Household Based Water Treatment and Diarrheal Diseases among Residents of Kyegegwa District Of Western Uganda

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Abstract: Introduction: *Diarrheal disease accounted for 4.6 Billion cases and 2.16 Million deaths worldwide in the year 2004 of which more than 50% were from low income countries. Africa and South East Asia countries accounted for 75% of all deaths; Uganda was among the 15 countries that accounted for 75% of all deaths (WHO, 2008).*
Objective: *This study seeks to assess the relationship among households-based water treatment and diarrheal diseases among residents of Kyegegwa district.*
Methodology: *A cross sectional descriptive study was carried out among 397 households of Kyegegwa district. A multi-stage cluster sampling techniques was used followed by simple random sampling technique; a well-structured questionnaire was also used. Data were statistically analysed using SPSS for relationship between variables*
Result: *Slightly more than half of the households used boiling as the treatment methods of choice 206(51.9%), filtration 104(26.2%), chlorination 24(6%), solar disinfection 16(4%) and I don't treat water 47(11.8%). It was found that households who used filtration as a methods of water treatment were twice more likely to have a member in the household who had suffered from a diarrheal disease in the previous three months prior to the study (OR = 2.4, CI = 0.127 – 1.481). Households who took 1 day to replace water in the container (duration) were three times more likely to have members with a history of diarrheal diseases (OR = 3, CI = 1.084 – 1.135).*
Conclusion: *The identified water treatments methods used among the households are boiling, filtration, chlorination and solar disinfection. It was found out that households who use filtration methods are twice more likely to have a history of a member who suffered from diarrheal diseases in the past 3 month more than those who used other methods.*
Recommendation: *Health education should be provided on the importance of treating water by boiling and storing them in a cleaned and covered container, Advocacy should be done on other effective methods of water storage approved by World health organization to replace some less effective local methods currently practiced as jerry can is considered the only effective storage facility in the community.*
Keywords: *household based; water treatment; diarrheal disease.*

I. Introduction

Diarrheal disease accounted for 4.6 Billion cases and 2.16 Million deaths worldwide in the year 2004 of which more than 50% were from low income countries. In the year 2004, one of the two leading cause of burden of disease was diarrhoea, also diarrhoea accounted for 32,203,037 Disability Adjusted life years (DALYS) in Africa (WHO, 2008). Africa and South East Asia countries accounted for 75% of all deaths; Uganda according to Boschi-Pinto et al, 2008 was among the 15 countries that accounted for 75% of all deaths.Water is one of the key determinants to life among the element of WASH. Lack of these three elements makes people more susceptible to illness and death.

Safe water, coupled with adequate sanitation, and proper hygiene education (WASH) can prevent illness and death, leading to improved health, poverty reduction, and socio-economic development (Bartram and Cain cross, 2010). Household water treatment also known as point of use water treatment (POU) such boiling, filtration and chlorination has been shown to be an effective means of reducing diarrhoea and other diseases associated with unsafe drinking water (Sobsey MD, 2012).

According to a study conducted in Tanzania, 2012, determined the proportional of treat water methods locally available and accessible to them. It was found that about 49.5% reported treating their water with any method (boiling, strain in cloth, use of chlorine and Let it stand and settle). According to the water quality monitoring work which was carried out by the Directorate of Water Resources Management (DWRM) of MWE,

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the compliance of rural safe drinking water sources to national water quality standards was 53% (E.coli being the key indicator), against a target of 95% (WESPR, 2014).

US$147 million is lost each year due to Premature Deaths; Approximately 23,000 Ugandans dies each year from diarrhea nearly 90% of which is directly attributed to poor water coupled with poor sanitation and hygiene (WASH/Uganda C R, 2012). This includes time absent from work or school due to diarrheal disease, seeking treatment from a health clinic or hospitals (WASH/Uganda C R, 2012). Hence, this justifies the need for this to assess the households-based water treatment, storage and diarrheal diseases among residents of Kyegegwa district in western Uganda.

