



Correlation Study of Domestic Water Use and Socio-Cultural Factors in Bauchi Town, Bauchi State-Nigeria

¹VICTOR Istifanus, ²ABDULKADIR Aliyu and ³BWALA Haruna.Baba

¹Department of Environmental Management Technology,

²Department of Urban and Regional Planning,

³Department of Urban and Regional Planning,

Faculty of Environmental Technology

Abubakar Tafawa Balewa University Bauchi, Nigeria

ABSTRACT

Globally, socio-cultural factors are thought to influence domestic water use. Researchers over the years have been interested in establishing the link between the quantity of water used for domestic purposes and the factors that are thought to influence domestic water use. This study, therefore, investigates the relationship between the quantity of domestic water use and some selected factors in Bauchi metropolis. Through exploratory research of mixed design, a structured questionnaire was administered using a stratified random sampling technique to collect data. Descriptive statistical tools were used in analyzing the data and the instrument of analysis was Microsoft Excel software. The study found out that there is a positive correlation between the quantity of domestic water use and education level, income, household size and marital status. The relationship between the price of water and the quantity of domestic water use is not very clear as water rates were essentially fixed. However apart from those having fixed rates other users of water showed a positive correlation between the quantity of water use and price of water. Other factors that have a significant relationship with the quantity of domestic water use are gender, religion, occupation, source of water and type of house. The study recommended that socio-cultural factors should be an integral part of any water planning scheme in Bauchi metropolis.

Key words: Domestic, Relationship, Quantity, Water use, Factors.

1. INTRODUCTION

Domestic water use is water used at household level for various activities. Domestic water or household water is defined as water used for drinking, bathing washing cloths and dishes flushing toilet and landscaping [1]. Domestic water use is a collective outcome. A number of factors determine the type of activity and quantity of water used in the domestic domain. It is certain that societies are going to have to confront, among other things, demographic transitions, geographical shift of population, technological advancement, growing globalization, degradation of the environment and emergence of water scarcities. Indeed, rapid growth in population, economic development and changes in life style have been responsible for the rapid growth in water demand use in many developing countries in the face of shrinking supplies due to over-exploitation and pollution [2]. There are many factors that contribute to the total water consumed at household level. [3] Examined the main issues in literature on residential water demand. They analyzed several tariffs and their objectives and identified water price, income or household composition as crucial determinants of residential water consumptions. Other researchers found out that the rate of water demand depends on the socio-economic standard of the people, the level of education and development, the nature of prevailing climate and hygiene characteristics of the people. Other factors include water use appliance and geographical location [4]. The list of factors keep increasing as society transits from one level of development to another. The relationship between factors and quantity of domestic water use have been of interest to scholars of domestic water use for a long time. Most of the studies in this area were primarily concerned about establishing the statistical relationship between some selected factors and domestic water use [5, [6],

[7]). That is whether the relation between the said factors are statistically significant or not. [8], in a study of determinants of domestic water use in Bauchi metropolis found out that all the eleven variables analyzed were statistically significant in predicting domestic water use. This study therefore, will go further than the theoretical statistical relationship to investigate the practical relationship between each factor and domestic water use in Bauchi metropolis

2. METHODOLOGY

Bauchi has a population of 349,232. This is made up of 43,654 households distributed in the low, medium and high density residential areas. A stratified random sampling technique was used for this study to administer the structured questionnaire. A sample size of 380 households were taken; in low density (54), medium density (130) and high density (196) [9]. Table 1, descriptive statistical tools are used, Microsoft Excel was used to analyze the practical relationship between each factor and quantity of domestic water use. The data analyzed is presented in tables, averages and percentages. The socio-cultural factors analyzed are Marital Status, Gender, Household Size, Age, Occupation, Income, Educational Level, Price of Water, and Sources of water, Types of house and Religion.

