**RUFORUM Working Document Series (ISSN 1607-9345), 2018, No. 17 (2): 255-259.**
***Available from http://repository.ruforum.org***

Research Application Summary

# Status of water quality in the springs of Huye town, Rwanda

Kasanziki, C.M.[1] & Anyemedu, F.[2]

[1]College of Agriculture and Environmental Sciences, School of Agriculture Sciences, Department of Extension and Innovation Studies, Makerere University, P. O. Box 7062, Kampala, Uganda

[2]Department of Civil Engineering, Faculty of Applied Sciences, National University of Rwanda, P. O. Box 1117, Huye, Rwanda

**Corresponding author:** kasnziki123@gmail.com, kasanzikic2001@yahoo.fr

## Abstract

The treatment and supply of drinking water in Rwanda is carried out by the Water and Sanitation Corporation (WASAC), a State owned public company. This company is however unable to supply water to all households. Consequently, the non-serviced households depend on springs to meet their water requirements. However, water quality in these springs is barely known. This study was conducted to establish baseline water quality in the rural areas around Huye Township. Interviews were conducted and questionnaires administered within the population of the project area. Bacteriological, physical and chemical parameters of water were analysed. Results showed that in the dry season the pH of spring water (6.21) and water from containers (5.62) is slightly acidic. The study revealed that during the rainy season, all springs are polluted with prevalence of faecal coliforms, Streptococcus, total coliforms and total aerobic flora at 62.5%. *Escherichia coli* contamination (25%) for water from family containers which was not in the water directly taken from the spring shows that more contamination occurs during water transportation and storage. There is need to undertake spring protection and *in-situ* water treatment at household level.

Key words: Drinking water quality, spring protection, spring water, Rwanda, water sanitation, water treatment

## Résumé

Le traitement et l'approvisionnement en eau potable au Rwanda sont assurés par la société Water and Sanitation Corporation (WASAC), une entreprise publique d'état. Cette entreprise n'est cependant pas en mesure de fournir de l'eau à tous les ménages. Par conséquent, les ménages non desservis dépendent des sources naturelles pour répondre à leurs besoins en eau. Mais la qualité de l'eau de ces sources est à peine connue. Cette étude a été menée pour établir une qualité de base de l'eau dans les zones rurales autour de Huye. Des entretiens ont été menés et des questionnaires administrés au sein de la population de la zone. Les paramètres bactériologiques, physiques et chimiques de l'eau ont été analysés. Les résultats ont montré que pendant la saison sèche, le pH de l'eau de source (6,21) et de l'eau des conteneurs (5,62) est légèrement acide. L'étude a révélé que pendant la saison des pluies, toutes les sources sont polluées avec une prévalence de coliformes fécaux, streptocoques, coliformes totaux et une flore aérobie totale de 62,5%. La contamination par *Escherichia coli* (25%) pour l'eau dans les contenants domestiques, qui n'était pas dans l'eau directement prélevée à la source, montre

qu'une plus grande contamination se produit pendant le transport et le stockage de l'eau. Il est nécessaire d'entreprendre la protection des sources et le traitement de l'eau in situ au niveau des ménages.

Mots clés: Qualité de l'eau potable, protection des sources, eau de source, Rwanda, assainissement de l'eau, traitement de l'eau

---

## Introduction

Water quality is an important human development indicator. It is at the core of sustainable development and is critical for socio-economic development, healthy ecosystems and for human survival itself (UN-Water and Sanitation, 2015). Ensuring access to safe, resilient and sustainable water and sanitation will accelerate attainment of multiple environment and health-related goals for sustainable development (United Nations, Rio Conferences, 2012). Africa faces huge challenges with multiple issues that adversely affect public health; one of which is the ability for both rural and urban Africans to access clean water supply (Lori Lewis, 2016). In 2004, only 16% of people in sub-Saharan Africa had access to drinking water through a household connection (an indoor tap or a tap in the yard) (WHO, 2006). Not only is there poor access to readily accessible drinking water, even when water is available in these small African towns, there are risks of contamination due to several factors.