II. Methodology

Study area: This study was carried out among the households of Kyegegwa district of western Uganda.

Study population and sample size: The study population was 59,332 been the number of households in Kyegegwa district on accounts of studying each household. The sample size used was 397, which was determined using Sloven's Formula.

Research design: The research design for this study was a cross-sectional descriptive design (snap shot), in which data was collected and analyzed largely by quantitative method. It used descriptive design because it offered a precise description and information of the household based water treatment, storage and diarrheal diseases as they exist.

Sampling technique: A multi stage cluster sampling techniques was employed followed simple random sampling techniques to achieve the desired sample.

Data collection methods and tools: A close ended structured researcher self-administered questionnaire for the household's heads and key informant guide for the health workers will be used to collect primary data.

Tools will pre-test to ensure validity.

Measurements of Variables

Independent variables: Water treatment methods were measured using the following; attributes boiling, filtration, solar disinfection and chlorination.

Dependents variables: diarrheal diseases were measured using attributes as follows; frequency of disease, duration of the disease, type of the disease.

Data analysis and interpretation: The data was collected and processed into tables using SPSS computer software. Descriptive Analysis; to compare independent variables with Dependent variables using Pearson`s coefficient was done. The independent variable was consider statistically significant for the effect measure at $P<0.05$.

Quality control: The Researcher conducts a pre-test of the study tools so as to assess the validity and reliability of data that would be collected for the study.

Table 1: Validity and reliability tests

Constructs	Cronbach's Alpha

Water treatment methods
    Boiling
    Filtration
    Solar disinfection
    Chlorination
	0.676

Water storage methods
  Water Tanks
  Jerry can
  Pots
    Pans
	0.963

Diarrheal diseases
    Frequency
    Duration
  Type
	0.899

Overall Value (Reliability)	0.902

Ethical consideration: An introductory letter from the University, addressed to the district health officer (DHO) was collected, endorsed and approved to conduct the study.

The consent to conduct the study in Kyegegwa district was sought by the district health officer (DHO).

The consent of respondent was sought, to participate in the research after citing the reasons why the research is been conducted and there right to withdraw from the study at any time of data collection process was clearly explained to respondents.

Confidentiality of respondents was considered by ensuring anonymity of respondents in the questionnaire.

All respondents was told on how the research findings will be confidentially handled and used for the greater good of the community by the district, Cavendish University and the community at large. However, data collected was purely be for educational and planning purposes.

Limitations of the study: The study encountered challenges of research assistance unwillingness to complete the questions under each questionnaire which was overcome by making sure that it was well level with the name of interviewer to be able to traced uncompleted questionnaires after data collection.

Limited available literature in term of publication from local perspectives as the district is among the newest in the country which was overcome by using mainly primary data.

III. Results

Socio demographic characteristics

Table24.1a: Socio demographic characteristics of the respondents

	Frequency n = 397	Percent
Gender		
Male	149	37.5
Female	248	62.5
Age (yrs)		
18-25	114	28.7
26-35	151	38.0
36-45	60	15.1
46-55	42	10.6
56-65	27	6.8
66-75	3	0.8
Marital status		
Single	129	32.5
Married	222	55.9
Divorced	46	11.6
Highest level of education		
None	120	30.2
Primary	113	28.5
Secondary	140	35.3
Tertiary	24	6.0
Number of people in household		
1	51	12.8
2-5	154	38.8
5-10	144	36.3
10 and Above	48	12.1

Majority of the respondents in this study were female 248 (62.5%), and most were aged between 26 – 35 years 151 (38.0%) with a mean age of 25.6 years. More than half of the respondents in Kyegegwa district were married 222 (55.9%), and most had been educated to secondary school level 140 (35.3%). The most frequently reported number of people in the households respondents came from was 2 – 5 people 154 (38.8%) with the mean household number being 7 people.