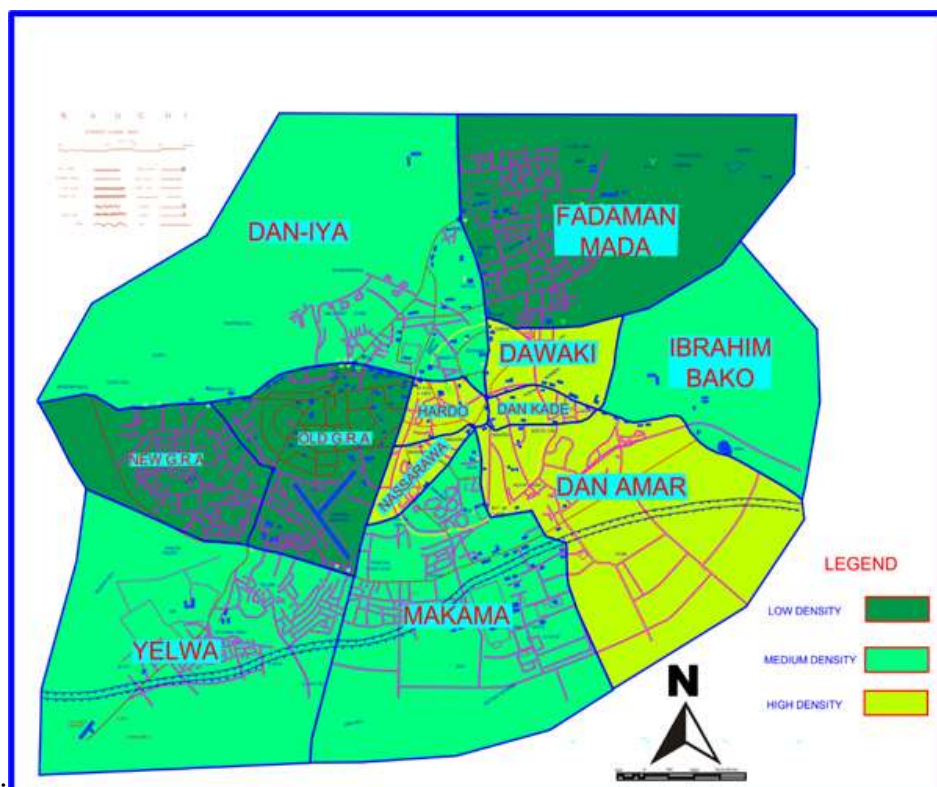


Figure 1: Map of Bauchi wards and density

Source: Field work, 2017

Table 1: Sampled households in Bauchi metropolis

Density	No. of sampled household	%	No. of people in sampled	%	Average household size
Low	54	16	463	14	9
Medium	130	28	809	34	6
High	196	56	1592	52	8
Total	380	100	2864	100	8

3. FACTORS OF DOMESTIC WATER USE

The determinants of domestic water use vary from place to place and from community to community. [10], reported that [11], summarized the factors potentially influencing domestic water use in North American context. These variables are in five major categories:

- i. Utility management policy variables (water rate)
- ii. Household economic variables (consumer income or wealth)
- iii. Household physical features and technological variables- (infrastructure of water using and water saving devices, lot size/ metered and unmetered).
- iv. Environmental factors- (temperature and precipitation).
- v. Demographic variables: (number of household's resident's altitudinal and cultural variables).

The list of variables affecting domestic water use keeps growing as society progresses. [5], used multiple regression models in a multiple demand study of Oklahoma City and Tulsa in Oklahoma. The results indicate that price and per capita income were predicative variable for Oklahoma City's water demand while only per capita income was found to be a predictor for consumption in Tulsa.

Mini, 2000 employed this approach in water demand studies in Ramallah & Khartoum (Sudan) respectively [6]. In both studies, household sizes were significantly associated with water use. While in Ramallah household size was positively associated with water use. In Khartoum reverse was the case. That is as household size increases per capita water use decreases).

Romano, 2014 estimated the determinants of Domestic Water Demand of chief towns in Italy [10]. Their result confirmed that the applied tariff had a negative effect on domestic water consumption. Income per capita had a positive effect while precipitation and altitude had a significance significant negative effect on water consumption. Temperature did not influence water demand. Moreover, people tend to use less water when there are demands management measures such as meters and variable prices on different uses. In Canada for example, in 1994, households that paid for water by volume used 263 L/p/c/d a figure that is 39 % less than 430 L/p/c/d consumed by households that paid a flat rate [11]. Cook et al, 2001 in a study of Ada & Canyon countries in Idaho identified income, household size and weather as factors influencing water demand [12]. In Toronto, Environment Canada, 2011 found population, location, metering and price to be the prime factors that affect water use [13].

