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A Survey of Public Perceptions and Attitudes about Water and Water Quality of springs in Rural Area of Irhambi/Katana Sub-County, D.R. Congo

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Abstract: A survey of public attitudes was conducted to determine their perception and attitudes about drinking water and water quality in the Irhambi/Katana sub-county in DR Congo. The objectives of this study is to explore the perceptions and attitudes of public about drinking water and its association with water quality, disease outbreaks, water quantity and household characteristics. To achieve these objectives, a survey was carried out on 214 respondents who were selected based on purposive sampling. The survey questionnaire included 15 questions addressing water resource, water quality, and other environmental issues. Physicochemical analyzes allowed us to test qualitatively and determine quantitatively chemicals in different springs. These springs water in general are in the standards recommended by the WHO for drinking water. Eleven springs are infested by micro-organisms. The presence of *E. coli* in particular indicates that the springs are not protected against fecal pollution from the human and animals. Some springs used for drinking water in the Irhambi-Katana sub-county needs to be threat and protected for pollution by surrounding people and uses.
Keywords: Perceptions, attitudes, water quality, springs. Irhambi/Katana, D.R. Congo.

INTRODUCTION

Water is essential to life because it heavily influences public health and living standard. Access to safe water in adequate quantity and acceptable quality is one of the biggest challenges in the recent times [1, 2]. According to the World Health Organization (WHO), more than one billion people do not have access to clear water capable of providing at least 20 liters of safe water per person per day [3,4].

They must rely on water that is not protected from outside contamination, such as surface water, unprotected springs, and unprotected hand dug wells [5]. Scarcity in terms of quantity and quality has severe implications on the overall development and health of household [2]. The percentage of the world's population that has access to drinking water has increased from 77% to 89% between 1990 and 2010 [6].

Access to water is difficult especially in the rural areas. The trend of the national water quality of the protected rural point water sources is concerning, having declined from 63% in 2013 to only 53% in 2014 compliance to the national standards. When the urban water quality compliance of is nearly 100%. It is evident that rural water supply is not receiving adequate attention [7]. In Tanzania, in which an estimated 29 million people, or 44% of the population, lack access to safe drinking water [8].

Factors such as poor availability, affordability and distance between water source and home may lead households to depend on less safe sources and reduce the volume of water used for hygiene purposes, resulting in water-related infections. Studies carried out in Nepal indicated that about one third of the total death of children below five years of age in the rural region was due to water borne diseases such as cholera, typhoid, dysentery and gastro-entities [9]. Over the past few years, several cases of water contamination and an intensified debate on environmental problems have increased the attention of the general public to water issues [10]. There are two major problems about water issues such as growing water demand and ensuring good water quality. With the expansion of new agglomerations in many sub-counties as increase the water demand and many springs are managing to supply water in these agglomerations. Surface water is also widely available but is intensively polluted by nutrients, agrochemicals and microbial contaminants. Access to safe and clean water is therefore a priority in the region and water supply facilities are considered to be a main solution to this problem [11]. The per capita water consumption in the rural area is 45 liter as compared to

60 liter in the urban area [3] but in rural area this rate is not achieved.

Drinking water quality in rural area of Irhambi-Katana County has become a critical problem in the area as recorded elsewhere in the world. However, the understanding of the relationship between household perception and household attitude regarding water quality and quantity is not well documented in Irhambi-Katana County. The aim of this study is to assess the consumer perception of drinking water quality and analyzed physicochemical and bacteriologic water quality in used spring by the population of Irhambi/Katana sub-county in DR Congo to identify the source of diseases and perception of the population against water.

MATERIALS AND METHODS

Study area

The study was conducted in Irhambi/Katana County in the villages of Mabingu, Mwanda and Kahungu, in DR Congo. Theses villages were chosen according to their high population in the County. They have also inadequate infrastructure and poor services including water supply. The water table in these villages is high.

Household Interviews

A total of 542 households were interviewed in the rural areas of Irhambi/Katana. Several villages in this sub-county were selected in order to cover the entire study region as optimally as possible. Moreover, the selected sub-county was in the region as the selected water springs (Figure 1).

After arrival at the selected villages, rural households were randomly interviewed with the following constraint: the minimum distance between two households was 500 m, in order to prevent interviewing similar type households. Amongst other purposes, the interviews aimed to assess the availability, usage, and households' perceptions of water quality and quantity in the village.

Selected households were asked which water sources (spring, lake, rivers) they used for drinking and for domestic purposes, such as washing, cleaning, dishwashing, *etc.* In addition, households were asked (i) the distance between the spring and the house that they used, (ii) whether this spring was construct or not, (iii) a series of open questions was asked regarding the volume of spring, the month and how the quality of the spring was perceived. The month of decreased of water quantity and why.

To calculate a representative sample size; the study adopted the formula of Cochran [12]. Structured questionnaires that were previously pretested before to administered to a total of 228 farmer households. The household data was cleaned, coded and entered in SPSS version 17.

Water sampling, physicochemical and bacteriological parameters and analytical procedures

Water temperature was measured by using a thermometer. pH and electrical conductivity (EC) measured by using HANNA instrument. Total alkalinity, total hardness, calcium and magnesium hardness, calcium, magnesium, sulphate, chloride were measured according to methods that were described by Golterman and al., [13]. While, total nitrogen, total phosphorus, phosphate, nitrate and ammonia were measured analytically using Spectroscopic methods [14].

The bacteriological parameters analyzed were total coliforms, fecal coliforms and fecal streptococci according to APHA [15].

