American Journal of Environmental Science and Engineering
2022; 6(4): 181-189
http://www.sciencepublishinggroup.com/j/ajese
doi: 10.11648/j.ajese.20220604.13
ISSN: 2578-7985 (Print); ISSN: 2578-7993 (Online)

Determination of Surface Water Quality Parameters and Their Effects to Human Life (The Case Study of South Lake Cyohoha)

Nikuze Marie Joselyne[1, *], Uliho Alphonse[2], Muhorakeye Pelagie[1], Mukashyaka Angelique[1], Nyiraminani Jeanne[1]

[1]Civil, Environmental and Geomatics Engineering, University of Rwanda, Kigali, Rwanda

[2]Key Laboratory of Industrial Biotechnology, Jiangnan University, Wuxi, China

Email address:

nikuzemariejoselyne@yahoo.fr (Nikuze Marie Joselyne), ngiruwonsangajoselyne@gmail.com (Nikuze Marie Joselyne), Ulihoalpha@gmail.com (Uliho Alphonse), pelagiem24@gmail.com (Muhorakeye Pelagie), shyakaangeclever52@gmail.com (Mukashyaka Angelique), Nyiraminani20@gmail.com (Nyiraminani Jeanne)

[*]Corresponding author

To cite this article:

Nikuze Marie Joselyne, Uliho Alphonse, Muhorakeye Pelagie, Mukashyaka Angelique, Nyiraminani Jeanne. Determination of Surface Water Quality Parameters and Their Effects to Human Life (The Case Study of South Lake Cyohoha). *American Journal of Environmental Science and Engineering*. Vol. 6, No. 4, 2022, pp. 181-189. doi: 10.11648/j.ajese.20220604.13

Received: June 9, 2022; **Accepted**: September 1, 2022; **Published**: December 29, 2022

Abstract: Water is one of the essentials that support all forms of plant and animal life**.** The lack of safe drinking water is the cause of disease in the world today. Every day, people die from causes related to contaminated water. The research is about the determination of Surface Water Quality Parameters and their Effects to Human Life the study relates to South Lake Cyohoha selected as case study which locate in Bugesera district in Eastern province. To achieve our goals for fulfilling our mentioned objectives different methods was used like site visit to measure the onsite parameters, Oral interview and discussion with different people where we did interview with the population living near the lake; who use the lake for different activities like domestic activities, agriculture and drinking to find out the reasons why they use lake as drinking water source. The results clearly showed that the water quality of south cyohoha lake is not suitable for drinking and some domestic purposes. As local communities are suffering from a variety of health problems including: Ankylostome, Ascaris, Tricomonas intestinal, Taenia (caused by fecal matter, Polantidium, Larvae angulure, Hookworm, Oxyre trichiuris, Giardia lambris, Oxyure trichocephale (children), Entamoeba, and histolytica (E-coli). This was indicated by the measured parameters of this lake. The maximum recorded values of pH, turbidity, hardness, total calcium and total magnesium, manganese, iron, total coliform, fecal coliform. Were 8.6, 17.5NTU, 11.2mg/L, 7.8mg/L, 0.245mg/L, 0.35mg/L, 18100mg/L, 2450mg/L, and 6.2mg/L, respectively. Concentration of turbidity, hardness, and Iron found in the South Cyohoha Lake is much higher than the standard permissible limit. It is recommended that water quality be monitored on a regular basis to avoid its devastating effects on public health.

Keywords: Surface Water, Water Quality Parameters, South Lake Cyohoha, Human Life, Water Pollution Diseases

1. Introduction

Safe drinking water is a basic need for good health and is also a basic human right. Fresh water is already a limiting resource in many parts of the world. In the next century, it will become even more restrictive due to increased population, urbanization and climate change [12]. Access to safe drinking water and sanitation is a global concern. The availability and quantity of water resources of freshwater continues to occasionally decline in Africa. The Sub-Saharan Africa, major water requirement domestic and industrial purposes are usually not met. The need to determine the quality of public water supplies enhanced as a result of increased water Global pollution caused by increasing