The final Rwanda progress report of the Millennium Development Goals shows that the country is still far from achieving the expected target of 100% of safe drinking water especially in rural and peri-urban area (Figure 1). With the Vision 2020, Economic Development for Poverty Reduction Strategies II and National Water Supply and Sanitation targets (2005), Rwanda committed to achieving 100% water supply coverage country wide by 2017. Despite these initiatives, water supply and sanitation is still a major issue. According to National Policy and Strategies for Water Supply and Sanitation Services (2010); the sources of rural water supply are distributed as follows: natural sources of water supply including unprotected sources (78.5%), protected springs (32.2 Piped water ( 46.3 %), boreholes (19.9%) or wells equipped with a hand pumps (1.6%). However, water quality in these springs is barely monitored as such, there is no baseline information on the quality of this ater. This study therefore determined the biological, physical and chemical water quality parameters of springs and household containers.

## Materials and methods

**Study area, data collection data analysis.** The study was conducted in Huye sector, Ngoma Sector, Mukura Sector and Tumba sector of Huye district (Fig. 2). The water points studies were mapped using a GPS (Fig. 2) to allow for geo-referencing. The annual rainfall in the study area varies from 1200 mm to 1400 mm per year while the average temperature is 19°C. Huye district topography is characterized by a vast number of hills and mountains, a fact that results in high soil erosion and loss of water. The choice of springs to be analysed was based on the availability of water in the dry season and supply to a big number of people.

Data analysis was undertaken using standard analysis procedures. Water pH was measured by potentiometry using an appropriate pH meter WTW-PH 538. Conductivity was established using a Conductimeter inoLab. Ammonium, nitrate and nitrites were measured by colorimetry. Microbiological analysis for total aerobic flora, total coliforms, faecal coliforms, *Escherichia coli*, *Streptococcus* spp.,

bacteria, *Salmonella* and *Shigella* spp were made in accordance with standard methods (AFNOR, 1997).

## Results and discussions

**Physicochemical parameters.** Table 1 shows results of physico-chemical parameters of spring water in Huye district. Table 2 shows corresponding parameters for water from household containers. The results showed that overall mean pH in dry season was lower than the WHO recommended range (6.5< pH< 9.2). This could be a result of soil acidity in the area. It is increasingly being recognized that although acid soils in Rwanda occupy approximately 45% of the arable land , 60% of the highland area are covered by acid soils with pH values of less than 5.5 (Beenart , 1999). Huye district is located in the highland region. Spring water analysed in the dry season was found to be slightly acidic and with a little excess of nitrates. This may cause corrosion of galvanized metallic pipes. Meanwhile, during the rainy season, the mean water pH was within the recommended WHO range. This could have been a result of dilution.

According to Premazzi *et al*. (1989), the health risks from exposure to nitrates are related not only to their intake but also to the presence or absence of conditions leading to their reduction to nitrites in the body. Infants constitute the most vulnerable group because lower acidity in their stomach allows growth of certain microbes that contain enzymes capable of reducing nitrates to nitrites.

**Bacteriological parameters.** Table 3 presents microbiological data of spring water in Huye district while Table 4 shows microbiological data of the same water from household containers. The bacteriological quality of a drinking water depends on the absence of certain bacterial species such as faecal coliforms, staphylococcus, streptococcus, *Escherichia coli*, salmonellas and shigellas. Bacteria are indicators of drinking water pollution and are used to determine whether water is safe for human consumption. For water taken directly from the spring, no *Escherichia coli*, *Salmonella* or *shigella* was encountered. However, other bacteria spp were found in all water sources and increased during the rainy season. So this water needs to be treated before it is consumed.

The four springs studied were chosen because they supply water to big numbers of people in addition to having water throughout the year. . The presence of *Escherichia coli* contamination (25%) for Water from family containers which was not taken from springs had *E. coli* contamination levels of 25%. This means that contamination also occur during transportation and water storage.