Table34.1b: Water provider at the source and the main source of your drinking water

	Frequency n = 397	Percent
Water provider at the source		
Government	38	9.6
Private operators	219	55.2
CBO/NGO	21	5.3
I don't Know	119	30.0
Main source of your drinking water		
Pipeline	42	10.6
Open well	58	14.6
Borehole	143	36.0
River water	52	13.1
Rainwater	13	3.3
Shallow well	37	9.3
Water vendors	52	13.1

The source of water for majority of the respondents was from private operator establishments 219 (55.2%), and the main source of drinking water for most of them was boreholes 143 (36%)

4.2 Water treatment methods used

Table 44.2: Distribution of water treatment methods used among households of Kyegegwa district

Method	Frequency	Percent
Treatment of drinking water (method used)		
Boiling	206	51.9
Filtration	104	26.2
Chlorination	24	6.0
Solar disinfection	16	4.0
I don't treat	47	11.8
Total	**397**	**100.0**
Filtration		
Let it stand and settles/Filter with clean cloth	80	76.9
All of the above	24	23.1
Total	**104**	**100.0**
Chlorination		
Filter 20ltrs	7	29.2
Filter 20ltrs and add to 2tabs	9	37.5
All of the above	8	33.3
Total	**24**	**100.0**
Solar disinfection		
Filter 20ltrs and Put in a clean container	11	68.8
Display in sun for 2hrs	5	31.2
Total	**16**	**100.0**
Reasons for not treating water		
Available	7	14.9
Cost	14	29.8
Bad taste and smelly of treatment	11	23.4
I believe water is safe from the source	10	21.3
I am used to drinking Untreated water and nothing happen to me	4	8.5
I don't know	1	2.1
Total	**47**	**100.0**

Regarding the water treatment methods, it was found that slightly more than half of the respondents used boiling as the treatment methods of choice 206(51.9%). However, for those who used filtration majority mentioned they let it stand and settle/Filter with clean cloth 80 (76.9%). For those who used chlorination, most of them 9(37.5%) mentioned that they filtered 20ltrs and added to 2tabs. For the respondents who used solar disinfection, most stated that they filtered 20ltrs and put in a clean container 11(68.8%).

4.4 Prevalence of diarrheal diseases

Table 54.4: Prevalence of diarrheal diseases in Kyegegwa district

	Frequency	Percent
What is the most frequent diseases in your community		
Diarrhea	214	53.9
Dysentery	47	11.8
Typhoid	119	30.0
I don't know	17	4.3
Total	**397**	**100.0**
Family suffered from the above diseases in past 3 months		
Yes	224	56.4
No	173	43.6
Total	**397**	**100.0**

The most frequent diseases in the communities of the respondents was mentioned to be diarrhea 214 (53.9%), and slightly above half of the respondents reported that a member in their family had suffered from a diarrheal disease in the past 3 months prior to the study 224 (56.4%).

"The most frequently reported diarrheal disease in Kyegegwa district are diarrhea and dysentery where diarrhea is mostly reported mostly from Ruyonzo sub-county which may be attributed from the following; No potential water sources for protection e.g. spring, wells, Therefore they depend on borehole water which is

expensive in terms of construction and maintenance, low latrine coverage and use, inadequate sanitization , low levels of education, sharing with animals and Poor health seeking behaviors.

And more so, can be reduced through; district tries to extend protected water sources but funds are limited and selection and training of village health teams to do home visiting, community health education.

I Recommend; need more funding to enable improvement of more villages; law enforcement provide motorcycles for health assistant, motivation of village health team". District Health Inspector (DHI-Kyegegwa)

"The most frequently reported diarrheal diseases in the district are Typhoid, Dysentery and helminthes which is attributed by poor hygiene/sanitation practices among the households, poor personal hygiene practices among the households, inadequate water supply in the district, illiteracy levels are high among the community, socio-economic status is low among the households, cultural practices and beliefs and attitudes of the community". Kyegegwa Town Council health inspector

Another also states that;

"The most frequently reported diarrheal diseases in the district are diarrhea, dysentery and typhoid, the most frequent and most reported is diarrhea followed by typhoid, which may be attributed by poor sources of drinking water, lack of adequate treatment at household's level, community attitude towards water treatments and Sharing water drinking with animals.

