Relationship between Household Size and Access to Improved Water Sources and Basic Sanitation in Bomet Municipality, Kenya

Koskei E.C., Ondimu K. N., Obwoyere G. O.

Abstract

Improved water sources, sanitation facilities and good hygiene are fundamental to health, survival, growth and development. The principal sources of water in Bomet municipality as well as sanitation are unimproved. As a result, diarrhoea, cholera and typhoid cases are still reported in the area. This study was conducted to determine if there is a relationship between household size and household access to improved water sources and basic sanitation in Bomet municipality. Multi-stage random sampling method was used to obtain the sample. 151 households were selected for the study. The questionnaire was the main instrument for data collection. Analysis of data was done using the SPSS. Data on household size and household level of access to basic sanitation and water were summarized using frequencies and percentages. Correlations at 5% level of significance were used to assess the relationship between household size and household access to improved water sources and basic sanitation. Results from the study indicated that there was a negative relationship between household size and household access to improved water sources as indicated by the correlation coefficient of -0.532 and that there was no relationship between household size and household access to basic sanitation as indicated by the correlation coefficient of -0.072. The amount of water used per person per day significantly decreases as the household size increases. Shifting from larger to smaller households can bring a reduction in household water use. There is need for a study to establish what impacts on household access to basic sanitation in Bomet municipality.

Keywords: household size, improved water sources, basic sanitation

Introduction

Safe drinking water, sanitation and good hygiene are fundamental to health, survival, growth and development (WHO/UNICEF, 2006). However, these basic necessities are still a luxury for many of the world's people. Over 1.1 billion people do not use drinking water from improved sources while 2.6 billion lack basic sanitation (UN/WWAP, 2003). The crisis is worst in Sub-Saharan Africa, where 2 in 5 people lack safe water (AMREF, 2010). According to UN Environment Programme (UNEP), 300 million people in Africa still do not have reasonable access to safe drinking water and nearly 230 million people defecate in the open (Vidal, 2012). While Kenya has launched broad ranging water sector reforms and has stepped up investment in water supply, Sanitation and Hygiene (WASH), the country still faces considerable challenges in reaching the water and sanitation Millennium Development Goals (MDGs). Thirteen million Kenyans lack access to improved water supply and 19 million lack access to improved sanitation (USAID, 2011).

WHO/UNICEF (2006) found that large number of people without adequate provision for safe water and sanitation live in urban areas. Insufficient water supply and sanitation is very often associated with an unsustainable exploitation of natural resources (WHO/UNICEF, 2006). According to Allain (1994), demographic factors contribute heavily to shape water requirements.

Population growth has been found to be a direct determinant of increases in water demand for domestic uses (Gleick, 2003). Another key demographic factor is change in the geographic distribution of population, which modifies the spatial pattern of demand for domestic uses. Urbanization, in particular, through increased population density and the concentration of demand, can make the latter a serious constraint on local resources (Allain, 1994). Urban poverty also contributes to the lack of adequate water and sanitation in poor households (Dungumaro, 2007). Lawrence *et al*. (2002) noted that socioeconomic status is a significant determinant of household access to water and basic sanitation in households. Other variables closely connected with the availability of water and adequate sanitation include, among others, household size and gender of the household head (Dungumaro, 2007).

Rapid pace of urbanization is one of the factors that have been attributed to failure to ensure sustainable access to water and adequate sanitation in many African countries Kenya included (Dungumaro, 2007). The expanding urban population growth creates unprecedented challenges among which provision for water and sanitation have been the most pressing and painfully felt when lacking (UN-HABITAT, 2010).This is because many disease vectors tend to thrive where there is an inadequate provision of these services (WHO, 1999). A lack of safe drinking water and sanitation results in faecal-oral diseases such as diarrhoea and outbreaks of malaria and cholera (UN-HABITAT, 2010). Access to and use of improved drinking water sources and sanitation can make an immense contribution to improved health, productivity, and social development. As part of the Millennium Development Goals (MDGs), the international community has set a goal of reducing the proportion of people without sustainable access to safe drinking water by 50 percent by the year 2015 compared to its level in 1990 (UN, 2010). The importance of water and adequate sanitation is also recognized at the International Decade for Action 'Water for Life' (2005-2015); and the 2008 International Year of Sanitation, to mention just a few. In spite of these concerted efforts, water and adequate sanitation remain a challenge for many people.