Data Analysis

Water quality from selected springs was compared with drinking water guidelines set by the World Health Organization [16]. Statistical tests were carried out with SPSS version 20.0. The differences in spring's quality were statistically assessed by applying the Mann-Whitney-U test. The results of the household interviews regarding availability and usage of water sources are presented graphically.

RESULTS AND DISCUSSION

Respondent characteristics

A total of 219 individuals responded to the survey, of which 67 coming from Mwanda, 52 from Kahungu and 100 coming from Mabingu completed the survey and were included in the analysis. The survey was aimed at all individuals living within the two area in Irhambi/Katana county region, including villages. However, there are some sources of error that can influence survey results such as poorly designed questions, and processing errors that are often difficult to quantify. But, the survey results provide a starting point for understanding future trends within the region of people's attitudes and perceptions of water.

The survey was conduct in rural area were people living in sparsely populated lands. A relatively even response rate occurred between males (45%) and females (55%). In addition, 80% of respondents have lived within the region for more than 10 years.

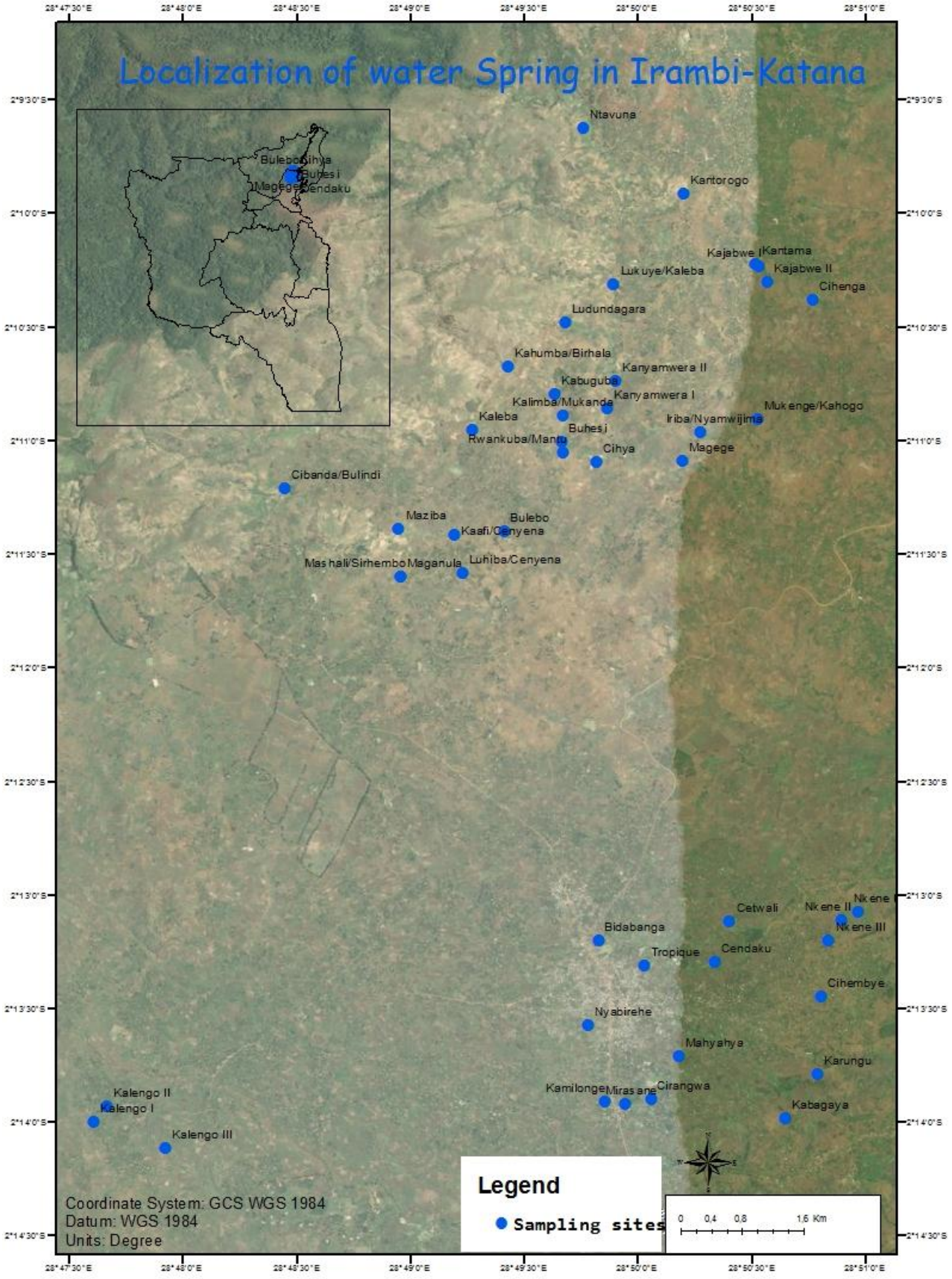

Fig-1: Map of study area and localization of different water spring

Perceptions about water

One of the objectives of the water survey was to understand the public's current perceptions about water within Irhambi/Katana County. A series of questions were developed to understand public perception of water health (quality and quantity of surface water); activities responsible for degrading water health; and impacts of climate change.

The survey assesses people's perceptions of the state of the water with respect to 5 natural resources are presented in the figure below.