Sleich, 2007 studied the determinants of domestic water demand in Germany and found the differences in price and income alone explain the largest part of the gap in domestic water use[14]. But household size had a negative impact on water demand while higher age appears to be associated with higher water use. They found out that wells in Germany, have a negative effect on per capita water demand as would be expected. In Barcelona, Corbella et al, 2009 in their study of "what lies behind domestic water use" found that the drivers of water use are income household size, ageing and climate [15]. Otaki et al, 2010 in their study of domestic water demand analysis by household activities in developed countries found out that the factors that influence water use were water resources, water price, climate, dietary culture and household size in that order of magnitude [16]. Mini, 2013 in a study of domestic water consumption in Los Angeles found the drivers of water consumption as income, land scape greenness and outdoor water use, tier water rates and allotment [17].

In a study of domestic water demand in Copenhagen, Denmark, Hausen, 1996 found that even prices of other goods and services such as energy were a significant variable for water demand [18]. Statzu, 2009 found that in Italy, home owners consumed less water than renters did, probably because rents often cover the water bill, and hence renters do not receive accurate price signals for their consumption behavior [19]. Garcia-Villians, 2005 in a study of domestic water demand demonstrated that restrictions implemented in Seville Spain during the drought seemed to have an important influence on water demand [20]. Mazzanti, 2006 found that altitude had a significant negative effect on water consumption in Italy [21]. Musolesi, 2007 in another study reported that water consumption increased in drought periods and in dry areas [22].

In contrast, Arbues, 2006 reported an association between high temperatures and low water consumption in the city of Zaragoza Spain, which they suggested was due to consumption levels tapering off in the summer because of the overflow of residents to holiday destination [23]. Nauges, 2000 reported that residential water consumption was significantly lower when individuals housing with meter recording was present and they thus encouraged the installation of water metering [24]. Martins, 2007, in Portugal demonstrated that high temperatures increased demand for water, although rainfall had no significant association with water demand [25]. In Barcelona metropolitan areas, Corbella et al, 2009 explore the link between immigration, ageing and domestic water consumption [15]. They found that immigration has more significant impact than ageing. Dangwe, 2012 in a study of Meravi Ethiopia found demographic and socio-economic factors such as head of households, and income as the determinants of domestic water use [26]. In their study of water efficient appliances in Brisbane, Australia, Fielding et al, 2012 found a mixed

effect [27]. Some water efficient appliances were associated with less water use, while others were associated with more water use.

Findings relating to age are less clear. While some research has shown that older households consume less water, it may be stage of life rather than age that determines water use. For example, being retired or having teenage children may increase water use. The former because people are at home more than when they are working and the later because teenagers are high water users [28].

In Nakemate town Ethiopia Ali, 2012 found the major determinants of water use were household size, income of households, occupation and education status. Distance and time spent, distributions of public taps were less important [29]. Sule *et al*, 2006 in a study of water consumption pattern in Ilorin found the factors that influence water use were socio- economic level, standard of living, age of community, population, availability of water and level of sanitation awareness [30].

Olujujegbe, 2010, in a study in Ado Ekiti found the source of water, adequacy of water supply, price and distance as the main factors influencing water use [31]. Studies on water demand at household level in Ilorin, Nigeria and found that income, education level and gender are the major determinants of water use. Sani, 2008 identified household size, income and housing type as the factors affecting water use in Gombe town [32].

4. RESULT AND DISCUSSION

4.1 Relationship between quantity of domestic water use and socio-cultural factors

Domestic water use is a collective outcome .However practically the study found significant relationship between quantity of domestic water use and the analyzed factors. The study found Females use 59 % (115,117 litres) of total domestic water while Males use 41% (79,596 litres). On per capita basis females use 75 litres while male use 60 liters a day. In the low density 39 % total water is used by males and 61 % is used by females. In the medium density areas, 40 % of water used by males while 60 % is used by females. Similarly in the high density areas 42 % of water is used by males and 58 % is used by females (Table 1). This may be due to the fact that women are more involve in domestic activities than men. Furthermore the physiological make up of females require them to maintain higher degree of personal hygiene than males.

Similarly the study also found 37 % of total water use is by those earning over 301, 000 naira while people earning less than 30,000 naira use only 11 % of total domestic water in Bauchi. People earning between 101,000 – 300,000 uses 20 % of total domestic water and so on (Table 2). This shows that as one income improves his water use increased. There is therefore a positive correlation between quantity of domestic water use and income.