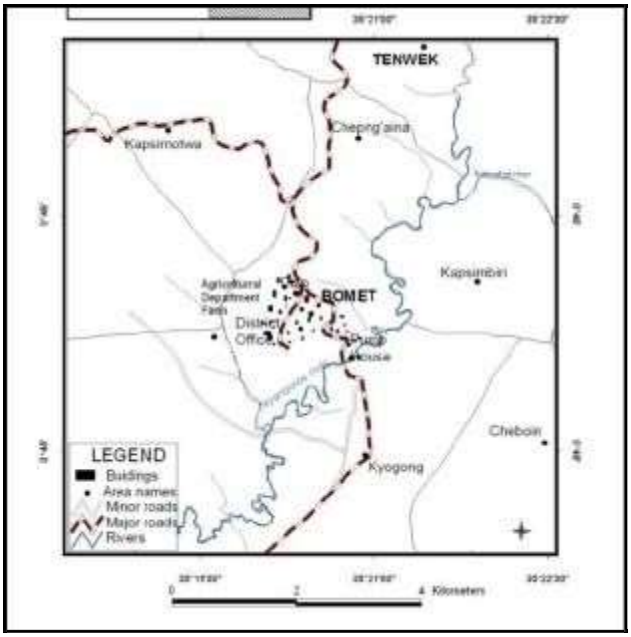
The people most vulnerable to water-borne diseases are those who use an unimproved drinking water source and sanitation (Mintz *et al.*, 2001). Diarrhoea claims the lives of an estimated 1.5 million children under the age of five each year (AMREF, 2010). Lack of access to improved water, sanitation and hygiene affects the health, security, livelihood and quality of life for women and girls. They are much more likely than men and boys to be burdened with caring of family members who are ill and collecting drinking water (WHO, 2002). Waterborne diseases represent a real public health problem in Kenya. Water, sanitation and hygiene (WASH) -related diseases and associated conditions (e.g., anaemia, dehydration and malnutrition) are the number one cause of under-five hospitalization, mortality and over 50% of hospital visits (USAID, 2011). Bomet Municipality is one of the areas in Kenya that are still reporting cases of diarrohea, cholera and typhoid, which are caused by unclean water and poor sanitation. Malaria, which is caused by mosquitoes, is also still reported in the area (Ministry of State for Planning, 2008). This will inevitably decline the attainment of sustainable development since health is regarded as the pillar for sustainable development.

Improved water sources include sources that, by nature of their construction or through active intervention, are protected from outside contamination, particularly faecal matter and are more likely to provide water suitable for domestic use than unimproved technologies (WHO/UNICEF,

2006). These include piped water into dwelling, plot or yard, public tap/ standpipe, tube well/ borehole, protected dug well, protected spring and rainwater collection**.** Unimproved drinking water sources include unprotected dug well, unprotected spring, cart with small tank/ drum, tanker, surface water (river, dam, lake, pond, stream, canal, irrigation and channel) and bottled water. Basic sanitation is the management of human waste at the household level. It is the lowest-cost technology for securing sustainable access to safe, hygienic and convenient facilities and services for excreta and sullage disposal that provide privacy and dignity while ensuring a clean and healthful living environment both at home and in the neighborhood of users (WHO/UNICEF, 2006).

The principal sources of water in Bomet are unimproved: they include wells, dams and rivers. Most households also use unimproved sanitation facilities such as the pit latrines. Baseline survey of the Mara River Basin (2004) reported that on average, households in Bomet get their water at a distance of 4 kilometers. Only about 3% of the households in the district have access to piped water and none is connected to sewer. The environment and natural resources in Bomet have in the recent years been under threat due to increased dependence on natural resources to meet basic needs. The population growth rate has over time become higher than the economic growth rate, hence the increasing pressure on the natural resources (Mara River Basin Survey, 2004). This study therefore investigates the nature of relationship between household size and access to improved water sources and basic sanitation in Bomet municipality.

2. Study Area



Bomet municipality is located in Bomet County in Rift Valley Province, Kenya (figure 1). It lies between 0^0 39' and 1^0 02' south of the Equator and between longitudes 35^0 00' and 35^0 32' east of prime meridian (33^3 East of the Greenwich meridian). It is the capital of Bomet County. It received its township status in 1989 and became a Municipality in 1992. Bomet municipality has six wards: Cheboin, Emkwen, Itembe, Mutarakwa, Township and Tuluapmosonik (Ministry of planning and National Development, 2008).

Bomet Municipality is characterized by gentle topography that gives way to flatter terrain in the south (Ministry of State for Planning, 2008).

Fig. (1). Location of the study area (S*ource:* Survey of Kenya, 2007).

The overall slope of the land is towards the south; consequently, drainage is in that direction and the altitude rises to 2018 M above sea level. The main river in the district, River Nyangores, flows from southwest Mau forest, and proceed southwards through Tenwek in Bomet Municipality (Fig 1). The soils are generally fertile with altitude, temperatures and rainfall as the

main determinants of farming practices in each area. Clay soil which covers 43.6 per cent of the district including the municipality does not allow water to percolate easily and therefore toilets (pit latrines) overflow pouring the sludge on the surface thus causing a threat to human health (Ministry of State for Planning,2008). The area experiences two rainy seasons; the long rains, which occur from March to May, and the short rains, which occur from August to October. Apart from November and December, all the months have mean rainfall of between 1100mm and 1500mm (Ministry of State for Planning, 2008).