population, urbanization, industrialization [4]. However, developing countries, such as Rwanda, have suffered from a lack of access to safe drinking water from improved sources and inadequate sanitation [18]. As a result, people are still dependent on unprotected water sources, such as rivers, streams and lakes. Water quality plays a key role in protecting habitats, agriculture, industry and public health, and sources of water quality pollution come not only from rivers and lakes but also from land use / cover and human productive activities. Generally; WATER is one of the most important and abundant compounds in the ecosystem. All living organisms on earth need water to survive and grow. So far, only the earth consists of a terrestrial planet with 29% and an aquatic planet with about 71% water. Economic growth, industrial use of fertilizers in agriculture and urbanization, along with demographic progress, are leading to significant increases in water consumption and polluting waste in water systems [19]. A large number of rivers and streams are highly polluted due to anthropogenic activities, such as pollution from industry and sanitation, a phenomenon that seriously affects water quality and endangers water reserves reduced in relation to the infectious waste received. Thus, pollution, a highly increasing phenomenon, seriously affects water quality and water reserves [2].

Poor quality water destroys crop production and infects our food, which is dangerous to aquatic life and human life. Contaminants disrupt the food chain and heavy metals; especially iron affects the respiratory system of fish.

An iron blockage in the gills of fish and is lethal to fish, when these fish are eaten by humans it leads to a major health problem. Metal-contaminated water causes hair loss, liver cirrhosis, kidney failure, and neural disorders [6].

The daily chromium requirement for adults is estimated to be 0.5 to 2 µg of absorbable chromium (III). Assuming a fractional absorption value of 25% for "biologically incorporated" chromium (III) in food, this is provided by a daily dietary intake of 2–8 µg chromium (III), equivalent to 0.03–0.13 µg of chromium (III) per kg of body weight per day for a 60 kg adult [1].

Ingestion of 1 to 5 g of "chromate" (unspecified) produces severe acute effects, including gastrointestinal disturbances, bleeding diathesis, and seizures. Death can occur after cardiovascular shock.

The modern world faces a wide variety of complex diseases due to different water qualities. Many types of surface water sources are available in our world, and the sources come from rivers, ponds, lakes, etc. Pond water is the primary source of water for many villages and their surrounding people [5]. Air and water can be polluted anywhere. Little is known about changes in contamination rates. The increase in water-related diseases is an accurate measure of the extent of environmental pollution [15].

In Rwanda, the abundance of water resources is reflected in the existence of a network of wetlands in various parts of the country. Wetlands and aquatic lands are generally represented by lakes, rivers, swamps associated with these lakes and rivers [14]. Rwanda is divided into two major drainage basins: the Nile to the east covering 67 percent and delivering 90 per cent of the national waters and the Congo to the west which covers 33 per cent, each basin have catchments to cover Nile basin have 7 catchments while Congo basin have 2 catchments as are classified [8].

Bugesera region has an area of 1303sq.km. It is found in the South-Eastern plains of the Eastern Province, the region is sandwiched between Rivers, Nyabarongo and Akanyaru which converge at the southern end to form the Akagera River. Bugesera area is characterized by numerous lakes, the biggest of which are Rweru and Cyohoha [17]. It constitutes 1 of the Rwandan districts which has 14 sectors and 40 cells. The Lake Cyohoha trans boundary catchment is locate in the Bugesera region which is shared by Burundi and Rwanda and is part of the wider Lake Victoria basin with 600 hectares. Its Characteristic Vegetation Consists of Dry Savannas and Farms Surrounding the Rivers and the Lake. Due to the persistence of drought and the friendly practices of marginalized people, where over-cultivation, defrosting of forests and anarchic animal husbandry, the basin of secrecy was confronted. In addition, both countries face raw material for food analysis due to small land area, poor agricultural practice, given the land and its rapid response [16].

Although Bugesera district has been blessed with many lakes in Rwanda but there is a serious problem of potable water scarcity that is why residents fetch lake water for domestic use [20] higher the alkalinity in lakes receiving that water. Globally, about 900 billion people still remain without access to improved sources of water. Similarly, about 2.6 billion have no axcccess to any form of improved sanitation services [11]. Poor people are at higher risk of disease due to inadequate sanitation, hygiene and water supply. Contaminated water has great negative effects on those women who are exposed to chemicals during pregnancy; leads to a higher rate of low birth weight as a result of impaired fetal health [7].

Thus, by this research paper determine the surface water quality parameters of south Lake Cyohoha and their effects to human life. Therefore; it is necessary that the quality of potable water should be controlled at regular time interval, because use of contaminated drinking water, human population suffers from varied water borne diseases.