Table 2: Relationship between Quantity of water use (in litres) and Gender in Sampled Households

Gender	Density								
	Low	%	Medium	%	High	%	Total	%	Per Capita
Male	12,212	39	21,932	40	45,452	42	79,596	41	60
Female	19,397	61	33,197	60	62,523	58	115,117	59	75
Total	31,609	100	55,129	100	107,975	100	194,713	100	

Table 3: Relationship between Quantity of Water Use (in litres) and Income in sampled households

Income	Low	%	Medium	%	High	%	Total	%
15000-30,000	1473	3	2135	4	18718	20	22326	11
31,000-60000	6099	13	5339	9	11628	13	23066	12
61,000-100,000	7093	16	8490	15	23737	26	39320	20
101000-300,000	3435	7	14778	26	20187	22	38400	20
Above 301,000	28069	61	26260	46	17272	19	71601	37
Total	46169	100	57002	100	91542	100	194713	100

The study found out that, people aged 0-14 uses 27 % of total domestic water, those aged 15-49 use 64 % while those aged above 50 use 9 %. On per capita basis people aged 0-14 use 56 l/p/c/d, 15-49 use 73 l/p/c/d while those aged above 50 years uses 77 l/p/c/d. In the high density areas 20 % of total domestic water is used by people aged 0-14, 71 % by those aged 45-49 and 9 % by those aged above 50 (Table 3). This study found out that at the age group level the quantity of water use at per capita have a positive correlation with age.

Table 4: Relationship between Quantity of Water Use (in litres) and Age in sampled households

Age	Low	%	Medium	%	High	%	Total	%	Per capita
0-14	14103	37	17108	36	21547	20	52758	27	56
15-49	20713	55	26026	55	77270	71	124009	64	73
Above 50	3169	8	4311	9	10466	9	17946	9	77
Total	37985	100	47445	100	109283	100	194713	100	

Similarly the study found out that, households who pay 1000 naira use 34 % of total; domestic water while those who pay 500 naira use 25 % of total; domestic water use, above 5000 naira use only 1 %. Households that pay 2000 naira use a total 20 % of domestic water and so on (Table 4). On price of water above the one thousand naira fixed rate, quantity of domestic water use is positively correlated with price of water.

Table 5: Relationship between Quantity of Water Use (in litres) and Cost of Water in Sampled Households

Cost of naira	Density						Total	
	Low	%	Medium	%	High	%	Total	%
500	12997	35	9748	18	25323	24	48068	25
1000	10239	27	24948	47	32959	32	68146	34
2000	6569	17	14259	27	18162	17	38990	20
3000	2438	6	1315	2	15449	15	19202	10
5000	5547	15	2600	5	11130	11	19277	10
>5000	-	0	291	1	739	1	1030	1
Total	37790	100	53161	100	103762	100	194713	100

Farther more the study found out that, Muslim households use a total of 82 % (159,665 litres) of domestic water while Christian households use a 17 % (3,101 litres) total water use and traditional worshiper’s use only 1 % (1,947 litres) of total domestic water use in Bauchi metropolis. However, in the medium density Christian households use 39 % of total domestic water as against 3 % in the low density areas (Table 5). The reason for the increase in the use of domestic water by Muslims relate to the fact the study found out that every Muslim apart from “traditional water use”, use an additional 7 litres of water for prayers alone per day[33].

Table 6: Relationship between Quantity of Water Use (in litres) and Religion in Sampled Households

Religion	Low density	%	Medium	%	High	%	Total	%
Muslim	48,351	97	35,409	60	75,905	88	159,665	82
Christian	1440	3	22,894	39	8767	11	33,101	17
Traditional	0		755	1	1192	1	1947	1
Total	49,791	100	59,058	100	85,864	100	194,713	100

Table 7: Relationship between Quantity of water use (in litres) and Marital Status in sampled households

Married	Low density	%	Medium	%	High	%	Total	%
Yes	20122	78	46519	87	107613	93	174254	89
No	5119	22	6968	13	8372	7	20450	11
Total	25241	100	53487		115985		194713	100

The study also found out that, 89 % (174,254 litres) of total domestic water is used by married households while 11 % (20,450 litres) is used by unmarried households. In the low density areas married households use 78 % of total domestic water use while unmarried use 22 % while in the high density areas, 93 % of total domestic water is used by married households while unmarried use only 7 % (Table 6) The reason for the high consumption of domestic water by married households is because they larger household sizes.