Bomet is one of the fastest growing towns in Kenya and is the largest urban centre within the Mara river basin. Rising birth rates and natural growth of the urban population in the region along with rural to urban migration occasioned by rural poverty have contributed to the growth. The population of those currently living in the area is estimated at 76,694 people. The municipality has a population density of 419 persons per square kilometer and the average household size is six (Ministry of State for Planning, 2008). The population of Bomet municipality rose by 134 % in 10 years between 1999 and 2009. Rapid urbanization and increased migration into urban areas within the District have resulted in urban decay, loss of environmental quality and health deterioration, water pollution, loss of biodiversity and encroachment of fragile ecosystems (NEMA, 2011). In both urban and rural areas, access to safe drinking water and basic sanitation is a critical environmental and health concern.

Methodology

Multistage random sampling technique was used to obtain the sample. Stage 1 was the division of the study area to various zones based on the distance from the Central Business District (CBD). Seven zones were created. The second stage involved listing of all households within the different zones out of which simple random sampling was used to select a sample of 22 households. One hundred fifty one households were selected for the study. Random sampling was done following a method described by Franzel and Crawford (1987). This technique is used as follows; a researcher starts from the estimated centre of a study area and proceeds in different directions using the available routes in the study area. The selection of routes is based on probability sampling procedures so as to remove bias and to make it possible get valid conclusions (Arye *et al*., 1972). Three different routes (roads) were used to transect each selected area. The data were obtained from households through personal interviews by use of a semi-structured questionnaire. The study focused mainly on household heads for interviewing to ensure uniformity of data collection process.

The data were obtained from households through observation and by use of semi structured questionnaire. A structured interview-administered questionnaire was designed to carry out a survey about household size and household access to water and sanitation among 151 residents. This involved questions on the number of household members, type of toilet facility used as well as their source of drinking water. Additionally, photographs of the various water sources and sanitation facilities in the study households were taken. The photographs have helped to illustrate the various water sources and sanitation facilities that were used by the households. The data collected was analyzed using correlation. Correlations at 5% level of significance were used to assess the relationship between household size and household access to improved water sources

and basic sanitation in Bomet municipality while data on household size and household level of access to basic sanitation and water were summarized using frequencies and percentages. The survey information was represented using tables.

Results

Household Size

The results (Table 1) show that the greater proportion of households (58 %) in Bomet municipality has up to seven members. About 25 % of households have eight members and above. It would therefore appear that majority (77 %) of households have large families. Households with less than three family members constitute only 17 %. It was also established that the average household size is six.

Table 1: Household sizes

Household size	Frequency	Percentage
Below 3 members	25	17
4 to 7 members	88	58
8 to 10 members	29	19
11 members and above	9	6
Total	151	100

Households' Access to Improved Water Sources.

In this study, an assessment of access to improved drinking water sources was based on WHO/UNICEF Joint Monitoring Programme (JMP) variables. According to WHO/UNICEF Joint Monitoring Programme (JMP) definition of access, distance covered, time spent, quantity of water collected, location of water source, water sources classified as improved and reliability of such sources are all essential for a declaration of access to water (WHO/UNICEF, 2008). The descriptive results presented in figure 2 show that majority of the households (57 %) used unimproved water sources; unprotected dug well, unprotected spring and surface water. Surface water obtained from rivers, dams and streams is the major source of drinking water for about 40 % of the households in the sample. It was established that out of the 40% households that used surface water, majority used the worst drinking water source -a dam. Access to improved water sources remains limited. The proportion of households who get water from tap or private standpipe is only about 21 %. Furthermore, the proportion of households who get water from borehole is only about 2 %.

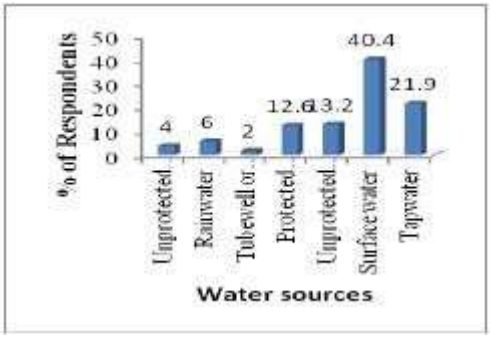


Fig. 2; Principal water sources used

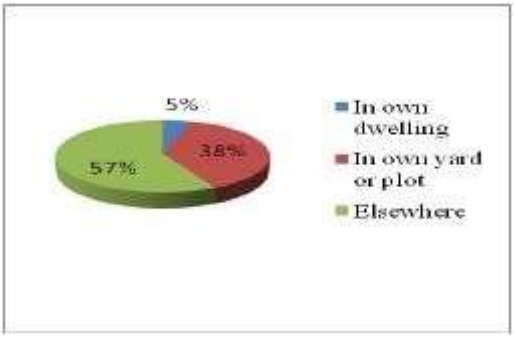


Fig. 3: Location of water sources in Bomet in Bomet municipality

(a) (b) (c)

(d) (e) (f)

Plate 1: Water sources used by households in Bomet Municipality

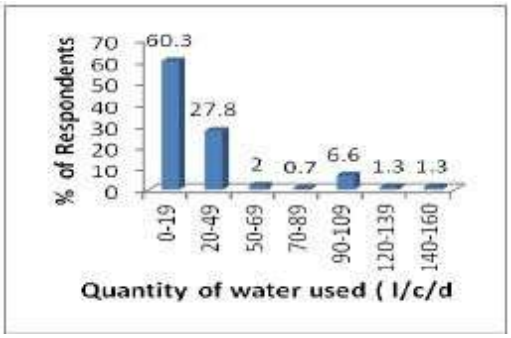
(a) Dam (b) River (c) Rainwater (d) Unprotected dug well (e) Spring (f) Tap water

Results show that only few households (5%) have their water source located in own dwelling (Fig. 3). Most sources (57%) are located elsewhere. The households that fetched water from a source that was not immediately accessible to the household transported using a donkey and human-powered transport. Women and children in Bomet almost exclusively do the considerable labour involved in water collection (see plate 2).