## Conclusions and recommendations

The results from the analysis show that the masonries of the four studied springs are visibly degraded and have not been rehabilitated since they were constructed. Results of physicochemical analyses show acceptable quality for all analysed parameters. However, old galvanized pipes may cause some health problems due corrosion. It's recommended that the population be educated on keeping containers used for drawing and storing water clean. The population is further advised to to boil water or use Ministry of Health recommended bactericides for disinfecting drinking water. The sources of contamination must be traced and eliminated through regular testing and monitoring by health authorities and local administration. Springs needs to be protected to reduce contamination. Water treatment technologies such as chlorination, filtration and solar based disinfection need to be employed. Further research to include other parameters with health significance is recommended.

**Table 1. Physical-chemical results for spring water in Huye district.**

| Season | Dry season | | | | Rainy season | | | |
|---|---|---|---|---|---|---|---|---|
| Water springs | Gahe | Mpare | Mpazi | Rwas | Gahe | Mpare | Mpazi | Rwas |
| pH | 6.25 | 6.1 | 6.68 | 5.81 | 8.02 | 6.8 | 7.1 | 7.9 |
| Conductivity (µS/cm) 131.8 | 74.7 | 121.1 | 129.1 | 111.6 | 69.8 | 121.9 | 134.5 | |
| Ammonium (mg/l) | 0.014 | 0.018 | 0.054 | 0.019 | 0.04 | 0.006 | 0.07 | 0.04 |
| Nitrates (mg/l) | 38.98 | 20.5 | 15.75 | 33.22 | 29.6 | 18.1 | 36.6 | 0.3 |
| Nitrites (mg/l) | 0.003 | 0.012 | 0.014 | 0.011 | 0.11 | 0.12 | 0.08 | 0.08 |
| WHO standards | 6.5< PH< 9.2 | Conductivity (µS/cm) < 1000 | Ammonium (mg/l) < 0.5 | Nitrates (mg/l)< 50 | Nitrites (mg/l) < 0.1 | | | |

**Table 2. Physicochemical parameters of water from household containers**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ammonium (mg/l) | 0.0146 | 0.0073 | 0.019 | 0.016 | 0.006 | 1.50 | 3.0 | 0.02 |
| Nitrates (mg/l) | 24.24 | 15.3 | 24.09 | 33.74 | 29.9 | 0.05 | 37 | 0.18 |
| Nitrites (mg/l) | 0.0173 | 0.0086 | 0.019 | 0.031 | 0.09 | 0.90 | 17.4 | 0.1 |
| WHO standards | 6.5< PH< 9.2 | Conductivity (µS/cm) < 1000 | Ammonium (mg/l) < 0.5 | Nitrates (mg/l) < 50 | Nitrites (mg/l) < 0,1 | | | |

**Table 3. Microbiological results for spring water during dry and rain seasons**

| Season | Dry season | | | | Rainy season | | | |
|---|---|---|---|---|---|---|---|---|
| Water springs | Gahe | Mpare | Mpazi | Rwas | Gahe | Mpare | Mpazi | Rwas |
| Total eerobic flora (cfu/100ml) | <1 | 3 | 124 | 25 | 2.1 | 5.1 | 3.1 | 5.1 |
| Total coliforms (cfu/100ml) | 4 | 24 | 1000 | 100 | >5.100 | >5.100 | >5.100 | >5.100 |
| Fecal coliforms (cfu/100ml) | <1 | <1 | <1 | <1 | <1.100 | < 1.100 | < 1.100 | < 1.100 |
| Escherichia coli (cfu/100ml) | A | A | A | A | A | A | A | A |
| Streptococcus (cfu/100ml) | <1 | <1 | <1 | 2.1 | 2.1 | >5.100 | >5.100 | >5.100 |
| Bacteria (cfu/20ml) | A | A | A | 14 | A | A | A | A |
| Salmonella &Shigella (cfu/5l) | A | A | A | A | A | A | A | A |
| WHO Standards | Total Aerobic | Total Coliforms : A | | Escherichia coli : A | Streptococcus: A | | Bacteria : A | Salmonella &Shigella : A |