In Bauchi the study found out that, total domestic water use by households with 1-3 persons is 9 %, 4-6 persons consume 25 %, while households with 10-12 persons consumed 29 %. In the medium density households with 4-6 persons use 36 % while those with 7-9 use 31 % of domestic water use, and so on (Table 7). This showed that there is a positive relationship between household size and domestic water use.

Table 8: Relationship between Quantity of water use (in litres) and Household Size in

Size	Sampled Households							
	Low density	%	Medium	%	High	%	Total	%
1,3	4563	8	6066	11	8100	10	18729	9
4,6	11261	22	20,436	36	16,733	20	48430	25
7,9	11077	20	17,574	31	23,585	28	52236	27
10,12	12,177	22	8629	15	35,493	42	56299	29
Above 12	14,967	28	4052	7	0	0	19019	10
Total	54054	100	56,757	100	83,911	100	194713	100

The result of the study showed that civil servants use 57 % of total domestic water while artisan uses only 3 % and farmers 13 % of total use. In the low density civil servant use 70 % of total domestic water use while traders use only 8 % and artisans 0 %. In the high density areas 43 % of total domestic water is used by civil servants while 16 % and 18 % are used by farmers and traders respectively (Table 8).

Table 9: Relationship between Quantity of water use (in litres) and Occupation in sampled households

Occupation	Sampled Households							
	Low density	%	Medium	%	High	%	Total	%
Farming	8043	17	3071	5	13993	16	25135	13
Trading	3916	8	6201	11	16,031	18	26176	13
Civil Servant	32,448	70	39,612	69	39123	43	111211	57
Artisan			2181	4	2989	3	5197	3
Farming/ C/Servant	847	2	2509	4	6805	8	10188	5
Farming Trading			547	1	3694	4	4268	2
Farming Artisan					0	0	0	0
Trading C/Servant	1415	3	3693	6	7595	8	12730	7
Total	46,669	100	57,814	100	90230	100	194713	100

The study found out that, households with tertiary education use 61 % of total domestic water while households with primary and informal education use 8 % and 7 % of total water use in Bauchi metropolis .Households with secondary education use 24 % of total domestic water. In low density 87 % of water is used by people with tertiary education while those with secondary education use only 13 % of total domestic water (Table 9). This showed that people with higher educational qualification use more domestic water. There is therefore a positive correlation between quantity of domestic water use and education level.

Table 10: Relationship between Quantity of water use (in litres) and Educational Level in Sampled Households

Education	Low	%	Medium	%	High	%	Total	%
Primary	0	0	5752	8	10682	17	16434	8
Secondary	7273	13	18202	24	20685	34	46160	24
Tertiary	49295	87	46112	60	23067	37	118474	61
Informal	0	0	6384	8	7261	12	13645	7
Total	56568	100	76450	100	61695	100	194713	100

The study also found out that, 54 % of total domestic water use is by people living in compound types of houses. Those living in flats use 35 % while those in single rooms use only 2 % of total domestic water. In the low density areas people in flats use 70 % while those in single rooms use only 5 % and room and parlour 4 %, and so on (Table 10). Although the trend in water use is similar to that of the metropolis, there is a slight variation within the densities. For example in the low density areas 70 % percent of the total domestic water use is by people living in flats while only 8 % of total water use is by those living in single rooms (Table 10). The reason for this could be that those living in flats use other water use facilities such as showers, flush toilets and son on.

Table 11: Relationship between Quantity of water use (in litres) and Type of House in Sampled Households

Type of house	Low	%	Medium	%	High	%	Total	%
Single Room	1979	5	894	2	334	0.3	3207	2
Room Parlour	1680	4	5294	14	11,143	10	18117	9
Compound	9261	21	13018	34	82217	17	104496	54
Flat	30,550	70	19274	50	19069	17	68893	35
Total	43470	100	138480	100	112763	100	194713	100

The study also found out that, 43 % of total water use is obtained from wells. Public borehole water provides 10 %, public tap 25 % and stream water account for only 3 % of total domestic water use in Bauchi. Private boreholes/ water vendors use 19 %. In the low density areas private boreholes/vendors account for 35 % of total domestic water use, while public tap account for 41 %, and so on (Table 11). The reason for high dependency on well water may due to the fact that 49% of household in Bauchi have personal wells table 19, and only 39% of household are connected to the public water supply. Another possible reason for the predominance of well could be related to the culture. In Islamic culture women are not allowed to roam about particularly in day time makes water source to be either close or in enclosed vicinity.