(a) (b)

Plate .2: Transportation of water in Bomet Municipality: (a) Using donkey (b) Human-powered transport

On the quantity of water used per capita per day, most persons (60%) used 19 liters and below per day (Fig.4). Only few individuals (22 %) met the minimum limit of the 20 liters per person per day set by World Health Organization (WHO). This implies that there is water shortage in Bomet municipality. Besides, the average time taken to water sources, fill containers and come back was one hour. Most households (88 %) took 30 minutes or less than half an hour (Fig.5). WHO/UNICEF (2008) recommends 30 minutes in a (normal) round trip to fetch water as adequate for a person to access a minimum of 20 litres of potable water needed per day and still have enough time to do other activities.



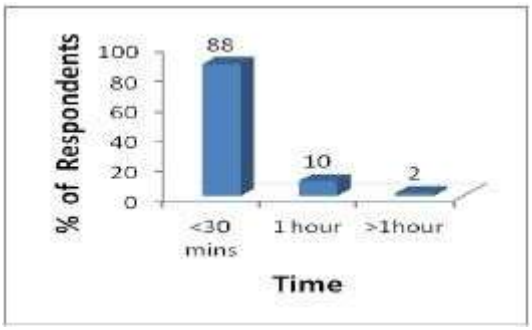
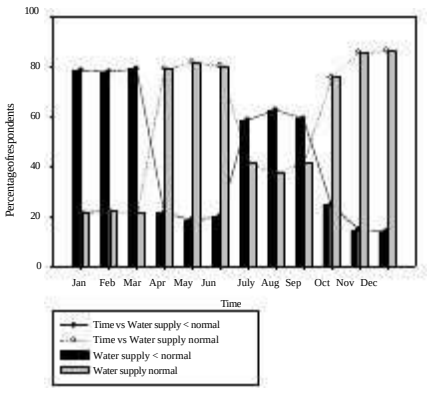


Fig.4: Total domestic water used In liters/person/day

Fig.5: Time spent collecting water

The average distance from households to water source was 0.8-kilometer. Most of the households (52%) traveled less than a kilometer to get to water source from their dwelling (Fig.6). Results from the findings (Fig. 6) indicate that the supply of water in Bomet municipality is less than normal to most of the households on January (78%),February (77.5%) and March (78.8 %) while to some of the households, the water supply is less than normal on July (58%), August (62%) and September (59 %). Only few of the respondents had water supply less than normal on April, May, June, October, November and December.



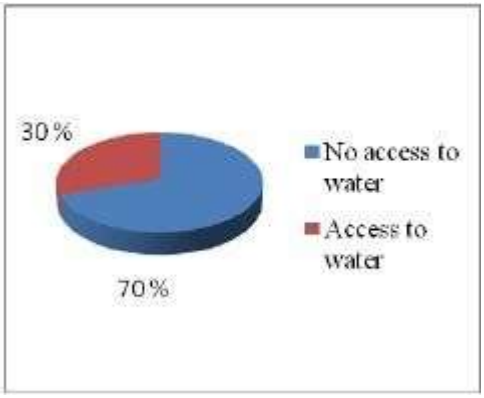


Fig 6. Seasonal variation in household access to water in Bomet municipality

Fig.7: Households access to improved source

The results indicate that only 30% of the households in Bomet municipality had access to improved water sources while 70% had no access (Fig. 7). This implies that there is acute water shortage in the Municipality.

Relationship between Household Size and Household Access to Improved Water Sources

Spearman's rank correlation coefficient was used to measure the level of association between household size and access to improved domestic water sources. The findings show that there was a significant negative relationship between household size and household access to improved water sources as indicated by correlation coefficient of -0.532** (Table 2). This means that an increase in household size would lead to a decrease in access to improved water by the household. These findings are in agreement with those of Arbués *et al. (*2010) and Lawrence *et al.* (2002) who observed a similar relationship between household size and access to water.