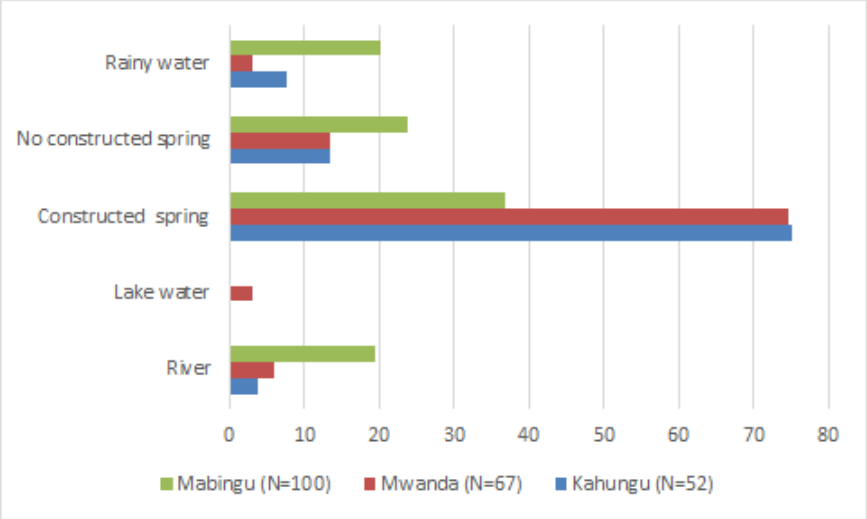

Fig-2: Perception about the resource of water use by the population in Irhambi/Katana Conty

In both communities of Mwanda, Kahungu and Mabingu in Irhambi/Katana County, springs (constructed or not) are regarded as very important and are currently the major source of water. This was also observed in Vondo and Meidingen rural areas in South Africa [17]. The Lake water was not used by the population of Kahungu and Mabingu because the Lake is located very far from this sub-County. But some respondent confirm that they used some time water from rivers and rainy water for their daily activities such as washing clothes and domestic utensils. These water was used by the population when the construct or the not construct spring is located for from the household. The perception of the population about the distance from the water supply is present in the following figure.

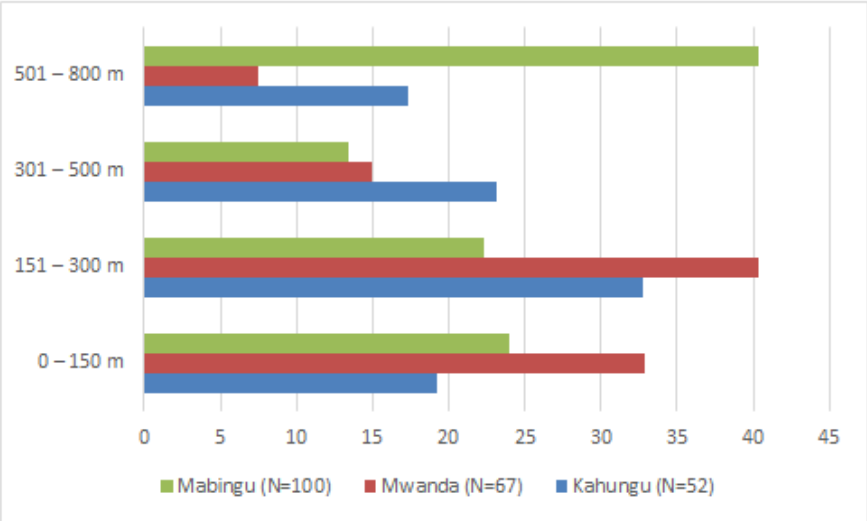

Fig-3: Distance between the principal springs of water and the houses in the sub-counties of Mabingu, Kahungu and Mwanda

People perception showed that high number of population in Mabingu Sub-county traveled long distance to find water then in others sub-county. The springs in this sub-county are located very far from household but from the population of Mwanda the springs are very cross of the houses. According to

Haward and Bartram [18], the distance admitted for the household to travel to find water is about 1000 m. This distance is probably find in Kahungu household were the mean distance is about 250 m from a water supply.

About 157 million people in the Eastern and Southern Africa region (ESAR) are not connected to a clean and safe water distribution system, and thus need to use external water sources [19].

Is there any change about the change of the supplying of water by the springs during the last period in the sub-county? The response of the different respondent in the tree sub-counties are present in figure

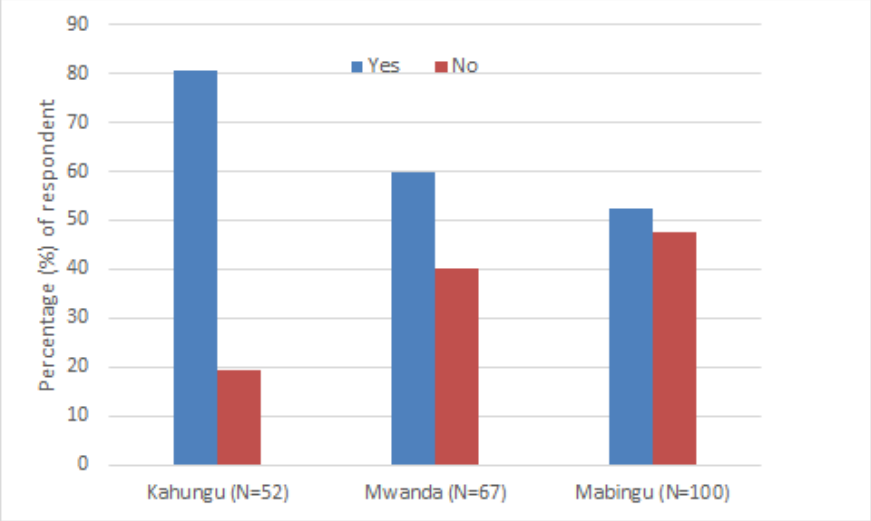

Fig-4: Population perception of changes in spring flow over time

Figure 4 shows the population's perception of spring change over time in the Mabingu, Kahungu and Mwanda sub-counties. In general the respondent confirms that there is change of water flow in the springs over time in their sub-counties. This situation is more observed in the locality of Kahungu where up to 80.8% of respondents agreed that their observed change over time in the springs in the sub-county. This change in water supply from springs has also been observed in other countries [20]. The change of the flow in the sub-counties is probably the climate variability change in the region and the destruction of vegetation cover in the sub-counties looking for space for agricultural land. These two challenges that the sub-counties are facing are responsible of reducing of water table in an area [20, 21]. As we can observed in the sub-counties the drought was be pointed by the respondent for the reducing of spring flow (Figure 5). Respondent from the sub-counties of Mawanda (65.67%) and Mabingu (55%) relate that drought is the principal cause of the decreased of flow in springs.