Table 12: Relationship between Quantity of water use (in litres) and Source of Water in Sampled Households

Source	Low	%	Medium	%	High	%	Total	%
Well	9649	21	25,881	47	48473	52	84003	43
Public Borehole	1392	3	6503	12	10,831	12	18,727	10
Public Tap	18393	41	8272	15	22,194	24	49551	25
Private Borehole/water Vendors	15,943	35	11,804	21	10015	11	37762	19
Stream	0	0	2863	5	1,808	1	4,671	3
Total	45377	100	55,323	100	94013	100	194713	100

5. CONCLUSION AND RECOMMENDATION

Although domestic water use is a collective outcome, the study found out that income, education level, household size, marital status and age group per capita are positively correlated with quantity of domestic water use. On price of water above the one thousand naira fixed rate, quantity of domestic water use is positively correlated with price of water. Other factors such as type of house, source of water, gender and religion are found to have significant relationship with quantity of domestic water use. This study has gone beyond theoretical frontiers and practically demonstrated that socio-cultural have profound influence on

domestic water use. It has also isolated the influence of each factor on quantity of domestic water use. It is hoped that municipal water managers, water suppliers and water planning agencies will consider and use this information in the planning and execution of any municipal water scheme.

ACKNOWLEDGEMENT

The authors appreciate the support of Abubakar Tafawa Balewa University, Bauchi.

REFERENCE

1. Donnelly, K. & Cooley, H. (2015). *Water Use Trends in the United States*, Pacific Institute. USA.
2. Shaban, A. & Sharma, R.N. (2007). Water Consumption Patterns in Domestic Household in Major Cities. *Journal of Economic and Political Weekly*.
3. Arbues, F., Garcia-valinas, M.A., & Martinez-Espineira, R. Estimation of Domestic Water Demand: a State of the Art Review. *Journal of Socio-Econs*, 32, 81-102. 2013
4. Lu, T. (2007). *Research Of Domestic Water Consumption: A Field study in Harbin China*. unpublished M.sc project at Loughborough University U.K. U.K.
5. Cochran Cotton, W.A. (1985). Municipal Water Demand Study, Oklahoma City and Tulsa. *Oklahoma Water Research*, 7(21):941-943.
6. Mini, Z. & Smith, M. (2000). Statistical Domestic Water Demand Model for. *West Bank Water International*, 25(3), 464-468.
7. Ayanshola, A.M F. & Salami, A.W. (2010). Modelling of Domestic Water Demand at Household Level in Illorin Nigeria. Retrieved May 6, 2014 from <http://www.unilorin.edu.ng/publications/ayanshola/modelyofresident>
8. Istifanus, V. (2017) Analysis of Quantity of Domestic Water Use in Bauchi Metropolis: *Journal of Environmental Science, Toxicology and Food Technology*, IOSR-JESTFT, 11 (6) (1) 1-5.
9. Krejcie, R. V. & Morgan, D. W. (1970). Determining sample size for research activities. *Education and Psychological Measurement*, 30, 607–610. <http://doi.org/10.1177/001316447003000308>
10. Romano, G., Salvali, N. & Guerrini, A. (2014). Estimating the Determinants of Domestic Water Demand in Italy. *Journal of Water Open*, 6, 2929-2945. Retrieved March 5, 2015 from <http://www.indi.com.journal/water>
11. Zhang, H.H. (2005). Domestic Urban Water Use. It Implication for Municipal Water Supply in Beijing. *Journal of Habitat International*.
12. Cook, Z., Urban, S., Maupin, M., Prah, R. & Church, J. (2001). *Domestic, Commercial, Municipal and Industrial Water Demand Assessment and Forcast in Ada and Canyon Countries*. USA: Adoho Department of Water Resources.Grima A.P. (1972). *Residentials Water Demand, Alternative Choices for Management Toronto The Un iversity of Toronto Press*. Toronto.
13. Environment Canada. (2011). Residential Water Use in Canada. *Environmental Indicators*, <https://www.ec.gc.ca/indicateurs-indicators/default.asp?.lang=endn=7e808512/>.
14. Schleich, J. & Hillenbrand, T. (2007). Determinants of Domestic Water Use in German. Working Paper Sustainability and Innovation number. *Fraundesfe Institute System and Innovation Research*. 3(1) pp27-34
15. Corbella, H.M. & Puyol, D.S. (2009). What lies behind Domestic Water Use? *A Review Essay on the Drivers of Domestic Water Consumption.*, *Boletin de la A.G.E. No. -*, 297-314.
16. Otaki, Y, Otaki, M., Aramaki, T. & Sakura, O. (2010). *Domestic Water Demand Analysis by Household Activities*. Tokyo: University of Tokyo Inter Faculty Initiative on Information Studies.
17. Mini, C. (2013). *Domestic Water Use and Landscape Vegetation Dynamics in*. Los Angeles: Ph .D Desertification, University of California, Los Angeles, CA 90095.
18. Hausen L. (1996). *Water and Energy Price Impacts on Residential Water Demand in Copenhagen Land Econ*, (72). green venture.

