

Quality of Drinking Water Sources Used By Rural Haitian Communities



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Abstract

Surface and well water samples that serve as the primary source of drinking water for the inhabitants were collected from 15 different locations. Retrieved water samples were then tested for various physical, chemical and biological attributes. Results for parameters of concern only are reported herein. High salinity and pathogens were the two main risks found to be associated with the water quality. TDS concentrations were denoted to be greater than 900 mg/L in 40% of the water samples. EC exceeded the 2500 $\mu\text{S}/\text{cm}$ value in 50% of the water matrices. All the water samples were tested positive for bacteria while 60% were contaminated with coliforms. Furthermore, 25% of the water samples exhibited Na and SO_4^{2-} concentrations exceeding 20 and 200 mg/L, respectively. All heavy metals analyzed met drinking water standards. Adequate sanitation and effective measures to protect drinking water sources are the fulcrum of preventing cholera outbreaks in deprived and rural communities in Haiti.

Keywords: Drinking Water; TDS; Pathogens; Health; Contamination

Introduction

Access to sustainable safe drinking water for an average typical Haitian household remains one of the most fundamental and urgent public health issues. This situational analysis is further compounded by frequent natural disasters. There is a large portfolio of case studies demonstrating the interplay between lack of access to safe drinking water in communities and good health. The perceived severity of risk and significance of this priority issue for Haiti and, as a matter of fact, many other countries around the world can be succinct scientifically as one of the leading causes of disease and death. The quality of life, productivity, economic well-being, and life itself, for many inhabitants depend on having immediate access to a healthy and sustainable drinking water supply.

Although water quality is dynamic in its composition and relative attributes, its ultimate quality is affected by temporal, spatial, and anthropogenic activities. This work reports on the findings of a water quality study designed to gain insights on the adequacy of various sources of drinking water sources accessed by various Haitian communities.

Water Testing Program

It is noteworthy to reiterate that water quality is intrinsically dynamic and ultimately influenced by various natural and anthropogenic factors. Hence, the goal was to gain a representative insight of the attributes of the water used by

various rural communities. The project was conducted during the years of 2015 to 2017. A total of 15 sources of communal drinking water located within a 140 km radius of the country capital of Port-au-Prince, were tested. Candidate sites were identified during meetings, strategically considered, formally discussed, accordingly prioritized and finally selected for the testing program. They were field and laboratory tested for various physical, chemical and bacteriological parameters. All analyses were performed in duplicate and according to standard methods of analysis. The average value is reported. Quality assurance and control were followed and maintained as specified by manufacturers. The main sources of water were categorized as surface water (including spring sources) and well water, respectively. Parameters of concern (POC) are reported herein.

Findings

Associated health risks are summarized in Table 1 highlighting potential health concerns that may arise from the quality of the water being ingested. In many instances, there are no established guidelines for the parameters investigated [1,2]. The test results for the POC are reported in Table 1. Oral ingestion remains the primordial exposure route to all the investigated water sources. Two main risks associated with the water quality for the inhabitants that are salinity and pathogens. More critically threatened are the health and life of newborns,

young infants, elders, pregnant women and their fetuses. It has been anecdotally reported of skin rashes and infection related to the domestic use of the subject water sources.

The quality of the drinking water sources used by the inhabitants is summarized in Table 1. The results were compared to United States Environmental protection Agency (EPA) and the World Health Organization (WHO). The overall quality of the various sources of water can be classified as very poor. This can be directly attributed to their vulnerability to contamination by pathogens because of lack of inadequate sanitation, anthropogenic activities as well as congruent and incongruent dissolution of the major contributing minerals to the hydrochemistry. Guideline levels for drinking water are typically based on taste quality and not health risk [3]. Flavor

may be affected by inorganic salts or metal ions, or products of bacteriological growths which will provide an objectionable taste to the water. It was denoted that 50% of the water samples had EC values exceeding 2500 $\mu\text{S}/\text{cm}$. The number of water samples for which pH values were outside of the recommended 6.5-8.5 range represented 25% of the investigated samples. TDS concentrations were found to be greater than 900 mg/L in 40% of the water samples. Furthermore, they were all tested positive for bacteria while 60% were contaminated with coliforms. The high levels of TDS and the presence of pathogens in the water make the palatability questionable and a significant health risk, in both instances, for the inhabitants. Furthermore, 25% of the water samples exhibited Na and $\text{SO}_4\text{-2}$ exceeding 20 and 200 mg/L, respectively.

Table 1: Test results of drinking water quality accessed by the subject communities.

Parameters	Concentration Range	EPA/WHO	Associated Health Risks
EC ($\mu\text{S}/\text{cm}$)	Surface: 180-700, Well: 200-7000	2500/NE ¹ As above	cardiovascular effects
pH	Surface: 7-7.8, Well: 7.8-8.9	6.5-8.5/6.5-8.5 As above	eye and skin irritation
TDS (mg/L)	Surface: 200-1800, Well: 400-5000	500/500 As above	cardiovascular effects
Na (mg/L)	Surface: 1-4, Well: 6-60	20/NE As above	cardiovascular effects, kidney and liver disease
Cl ⁻ (mg/L)	Surface: 0.5-10, Well: 10-1400	NE/NE As above	cardiovascular effects
$\text{SO}_4\text{-}^2$ (mg/L)	Surface: 10-40, Well: 80-600	250/250 As above	upset stomach, diarrhea
Total HPC (CFU ¹ /mL)	Surface: 80-2 x10 ³ Well: 12-800	0/0 As above	serious infectious complications
Total Coliforms (CFU ² /100 mL)	Surface: 2000-4x10 ⁵ Well: ND ² -30,000	0/0 As above	severe diarrhea, cramps, headaches, jaundice, nausea, fatigue, death vomiting, dizziness

NE¹=Not established; CFU2 = Colony Forming Unit.

Cholera outbreaks have a common genesis that is in poor public sanitation. This acute infection is endemic in rural communities of Haiti and is one of the most fatal diseases in the country. This offers prima facie evidence of a national leadership deficit in public health protection. This public health tragedy is intolerably unacceptable and totally preventable. Access to good drinking water quality is essential to prevent diseases and enhancing socio-economic development. The quality of life, productivity, economic well-being, and life itself, for Haitians depend on having immediate access to a healthy and sustainable drinking water supply. In that regard, a well-thought out national, multifaceted, innovative, coherent, and leadership blueprint are the fulcrum to resolving this pressing issue.

Summary

Nowhere in Haiti are affliction felt so strongly as at the interface of drinking water quality and human health. The great majority of wells water are overwhelmingly characterized by high salinity due to the natural geology of the water-bearing zone. Current membrane technologies are too cost prohibitive, high maintenance, not easy to operate, and inefficient to be deployed in deprived and rural communities in Haiti and similarly around the world. Paradoxically, making the water less saumâtre represents one of the most important challenges going forward in the context of drinking water attribute. A new architectural paradigm shift at providing basic sustainable

drinking water for Haiti rural communities must be shaped in light of the findings of this study.

Acknowledgment

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