



International Journal of Development and Sustainability

Online ISSN: 2168-8662 – www.isdsnet.com/ijds

Volume 2 Number 2 (2013): Pages 1499-1512

ISDS Article ID: IJDS13041905



Special Issue: Development and Sustainability in Africa – Part 2

Determinants of variation in households' level of access to improved water sources and basic sanitation in Bomet municipality, Kenya

E.C. Koskei^{1*}, K.N. Ondimu², G.O. Obwoyere³, J.M. Mironga²

¹ Department of Education and Arts, Kabarak University, Private Bag-20157, Kabarak, Kenya

² Department of Geography, Egerton University, P.O. Box 536-20115, Njoro, Kenya

³ Department of Natural Resources, Egerton University, P.O. Box 536-20115, Njoro, Kenya

Abstract

This study investigated if there was variation in households' levels of access to water and basic sanitation and determining factors in Bomet municipality. Water supply and sanitary facilities in Bomet are characterized by low levels of access. As a result, incidences of waterborne diseases such as diarrhoea, cholera and typhoid are still reported in the area. Multi-stage random sampling method was used to obtain the sample of 151. The questionnaire was the main instrument for data collection. The SPSS was used to manage data and analysis done using descriptive statistics, service level and Chi-Square at 5% level of significance. The findings show that levels of access to improved water and basic sanitation varied within Bomet Municipality. There was significant association between types of source, quantity of water used per capita per day, household size, education level and access to improved water. The type of toilet facility used, sewerage facilities and marital status of household head significantly determined variation in households' level of access to basic sanitation. There is need for basic education. This will equip Bomet residents with means to fight their poverty, slow population growth and to adopt improved water and sanitation technologies.

Keywords: Basic sanitation; Determinants; Improved water sources; Variation

Copyright © 2013 by the Author(s) – Published by ISDS LLC, Japan

International Society for Development and Sustainability (ISDS)

Cite this paper as: Koskei, E.C., Ondimu, K.N., Obwoyere, G.O. and Mironga, J.M. (2013), "Determinants of variation in households' level of access to improved water sources and basic sanitation in Bomet municipality, Kenya", *International Journal of Development and Sustainability*, Vol. 2 No. 2, pp. 1499-1512.

* Corresponding author. E-mail address: koskeiednah@gmail.com

1. Introduction

Urban population ratios that have access to water and sanitation in Kenya are 57 % and 47 % respectively yet the Millennium Development Goals (MDG) targets by 2015 are 73 % and 70 % respectively (UNICEF, 2006). About 85 % of households in Bomet Municipality lack access to basic sanitation and 52 % lack access to safe drinking water. The principal sources of water in Bomet are non-improved: they include dug wells, dam water and river. The average distance to the nearest potable water point is 4 kilometers and about 90 % of the households use low/basic service level sanitation-the pit latrines (Ministry of State for Planning, National Development and Vision 2030, 2008). One of the UN Millennium Development Goals (MDG) targets is to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation, with 1990 as the baseline year (WHO, 2012). Increasing access to improved drinking water and ensuring adequate sanitation facilities is one of the Millennium Development Goals that Kenya along with other nations worldwide has adopted (United Nations General Assembly, 2001). While 35.5 million people in Kenya gained access to both improved drinking water sources and improved sanitation in 2006, another 11.9 million need to gain access from 2007 to 2015 to attain the Millennium Development Goals sanitation target and 11.9 million needs to gain access to meet the drinking water target. From the baseline in 1990 to the target date in 2015, the number of rural dwellers without access to basic sanitation will decrease, whereas the number of urban residents without access will increase because of population growth (WHO/UNICEF, 2006).

The United Nations General Assembly and the UN Human Rights Council recognized access to safe drinking water and sanitation as a human right (WHO, 2012). In the current Kenya water law-the Water Act of 2002, access to water is recognized as a basic right (KWAHO, 2009). According to WHO (2004), the right to water implies access to the least amount needed for basic needs at individual level. Worldwide realization of this level of service can result in great gains in public health and is at the centre of attention on international policy initiatives through the Millennium Declaration Goals and of monitoring activities through the WHO/UNICEF Joint Monitoring Programme (WHO, 2012). A basic level of service for water includes water used for drinking, cooking, bathing, personal and household hygiene and sanitation (Bendahmane *et al*, 1999) but access to this level is determined principally by distance, time, reliability and potential cost. A basic level of service for sanitation would comprise on-site sanitation such as pit latrine (WHO/UNICEF, 2008). Pit latrines are all that most people in Bomet, as in other developing countries can afford. Given sensitive guidelines and a little technical help, families can build pit latrines for themselves at very low cost (Pickford, 1995).