2. Problem Statement

Lake South Cyohoha is the lake found in Bugesera district. However, many people use this lake as a drinking water sources and for different domestic activities without treatment. We visited the site and we have found that the lake receives different pollutants from point and non-point sources such as pesticides from agricultural activities, rainfall runoff from different sites, and Cow dung since the area used as a grazing land. In fact, this lake's water quality is not safe to human health unless treatment is done. Therefore, the water quality of the Lake South Cyohoha needs to be studied comprehensively for the area's importance and for security of human health.

Figure 1. *Lake Cyohoha.*

3. Methodology

3.1. Description of South Lake Cyohoha

3.1.1. Localization

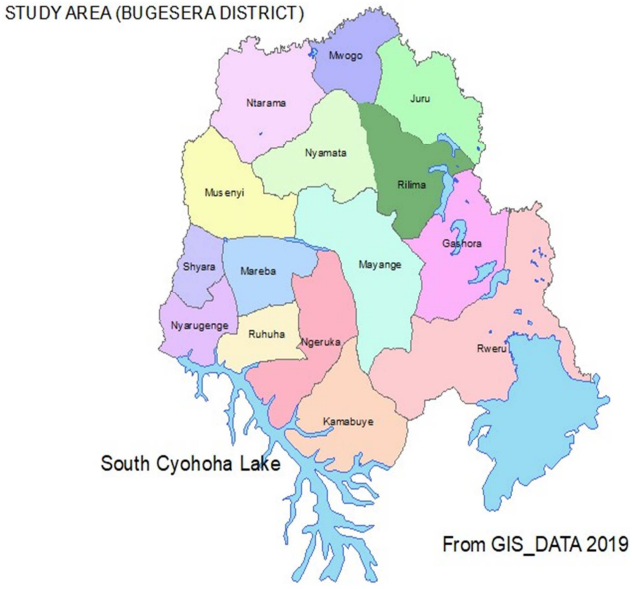

Figure 2. *Map of study area (BUGESERA), Source: ArcGIS Data 2019.*

The South Cyohoha Lake transboundary catchment is located in the Bugesera region which is shared by Burundi and Rwanda and is part of the wider Lake Victoria basin. It is bounded by four sectors which are: Nyarugenge, Ngeruka, Ruhuha and Kamabuye. Lake Cyohoha and its wetlands as well as the rivers are the principal source of water for humans. To achieve our goals for fulfilling our mentioned objectives different methods was used. Like preliminary site investigation of our site to measure the onsite parameters, interview and discussion with different person where we did Oral interview with surrounding hospitals to get data about water related diseases to the population live near.

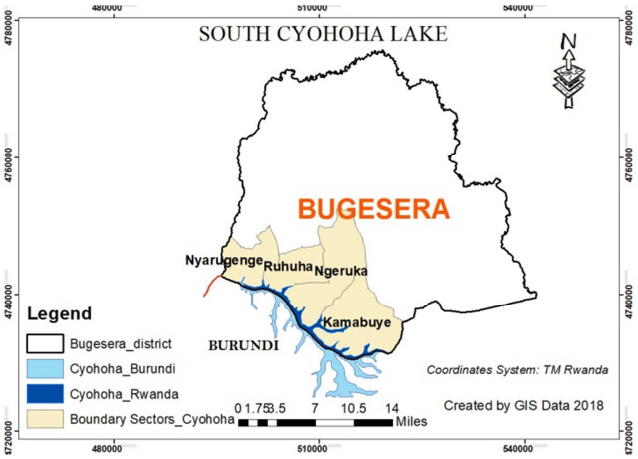

Figure 3. *Map of South lake Cyohoha, Source: ArcGIS Data 2018.*

3.1.2. Characteristics of Bugesera Region

The Bugesera District is part of the eastern province and is located just south of Kigali bordering Burundi. The region is sandwiched between Rivers Nyabarongo and Akanyaru which converge at the southern end to form the Akagera River. Bugesera area is characterized by numerous lakes, the biggest of which are Rweru and Cyohoha. These two plus the other small lakes in the region comprise an estimated surface area of 10,635 hectares. The land is characterized by plateaus, wavy hills and dry savannas with grass, shrubs and short trees. In terms of climate, the area is a low rainfall zone that receives an average of about 900 mm per year. The climate is dry and the area has been affected by desertification, although some measures introduced by the government have succeeded in reversing this trend. However, climate forecasts suggest that the annual average temperature in Rwanda will increase by 1.5-2oC by 2050, which is likely to increase the incidence of drought in this region. With population growth, a dependence on rain-fed agriculture (68% of people over 16 are independent farmers and agriculture contributes 46% in household income) and high levels of poverty (48% of the population is poor, including 28% of the extremely poor and 20% of the poor) droughts are potentially devastating events for the local population [13].