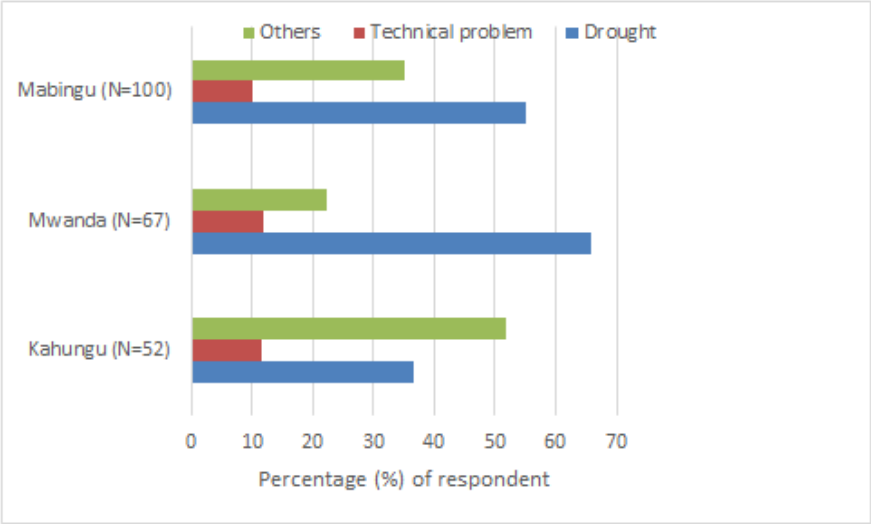

Fig-5: Perception of population about the causes of change in spring flow during the period of time

Water as many used in the household in the sub-counties of Mabingi, Kahungu and Mwanda. The perception of respondent about the reason for use of water are present in table 1.

Table-1: Reason for use of water by households

Reason for use	Kahungu (N=52)	Mwanda (N=67)	Mabingu (N=100)
Kitchen	46.15	22.39	22
Bath	11.54	16.42	25
Washing	11.54	26.87	25
Drinking	17.31	20.90	9
Agricultural	9.62	8.96	6
Live stock farming	3.85	4.48	13

Six main reason for the use of water by households was mainly cited by the respondent for the use of water. Domestic reasons was the mainly cited such as washing, drinking, bath and Kichen. Agriculture and livestock farming was less cited by the respondent in the tree sub-counties. Indeed, this part has a mild tropical moist climate that allows to grow even vegetables during the dry season this makes the use of water for agriculture is not too common. According to the statistical test, a significant difference ($T = 4.269$; $P < 0.05$) is observed according to the answers of the respondents. Fernanda and Magerle [22] have also concluded that in Colombia in a rural environment, 60% respondent indicated that water was used for domestic purposes.

According to the regularity of water during the year, the respondent shown that water is not permanently supply in the year. This is present in the figure below.

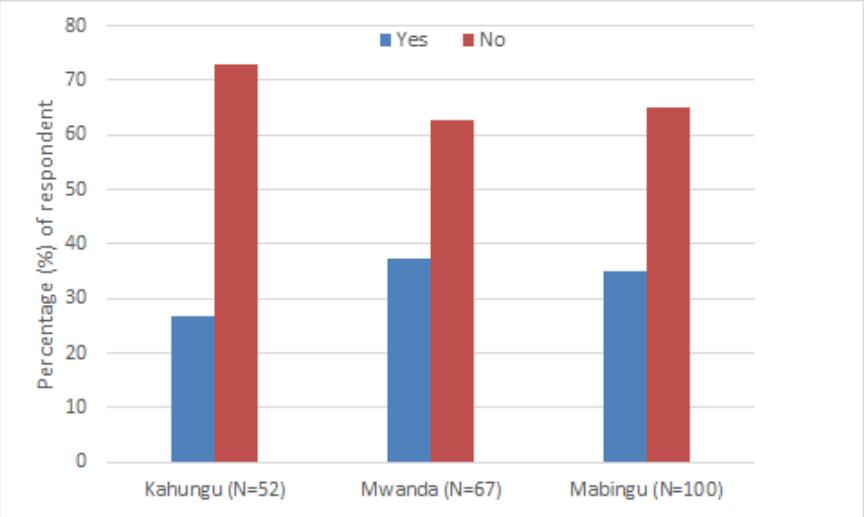

Fig-6: Perception of respondent on frequency of water supply during the year

Table-2: Months of water scarcity in Kahungu and Mwanda

Months in the year	Kahungu (N=52)	Mwanda (N=67)	Mabingu (N=100)
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	17.91	0
June	30.77	19.40	31
July	46.15	26.87	37
August	17.31	11.94	32
September	5.77	23.88	0
October	0	0	0
November	0	0	0
December	0	0	0

The respondent response shown that the access to water throughout the year is not permanently in the tree sub-counties as already observed that there are some time when the flow of the springs decreased. Decreased or the time during the year of water shortage is presented in the table 2.