The amount of water collected by or delivered to the household and used there for drinking, cooking, bathing, personal and household hygiene and sanitation by the inhabitants of the household is an important aspect of domestic water supplies, which influences one's other productive, social or education and health (WHO, 2003). Overcoming a lack of basic access where the distances and time involved in water collection result in use of inadequate volumes is essential (WHO, 2004). This level of service will contribute both directly and indirectly to income generation, health, education, and MDG number seven which calls for ensuring environmental sustainability through halving the proportion of people without access to safe

drinking water and basic sanitation between 1990 and 2015. Esrey et al., (1991) and Huttly et al., (1997) found that health gains associated with better water quality are smaller than those obtained through increases in the quantity of water. Population groups that constantly use more water have better health than groups that use less water as this will allow better personal and domestic hygiene practices such as hand washing, food washing, utensils washing and household cleaning (Bendahmane et al., 1999).

Water supply and sanitary facilities in Bomet municipality are characterized by low levels of access. As a result, cases of diarrhoea, cholera and typhoid that are caused by unclean water and poor sanitation are still reported in the area (Ministry of State for Planning, National Development and Vision 2030, 2008). Levels of access to improved water sources and basic sanitation vary widely across Bomet municipality. The variation in household level of access to improved water sources is attributed to quantity of water used per capita per day, type of water source used by household, household size and education level of the household head. Variation in households' levels of access to basic sanitation is attributed to the type of toilet facility used by household, household access to sewerage facilities and marital status of household head. This paper is out to investigate if there is variation in households' levels of access to water and basic sanitation and determining factors in Bomet municipality.

2. Study area

Bomet municipality is located in Bomet County in Rift Valley Province, Kenya (Figure 1). It lies between 0°39' and 1°02' south of the Equator and between longitudes 35°00' and 35°32' east of prime meridian (33° East of the Greenwich meridian) (Ministry of State for Planning, National Development and Vision 2030, 2008). The main river in the district, River Nyangores, flows from southwest Mau forest, and proceed southwards through Tenwek in Bomet Municipality; River Amalo flows along the southwestern boundary of the district; and Kiptiget /Tebenik flows along the northern boundary of the district. The lower parts of the district and the surrounding areas depend on water pan and dams. The district 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, National Development and Vision 2030, 2008). 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, National Development and Vision 2030, 2008).

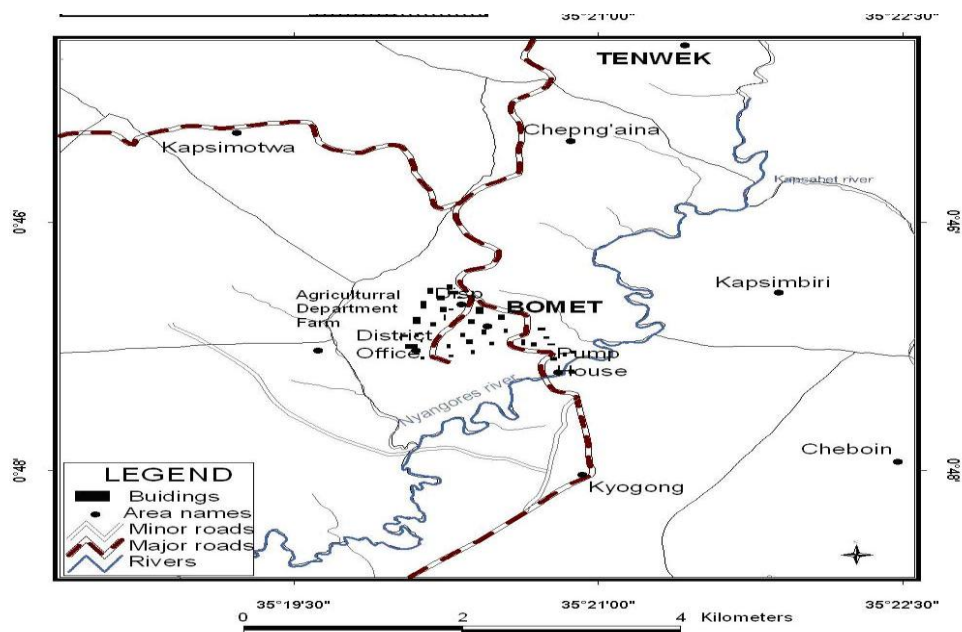


Figure 1. Map of Bomet Municipality (Source: Survey of Kenya, 2007)