Flora< 20 cfu/ml coli : A. Note: A: absence and P: presence. Source: LHEDA-UR (Laboratory of Water and Food Hygiene)

**Table 4. Microbiological results from household containers during dry and rain seasons**

| Season | Dry season | | | | Rain season | | | |
|---|---|---|---|---|---|---|---|---|
| Water springs | Gahe | Mpare | Mpazi | Rwas | Gahe | Mpare | Mpazi | Rwas |
| Total Aerobic Flora (cfu/100ml) | $3.10^3$ | $2.\ 10^2$ | $3.10^4$ | $7.10^2$ | $2.\ 10^3$ | $>3.\ 10^3$ | $>3.\ 10^3$ | $4.\ 10^2$ |
| Total Coliforms (cfu/100ml) | $3.\ 10^4$ | $2.\ 10^4$ | $4.10^4$ | $5.\ 10^3$ | $>5.10^2$ | $>5.10^2$ | $>5.\ 10^2$ | $>5.10^2$ |
| Fecal Coliforms (cfu/100ml) | 20 | <1 | $1.\ 10^3$ | $2.\ 10^2$ | 3.1 | $>5.\ 10^2$ | $>5.\ 10^2$ | $2.10^2$ |
| Escherichia coli (cfu/100ml) | A | A | A | A | A | A | P | P |
| Streptococcus (cfu/100ml) | $5.\ 10^2$ | $2.\ 10^3$ | $3.\ 10^3$ | $3.\ 10^3$ | $>5.10^2$ | $5.\ 10^2$ | $2.\ 10^2$ | $10^2$ |
| Bacteria (cfu/20ml) | A | A | 12 | 40 | 6 | A | A | A |
| Salmonella &Shigella (cfu/5l) | A | A | A | A | A | A | A | A |
| WHO Standards | Total Aerobic | Total Coliforms : A | | E. coli: A | Streptococcus : A | | Bacteria : A | Salmonella & Shigella : A |

**Acknowledgements**

Our thanks go to Prof. Dr. Jean Bosco Gashagaza and Prof J. Monney for their constructive discussions during this work, and to WREM (Water Resources and Environmental Management) Staff and Mr. Albert Mashaku, the Director of the LHEDA-NUR (Laboratory of Water and Food Hygiene) for their support during this study. This paper is a contribution to the Sixth African Higher Education Week and RUFORUM 2018 Biennial Conference.

**References**

Ahmed, R. 2010. Drinking water contamination its and effects on human health.

Bartram, J. and Cairncross, S. 2010. Hygiene, sanitation, and water: forgotten foundations of health. *PLoS medicine* 7 (11): e1000367.

Clesceri, L.S., Greenberg, A.E. and Trussell, R.R. 1996. Standard methods for the examination of water and wastewater. APHA, AWWA and WPCF, Washington DC., USA.

Fipps, G. 2003. Irrigation water quality standards and salinity management strategies. Texas Farmer Collection.

Millennium Development Goals: (MDGs). 2003. Into Action through Water Supply and Sanitation. Mexico, 2006, 4th Water Forum on Rural Water Supply and Sanitation Initiative.

Premazzi, G., Chiaudani, G. and Ziglio, G. 1989. Scientific assessment of EC standards for Drinking water quality. Vol. 12427. Office for Official Publications of the European Communities.

Rodier, J., Geoffray, C. and Rodi, L. 1975. L'analyse de l'eau: eaux naturelles, eaux résiduaires, eau de mer: chimie, physico-chimie, bactériologie, biologie. Dunod.

World Health Organization. 2004. Guidelines for drinking-water quality. Vol. 1. World Health Organization..

Wales, N.S., 2004. Approved methods for the sampling and analysis of water pollutants in New South Wales. Department of Environment and Conservation.