It appears that the months of June, July and August were the month when water scarcity is perceived in households. At this time of the year the population has to travel several kilometers to find water. This was also noticed in South Africa rural areas while water from the spring is available throughout the year but households indicated that during winter the level drops and hence during this time water is not sufficient to meet their households' needs [17].

The quality of water supply in the tree sub-counties is perceived differently by the respondent as shown in the figure below.

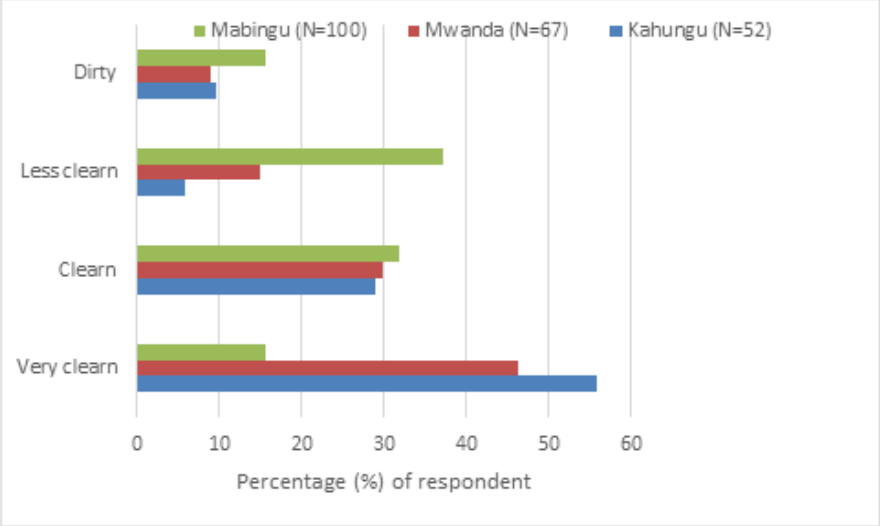

Fig-7: Level of appreciation of water quality in households

The respondent's overall (>60%) perception about water quality in the different supply springs is clearn and adequate health. However, some respondent recognize that water supply is dirty especially from Mabingu sub-county (15%). As water was not clearn, the respondent perception techniques to treat water before used show that the any treatment is used for water supply. But some respondent used heating to treat the water before used. The use of the tablet of PURE is not common. Only the respondent form Mwanda near the Hospital of Reference of Fomulac/Katana used the tablet (Figure 8). For this sub-county, explanations about the use of the tablet are providing by the team of the health center. But in Kahungu and Mabingu, the sensitization is not yet done about the use of "Pure" tablets.

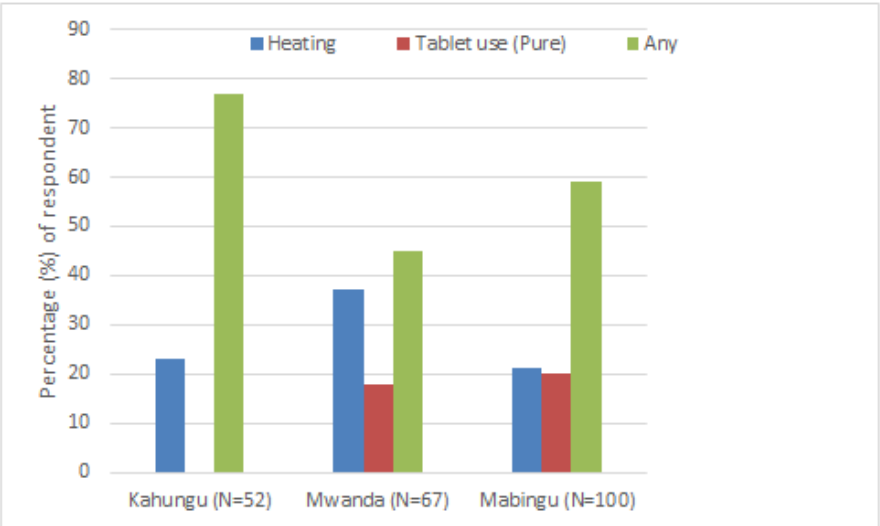

Fig-8: Treatment used by households

The perception of the respondent on the status of water in the tree sub-counties is present in table 3.

According to our respondents in the tree sub-counties, the springs are treated with many pollution sources. High rate of pollution sources around the spring are noticed by the respondent during the survey. Other source of degradation of water quality is the presence of human excrement near the spring in all the sub-counties. This is in correlation of high frequentation of children at the springs. Indeed, in several water springs peoples wash their clothes, clearn their utensils and children come to wash and played. At these springs, fecal matter is observed. This situation has also been reported in North Kivu in water sources [23].

Table-3: Current status of water supply points

Supply Point Status	Kahungu (N=52)	Mwanda (N=67)	Mabingu (N=100)
Pollution source at 10m from the structure	42.31	34.33	19.3
Stagnant water next to the structure	13.46	8.96	29.7
Human excrement	19.23	14.93	23.5
Excessive frequentation of children	25	41.79	27.5

The perception of people to access water in the tree sub-counties grouped in tree items as water shortage in different springs, distance form household to springs and diseases recorded at the springs (figure 9).