2.1. Bomet's population

According to 2009 Housing and Population Census, total estimated population of Bomet district was 353,923 and Bomet municipality was 76,694 people which is higher compared to other major towns within the Mara River Basin in Kenya such as Narok town with a population of 42,505 people. It has a population density of 419 persons per square kilometer and the average household size is six (Ministry of State for Planning, National Development and Vision 2030, 2008) which is higher compared to average for Kenya (five) (KNBS, 2010). 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. Allain (1994) found that urbanization, through increased population density and the concentration of demand can impose constraint on local resources. The demand for water in all sectors of the economy including domestic is increased by population growth (Tobin, 2000). Population growth is a direct determinant of increases in water demand for domestic uses. According to KWAHO (2009), population growth and the subsequent demand for water is one of the largest pressures influencing the state of water resources in Kenya Bomet.

3. 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. In total 151 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 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 observations and by use of semi-structured questionnaire and household head was the subject of analysis. The data collected were analyzed using descriptive statistics, service level and inferential statistics. Data on household level of access to basic sanitation and water were summarized using frequencies and percentages. Accessibility was categorized based on service level while chi-Square test at 5% level of significance was used to analyze factors that determined variation in levels of access to water and basic sanitation.

4. Results

The results (Table 1) indicated that only 9% of the sampled households in Bomet Municipality had achieved optimum access service level, 4 % had achieved intermediate level of access while 25% had basic access. The other households (62%) can be said to have no access to improved water sources.

The data, however, reveal wide variation in levels of access to improved water sources across Bomet municipality with some households having no access. These figures show that there remains a significant proportion of the municipality population (62 %) without access to an improved water supply within one kilometer of their dwelling and that 87 % do not have access to an intermediate level of service (Table 1).

Table 1. Water service level of Bomet municipality

Service level	Percentage	Likely volume of water collected	Access measure
Optimal access	9	100-200 liters per capita per day	Water supply within house with more than one tap
Intermediate access	4	About 50 liters per capita per day	At least one tap in premises or close by
Basic access	25	About 20 liters per capita per day	Less than 1KM and 30 minutes round trip
No access	62	About 5 liters per capita per day	More than 1KM and over minutes round trip
Total	100		

Using the service level (Table 2), about 95% of the households used basic/low level of service while the remaining 5% used intermediate level of service. None of the households sampled had achieved full/high level of service because conventional household sewer connections are costly and require substantial volumes of water for proper use.

There is a great variation of levels of access to basic sanitation among households in Bomet municipality with 95% of the households using basic/low level of service and 5% using intermediate level of service. None of the sampled households had achieved high service level.

Table 2. Sanitation service level of Bomet municipality

Service level	Access measure	Frequency	Percentage
Basic/Low service level	Dry onsite sanitation	144	95
Intermediate level of service	Wet onsite sanitation	7	5
Full/High service level	Offsite sanitation	0	0
Total		151	100

Analysis of the findings in Table 3 indicates that household level of access to improved water sources was associated with the type of water source used by the household ($\chi^2=67.03$, $df=18$, $p<0.00$). Most of the households (33 %) that used unimproved source (surface water obtained from wells, dams and rivers) as the main source of water for domestic use in Bomet Municipality had no access to improved water sources. Only few households (4%) that used improved source such as public or private standpipe had no access.

Households' levels of access to improved water sources was associated with the size of household ($\chi^2=169.61$, $df=45$, $p<0.00$). Majority (60 %) of the households that had large families (4 members and above) in Bomet municipality had no access to an improved water sources. Households' levels of access to improved water sources was also associated with the level of education of household head ($\chi^2=16.2$, $df=6$, $p<0.01$). Only 9 % of the households whose heads had achieved tertiary education had no access to improved water sources. Most (38 %) of those who had achieved only primary education had no access because low educational attainment leads to low incomes. Most household heads (52%) in Bomet municipality had acquired only primary education.