Table 1. *The Bugesera region lakes.*

Lake	Geographical Location	Surface area (ha)	Depth (meters)
Cyohoha South	Ngenda, Gashora & Nyamata Sectors	600	1.4
Gashanga	Rwinume and Rilima Sectors	232	2.5
Kidogo	Rilima Sector	225	2.5
Rumira	Gashora and Rilima Sectors	280	3
Mirayi	Gashora and Mwendo Sectors	232	4
Kirimbi	Mwendo Sector	230	2.5
Gaharwa	Mwendo and Nkanga Sector	230	2.5
Rweru	Rweru Sector	1.868	5.6

Source: (Experco, 2003).

3.1.3. Land Use and the Geographical Coverage

The catchment area of Lake Cyohoha falls into the Akagera sub-basin of the wider catchment area of Lake Victoria which is part of the Nile Basin. Lake Cyohoha has a catchment area of 508 km^2, of which 369 km^2 are in Burundi and 139 km^2 in Rwanda. The lake is 27 km long and 5 to 2 km wide. It spans up to 9 km and is separated from the Akanyaru River by a series of swamps on the southern border lake and the northern lake in Rwanda. In terms of climate, the area is a low rainfall zone that receives an annual average of about 900 mm. currently; the area is periodically experiencing a persistent drought. Land use in the Bugesera and especially around the catchment area of Lake Cyohoha, has changed tremendously in recent decades. Today, rain agriculture is the most important livelihood for 90% of the population living in the catchment area of Lake Cyohoha. Because of this, almost all wetland savannas, forests and savannas have been converted into farms. These changes destroyed the wetlands and thus caused the microclimate change. Lake Cyohoha North depends on the surrounding wetlands for water that has shrunk significantly in the last two years. In addition to drought, water scarcity has become a persistent threat to locals. Also, pesticides from agriculture are an important source of pollution for both wetlands and Lake Cyohoha.

Moreover, the area is also plagued by food insecurity caused by poor agricultural practices, land degradation and population pressure, as well as small plots of land.

3.2. Determination of the Concentration of the Surface Water Quality Parameters of the Study Area

3.2.1. Sampling Method

The method used for sampling is Direct Method where we took three difference samples from areas where people mostly fetch water in south cyohoha lake at Depth of 20 cm to avoid collection of floating debris and then after, the samples were carried to NGENDA water treatment plant for the analysis of parameters. The water quality control is done according to experimental analysis performed in laboratory. This laboratory tests is based on determining the physic-chemical parameters such as Turbidity, pH, Nitrates, Hardness (Ca, Mg), Heavy metals like (Pb, Cr, Fe, Mn) and biological parameters (Coliforms and E-coli).

3.2.2. Labolatory Analysis

(i). Physic-Chemical Analyses

The analysis was carried out at NGENDA Water Treatment Plant Laboratory in Bugesera District.

1) pH Measurement

The pH is a very important factor, because certain chemical processes can only take place when water has a certain ph. For instance, chlorine reactions only take place when the pH has a value between 6.5 and 8. The pH is an indication for the acidity and alkalinity of a substance. It is determined by the number of free hydrogen ions (H+) in a substance. Acidity is one of the most important properties of water. Water is a solvent for nearly all ions. The pH serves as an indicator that compares some of the most water-soluble ions. The outcome of a pH- measurement is determined by a consideration between the number of H+ ions and the number of hydroxide (OH-) ions. When the number of H+ ions equals the number of OH- ion the pH of water can vary between 0 and 14. When the pH of a substance is above 7, it is a basic substance. When the pH of water is below 7, it is an acidic substance. The further the pH lies above or below 7, the more basic or acid a solution is. The water is neutral when it has a pH of 7. This measurement will help us to know the quantity of H+ ions presented in water. According to the pH determination, we can follow this formula pH = -log H+.

Procedures

Pour 5ml of sample in the test tube, then add 5drops of universal indicator Methyl orange and then observe the color change. After, we compare the color obtained with the color of the comparator.