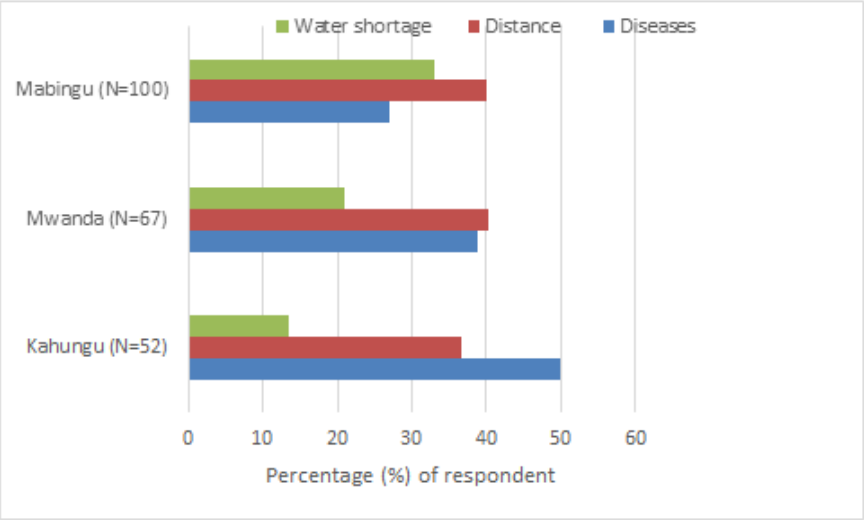

Fig-9: Constraints related to access to water in the localities of Kahungu, Mwanda and Mabingu

The results show that disease-related constraint is a major constraint on access to water in these two localities in general. Water storage was find to be the main constraint for water access in Mabingu compare to others sub-counties. While diseases was high in Kahungu and distance was in Manda. In the sub-county of Mwanda the springs are located far to the household; this is probably the reason of access difficult to water resources to population. The challenge is that water from the springs in the tree sub-county was perceved to be contaminated and compromising to the health of communities as reported by the respondent. Different diseases were pointed with our respondent in the tree sub-counties (Table 4).

Table-4: Knowledge about water-related diseases

Diseases	Kahungu (N=52)	Mwanda (N=67)	Mabingu (N=100)
Diarrhea	26.92	37.31	23.7
Dysentery	3.85	7.46	15.3
Typhoid fever	0	0	0
Verminosis	13.46	7.46	0
Malaria	19.23	17.91	24
Schistosomiasis	0	0	0
I don’t know	36.54	29.85	37

The results show that water-related diseases such as typhoid fever and schistosomiasis are not known by our respondents in the tree sub-county. The high disease cited in the area during this study are diarrhea and malaria but also verminosis. This situation was observed in Colombia by Fernanda and Megerle [22] in their study on the perception of water quality and the risk to health in rural Medellin that these diseases are common in rural areas. Malaria and diarrhea are the most frequent water-borne diseases [24] in several medical facilities (Katana Health Zone). According to Howard *et al*. [25] the consumption of contaminated drinking water is a serious challenge, and remains one of the most significant causes of ill health worldwide. But, high number of respondent doesn't know the disease that occurred in drinking contaminated water.

Respondents would like to rise awaness on water management and water related diseases in the sub-counties Mabingu, Kahungu and Mwanda (Figure 11).

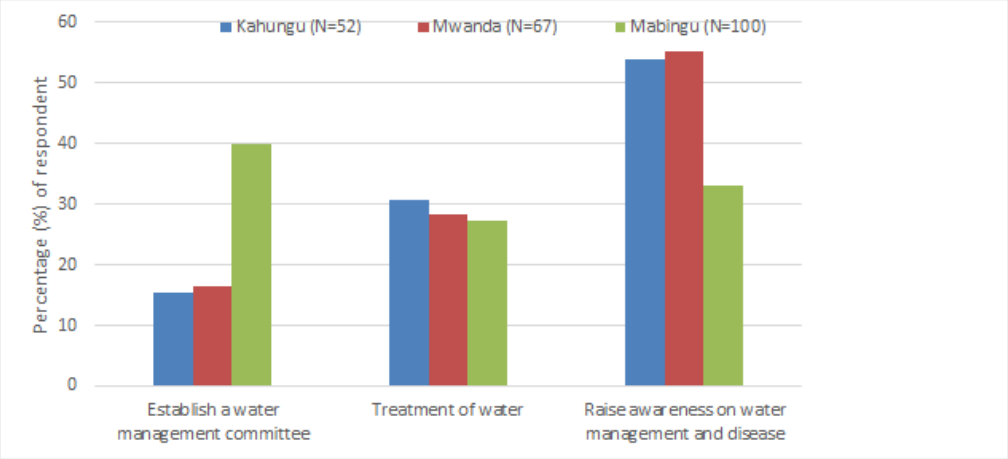

Fig-10: Respondents' recommendations on water quality and quantity in Kahungu, Mwanda and Mabingu

According to our respondents, high percentage of respondents concluded that it is necessary to educate the population about water management and water-related diseases in these two localities including Mabingu, Kahungu and Mwanda, but less recommended that drinking water treatment is essential.

Physico-chemical and bacteriological parameters of water springs in the sub-counties of Mabingu, Kahungu and Mwanda

The quality of water for different spring in the sub-counties was assess for microbiological and physicochemical contaminants. In this study, the assessment of the potability of water focused mainly on physicochemical parameters including nitrate, chloride, sulfates, electrical conductibility, total dissolved sediment and water discharge as they have insidious health effects [26] and bacteriological parameters such as the presence of *Escherichia coli*, *Enterobacter*, *Klesbiella* and *Hafnia*. The physicochemical and bacteriological analyzes were carried out in two seasons. The results of some physicochemical parameters for the two periods are present as the mean values and standards deviation in the table 5.

