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Research Application Summary

Water, sanitation and hygiene status in Kampi Samaki, Lake Baringo, Kenya

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Abstract

Adequate water, sanitation and hygiene is essential to health. However, in sub-Saharan Africa access to improved water and sanitation sources is a challenge. In Baringo, more than 50% of the people rely on unimproved water and sanitation sources. This research is part of a larger cross-sectional study that reports on water, sanitation, and hygiene status in Kampi Samaki. An observational survey was undertaken. A semi-structured questionnaire was used to collect data. A systematic random sampling technique was employed to select sample. Statistical Packages for Social Sciences software was used for data analysis. Seventy percent of respondents in Kampi Samaki rely on lake water for drinking. Waterborne diseases such as typhoid and diarrhea have been reported among the residents. Lack of drinking water treatment was reported among more than half of the population (56%). Forty-nine percent of the respondents reported that children access drinking water by themselves from the storage containers The study reports that the Water, Sanitation and Hygiene (WASH) status is inadequate. This can be attributed to the prevalent waterborne diseases. Proper water treatment and hygienic handling of stored water are recommended.

Key words: Lake Baringo, waterborne diseases, water treatment

Résumé

L'eau, l'assainissement et l'hygiène adéquats sont essentiels à la santé. Cependant, en Afrique sub-saharienne, l'accès à des sources d'eau et d'assainissement améliorées est un défi. A Baringo, plus de 50% de la population dépend de sources d'eau et d'assainissement non améliorées. Cette recherche fait partie d'une étude transversale plus large qui renseigne sur l'état de lieu de l'eau, de l'assainissement et de l'hygiène à Kampi Samaki. Une enquête observationnelle a été menée. Un questionnaire semi-structuré a été utilisé pour collecter les données. Une technique d'échantillonnage aléatoire systématique a été utilisée pour sélectionner les enquêtés. Le logiciel SPSS a été utilisé pour l'analyse des données. Soixante-dix pour cent des personnes interviewées à Kampi Samaki dépendent de l'eau du lac pour la boisson. Des maladies d'origine hydrique telles que la typhoïde et la diarrhée ont été signalées parmi les résidents. L'absence de traitement de l'eau potable a été signalée chez plus de la moitié de la population (56%). Quarante-neuf pour cent des personnes interviewées ont déclaré que les enfants accèdent à l'eau potable par eux-mêmes à partir des contenants de stockage. L'étude indique que l'état de lieu de l'eau, de l'assainissement et de l'hygiène (WASH) est inadéquat. Cela peut être attribué à la prévalence des maladies d'origine hydrique. Un traitement adéquat de l'eau et une manipulation hygiénique de l'eau stockée sont recommandés.

Mots clés : Lac Baringo, maladies d'origine hydrique, traitement de l'eau

Introduction

Worldwide, approximately one billion people annually lack access to safe water with, 2.5 billion using unimproved sanitation facility (World Bank, 2015). However, the developing nations are the most adversely affected (Sommer *et al*., 2015; WHO/UNICEF, 2015). The use of unimproved water and sanitation sources has resulted in many deaths arising from water related illnesses. (WHO/UNICEF, 2013).

Access to Safe drinking water and improved sanitation is key to health. However, its provision in developing countries for instance, Kenya has proven to be a challenge thus creating a barrier in achievement of the Kenya Vision 2030 and also the post Sustainable Developments Goals (SDG) 3 and 6 (WHO, 2016). Waterborne diseases resulting from consuming unsafe drinking water and from poor sanitation has proven to be a significant burden to human health resulting in high morbidity and mortality (WHO, 2011, Clasen, 2015).