According to the results presented in Table 4, Variation in households' levels of access to basic sanitation in Bomet municipality was associated with the type of toilet facility used by the household ($\chi^2=151$, $df=4$, $p<0.00$). Majority (91%) of the households that used unimproved facilities- hanging, pit and open pit latrines used low service level. There was a significant association between households' levels of access to basic sanitation and sewerage facilities in Bomet municipality ($\chi^2=57.86$, $df=3$, $p<0.00$). None of the sampled households had achieved full access because there are no sewerage facilities in the area. There was a significant association between households' levels of access to basic sanitation and marital status of the household head in Bomet municipality ($\chi^2=21.96$, $df=3$, $p<0.00$). Among the household heads interviewed in Bomet Municipality, it was noted that the female heads were either single, widowed or separated while male heads were married. Most of the married heads (76 %) had access to basic service level. None of the separated heads had achieved basic service level because female-headed households have limited access to resources.

Table 3. Determinants of variation in households' levels access to improved water sources in Bomet municipality

	Households' levels of access to improved water sources				
	Optimal access (%)	Intermediate access (%)	Basic access (%)	No access (%)	Total (%)
Household size					
Below 3 members	5	1	12	2	20
4 to 7 members	5	1	13	36	55
8 to 11 members	0	1	0	19	20
11 members and above	0	0	0	5	5
Total	10	3	25	62	100
Chi-square test: Value = 169.61, df=45, Significance = 0.00, $\alpha=0.05$					
Education level					
primary	3	1	9	38	51
secondary	2	1	11	16	30
tertiary	4	1	5	9	19
Total	9	3	25	63	100
Chi-square test: Value = 16.2, df = 6, Significance = 0.01, $\alpha=0.05$					
Type of water source					
Unprotected dug well	0	1	1	3	5
Rainwater	0	1	2	3	6
Tube well or Borehole	0	0	1	1	2
Protected Dug well	0	0	2	10	12
Unprotected spring	2	1	3	7	13
Surface water	0	1	7	33	41
Tap water	7	1	9	4	21
Total	9	5	25	61	100
Chi-square test: Value = 67.03, df=18, Significance = 0.00, $\alpha=0.05$					
Amount of water used per cerpita per day					
0-19	0	0	0	60	60
20-49	0	2	25	1	28
50-69	0	2	0	0	2
70-89	2	0	0	0	2
90-109	5	0	0	1	6
120-139	1	0	0	0	1
140-160	1	0	0	0	1
Total	9	4	25	62	100
Chi-square test: Value = 402.43, df = 120, Significance = 0.013, $\alpha=0.05$					

Table 4. Determinants of variation in households' levels of access to basic sanitation in Bomet Municipality

	Households level of access to basic sanitation.			
	Basic/Low service (%)	Intermediate service (%)	Full access (%)	Total (%)
Type of toilet facility				
Ventilation improved pit latrine	5	0	0	5
Pit latrine	85	0	0	85
Hanging latrine	3	0	0	3
Flush/pour flush	0	4	0	4
Open pit	3	0	0	3
Total	96	4	0	100
Chi-square test: Value = 151, df = 4, Significance = 0.00, $\alpha=0.05$				
Marital status				
single	11	0	0	11
married	76	4	0	80
widowed	8	0	0	8
separated	0	1	0	1
Total	95	5	0	100
Chi-square test: Value = 21.96, df = 3, Significance = 0.00, $\alpha=0.05$				
Type of sewerage facility				
Underground drains	7	5	0	12
Open drains	35	0	0	35
Soak pit	1	0	0	1
No facility	52	0	0	52
Total	95	5	0	100
Chi-square test: Value = 57.86, df = 3, Significance = 0.00, $\alpha=0.05$				

5. Discussion

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. Most households (62%) in Bomet municipality had no access to improved water sources because of the distances and time involved in water collection. Distance between the dwelling and water source is one of the factors influencing the volumes of water used by people in different households (Kjellén et al., 1996). If the home or compound is not connected directly to a piped system or that a source is not

located within one kilometer of the home, people are more likely to compromise their daily water consumption, carrying less water than the household needs for basic needs such as drinking, food preparation and personal hygiene (Cairncross and Feacham, 1993). Kjellén et al., (1996) found that indoor piping simplifies all household water issues. Significant gains occur largely when water is available at household level (WHO, 2003). These include health gains and increased time for activities such as child-care, food preparation and productive activities.