Table 2: **Relationship between household size and access to water in Bomet municipality**

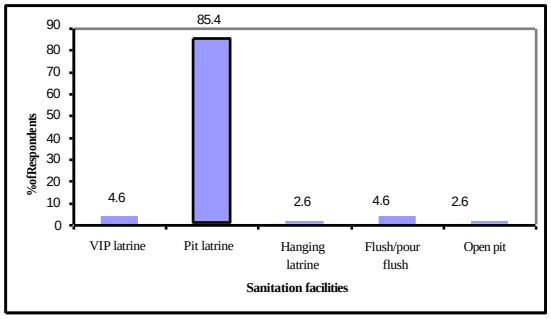
			Household size	Access to improved water
Household size	Correlation Coefficient		1	-0.532**
	Sig. (2-tailed)		.	0.000
Access to domestic water	Correlation Coefficient		-0.532**	1
	Sig. (2-tailed)	0.000	.	
	N		151	151

**Correlation is significant at the 0.05 level (2-tailed).

Households' Access to Basic Sanitation

An assessment of access to basic sanitation was also based on WHO/UNICEF Joint Monitoring Programme (JMP) variables. The WHO/UNICEF Joint Monitoring Programme (JMP) recommend the following indicators to be used in household access to basic sanitation: diarrhea prevalence, hygienic sanitation facilities, sanitation facilities classified as improved, safe and private toilet facilities (WHO/UNICEF, 2008).

The results (Fig.8) show that only few households (9 %) used improved sanitation facilities such as Flush/pour flush toilet and ventilation improved pit (VIP) latrine. Majority of the households (91 %) used unimproved sanitation facilities (pit latrine without a slab, open pit and hanging latrine). Majority of the households (53 %) had no sewerage facilities as (Fig. 9). There was evidence of wastewater flowing out of the compounds uncontrolled, which constituted a threat to health of residents of Bomet (see plate 4).



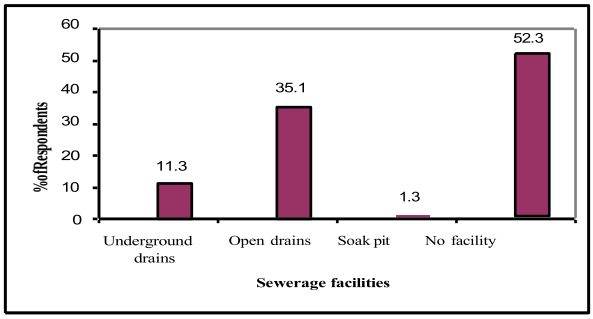


Fig. 8: Sanitation facilities in Bomet

Fig. 9: Sewerage facilities in Bomet municipality

(a) (b) (c)

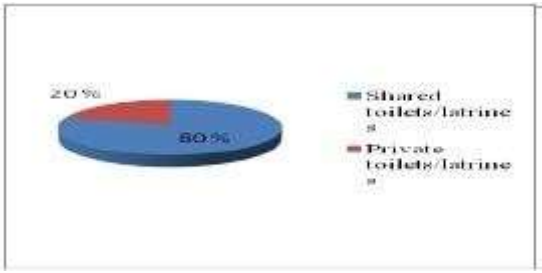
(d) (e) (f)

Plate 3: Sanitation facilities used in Bomet municipality

(a) Flush toilet (b) Pour flush toilet (c) open pit latrine (d) VIP latrine (e) Pit latrine with a slab (f) Pit latrine

Plate 4: Open drains in Bomet municipality

Results (Fig. 10) indicated that only 20 % of the households sampled in Bomet Municipality used private sanitary facilities. Most households (80%) shared a toilet or used public facilities. It was also noted that most households (69%) used unhygienic sanitation facilities as shown in Fig.11.



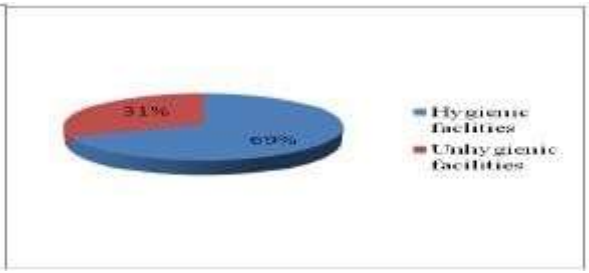
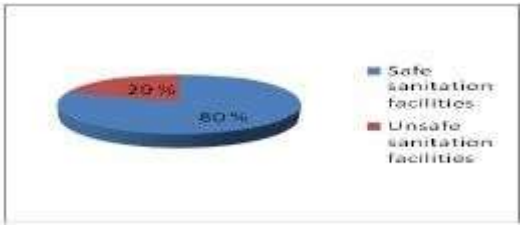


Fig.10: Privacy of sanitation facilities **Fig.11:** Toilets/latrines hygiene

Most of the sanitation facilities (80%) were safe for every member of the household (Fig.12). Unsafe facilities may be attributed to lack of private sanitation facilities in some households. Only 11% of the households sampled reported their children (< 36 months) to have had diarrhea in the two preceding weeks (Fig.13). The diarrhoea cases reported in Bomet may be attributed to pit latrines that overflow when it rains due to high water table.