In Baringo County, 76% of the people depend on unimproved water sources, some 61% rely on unimproved sanitation while some households lack any sanitation facilities (KNBS and SID, 2013). Inadequate sanitation increases water contamination with fecal pathogens. The poor rural communities are worst hit (Gordon, 2005; Busienei *et al*., 2019). Open water source, e.g., from lakes and rivers are at risk of contamination by human and animal fecal matter because of poor sanitation (Okullo *et al.,* 2017). Indeed consumption of water from contaminated sources increases risk of waterborne illnesses like typhoid and cholera (Luby *et al*., 2008; Rajgire, 2013). Lack of latrine facilities among poor households has increased the practice of open defecation (Busienei *et al*., 2020). Globally, 1.3 billion people still practice open defecation especially in rural areas of developing countries (WHO/UNICEF, 2015). In Kenya, 5.6 million people still practice open defecation (Njonjo, 2013). Fecal matter is carried as runoff into the water sources exposing affected communities to fecal pathogens (Mara, 2017).

Drinking water especially from open sources require proper drinking water treatment to prevent waterborne illnesses (Cohen and Colford, 2017). However, majority of individuals from developing countries and particularly from rural areas still do not treat drinking water thus placing them at a greater risk of waterborne diseases (NFHS, 2017, Fernades and Chakkarwar, 2018). Poor hygiene of drinking storage containers and hands especially among children increases risk of contamination. Different studies have reported unhygienic handling of stored drinking water to be associated with waterborne diseases (Pickering *et al*., 2010; Rufener *et al*., 2010; Dada *et al*., 2013). This paper examines the status of water sanitation and hygiene and waterborne diseases among local communities living in Kampi Samaki in Baringo, Kenya. It is hoped that the information generated would help in educating the general public on importance of proper WASH on their health.

Materials and Methods

Study setting. This study was a part of a larger survey, which was conducted at Kampi Samaki, Baringo County. The area lies between Longitudes 36 1′3.63″-36 1′55.11″ East and Latitudes 0 36′42.40″-0 37′37.63″ North. Lake Baringo is a freshwater lake, located about 150 km North of Nakuru town at 0 38′N 36 05′E. It covers about 130 km^2, which can rise to 168 km^2 during the rainy seasons, and an altitude of about 1100 m and is surrounded by mountains rising to almost

3000 m.a.s.l. The lake is fed by two permanent rivers, Perkerra and Molo, and seasonal rivers Ol Arabel, Mugurn, Tangulbei, Chemeron, Endao, Makutan and Dau. Majority of the residents in Baringo County depend on unimproved drinking water sources such as lake Baringo and also, unimproved sanitation (KNBS and SID, 2013). There have been frequent outbreaks of waterborne diseases like diarrhea in the area (Baringo County Action Plan 2015/2016).

