

**PHYSICOCHEMICAL ANALYSIS OF SELECTED BOREHOLE WATER  
IN OSUKURU SUB-COUNTY, TORORO DISTRICT**

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**DECLARATION**

I, Peke Joel, declare that this work has been out of my own reading/research except the citations made from different references, and has not been submitted before to any university for any award.

Signed.....

Date...../...../.....

**APPROVAL**

This research report by Peke Joel was done under my supervision and is now ready for examination.

Signed.....

Date...../...../.....

Supervisor: Mr. Egor Moses

## **DEDICATION**

I dedicate this book to my beloved brother, Wandela Geoffrey because of his continued support, unity and love he showed me throughout my time of studies.

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## **ABSTRACT**

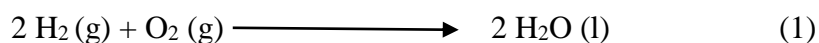
Groundwater is the major source of drinking water in many areas which is abstracted through domestic boreholes for domestic and industrial use. Effective water quality monitoring assists in checking the quality of water available for consumption. This study was carried out to evaluate the physicochemical quality of borehole water parameters from domestic boreholes in Osukuru Sub-County, a phosphate mining area in Tororo District, Eastern Uganda where ground water is the main source of drinking water and provide treatment methods for water contaminants prevention. Eight water samples were collected randomly from eight selected boreholes in this community. The physicochemical parameters analyzed include pH, temperature, color, odor, taste, total dissolved solids, electrical conductivity, salinity and total hardness, using standard methods of analysis. Obtained results were compared with the World Health Organization standards (WHO), for drinking water. Treatment methods for domestic boreholes include; strictly observe proper sanitation (hygiene) around the vicinity of the boreholes and appropriate treatment should be done with respect to the important physicochemical parameters. For example pH adjustment to raise the pH level using calcium carbonate filters; chlorinator is used to kill bacteria, viruses and other pathogenic microorganisms that causes water borne diseases.

## CHAPTER ONE: INTRODUCTION

### 1.1 Background

Water is one of the most important and valuable natural resource. It is essential in the life of all living organisms from the simplest plants and microorganisms to the most complex living system known as human body (Onifade, 2008).

Water constitutes about 70% of the body weight of almost all living organism. Life is not possible on this planet without water (Jameel et al., 2006). Water is a universal solvent, which consists of hydrogen and oxygen atoms. Chemically, it can be defined as a chemical substance with two atoms of hydrogen and one atom of oxygen connected by covalent bonds in each of its molecules; hence the molecular formula is H<sub>2</sub>O. It is formed by the direct reaction of hydrogen with oxygen as shown below (Olubanjo et al., 2019).



Water is significant due to its unique chemical and physical properties. It is an inorganic substance that occurs in three states; liquid, gaseous and solid states and is known to be the most abundant compound (70%) on earth (Obi et al., 2007). Water in its pure form has a pH value of 7.0, freezing point of 0°C and boiling point of 100°C at 760 mmHg. It is also a colorless, transparent, odorless and tasteless liquid (Adogo et al., 2016).

Water originate from various sources which include rain water, surface water and groundwater. But the most important one is the groundwater which originate as a result of rainfall infiltration into the ground through the pores of rock and soil thus meeting the water table. It is normally abstracted through domestic boreholes and essential used for human consumption ( Oguntuase et

al., n.d.). On earth, it is found mostly in oceans and other large water bodies such as lakes, with 1.6% of water below ground in aquifers and 0.001% in the air as vapour clouds (formed from the solid and liquid water particles suspended in air), and precipitation. Oceans hold 97% of surface water, glacier and polar ice cap 2.4% and other land surface water such as rivers, lakes and ponds 0.6% (Olubanjo et al., 2019). A very small amount of the earth's water is contained within biological bodies and manufactured products.

The characteristics of ground water are influenced by geological processes such as weathering of minerals, precipitation, dissolution, ion exchange, oxidation, reduction and residence time (flow rate) of ground water (Egor & Birungi, 2020).

Water on earth moves continually through a cycle of evaporation, transpiration, precipitation and runoff usually reaching the sea. Overland, evaporation and transpiration contribute to the precipitation. Small amount of gases like nitrogen, oxygen and carbon dioxide in the atmosphere are contained in all-natural water. Water in its pure state is acclaimed key to health and the general contention is that water is more basic than all other essential things to life (Olubanjo et al., 2019). Man can go without food for twenty-eight days, but only three days without water, and two third of a person water consumption per day is through food while one third is obtained through drinking (Bhat, 2014). Water is the most common solvent for many substances and it rarely occurs in its pure nature (Bhat, 2014). Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells (Okonko et al., 2008).

Clean and fresh drinking water is essential for human and other forms of life. . There is abundance of water on the earth surface but the quality as well as the quantity to serve its intended purpose is where the problem lies. Drinking water has always been a major issue in many countries like

Uganda (Rajini et al., 2010) and majority of the rural population in Uganda do not have access to potable water. Only few people can afford and rely on purified and treated bottled water particularly for consumption therefore, borehole water serve as the major source of both drinking and domestic water used in the local population of Uganda .