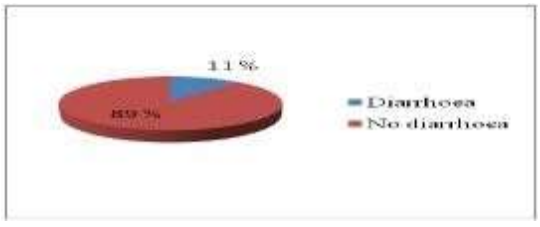
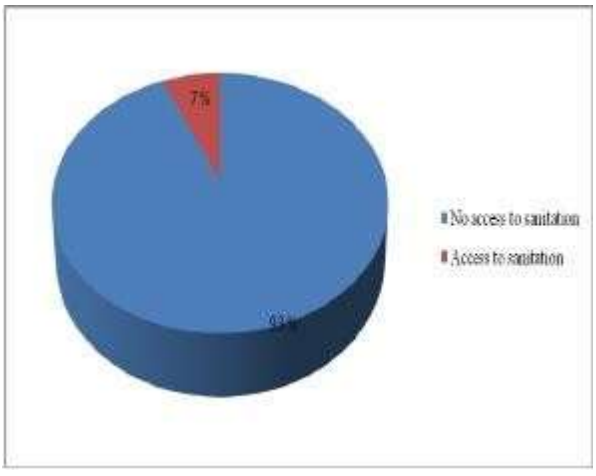


Fig.12: Safety of sanitation facilities **Fig.13**; Instances of diarrhoea reports

The results indicate that only 7 % of the households in Bomet municipality had access to basic sanitation while 93% had no access as shown in figure 13.



Household Size and Household Access to Basic Sanitation

The spearman's rank correlation coefficient was run to test the significance of relationship between household size and access to improved basic sanitation. Results (Table 3) indicate no relationship between household size and household access to basic sanitation as indicated by correlation coefficient of -0.072.

Table 3: Relationship between household size and access to basic sanitation in Bomet municipality

		Household size	Access to basic sanitation
Household size	Correlation Coefficient	1	-0.072
	Sig. (2-tailed)	.	0.379
Access to basic sanitation	Correlation Coefficient	-0.072	1
	Sig. (2-tailed)	0.379	.
	N	151	151

DISCUSSIONS

Majority of households (58% and 19%) in Bomet municipality have large families. Household size is an important consideration in household water availability as it determines the amount of water that is required for use in the household (Demeke, 2009). Majority of the households (57 %) used unimproved water sources; unprotected dug well, unprotected spring and surface water. Surface water (dug wells, dam and river) is the main source of water for domestic use in Bomet Municipality. The main source of river water is Nyangores River. According to KNBS (2010), the source of drinking water is an indicator of whether it is suitable for drinking.

WHO/UNICEF Joint Monitoring Programme (JMP) recommends the source be located within 1 kilometre of the dwelling. Most households (57%) in Bomet fetched water from a source that was not immediately accessible to the household**.** From the results, it was evident that the responsibility of drawing water, according to the Kipsigis customs, lies with women and children. Girls carried containers full of water on their backs (see plate 2). Water sources that are considered safe for use can become contaminated between point - of - collection, storage and household use (KNBS, 2010). When water is obtained from sources outside the home, average consumption drops to roughly one-third of the average consumption at a compound tap and one tenth that of household with water piped into the house (Well, 1998). Most of the households in Bomet municipality relied on water systems in which water was supplied on a community or group basis.

On the quantity of water used per capita per day, most persons (60%) used 19 liters and below per day. This figure is slightly lower than the WHO guidelines, which state that the per capita water consumption should be at least 20 liters per day (Mengesha *et al.*, 2003, Minten *et al.*, 2002 and Collick, 2008). The distance between the nearest water access point and each household is one indicator of the access to improved water sources. The average distance from households to water source in the municipality was 0.8-kilometer. November and December are the drought months, water quantity is lowest at these times of the year and many of the improved sources dry up in some locations of the Municipality such as Kapkesosio, Ithembe and Kyogong forcing women and children to travel longer distances in search of water from unimproved water sources. It was equally noted that lack of sufficient amount of water in other times of the year

with most respondents was not due to climatic factors. The respondents however cited reasons such as power failure and increasing population within the municipality as some of the factors for inadequate water in other times of the year.

Overall, only 30 % of he households in Bomet municipality had access to improved water sources**.** This implies that only 30% of the sampled households had their water source located within one kilometer from their homes, spent 30 minutes or less to fetch water, used water sources classified as improved and were able to reliably obtain at least 20 liters per member of a household per day as recommended by WHO/UNICEF.

Results indicated that there was a significant association between household size and household access to improved water sources in Bomet municipality. An increase in household size would lead to a decrease in access to improved water by the household. The results are in agreement with those of Shonnar (2007) who found that the larger the family size, the more the amount of water consumed or demanded. There are more people in the municipality and increasing consumption of water for domestic use. These have created demands for clean water which, in turn, exacerbate water shortages hence people are most likely to use water from unimproved sources.