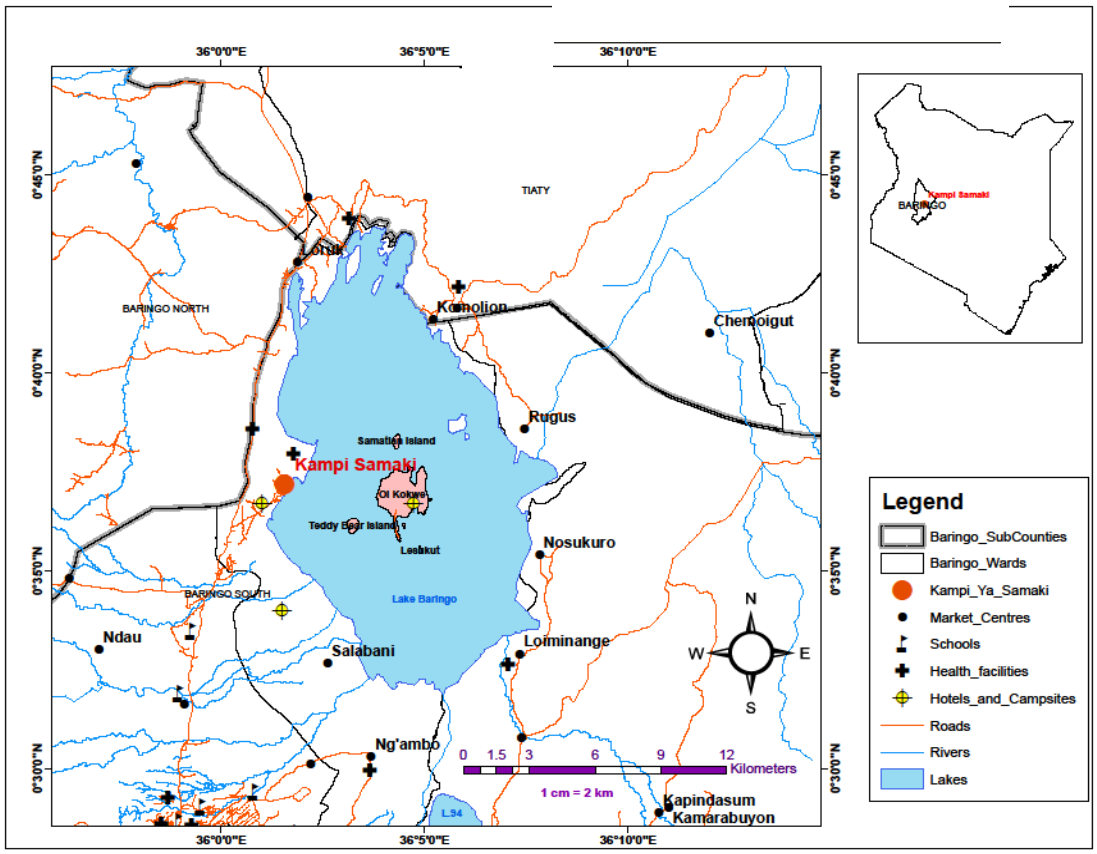

Figure 1. Map of Kampi Samaki area Baringo County

Research Design

This study was a cross-sectional survey that assessed the Water sanitation and hygiene (WASH) attributes and waterborne diseases (WBDs) among local community at Kampi Samaki. It employed semi structured questionnaires and observation checklist.

Target population and sampling. Fisherfolk living in Kampi Samaki formed the sampling unit for this study. They were aged at least 18 years and above. Systematic random sampling was used in the selection of respondents. According to Kenya population and housing census of 2009, there are 300 households at Kampi Samaki.

This sample size was calculated using the Nassiuma 2000 formula, Estimated sample size= number of households*(coefficient of variance)^2 /(coefficient of variance)^2+(number of households-1)e^2 (n= NC^2/(C^2 + (N – 1)e^2). where n is the estimated sample size, N is the total number of households

in the study area (300 households), C is coefficient of variance (30%) and e is the margin of error (0.03). A sample size of 100 households was estimated.

Research design and instruments. The research design adopted was a cross-sectional social survey. Semi-structured questionnaire and observation checklist were adopted. The questionnaires were then administered to the respondents to collect data on water sanitation and hygiene (WASH) and waterborne diseases. More information on WASH were explored through interviews with local community and from secondary literature sources. A pilot study was conducted at Salabani, a fishing landing site in Lake Baringo, which had similar ecological conditions to pretest the tools. The respondents were given semi-structured questionnaire and were exposed to the same questions. The same coding system was used to record their responses throughout the study. In-person interview procedure was used to assist the respondents without formal education. This ensured that all the questionnaires were filled.

