low income area	45.7%	31.4%	5.7%	4.2%	12.8%	0	0	70
Middle income area	0	11.4%	30%	10%	29%	7.1%	0	70
High income area	4.2%	18.5%	21.4%	14.2%	32.8%	7.1%	1.4%	70

Field Survey, Author (2013)

Table 1.5: ANOVA Test of Relationship between Household Water Demand and House Type in the three Areas

Areas		Sum of Squares	df	Mean Square	F	Sig.
Low income area	Between Groups	15.824	1	15.824	1.439	.234
	Within Groups	747.662	68	10.995		
	Total	763.486	69			
Middle income area	Between Groups	94.691	2	47.345	.769	.468
	Within Groups	4125.081	67	61.568		
	Total	4219.771	69			
High income area	Between Groups	129.066	2	64.533	.880	.420
	Within Groups	4914.420	67	73.350		
	Total	5043.486	69			

Field Survey, Author (2013)

both middle and high income areas. Single rooms' estates were thought to be cheaper and affordable for the low income earners. Furthermore, the size of the house in relation to the number of rooms across the three areas was also established to correlate with its water demand. The results indicate that of the sampled household respondents in the low income area over 70% lived in single rooms without the following sitting room, bathroom, toilet and kitchen. The tenants share common bathroom and toilet located in the compound. On the other hand, the double room houses consist of a sitting room and a bed room with in-built toilet and bath. The middle and high income area most respondents lived in 3 to 5 bedrooms' houses exclusion of sitting room, bathroom, toilet and kitchen (Table 1.4).

The results in Table 1.4 indicate the relationship between households' water demand and property (house) type and size (number of rooms) in the low, middle and high income areas respectively of Ruiru Municipality. To accomplish the hypothesis "there is no relationship between household level of water demand and house type" one- way ANOVA tested was carried out in the next section.

ANOVA Findings of Relationship Between Household Level of Water Demand and House Type: The study through one-way ANOVA test sought to ascertain the hypothesis "there is no relationship between household level of water demand and house type". The test result for low, middle and high income were $F_{1,68} = 1.439$, $p > 0.05$, $F_{2,67} = .769$, $p > 0.05$ and $F_{2,67} = .880$, $p > 0.05$ as in Table 1.5.

This shows that for each of the three suburbs there was no difference in the means of house type and household daily per capita water demand. Therefore the null hypothesis "there is no relationship between household water demand and house type" was accepted. This confirms that water demand in the Ruiru Municipality is more determined by household size than the type of housing. The association between household daily per capita water use and household size demonstrate that increase in household daily water usage can better be explained by the growing number of household size than house size (number of rooms).

CONCLUSION

The study shows that there was significant difference in the means of the predictor variables for household daily per capita water for the low, middle and high income areas of Ruiru Municipality. The findings of the study indicates household size, age and monthly cost of water ($R^2 = 43.7$); household size ($R^2 = 29.7$); and household size and monthly cost of water which yielded $R^2 = 21.4$ were the predictors for daily per capita water demand for the low, middle and high income areas respectively (significant at $P < 0.05$). House ownership was indicated to contribute household sustain water use practices (97%, 91.4% and 74% respectively of the low, middle and high income areas). It further established that there is no relationship between household level of water demand and house type (significant at $p > 0.05$). In regards, household water demand management practices must be dependent on

household demographic characteristics of the areas socioeconomic conditions and house ownership leading to water efficiency technologies adoption.

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