Access to basic sanitation in Bomet municipality is also limited. Majority of the households (91 %) used unimproved sanitation facilities; pit latrine without a slab, open pit and hanging latrine. The high percentage of people using pit latrines can be explained by the fact that pit latrines can be build and maintained at low cost**.** Pit latrines are all that most people in the developing world can afford (Pickford, 1995). Given sensitive guidelines and a little technical help, families can build pit latrines for themselves at very low cost. Many households (57 %) drained wastewater from washrooms within their compounds although they knew the consequences of such action. There was also evidence of uncontrolled wastewater flowing out of the compounds that constituted a threat to public health (see plate 4). Lack of sewerage facilities may be attributed to high per capita cost and poor access to water services in the Municipality.

A household is classified as having an improved toilet if the toilet is used only by members of one household (that is, it is not shared) and if the facility used by household separates the waste from human contact (WHO/UNICEF, 2006). Most households (80%) shared a toilet or used public facilities. The use of public facilities by Bomet residents may be attributed to greater numbers of tenants. Most households (69%) used unhygienic sanitation facilities. The dirty latrines were the shared household latrines because of poor management. If a toilet is dirty and smelly, no one will want to use it — and it may spread disease (UNDP, 2005).

The nature of the construction and distance between households is also another indicator of latrine availability. Most of the sanitation facilities (80%) were safe for every member of the household. It was established that the unsafe facilities were the public facilities. Maintenance of shared facilities is often problematic and is not used by all members of the household (UNDP, 2005). In addition, distance may be a factor affecting convenience and therefore use (ibid). Latrines were not used by young children (>5 years of age) and women in some areas of the municipality because they were poorly constructed, located in a bush or far from home. World Bank (2011) found that for sanitation to be effective, facilities must be correctly constructed, properly maintained and in a safe place.

The proportion of children in the households sampled who had diarrhoea at the time the information was collected or who have had it anytime in the two preceding weeks was also considered. Only 11% of the households sampled reported their children (< 36 months) to have had diarrhea in the two preceding weeks. It was established that the households that reported diarrhoea cases used unimproved sanitation facilities. Improvements in sanitation have been shown consistently to result in better health as measured by fewer diarrhoeas, reductions in parasitic infections, increased child growth, and lower morbidity and mortality (Bendahmane *et al.,* 1999).

Overall, only 7 % of the households in Bomet municipality had access to basic sanitation while 93% had no access. This implies that only 7% of the households used improved, hygienic, private and safe sanitation facilities as recommended by WHO/UNICEF.

There was no relationship between household size and household access to basic sanitation in Bomet municipality. Although it appear logical to think that sanitation decreases as the population grows, this is not true as reported by (WRI, 1996). Technological advancements have greatly increased sanitation. There are various sanitation technologies in Bomet ranging from the lowest cost technology (such as pit latrines, simple defecation trenches etc) to highest cost technology (such as private sewer connection, flush toilets etc). Pit latrines are affordable and can be shared between several families (Pickford, 1995).

Conclusions and Recommendations

The study suggests that the type of water source used by household was significantly influenced by the size of the household. Average daily water consumption varies depending on household size. As the household size increases, the amount of water used per person per day significantly decreases (Demeke, 2009). Thus households with more members are likely to use water from unimproved source. Especially, it has emerged from the study that the number of household members is the fundamental factor, which compels households to rely on unimproved sources. Shifting from larger to smaller households can bring a reduction in household water use. The government should take action to slow the growth in demand for freshwater by slowing population growth. Continuing and expanding family planning programs can help assure that population growth eventually slows to sustainable levels in relation to the supply of freshwater. Policymakers and the general public need to be educated about water resources, sanitation and population dynamics, with an emphasis on making human activities sustainable with respect to water availability.

There was no relationship between household size and household access to basic sanitation in Bomet municipality. Despite increase in population, technological advancement has greatly increased sanitation. A wide range of sanitation technologies exist ranging from the lowest cost technology (such as shared household latrines) to highest cost technology (such as individual household latrines). Shared household latrines are cheaper to construct than individual household latrines and can be shared between several families where crowding prevents household solutions. There is need for a study to establish what impacts on household access to basic sanitation in Bomet municipality.

REFERENCES

Arbués, F., Villanua. and Barberan, R. (2010). "Household Size and Residential Water Demand: An Empirical Approach". *The Australian Journal of Agricultural and Resource Economics*, Blackwell Publishing, Asia Pty Limited.

Allain, M., 1994. Population and Water Resources. United Nations Population Information Network (POPIN) UN Population Division, Department of Economic and Social Affairs and FAO,UN.

AMREF, (2010). Waterborne diseases. Available at http://uk.amref.org/what-we-do/fight-disease-/waterborne-diseases .(Accessed on 23 June 2011)

Arye, D., Jacobs, L.C. and Razavien, A. (1972). Introduction to Research in Education, Holt Rinehart and Winston Inc.USA.

Baseline Survey of the Mara River Basin (2004). Bomet Environmental issues, Nairobi Rotary Club, Kenya.

Bendahmane, D., Billig, P. and Swindale, S. (1999). Water and Sanitation Indicators Measurement Guide. U.S. Agency for International Development, USA.

Collick, A. (2008). Community Water Use in the Yeku Watershed and Hydrological Modeling in Watersheds of the Upper Nile Basin, Northern Ethiopia: Dissertation, Cornell University, Ithaca, New York, USA.