From this table 5, the electrical conductivity (EC) of sampled sources varies from a maximum of 339 µS/cm (Nkene 3 spring) to a minimum of 219 µS/cm (Mirasame et Minyanya springs) during the sampling period with values below WHO standards [16]. Total dissolved solids are also lower with a maximum of 169 mg/L (Nkene 3 spring) and a minimum of 109 mg/L (Mirasame spring). The calcium and magnesium also vary from one source to the other with a mean of respectively from 0.4 – 2 mg/L for calcium and 0.04 – 1 mg/L for magnesium. But these values are all lower than the WHO standards for drinking waters. This shows that these sources have waters whose hardness is still below the WHO critical threshold.

The different springs serving populations for drinking water in the sub counties of Mabingu, Kahungu and Mwanda contained chloride (Cl^-) concentrations values ranging from a minimum of 19±0.0 mg/L (Kabangaya spring) to a maximun of 41.5 ± 9.19 mg/L (Kalengo 3). These values are lower than those recommended by WHO. As for sulphate (SO_4^{--}), the maximum value was recorded at Mirasane spring (111.36 ± 6.79 mg/L) and the minimum value at Kalengo 1 (48.48 ±11.54 mg/L). These concentration of sulfate have no adverse effect on health as the recommended value is 200 mg/L. Phosphate and Nitrate are low in the all the springs in the tree sub counties. The phosphate in these springs has a maximum value of 0.47±0.04 µmol/L (Kalengo 1 spring) and nitrate a maximum value of 1.7±1.67 µmol/L (Nkene 2). All these phosphate and nitrate values are below the WHO threshold for drinking water [16]. Flows from the springs are between the values of 14 L/s and 1 l/s during the sampling period in the two seasons.

The bacteriological analyzes of these sources during the period of study are presented in the table 6.

From this table 6, five micro-organisms including Enterobacter, Klesbiella, Hafnia, E. coli and Citrobacter were found in the water. Eleven springs are infested by micro-organisms. The presence of *E. coli* in particular indicates that the springs are not protected against fecal pollution from the human and animals. This contamination can be correlated with the lack of hygiene of the sources of water especially the presence of the human excreta in the vicinity of the springs as argues by the population during the survey. Fecal coliforms, *E. coli* and enterococci are bacteria of fecal origin found in the digestive tract of humans and animals [27]. The detection of these bacteria may be an indication of the presence of other microorganisms, such as bacteria, viruses and protozoa, which can lead to diseases, the most common of which is gastroenteritis. Although it is often mild, it can sometimes have serious health consequences. In the sub-county, diarrhea is a major waterborne diseases as reported in several health report [24]. Diarrhea is common in children living in households without access to an improved water source [28]. The risk of dying for these children is higher than for those with direct access to running water [29].

Table-5: Results of physicochemical analyzes of water sources from Mabingu, Mwanda and Kahungu sub-counties during the two seasons (dry and wet seasons)

Sources	Ca	Mg	Cl^-	SO_4^{--}	PO_4^{---}	NO_3^-	pH	EC	TDS	Discharge
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(umol/L)	(umol/L)		(uS/cm)	(mg/L)	(L/s)
Kalengo 1	1.12±0.23	0.24±0.0	23.5±2.12	48.48±11.54	0.47±0.04	1.35±0.48	8.16±0.91	258	130	2.2±1.6
Kalengo 2	1.08±0.4	0.16±0.1	29.5±2.12	70.89±21.51	0.15±0.1	1.24±0.69	7.89±1.16	253	127	5.8±7.35
Kalengo 3	1.34±0.43	1±0.1	41.5±9.19	72.48±21.04	0.46±0.05	0.65±0.31	7.53±0.64	308	153	14.1±19.7
Kamilonge	1.32±0.0	0.1±0.0	20.5±0.71	76.32±10.18	0.45±0.15	0.5±0.04	7.82±0.62	285	143	5.2±6.8
Nyabirehe	1.02±0.25	0.24±0.1	21.5±0.71	85.92±26.47	0.3±0.22	0.26±0.01	7.57±0.55	243	121	5.2±6.8
Bidabanga	1.22±0.2	0.26±0.0	21.5±2.12	99.36±12.9	0.26±0.06	0.55±0.32	6.88±1.1	248	126	1.9±2.1
Mirasane	1.12±0.0	0.23±0.1	31±1.41	111.36±6.79	0.1±0.08	0.32±0.12	7.58±0.41	219	109	6.2±8.2
Cirangwa	1.97±1.42	0.04±0.0	30.5±4.95	105.6±16.29	0.24±0.17	0.5±0.3	7.6±0.8	253	126	5.2±6.79
Mahyahya	0.52±0.17	0.3±0.1	23.5±3.54	93.6±2.04	0.12±0.13	0.37±0.11	7.76±0.51	219	110	2.45±2.9
Cetwali	0.4±0.0	0.11±0.2	22±2.83	73.92±4.07	0.18±0.21	0.47±0.39	7.61±0.37	229	114	2.05±2.3
Kabangaya	0.76±0.0	0.24±0.1	19±0.0	100.8±9.50	0.14±0.14	0.49±0.36	7.79±0.95	238	119	1.9±2.12
Cihembye	0.96±0.0	0.79±0.6	22.5±0.71	113.76±25.12	0.14±0.13	0.51±0.23	7.56±0.3	278	139	2.5±2.12
Karungu	1.52±0.28	0.06±0.0	27.5±2.12	105.12±4.75	0.3±0.1	0.31±0.06	7.77±0.4	294	147	1±0.0
Nkene 1	1.4±0.0	0.06±0.0	33±2.83	107.52±8.15	0.12±0.15	0.31±0.03	8.22±1.42	277	139	5.45±6.3
Nkene 2	1.2±0.28	0.12±0.1	28±2.83	72.96±13.58	0.13±0.12	1.7±1.65	8.07±1.09	329	164	3.4±3.39
Nkene 3	1.04±0.0	0.14±0.1	25±0.0	85.44±9.5	0.04±0.04	1.21±1.0	7.68±0.69	339	169	3.85±4.03
Tropique	1.1±0.0	0.05±0.0	17±0.0	104±0.0	0.08±0.0	0.22±0.0	-	-	-	-
Cendaku	1.2±0.0	0,04±0.0	15±0.0	102±0.0	0.11±0.0	0.25±0.0	-	-	-	-
Kabuguba	0.2±0.0	0.05±0.0	15±0.0	85±0.0	0.23±0.0	0.41±0.0	-	-	-	-
Iriba	0.7±0.0	0.17±0.0	15±0.0	87±0.0	0.19±0.0	0.38±0.0	-	-	-	-
Kantorongo	0.7±0.0	0.17±0.0	16±0.0	92±0.0	0.09±0.0	0.27±0.0	-	-	-	-
Ntavuna	0.9±0.0	0.22±0.0	15±0.0	89±0.0	0.07±0.0	0.27±0.0	-	-	-	-
Kajabwe	0.8±0.0	0.19±0.0	19±0.0	90±0.0	0.07±0.0	0.26±0.0	-	-	-	-
Kanyamwera 2	1±0.0	0.24±0.0	16±0.0	87±0.0	0.03±0.0	0.23±0.0	-	-	-	-
Buliba	2.3±0.0	0.55±0.0	16±0.0	102±0.0	0.03±0.0	0.24±0.0	-	-	-	-
Cihenga	1.2±0.0	0.29±0.0	13±0.0	93±0.0	0.08±0.0	0.24±0.0	-	-	-	-
Magege	0.4±0.0	0.10±0.0	18±0.0	89±0.0	0.14±0.0	0.32±0.0	-	-	-	-
Maganula	1.4±0.0	0.34±0.0	14±0.0	92±0.0	0.20±0.0	0.24±0.0	-	-	-	-
Kaleba	1.5±0.0	0.36±0.0	13±0.0	103±0.0	0.12±0.0	0.25±0.0	-	-	-	-
Kaleba 2	1.5±0.0	0.36±0.0	14±0.0	93±0.0	0.10±0.0	0.26±0.0	-	-	-	-
Lugohwa	0.7±0.0	0.17±0.0	11±0.0	92±0.0	0.20±0.0	0.27±0.0	-	-	-	-