Data management and analysis. The collected data were coded and entered in a SPSS database. Both descriptive and inferential statistics were used in data analysis. Frequencies and valid percentages were used to analyze the descriptive data. Multinomial logistic regression analysis was used to identify the relationships between dependent variable (Waterborne diseases) and independent variables (water treatment, water storage, water covering, livestock access to water source, children access to drinking water). This approach was found to be suitable for the study because both the dependent and independent variables had different categories/levels that were nominal. MLR explains relationship between nominal dependent variable with two or more levels (diarrhea and typhoid) and one or more independent variable (water storage, water source, water treatment etc.). The logistic regression model was of the following form: $\ln (p/1-p) = \beta o+\beta iXi$; Where p = the probability of waterborne disease; (p/1-p) = odds of waterborne disease; βo = constant; Xi = vector of independent variables; βi = parameter estimate for the i^{th} independent variable. The logistic regression is powerful in its ability to estimate the individual effects of continuous or categorical independent variables on categorical dependent variables (Wright, 1995). The multinomial logistic regression model used is generally effective where the dependent variable is composed of a category having multiple choices. The results were presented in the form of tables and graphs. The level of significance was tested at alpha= 0.05. The model fitted the study at chi square value of 50.834, $p<0.05$.

Ethical issues. Prior to data collection, approval to conduct this research was sought from the National Council for Science and Technology (NACOSTI) for ethical reasons (Permit No. NACOSTI/P/18/52733/25734). Further ethical clearance was given by the Bioethics Research Committee under the Division of Research and Extension of Egerton University. Finally, the researchers sought informed consent from the respondents who participated in the study.

Results

WASH attributes at Kampi Samaki. Seventy percent (70%) of the respondents used lake water for drinking. Eighty percent indicated that the livestock also drank water from the same water source that is the lake. Fifty-six (56%) reported not treating water. Ninety two percent covered their drinking water containers. Fifty one percent indicated that an adult fetched drinking water for the children (Table 1).

Table 1. WASH attributes at Kampi Samaki

Characteristics	Valid percent	Characteristics	Valid percent	Characteristics	Valid percent
Water source		Water storage containers		Water treatment	
Lake water	70.0	Plastic container	33.0	Yes	44.0
Tap water	11.0	Jerry can	45.0	No	56.0
Water pans	5.0	Clay pot	4.0	Boiling	20.0
Boreholes	6.0	Jerrycan, plastic container	18.0	Chlorine	19.0
Water vendors	8.0	Water storage container cover		Filtration	5.0
Do livestock drink the same water: source		Yes	92.0	No Treatment	56.0
Yes	80.0	No	8.0	Children access to drinking water:	51.0
No	20.0			Adult fetches for them	

Seventy two percent (72%) of the respondents indicated having pit latrines, 26% had no latrine facilities in their homes. About 32% indicated that their sanitation facilities were located 15-20 metres while, 8% are located 10-15 metres from the water source (Table 2).

Table 2. Sanitation Information at Kampi Samaki

Characteristics	Valid percent	Valid percent	Characteristics	Valid percent
Sanitation facility presence			Distance of sanitation facility to water source	
Yes	74.0	72%	5-10metres	8.0
No	26.0	1%	10-15metres	5.0
		1%	15-20metres	32.0
		26%	Above 20metres	29.0
			N/A	26.0

Health records showed that there was prevalence of waterborne diseases in Kampi Samaki. The most prevalent of the waterborne diseases was typhoid (Table 3).

Table 3. Prevalence of Waterborne Diseases in Kampi Samaki

Waterborne disease	Adults
Typhoid	289 (19.3%)
Diarrhea	147 (9.8%)

Relationship between WASH attributes and waterborne diseases in Kampi Samaki. The results of the study indicated that respondents who treated drinking water were 0.035 less likely to have suffered from typhoid as compared to those who did not. The respondents who cover drinking water were 0.963 less likely to have had typhoid compared to those who did not cover. There was 1.087 higher likelihood of having had typhoid where children accessed drinking water themselves as compared to where adult fetched drinking water for the children. There was 0.088 lower likelihood of having suffered from diarrhea for respondents who treated drinking water as compared to those who did not treat. Respondents who covered drinking water had 0.454 lower likelihood of having suffered from diarrhea compared to those who did not cover (Table 4).