None of the sampled households in Bomet municipality had achieved full/high level of service of sanitation because conventional household sewer connections are costly and require substantial volumes of water for proper use. Bakalian et al., (1994) found that when sewerage is operated correctly and waste is treated, sewerage is an effective method of excreta disposal. In many areas of the Bomet however, sewage is allowed to flow directly into rivers untreated. Uncontrolled wastewaters flowing out of the compounds constitute a threat to health of Bomet residents.

Basic/low service level that comprises dry onsite sanitation such as pit latrine is mostly used in Bomet municipality because it is the most successful in water-scarce environments. However, costly adaptations can result where shallow rock or shallow water tables occur (Department of Water Affairs and Forestry, 2002) as in Bomet municipality (Ministry of State for Planning, National Development and Vision 2030, 2008). Intermediate service level that comprises wet onsite sanitation such as pour /flush toilet and LOFLOS (low flush on-site sanitation system) is suitable for small volumes of water and can accept domestic water generally carried by hand to the latrine (UNICEF, 2010). This system however, provides more affordable improved services provided the water utilization is adequately high (Bakalian et al., 1994). Thomas and Syme (1988) found that in order to ensure access to adequate sanitation facilities for all in the country within the constraints of the country's financial resources, it will be necessary to use a mix of levels of service an option which (ignoring costs of pollution) is significantly cheaper than high levels of service throughout.

Households' levels of access to improved water sources was associated with the type of water source used by the household ($\chi^2=67.03$, $df=18$, $p< 0.00$). Most of the households (33 %) that used unimproved source had no access to improved water sources. The source of drinking water is an indicator of whether it is suitable for drinking (KNBS, 2010). 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 likely to provide water suitable for drinking are identified as improved sources (WHO/UNICEF, 2008). These include household connection, public standpipe, and tube well or borehole, protected dug well, protected spring and rainwater collection. Unimproved sources include vendors, tanker trucks, surface water (river, dam, lake, pond, stream, canal, irrigation and channel) and unprotected wells and springs (WHO/UNICEF, 2008).

Households' levels of access to improved water sources was associated with the size of household ($\chi^2=169.61$, $df= 45$, $p< 0.00$). Majority (60 %) of the households that had large families (4 members and above) in Bomet municipality had no access to an improved water sources because households with more members use more water per member than smaller households hence reducing the quantity to be made available per capita hence people are most likely to use water from unimproved sources. Household size is an

important consideration in household water availability as it determines the amount of water that is available for use in the household (Demeke, 2009). Households' levels of access to improved water sources was also associated with the level of education of household head ($\chi^2=16.2$, $df=6$, $p<0.01$). Majority of the household heads (38 %) who had achieved only primary education had no access because low educational attainment leads to low incomes and economic status of households is closely linked with the affordability of services such as water (Kimenyi and Mbaku, 1995).

Variation in households' levels of access to basic sanitation in Bomet municipality was associated with the type of toilet facility used by the household ($\chi^2=151$, $df=4$, $p<0.00$) as indicated in Table 4. It was established that majority (91%) of the households that used unimproved facilities used low service level. Improved sanitation facilities are those that reduce the chances of people being exposed to human excreta and provide a higher level of service than unimproved facilities. They include public sewer connection; septic system connection; pour-flush latrine; ventilated improved pit latrine; ecosan toilets; pit latrine with slab and composting toilet while unimproved sanitation facilities includes flush / pour flush to elsewhere (street, yard or plot, open sewer, ditch, drainage way, channel river or stream), pit latrine without slab / open pit, bucket, hanging toilet / hanging latrine and bush/field or no facilities (UNICEF, 2010). There was a significant association between households' levels of access to basic sanitation and marital status of the household head in Bomet municipality ($\chi^2=21.96$, $df=3$, $p<0.00$). This suggests that the people who are married access water and sanitation more than those who are not. Female-headed households have limited access to resources (KNBS, 2010; Mbugua, 1997; Oppong, 1997; World Bank, 1991). While women have needs for safe and healthy sanitation, they may not have the money, resources, power, or confidence to ensure that their needs are met (UNDP, 2005).