Table-6: Result of the bacteriological analyzes of the different springs in the sub counties of Mabingu, Mwanda and Kahungu

Sources	*Enterobacter* (col/mL)	*Klesbiella* (col/mL)	*Hafnia* (col/mL)	*E.coli* (col/mL)	*Citrobacter*
Kalengo 1	1000±1414.2	600±848.5	0	0	0
Kalengo 2	0	1500±2121.3	0	0	0
Kalengo 3	0	1050±1484.9	0	0	0
Kamilonge	0	1300±1838.5	0	0	0
Nyabirehe	0	0	0	1900±2687.0	0
Bidabanga	0	0	0	0	0
Mirasane	0	0	1000±1414.2	0	0
Cirangwa	0	0	0	0	0
Mahyahya	0	1500±2121.3	0	1600±2262.7	0
Cetwali	0	0	0	0	1800±0.0
Kabangaya	500± 0.0	0	0	0	0
Cihembye	0	0	240±339.4	0	0
Karungu	1800±2545.6	0	0	0	0
Nkene 1	0	0	0	0	0
Nkene 2	0	0	0	0	0
Nkene 3	1200±1697.1	0	0	0	0
Tropique	0	0	0	0	0
Cendaku	0	0	0	0	0

CONCLUSION AND RECOMMENDATIONS

Our study was carried out in the Irhambi/Katana sub county consisted in determining the perception and attitude of the population on the quality and quantity of the drinking water. The survey results however provide the area with a starting point for understanding future trends within the region of people's attitudes and perceptions of water. Physicochemical analyzes allowed us to test qualitatively and determine quantitatively chemicals in different springs. These springs water in general are in the standards recommended by the WHO for drinking water. But from the bacteriological point of view, some springs carry germs that can be harmful to the health of the population. The information in this study is important because it can be used in consumer views for selecting a spring of suitable quality of water resource. The standards of water quality should be designed based on the protection of human health of the population. Some springs used for drinking water in the Irhambi-Katana sub-county needs to be threat and protected for pollution by surrounding people and uses.

This study is the first to report clear quantitative and qualitative information from household on their perceptions, attitudes and opinions about drinking water quality in the community of Irhambi/Katana. For future additional research for surveying people's perception and preference on drinking water, springs could be an interesting avenue for future research in this field in the region.

This study proposes some measures to combat springs contamination by

- Set up a water management committee;
- Treated drinking water before being consumed by the population;
- Sensitize the population on water management and water-borne diseases;
- Sensitize the population on the construction of latrines but not build it next to water sources
- Prohibit the use of children beside water sources and animals
- Cultivate the lawn around the source and construct an enclosure for the fight against the pollution of the springs

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Conflict of Interest

There is no conflict of interest to be declared.

Authors' contributions

Basabose was statistical consultant and text editor of the study. Bagalwa was designer, performer and leader of the study. Buruku, Cinyambiriri and Safina were advisors of experiment, sampling, analyzing and GIS map provide.

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