*Which can also be reduced by Education and sensitization of the community on proper water treatment at households level, Lobby for construction of proper and safe water source at various communities, protecting some of the community water sources like rivers and Facilitation of the village health team (VHTS) to improves home visiting"*Clinician-HC(IV)

4.5 The relationships between water treatment methods and diarrheal diseases among residents of Kyegegwa district

Table 64.5a: Bivariate analysis for the relationships between water treatment methods and diarrheal diseases among residents of Kyegegwa district

	Incidence of diarrheal disease				
	Occurred	**Never occurred**	**X^2**	**df**	**P- value**
Treatment of drinking water (method used)					
Boiling	125(60.7%)	81(39.3%)			
Filtration	84(80.8%)	20(19.2%)			
Chlorination	3(12.5%)	21(87.5%)	81.588	4	0.000**
Solar disinfection	2(12.5%)	14(87.5%)			
I don't treat	10(21.3%)	37(78.7%)			
Filtration					
Let it stand and settles/Filter with clean cloth	44(55.0%)	36(45.0%)			
All of the above	17(70.8%)	7(29.2%)	1.908	1	0.167
Chlorination					
Filter 20ltrs	1(14.3%)	6(85.7%)			
Filter 20ltrs and add to 2tabs	3(33.3%)	6(66.7%)			
All of the above	4(50.0%)	4(50.0%)	2.143	2	0.343
Solar disinfection					
Filter 20ltrs and Put in a clean container	2(18.2%)	9(81.8%)			
Display in sun for 2hrs	0(0.0%)	5(100.0%)	1.039	1	0.308

The results in the table above show that water treatment methods had a statistically significant relationship with the incidence of diarrheal diseases in Kyegegwa district with a Chi square value of 81.588 and a p value of 0.000. Majority of the respondents whose families had had a diarrheal disease within the past 3 months of the study where those who had used filtration as a treatment method

Table 74.5b: Regression analysis for the relationships between water treatment methods and diarrheal diseases among residents of Kyegegwa district

	Incidence of diarrheal disease			Confidence interval	
Factor	**Occurred**	**Never occurred**	**AOR**	**Lower**	**Upper**
Treatment of drinking water (method used)					

Boiling	125(60.7%)	81(39.3%)	1.091	.661	6.612
Filtration	84(80.8%)	20(19.2%)	2.434	.127	1.481
Chlorination	3(12.5%)	21(87.5%)	1.067	.129	8.793
Solar disinfection	2(12.5%)	14(87.5%)	.000	.000	.
I don't treat	10(21.3%)	37(78.7%)	1.000		

The results in the table above are logistic regression results for the Regression analysis for the relationship between water treatment methods and diarrheal diseases among residents of Kyegegwa district. It can be seen that respondents who used filtration as a methods of water treatment were twice more likely to have a member in the household who had suffered from a diarrheal disease in the previous three months prior to the study (OR = 2.4, CI = 0.127 − 1.481).

IV.   Discussion

Water Treatment Methods Used Among Households: In this study it was found out that most of the respondents 219 (55.2%) mentioned private operators as their main water provider at source, followed by those that don't know their water provider at source 119 (30%) which is a big portion. Majority of the respondents mentioned borehole as their main source of drinking water which is privately owned 143 (36%) followed by open wells 58 (14.6%), river water and water vendors both at 52 (13.1%) of the respondents, pipeline water was at 42 (10.6%), shallow well 37(9.3%) and rain water 13 (3.3%) respectively.