Variation in households' levels of access to basic sanitation in Bomet municipality was also associated with sewerage facilities in Bomet municipality ($\chi^2=57.86$, $df=3$, $p<0.00$). None of the household sampled had achieved full access because there are no sewerage facilities in the area. In areas with low population densities, it is common to store and treat wastes where they are produced - on-site while in more densely packed areas sewerage systems are frequently used to transport wastes off-site where they can be treated and disposed (Franceys et al., 1992). Conventional centralized sewerage system requires an elaborate infrastructure and large amounts of water to carry the wastes away. The cost of a sewerage system, which can be as much as 70 times more expensive than on-site alternatives, and its requirement of a piped water supply preclude its adoption in communities that lack adequate sanitation (Ministry of State for Planning, National Development and Vision 2030, 2008). Lack of sewerage facilities may be attributed to high per capita cost and poor access to water services in the Municipality. Conventional household sewer connections require substantial volumes of water for proper use (approximately 6-15 liters per flush). Department of Water Affairs and Forestry (2002) found that options for sanitation are greatly influenced by water availability and wastewater disposal requiring a sanitation solution.

6. Conclusions and recommendations

In sub-Saharan Africa, mainly in Africa, several families do not have access to improved drinking water sources and sanitation (UNICEF, 2006). 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 practice open defecation (Vidal, 2012). USAID (2011) found that 13million Kenyans lack access to improved water supply and 19 million lack access to improved sanitation despite the efforts made by local and national governments, Non Governmental Organizations, foundations and corporations to bring clean water and sanitation facilities to Kenya. The study suggests that levels of access to improved water sources and basic sanitation varied widely within Bomet municipality. There are large disparities in the provision of safe water and proper sanitary facilities in Bomet municipality: some households have by far the lowest coverage rates of piped water and improved sanitation among the municipality residents. The numbers of people with no access to improved sources of drinking water was 2.5 times higher than the numbers of people with basic access. There is need for projects aimed to improve access to water and sanitation services in Bomet.

Where the basic access service level for water has not been achieved, consumption cannot be assured, hygiene is not possible and there is a very high level of health concern. Thus households that fetch water from a source that is not immediately accessible to the household are likely to use water from unimproved source and are likely to carry less water than the household needs for basic needs such as cooking, drinking and personal hygiene. Especially, it has emerged from the study that distances and time involved in water collection (proxies of accessibility) are the fundamental factors, which compel households to rely on unimproved sources as they cannot access the improved sources. There is need to improve access to improved water sources in Bomet municipality. Water facilities need to be located very close to the user's dwelling place or even inside the house. Thus, authorities should grant special attention to households with no piped connections when implementing strategies for population access to safe and reliable water. It has also emerged from the study that lack of access to water and sewerage facilities are the fundamental factors which compel most households to use low level of service for waste disposal. The government should connect facilities to a public sewer or septic system and a water supply in order to increase the numbers of households with full access level of service in Bomet. London School of Hygiene and Tropical Medicine (2009) found that proper disposal of human faeces is more effective in preventing faecal-oral transmission than food hygiene, provision of clean water, health education, or other preventive interventions.

From the empirical results of the study, it is noted that the quantity of water used per capita per day, type of water source used by household, household size and education level of the household head determine variation in levels of access to improved water by households. Average daily water consumption varies depending on household size. Households with fewer members tend to use more water per member than multiple-person households. Shifting from larger to smaller households can bring a reduction in household water use. Low-income families that lack a household water supply spend as much money on water as do families with better income. Most people in Bomet are low income. People with the money and resources to spend on water and sanitation services have better access than those in poorer areas. There is need for basic

education. Providing basic education locally will have a tremendous leverage effect; it will equip the future people of Bomet with the means to fight their poverty and manage water and sanitation better.

Acknowledgement

The fieldwork for this study was conducted in 2011 and was supported by the USAID Global Water for Sustainability (GLOWS) scholar's program funds.