Access to safe drinking water has improved steadily and substantially over the last decades in almost every part of the world (Adesogan, 2014; Mohammed, 2011), especially Uganda, but approximately 1.1 billion people still lack access to safe water and over 2.6 billion worldwide lack access to adequate sanitation which causes water borne illnesses such as cholera, diarrhoea, botulism, e. coli infection, dysentery, legionellosis, leptospirosis, salmonellosis, typhoid fever, and vibrio illness (Fadaei et al., 2014a).

The presence of nitrate compounds, heavy metals, pesticides etc. in our drinking water can also constitute undesirable pollutant when they are not within World Health Organization (WHO) guidelines for drinking water (Fadaei et al., 2014a). There is a correlation between access to safe water and GDP, per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water based vulnerability (Taiwo et al., 2015).

Pollution as the deliberate or accidental contamination of the environment with man's waste. Agricultural processes involving the use of fertilizers, herbicides and pesticides produce toxic substances that are transported as effluents into water sources and these pollute water bodies (Obi et al., 2007). Similarly, textile industries emit wastewater that contains organic dyes which introduce different ions into water that can alter its composition (Bisschops & Spanjers, 2003).

Fig. 1 is a poorly sited domestic borehole located near the septic tank. This particular borehole will be highly contaminated through infiltration especially during rainy season.



**Figure 1: Poorly sited domestic borehole**

A number of scientific procedures and tools have been developed to assess the water contaminants. These procedures include the analysis of different parameters such as pH, turbidity, conductivity, total suspended solids (TSS), total dissolved solids (TDS) and heavy metals. These parameters can affect the drinking water quality, if their values are in higher concentrations than the safe limits set by the World Health Organization (WHO) and other regulatory bodies (World Health Organization (WHO), 2011). Therefore, the investigation of the drinking water quality by researchers and governmental departments has been performed regularly throughout the world (World Health Organization (WHO), 2004).

There is a gap in knowledge of anthropogenic, geological and hydrological factors impacting on borehole water quality and the patterns of borehole water consumption to identify areas with water stress and understand consumption patterns, like the effects of distance from the borehole,

household size and changing seasons on daily per capita borehole water consumption. Although some of these pollutants are essential, others are toxic to animals, man and plants. When these pollutants accumulate beyond the recognized and recommended limits, they become toxic to living organisms (man, animals and plants) (Borne et al., 1978; Taiwo et al., 2015).

The consumption or use of water from polluted water sources is capable of causing water or chemical related diseases. Disease contacted through drinking water kill about 5 million children annually and make 1/6th of the world population sick (Taiwo et al., 2015; World Health Organization(WHO), 2004). Also water demand has increased due to population increase, urbanization, industrial as well as agricultural activities, etc. Thus, the quest for alternative sources to satisfy water demand has led to the indiscriminate construction of boreholes by individuals as coping strategy without any concern on the quality of water abstracted (Ngozi et al., 2018).

## **1.2 Problem Statement**

Water quality has a direct impact on public health. More than 80% of deaths is caused due to water borne diseases (Khan et al., 2003). The water supply system in Osukuru Sub-County is insufficient as per demand of consumers both the locals and cement industry. Mostly driven by the unreliable and quality compromised borehole water supply and in part due to the perception and expectation of pure and safe drinking water. With the increasing demand and insufficient supply, it seems that in the near future, the urban dwellers would not have an option other than using bottled water for drinking. Thus it's high time to check the quality and monitor the borehole water. However, very few studies have been carried out to assess their quality and there are no agencies that regularly monitor their quality (Budhathoki, 2014).

### **1.3 Justification**

Safe drinking water is a fundamental right of every human being. However, is the water that we drink safe? The answer is obviously “NO” as shown by the death statistics from water borne diseases which accounts to 80% (World Health Organization (WHO), 2011). This is due to pollution of the water sources.

Although some of these pollutants are essential, others are toxic to animals, man and plants. When these pollutants accumulate beyond the recognized and recommended limits, they become toxic to living organisms (man, animals and plants) (Ikeme et al., 2014) . The consumption or use of water from polluted water sources is capable of causing water or chemical related diseases. Driven by the perception of purity, people switch to buy bottled water. It is on these basis that an attempt is being made to determine the extent of underground pollution of ground water sources basing on their physicochemical properties such as pH, temperature, electrical conductivity, colour, odour, total dissolved solids <sup>an-d</sup> total hardness in Osukuru sub-county.

#### **1.4.1 Objectives of the Study**

#### **1.4.2 General Objective**

This study is aimed at determining and assessing the extent of underground water pollution from a phosphate mining site and cement factory to nearby ground water sources (boreholes) based on certain physicochemical parameters of interest such as; total dissolved solids, temperature, electrical conductivity, pH, salinity and total hardness in Osukuru sub-county, a phosphate mining area in Tororo District, Eastern Uganda where ground water is the main source of drinking water.



#### **1.4.2 Specific Objectives**

To analyze the Physicochemical parameters of borehole water used in Osukuru Sub-County.

To comparing the values obtained from analysis with that of World Health Organization (WHO) standards with a view to improve the quality of borehole water.

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