Regarding the water treatment methods, it was found that slightly more than half of the respondents used boiling as the treatment methods of choice 206(51.9%), followed by filtration 104 (26.2%),chlorination 24(6.0%), solar disinfection 16 (4.0%) and those who said I don't know 47(11.8%) respectively. However, for those who used filtration majority mentioned that they let it stand and settle/Filter with clean cloth 80 (76.9%). For those who used chlorination, most of them 9(37.5%) mentioned that they filtered 20ltrs and added to 2tabs. For the respondents who used solar disinfection, most stated that they filtered 20ltrs and put in a clean container 11(68.8%), It was also seen in a slightly similar study conducted by Ghislaine Rosa in 2010 were he extract data from national surveys as retrospective study and reports on scope of household water treatment in sixty four (67) countries worldwide indicated that the proportion of water treatment by boiling in Uganda were 39.8% and Zambia (15.2%) whereby in Latin America chlorine is practiced by 17.1% of the households while Guinea Bissau (70.9%) and Mali (24.0%) strain drinking water through cloth.

Also in a study conducted in Tanzania by RemidiusKakulu, where he determined the proportional of respondents who treat their drinking water with any method locally available and accessible to them. It was also found that about 49.5% of the respondents in his study reported treating their drinking water with any method (boiling, strain in cloth, use of chlorine/ chlorination and Let it stand and settle).Water treatment by boiling and Let it stand and settle were frequently practiced by respondents as methods of water treatment, fewer of the respondents reported using water guards and strain in cloth, where boiling was the most used among the households similarly to my study.

Moreover, in a study conducted in Egypt it was also found that 5.9% of households treated their water with any method (95%CI 5.2-6.7%) filtration and let it stand and settle were the common methods practiced (Jim Wright & Gundry, 2009) which the results was slightly different from my study.

Majority of the respondents 14 (29.8%) also report cost of treatment as a major hindrance to water treatment followed by bad taste and smelly of treatment 11 (23.4%), and for those who believe water is safe from the source 10(21.3%). Therefore, boiling is considered the most used method of water treatment among the household of the district and cost of treatment was identified as the main reason for not treating their drinking water.

Prevalence of Diarrheal Diseases among Households

It was found out in this study that the most prevalent diarrheal disease in the district was diarrhea 214 (53.9%) which is slightly more than a half of the respondents, followed by typhoid as the second most reported disease 119(30.0%) of the reported diarrheal diseases, dysentery only 47(11.8%) of reported diarrheal diseases and for those who don't know about the prevalent diarrheal disease are 17(4.3%) of the total respondent.

The above result also justify the higher magnitude of diarrheal diseases recorded worldwide as It was found out that diarrheal disease accounted for 4.6 Billion cases and 2.16 Million deaths worldwide in the year 2004 of which more than 50% were from low income countries like Uganda which buttressed my study.

In the year 2004, one of the two leading cause of burden of disease was diarrhea as a single disease among number of diarrheal diseases, which is in line with my study result and also diarrhea accounted for 32,203,037 Disability Adjusted life years (DALYS) in Africa (WHO, 2008), more so the study also justify the result reported on diarrhea worldwide.

In most African and some South East Asian countries accounted for 75% of all deaths; Uganda according to Boschi-Pinto et al, 2008 was among the 15 countries that accounted for 75% of all deaths worldwide.

Furthermore, in Uganda it was reported that approximately 23,000 Ugandans die each year from diarrhea as a single disease among all diarrheal diseases, nearly 90% of which is directly attributed to poor water, coupled sanitation and hygiene whereas these report was similar to my study where diarrhea accounts for 53.9% of all diarrheal diseases in the district (WASH/Uganda C R, 2012).

Moreover, the district recorded success in cholera control as no reported cases and also confirmed by the district health inspector(DHI-Kyegegwa district) that no cholera cases reported in the last one decade in that district which is a great achievement to public health towards prevention and control of all communicable diseases in our communities.

It was also found out in the study that majority of the respondent 224(56.4%) reported with history of diarrheal disease in the past 3month, followed by no reported history of the disease 173 (43.6%) of the respondents respectively.