Demeke, A. (2009). Determinants of Household Participation in Water Source Management: Achefer, Amhara Region, Ethiopia. Msc Thesis, Cornell University ,New York.

Dungumaro, E. W. (2007). "Socioeconomic Differentials and Availability of Domestic Water in South Africa", *Journal of Physics and Chemistry of the Earth*, Volume 32, pp. 15-18.

Franzel, S. and Crawford, E.W. (1987). Comparing Formal and Informal Survey Techniques for Farming Systems Research. A Case of Kenya. Agriculture Administration and Extension: Dissertation, Egerton University, Kenya.

Gleick, P.H. (2003). Water Use. *Annual Review of Environment and Resources Journal*, Vol.28, pp.275–314.

Kenya National Bureau of Statistics (KNBS), (2010). Kenya Demographic and Health Survey 2008-09. KNBS and ICF Macro, Calverton, Maryland.

KWAHO, (2009). Enhancing Water and Sanitation Governance in Kenya. Human Rights Based Approach to Reforms in the Kenya Water Sector. Kenya Water for Health Organization, Kenya.

Lawrence, P., Meigh, J. and Sullivan, C. (2002). "The Water Poverty Index: An International Comparison", *Keele* Economics Research Papers. Available at http://www.keele.ac.uk depts/ec/wpapers. (Accessed on 8 July 2010) .

NEMA (National Environment Management Authority), (2011). Bomet District Environment Action Plan 2009-2013. Ministry of Environment and Mineral Resources. National Environment Management Authority, Republic of Kenya.

Mengesha, A., Abera, K. and Mesganaw, F. (2003). "Sustainability of Drinking Water Supply Projects in Rural of North Gondar, Ethiopia", *Ethiopian Journal of Health Dev*elopment, Vol.3, pp. 221-229.

Ministry of State for Planning, National Development and Vision 2030, (2008). Bomet District Development Plan (2008-2012). Rural Planning Development. Office of the Vice President and Ministry of Planning and National Development, Kenya.

Minten, B., Razafindralambo, R., Randriamiarana, Z. and Larson, B. (2002). Water Pricing, the New Water Law, and the Poor: An Estimation of Demand for Improved Water Services in Madagascar, SAGA Working Paper. USAID-International Labour Organisation (ILO) program,Madagascar.

Mintz, E., Bartram, J., Lochney, P., and Wegelin, M. (2001). "Not just a drop in the bucket: Expanding access to point of-use water treatment systems", *American Journal of Public Health*, N0.91, pp. 1565-1570.

Pickford, J., (1995). Low Cost Sanitation - A survey of practical experience, Intermediate Technology, United Kingdom.

Shonnar, B.O., (2007). Households' Affordability and Willingness to Pay for Water and Wastewater Services. Published Thesis. Institute of Environmental and Water Studies, Palestine.

Survey of Kenya, (2007). Kenya Maps. Nairobi, Kenya

UN (United Nations), (2010). United Nations Millennium Development Goals. Available at http://www.un.org/millenniumgoals/environ.shtml (Accessed 10 November 2011).

UNDP (United Nations Development Program)., (2005). Sanitation and Cleanliness for a Healthy Environment. Bureau for Development Policy, Energy and Environment Group, Hesperian Foundation, New York.

UN-HABITAT, (2010). "State of the World's Cities 2010/2011" Available at :http://www.unhabitat.org/content.asp?cid=8051&catid=7&typeid=46&subMenuI(Accessed 10 November2011).

UN/WWAP (United Nations / World Water Assessment Programme) (2003). "Water for people, Water for live". Available at: http://unesdoc.unesco.org/images/0012/001295/129556e.pdf. (accessed 9 September 2010).

USAID, 2011. Water and Sanitation. USAID, Kenya. Available on: http:/ /kenya. USAID gov/ programs/water- and-sanitation. (Accessed 10 November2011).

Vidal, J., 2012. Water and Sanitation Still not Top Priorities for African Governments. Available on http:/ /www. guardian. co. uk/ globaldevelopment// water- sanitation priorities- African-governments.(Accessed 30 August 2012).

Well, (1998). Guidance Manual on Water Supply and Sanitation Programmes, WEDC, Southborough; United Kingdom.

WHO, (1999). "Creating Healthy Cities in the 21st Century", in: Satterthwaite, D (Ed) *The Earthscan Reader on Sustainable Cities*, London: Earthscan

WHO, (2002). The World Health Report 2002: Reducing Risks, Promoting Healthy Life, WHO,Geneva.

WHO/UNICEF, (2006). Meeting the MDG Drinking Water and Sanitation Target. The Urban and Rural Challenge of the Decade. WHO Press, World Health Organization, Switzerland

WHO/UNICEF, (2008). Progress on Drinking Water and Sanitation: Special Focus on Sanitation. UNICEF, New York and WHO, Geneva.

World Resources Institute (WRI), (1996). World Resources 1996-97. New York and Oxford: Oxford University Press. (Jointly published with the United Nations Environment Program, the United Nations Development Program, and the World Bank.)