19. Statzu, V. & Strazzera, E. (2009). *Water Deman for Residential Uses in a Mediterranean Region*. Retrieved December 20, 2015, from Econometric Analysis and Policy Implications. available online: <http://www.info/conf/2009/iceee2009.submission88pdf>
20. Gercia- Vallinas, M.A. (2005). efficiency and equality in natural resources pricing. a proposal for urban water distribution service. *Environs Econ.*, **32**, 183-204.
21. Mazzanti, M., &Montini, A. (2006). The Determinants of Residential Water Demand. Empirical Evidence for a panel of. *Italian Municipal App. Econs. Lett.*, **13**, 107-111.
22. Musolesi, M., Mosvelli, M. (2007). Dynamics of Residential Water Consumption in a Panel of. *Italian Municipalities. Appl Econ Lett*, **14**, 441-444.
23. Arbues, F. & Villanua, I. (2006). Potentials for Pricing Policies in Water Resource Management Estimation of Urban Residential Water Demand. *Zaragoza Spain Journal of Urban Studies*, **43**, 2421-2442.
24. Nauges, C. & Thomas, A. (2000). Privately - Operated Water Utilities Municipal Price Negotiation and Estimation of Residential Water Demand. *The case of France Land Econ.*, **76**, 68-85.
25. Martins, R., & Fortunato, A. (2007). Residential Water Demand under block rate. *A Portuguese case study Water Policy*, **9**, 217-230.
26. Dagneu, D.C. (2012). *Factor Determining Residential Water Demand in North Western Ethopia, the case of Metrowi*. UK: Unpublished Master of Professional Study Correll University .
27. Feilding, K.S., Rusell, S., Spirinks, A & Manked, A. (2012). Determinant of Household Water Conservation: The Role of Demographic, Infrastructure, behaviour and Psychosocial Variables. *Institute for Social Research, University of Queensland Brisbane*.
28. Makki A. Stewart R.A., Panuatwanich K, & Beal C. (2011). Revealing the Determinants of Shower water end use consumption: Enabling better targeted urban water conservation strategies. *Clean Production doi; 10.1016/j.jclepro;2011.08.007*.
29. Ali, M. & Tarfa, A.B. State of Water Supply and Consumption in Urban Areas at Household Level. A Case study of East Wollaga Zone Ethopia. *British Journal of Humanities and Social Sciences*, **5(2)**, 1-15. 2012
30. Sule, B.F., Ayonshola, A.M. & Salami, A.W. (2006). Water Consumption Pattern in Illorin Kwara State Nigeria. Retrieved May 6, 2014, from <http://www.unilorin.edu.ng/publication/ayanshola/waterconsumption>
31. Olajuyigbe, A.E. & Fasakin, J.O. (2010). Citizens Willingness to pay for Improved Sustainable Water Supply in a Medium Sized City in South Wastern Nigeria. *Current Research Journal of Social Sciences*, **2(2)**, 41-50.
32. Sani, M. (2008). *A study of Domestic Water Use in Gombe Town*. Bauchi: Unpublished B.Tech Project Abubakar Tafawa Balewa University,.
33. Istifanus, V. (2017), Determinants of Domestic Water Use in Bauchi Metropolis: A Model Perspective; *Journal of Environment and Earth Science*. **7 (6)** P1-4.