Table 4. Relationship between WASH attributes and Prevalent WBDs at Kampi Samaki

Waterborne Diseases	WASH Attributes	B	Std. Error	df.	EXP(B)
Typhoid	Intercept	1.057	1.654	1	.035
	Drinking water treated	-3.365	.749	1	.
	Drinking water not treated	0[b]	.	0	.963
	Water storage containercovered	-.038	1.244	1	.
	Water storage container not covered	0[b]	.	0	1.624
	Livestock drink from the same water source	.485	.791	1	.
	Livestock do not drink from the same source	0[b]	.	0	1.087
	Children access drinking water themselves	.083	.650	1	.
	An adult fetch drinking water for children	0[b]	.	0	
Diarrhea	Intercept	.692	1.559	1	
	Drinking water treated	-2.429	.708	1	.088
	Drinking water not treated	0[b]	.	0	·
	Water storage container covered	-.790	1.076	1	.454
	Water storage container not covered	0[b]	.	0	·
Diarrhea	Livestock drink from the same water source	1.061	.817	1	2.889
	Livestock do not drink from the same source	0[b]	·	0	.
	Children access drinking water themselves	.521	.627	1	1.684
	An adult fetches water for children	0[b]	·	0	.

N=100 (Number of Respondents) Model fitting chi square= 50.834, $p<0.05$; Reference category; N/A= No Waterborne Disease; B= variable Coefficient; Exp (B) = Odds Ratio.

Discussions

This study assessed WASH attributes and relationship with Waterborne Diseases at Kampi Samaki. Majority of the respondents indicated that they relied on Lake Baringo for drinking water. However, this water source is categorized as an unimproved (Table 1, WHO, 2008). According to KNBS and SID (2013) report, only 24% of residents in Baringo County have access to improved water sources. Approximately 663m people globally use unimproved water sources and nearly half of these population live in Sub-Saharan Africa (WHO/UNICEF, 2015). Unimproved water sources are at high risk of water contamination by pathogen that cause waterborne diseases such as typhoid, diarrhea (Vaziri *et al*., 2010).

Worldwide, waterborne diseases are a major cause of death, with children under five being the most susceptible (WHO/UNICEF, 2013; WHO, 2015). Eighty percent (80%) of the respondents indicated that the livestock drink from the same water source which is Lake Baringo. Pandey *et al*. (2014) reported that poor disposal of human waste and direct deposits of fecal matter from livestock are responsible for microbial contamination in water sources. This increases the risk of waterborne diseases to the consumers (Daniel's *et al*., 2015; Schriewer *et al*., 2015). Livestock excreta may contain potential pathogens such as *Salmonella* spp and *Escherichia coli* that contaminate surface water making it unsafe for consumption (Kurui *et al*., 2017). A study done in rural India reported contamination of water sources with both human and animal feaces (Schriewer *et al*., 2015). Similarly a study done in Zimbabwe attributed pathogen contamination of water source to livestock faeces (Navad-Daneshmand *et al*., 2018).

Improvement in water quality and sanitation have been shown to reduce diarrhoea morbidity and mortality (Cairncross *et al*., 2010; Orimoloye *et al*., 2015). Moreover, Cohen and Colford (2017) reported that adequate household water treatment improved water quality thus reducing incidence of waterborne diseases. More than half of the respondents did not treat drinking water thus increasing the risk of waterborne diseases among the local community at Kampi Samaki (Table 1). Similarly Fernandes and Chakkarwar (2018), reported that 47.4% of respondents from Sakhwar, Mumbai did not treat drinking water. In southern Rwanda, 55% of the population were also reported to use untreated drinking water (Ntakirutimana *et al*., 2020). Additionally, the National Family Health Survey (2017) reported that 72.7% of residents in rural India did not treat drinking water. The lack of treatment of drinking water may be due to poverty among the rural populations, hence they do not prioritize water treatment. In another study done in New Zealand, there was a significant risk of waterborne diseases as a result of lack of drinking water treatment (Ball, 2006). Furthermore, Maharjan (2013) reported outbreak of water borne diseases in Nepal attributed to drinking untreated water. Different water treatment methods are used at household level including boiling, and chlorination (Ma *et al*., 2017). Nineteen percent of the respondents indicated to use chlorine in treating water (Table 1). Lack of knowledge on the use of chlorine may pose great potential risks; either underuse of chlorine resulting into inadequate treatment or excess use of chlorine which may result in negative health effects as it increases cancer risks to the consumers (Mishra *et al*., 2014).