Therefore Diarrhea which is the most prevalent among diarrheal diseases as also preventable disease is a great public health challenge among households of that community.

Relationship between Water Treatment Methods and Diarrheal Diseases among the Residents:

The results shows that water treatment methods had a statistically significant relationship with the prevalence of diarrheal diseases among the households of the district with a Chi square value of 81.588 and a P-value of 0.000 where majority reported using boiling as most common practice of water treatment. Majority of the respondents whose families had a diarrheal disease within the past 3 months of the study where those who had used filtration as a treatment method which 84(80.8%), followed by those who uses boiling as water treatment method 125 (60.7%) respectively. These indicate great difference with a study conducted in the near country of Tanzania in 2012, were the researcher determined the relationship between diarrheal diseases and other water treatment methods. Water treatment by any method protected adults and children against diarrheal diseases by 51% protective factor and water treatment by boiling protected children by 61% which is 10 fold higher than any of the methods used.

It was also found out that filtration was not significant at chi-square value of 1.908 and p-value of 0.167, chlorination at Chi-square value of 2.143 and 0.343, solar disinfection at Chi-square value of 1.039 and P-value of 0.308 respectively, which similar to the study conducted by Remidius K, 2012 were Use of chlorine/Chlorination, Let it stand and settle and straining on clothing (filtration) showed no significant impact on diarrheal diseases among the resident. Water treatment by boiling is known to be effective against a full range of microbial pathogens and that can be employed regardless of turbidity or dissolved constituents of water. The findings of this study are supported by study done for evaluating effectiveness of water treatment methods, Treatment by chlorination were not found to be significant in reduction of diarrheal diseases among the resident this might be due to human factors like proper dosing for residual chlorine.

More so, based the results from the regression analysis it was found out that respondents who used filtration as a methods of water treatment were twice more likely to have a member in the household who had suffered from a diarrheal disease in the previous three months prior to the study (OR = 2.4, CI = 0.127 − 1.481).

Therefore, its recommended to treat water before drinking by any method discussed above as boiling was believe to be the most effective method of water treatment among the households of that community.

Conclusion: This study concluded that the identified water treatments methods used among the households are boiling, filtration, chlorination and solar disinfection. The water storage methods identified are jerry can, pot, small pans and tanks.

It was found out that households who use filtration methods are twice more likely to have a history of a member who suffered from diarrheal diseases in the past 3 month more than those who used other identified methods use as boiling, chlorination and solar disinfection.

V.   Recommendations:

Health education should be provided on the importance of treating water by boiling and storing them in a cleaned and covered container.

The government should provide safer water sources like bore boles, protected streams to ensure water safety at the source to supplement the ones available.

Since the people prefer strain their water in clean cloth because it is not related to objectionable odour it is the high time to promote filtration by ceramic filters.