References

- 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.
- Arye, D., Jacobs, L.C. and Razavien, A. (1972), Introduction to Research in Education, Holt Rinehart and Winston Inc, USA.
- Bakalian, R., Netto, J. and Wright, A. (1994), Simplified Sewerage Design Guidelines, World Bank, Washington.
- Bendahmane, D., Billig, P. and Swindale, S. (1999), Water and Sanitation Indicators Measurement Guide, United States Agency for International Development, U.S.A.
- Cairncross, S. and Feacham, R. (1993), Environmental Health Engineering in the Tropics; an Introductory Text, (2nd Ed.). John Wiley and Sons, Chichester, U.K.
- Demeke, A. (2009), Determinants of Household Participation in Water Source Management: Achefer, Amhara Region, Ethiopia. Msc Thesis, Cornell University, Ethiopia.
- Department of Water Affairs and Forestry (2002), Sanitation for a Healthy Nation: Sanitation Technology Options, Department of Water Affairs and Forestry, Republic of South Africa.
- Esrey, S., Potash, J., Roberts, L. and Shiff, C. (1991), "Effects of Improved Water Supply and Sanitation on Ascariasis, Diarrhea, Dracunculiasis, Hookworm Infection, Schistosomiasis and Trachoma", *Journal of World Health Organization*, Vol. 60, pp. 609-621.
- Franceys, F., Pickford, J. and Reed, R. (1992), A Guide to the Development of On- Site Sanitation, World Health Organization, Geneva.
- 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.
- Huttly, S., Morris, S. and Pisani, V. (1997), "Prevention of Diarrhea in Young Children in Developing Countries", *Journal of World Health Organization*, Vol.75 No.2, pp. 163-174.

- Kimenyi, M.S. and Mbaku, J.M. (1995), "Female Headship, Feminization of Poverty and Welfare", *Southern Economic Journal*, Vol. 62 No.1, pp. 44-52.
- Kjellén, M., Bratt, A. and McGranahan, G. (1996), Water Supply and Sanitation in Low and Middle Income Cities: Comparing Accra, Jakarta and São Paulo. Urban Environment, Series No. 1, Stockholm Environment Institute, Stockholm.
- KNBS (Kenya National Bureau of Statistics (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.
- London School of Hygiene and Tropical Medicine, (2009), The use of epidemiological tools in conflict-affected populations: open-access educational resources for policy-makers. Available at: http://conflict.lshtm.ac.uk/page_17.htm. (Accessed 12 September 2013).
- Mbugua, W. (1997), "The African Family and the Status of Women's Health", in: Aderanti Adepoju (Ed.), *Family, Population and Development in Africa*, London, Zed Books Ltd, pp. 39-157.
- 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.
- Oppong, C. (1997), "The African Family and the Status of Women's Health", in: Aderanti Adepoju (Ed.), *Family, Population and Development in Africa*, London, Zed Books Ltd, pp.158-182.
- Pickford, J. (1995), Low Cost Sanitation - A survey of practical experience, Intermediate Technology, United Kingdom.
- Survey of Kenya (2007), Kenya Maps, Nairobi, Kenya.
- Thomas, J.F. and Syme, G. (1988), "Estimating Residential price Elasticity of Demand for water; A Contingent Valuation Approach", *Water Resource Research Journal*, Vol. 24 No. 2, pp. 1847-1857.
- Tobin, R.J. (2000), "Environment, Population, and the Developing World", in Norman, J. and Michael, E. (4th Ed), *Environmental Policy*, Washington, D.C.: CQ Press.
- UNDP (2005), Sanitation and Cleanliness for a Healthy Environment. Bureau for Development Policy, Energy and Environment Group, Hesperian Foundation, New York.
- UNICEF (2006), Progress for Children: A Report Card on Water and Sanitation, UNICEF, New York.
- UNICEF (2010), Progress on Sanitation and Drinking Water, UNICEF, New York.
- United Nations General Assembly (2001), Road map towards the implementation of the United Nations Millennium Declaration, United Nations.

USAID (2011), "Water and Sanitation", available at: <http://kenya.usaid.gov/programs/water-and-sanitation> (accessed 9 September 2010).

Vidal, J. (2012), Water and Sanitation Still not Top Priorities for African Governments. Available at: <http://www.Guardian.co.uk/globaldevelopment/2012/aug/30/water-sanitation-priorities-African-governments>. (Accessed 30 September 2012).

WHO (2004), Domestic water quantity, service level and health, World Health Organization, Geneva

WHO (2012), Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage, World Health Organization, Switzerland.

WHO (2003), Right to water. Health and Human Rights Publication, Series; No. 3, World Health Organization, Switzerland.

World Bank (1991), Gender and Poverty in India. The World Bank, Washington.

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

WHO/UNICEF (2008), "Progress on Drinking Water and Sanitation: Special Focus on Sanitation", Available at: http://www.who.int/water_sanitation_health/monitoring/jmp2008/en/index.html (accessed 9 September 2010).