Forty nine percent (49%) of the respondents indicated that the children accessed drinking water from storage containers, which is a potential source of waterborne diseases as they may contaminate drinking water with their dirty hands (Table 1). Pickering *et al*. (2010) reported contamination of household stored drinking water in Tanzanian communities by children. Inadequate water

sanitation and hygiene practices accounted to about 685,000 diarrheal illnesses globally (Prüss-Ustün *et al*., 2014). World Health Organisation, (2002) reported that unhygienic handling of stored household drinking water served as a source of pathogens causing waterborne diseases. A study done by Rufener *et al*. (2010) reported that inadequate handling of stored drinking water in Bolivia was associated with increased diarrheal diseases. Dada *et al*. (2013) also reported microbial contamination of stored drinking water with *Escherichia coli* due to poor handling in Laos and Thailand. Furthermore, in Ibadan, Nigeria, *Escherichia coli* was reported to be present in samples in stored drinking water in households and absent in water sample from source, indicating microbial contamination associated with inadequate hygiene during handling (Oloruntoba *et al*., 2014). According to Schriewer *et al*. (2015), 72% of the stored household drinking water in rural India were reported to contain fecal matter (Schriewer *et al*., 2015).

Seventy-two (72%) of the respondents indicated having a pit latrine, while 26% indicated not having any sanitation facility (Table 2). According to WHO/UNICEF, (2013), most people in sub-Saharan Africa practice open defecation thus causing contamination of surface water sources such as lakes. Forty-six (46%) of the residents in Baringo had pit latrines and 49% practiced open defecation (Baringo County Action Plan 2015/2016). Open defecation poses a risk of water borne diseases since it increases contact with fecal matter on ground and also during rainy seasons the fecal matter may end up in water sources as runoff. Globally, open defecation has been a major cause of diarrheal illnesses (WHO/UNICEF, 2014). Different studies have reported high prevalence of waterborne diseases during rainy season as a result of poor sanitation such as open defecation (Oloruntoba *et al.,* 2014; Wardrop *et al*., 2018; Gwimbi *et al.,* 2019). Prüss-Ustün *et al*. (2014) reported that inadequate sanitation facilities such as bucket latrines increase incidence of waterborne diseases. Additionally, Rajgire (2013) reported the burden of waterborne diseases to be more in low-income areas where adequate sanitation facilities are limited. Moreover, Busienei *et al*. (2019) associated poverty with open defecation among residents in Lodwar in Kenya. Often there are more latrine coverage in households with high income sources than in low-income sources in Lodwar (Busienei *et al*., 2019). Studies indicate more contamination of water sources in areas where open defecation is practiced (Tambekar *et al*., 2012; Okullo *et al*., 2017). Open defecation practices increase risk of water sources contamination resulting into waterborne diseases such diarrhea. (Guerrant *et al*., 2013).

Conclusions and Recommendations

Unimproved water, sanitation and poor hygiene practices, are a huge threat to human health. The findings of the study indicate that majority residents at Kampi Samaki depend on Lake Baringo, an unimproved water source for drinking. Furthermore, some residents practice open defecation creating a risk to waterborne diseases due to lake water contamination. Therefore treatment of drinking water is essential in reduction of waterborne diseases. The inadequate WASH attributes in Kampi Samaki are responsible for the high occurrence of waterborne diseases in the area such as typhoid and diarrhoea in the region. Therefore, there is need for more public health campaigns to educate the residents on the importance of proper water treatment and its importance in reducing the burden of waterborne diseases.

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