References

[1]. Annual Health Sector Performance Report, Ministry of Health (MoH) Uganda Financial Year 2013/2014
[2]. Arnold B, Colford J (2007). Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhoea in developing countries: a systematic review and meta-analysis. Am J Trop Med Hyg. 76(2):354-64
[3]. Bartram J, Cairncross S (2010) Hygiene, Sanitation, and Water: Forgotten Foundations of Health. PLoS Med 7(11): e1000367. doi:10.1371/journal.pmed.1000367.
[4]. Boschi-Pinto, C, Velebit, L.And Shibuya, K. (2008).Estimating child mortality due to diarrhoea in developing countries. Bulletin of the World Health Organization ; vol. 86, no. 9 ; p. 710-717.
[5]. Clasen T (2006). Household water treatment for preventing diarrhoeal disease [PhD thesis].London, London University, London School of Hygiene & Tropical Medicine.
[6]. Clasen T, Haller L, Walker D, Bartram J, Cairncross S (2007). Cost-effectiveness analysis of water quality interventions for preventing diarrhoeal disease in developing countries. J. Water & Health 5(4):599-6 .
[7]. Development Finance International (DFI), a Case study of Financing of the water,sanitation and hygienesector in Uganda, 2011.
[8]. Dr. CallistTindimugaya Commissioner, Water Resources Regulation Ministry of Water and Environment Presentation made during the Water is Life project workshop, 3rd November 2010, Makerere University, Kampala
[9]. Ghislaine Rosa and Thomas Clasen(2010),Estimating the scope of household water treatment in low and Medium income countries AM.J.Trop.med.hyg,82(2) pp.289-300.
[10]. Interventions to improve water quality for preventingdiarrhoea: systematic review and meta-analysis, Thomas Clasen,Cite this article as: BMJ, doi:10.1136/bmj.39118.489931.BE (published 12 March 2007).
[11]. Jim Wright & Gundry, SW. 'Household characteristics associated with home water treatment: an analysis of the Egyptian Demographic and Health Survey', Journal of Water and Health, 7, (pp. 21-29), 2009. 10.2166/wh.2009.056
[12]. JMP 2012.Joint Monitoring Programme. New York: WHO/UNICEF
[13]. Kosek M, Bern C, Guerrant RL. The global burden of diarrhoeal disease, as estimated from studies published between 2000 and 2008. Bull World Health Organ 2009;81: 197-204.
[14]. Kyegegwa district Health office (DHO),report, 2015.
[15]. National Water Policy,1999
[16]. NGOs in the Ugandan Water and Sanitation Sector (UWASNET), Performance Report for FY, 2011/12
[17]. Njuguna, V., Karanja, B., Thuranira, M., Shordt, K., Snel, M., Cairncross, S., Biran, A., & Schmidt, W.-P., 2008. The sustainability and impact of school sanitation, water and hygiene education in Kenya.IRC& UNICEF.
[18]. RemidiusKamuhabwaKakulu, Diarrhoea among under five children and household water treatment and safe storage factors in Mkuranga district, Tanzania Muhimbili University of Health and Allied Sciences, November, 2012.
[19]. Roberts L et al. (2011).Keeping clean water clean in a Malawi refugee camp: A randomized intervention trial. Bulletin of the World Health Organization, 79:280–287.
[20]. Sobsey MD (2002). Managing water in the home: accelerated health gains from improved water supply. Geneva: TheWorld Health Organization (WHO/SDE/WSH/02.07)
[21]. Souter PF, Cruickshank GD, Tankerville MZ, Keswick BH, Ellis BD, Langworthy DE, Metz KA, Appleby MR,Hamilton N, Jones AL, Perry JD. Evaluation of a new water treatment for point-of-use household applications to remove microorganisms and arsenic from drinking water. J Water Health (2012):73-84
[22]. Stauber CE, Elliott MA, Koksai F, Ortiz GM, DiGiano FA Sobsey MD (2006). Characterisation of the biosand filter for E. Coli reductions from household drinking water under controlled laboratory and field use conditions. Water SciTechnol. 54:1-7
[23]. Uganda Bureau of statistics 2016, the national population and housing census 2014. Main report, Kampala.
[24]. Water and Environment Sector Performance Report 2014.
[25]. Water and Environment Sector Performance Report, Ministry of Water and Environment Uganda, October 2014.
[26]. Water sanitation program (WSP),economic impacts of poor sanitation in Africa, March 2012.
[27]. WHO (2007).Combating waterborne disease at the household level. Geneva, World Health Organization.
[28]. WHO (2008a). The global burden of disease: 2004 update. Geneva, World Health Organization
[29]. World Health Organisation, 2013.Sustaining the drive to overcome the global impact of neglected tropical diseases. Second WHO report on neglected tropical diseases.
[30]. World Health Organization and UNICEF. Progress on Drinking Water and Sanitation: 2012 Update.External Web Site Icon
[31]. WSSCC 2004 The Campaign: WASH Facts and Figures