Figure 4. *pH Comparator.*

2) Measuring of Turbidity

This is the property of water of being trouble that is based on the presence of particles (Microorganisms) in suspension such as clay, organic matter and inorganic matters. Those are the one cause cloudiness of water.

Procedures

Pour raw water in a sample cell of 10ml and then pour distilled water in a clean sample cell of 10 ml for stabilizing the machine. Clean that cell clearly and put it into a Turbidimeter which is kept down completely and cover the sample with the light shield. After covering or closing the sample we read the results on screen of instrument which is

in Nephelometric turbidity unity (NTU).

Figure 5. *Turbidimeter.*

3) Hardness (Ca, Mg)

Total hardiness of water comes mainly from the salts of calcium and magnesium. Those salts are dissolved in water when water gets in contact with soil or rock materials. They are present in form of ions Ca^{2+} and Mg^{2+}. Iron and Aluminum ions also contribute to water hardiness. TH in water has a negative effect in food cooking, it distributes the heat fatly and the foods are not well cooked. It has also an effect in washing as it does not produce lather with the soap.

Procedures

Pour 100 ml of water sample in conical flask, add 3-4 drops of hardness buffer solution followed by a few amounts of Maniver reagent then we Titrated with EDTA solution of 0.02N until the color changes from pink to blue. We recorded the volume of titrant (EDTA) used.

4) Measuring of Total calcium (Tca) Procedures

We took 100 ml of sample and poured into conical flask then we added 3-4 drops of KOH solution followed by a few amount of Murexide reagent, EDTA solution of 0.02N was used as titrant after we recorded the amount of EDTA solution of 0.02N used.

5) Total magnesium (TMg)

Total magnesium is calculated from total hardness and total calcium using the formula below:

$$TH = TMg + Tca \text{ and } TMg = TH - Tca$$

Procedures

Press stored program, select the test then prepare blank solution by pouring 10 ml of deionized water to square cell and prepare the sample by pouring other 10 ml into second square cell for each cell, add a content of ascorbic acid powder pillow. Stopper and invert to homogenize the mixture, add 12 drops of alkaline-cyanide solution to each cell, swirl gently to mix. A cloudy solution may be formed. Add 12 drops of PAN 0.1% indicator solution to each sample cell; stopper and swirl gently to mix. An orange color developed in the sample indicating the presence of manganese. Press the timer ok and wait for two-minutes for reaction to take place. When the time expires, wipe the blank and insert it into the cell holder with the fill line facing light. Press zero in order to display 0.00 mg/l Mn. Wipe the sample cell and insert it into the cell holder with the fill line facing light Press read and sees the quantity of manganese present.

6) DETERMINATION OF IRON Procedures

Using spectrophotometer, select 267 code, put 25ml of sample in graduated cylinder, add a reagent of Ferover and invert in order to homogenize the mixture, set time of 5 minutes for the reaction, we observed orange color showing iron presence. We prepared the blank solution by filling 10 ml of sample into cell and wait for 5 minutes, pour 10 ml of the prepared sample into second clean sample cell then after, put blank solution into the cell holder line facing right in order to have 0.00mg/l Fe, remove the blank and insert the cell of sample, then read to obtain the result of iron in mg/l.

7) MEASUREMENT OF NITRATE (NO_3^-) Procedures:

Press stored program and Select the test, put 10 ml of sample in a sample cell, add the content of NitriVer®5 reagent Powder pillow and stopper. Set the timer for one- minute reaction begin, shake the cell vigorously until the time expires, prepare the blank by filling 10 ml of sample and press Timer again for five-minutes, Press zero in the spectrophotometer, the display will show 0.0mg/L NO_3—N, wipe the prepared sample and insert it into the holder with the fill line facing right, Press read and results are in mg/L NO_3—N.

8) Measurements of Organic Matter

The organic matters found in water are mainly come from the dead animals and plants. They are highly made of carbon compounds. Those organic matters are degraded or broken down by bacteria which affect the water quality in terms of color, test and smell and also contribute to increase of heavy metals in water.

Procedures

Figure 6. *Organic matter testing.*

We took 100 ml of water sample and poured into conical

flask, then add 10 ml of sulfuric acid of N/25 after we heated the mixture within 10 minutes to boil. Again we added 10 ml of potassium permanganate solution ($KMnO_4$) purple color will develop, heat again for 10 minutes maintain to boiling point. Add 10 ml of oxalic acid N/80 until the color changed from purple to colorless and titrate with $KMnO_4$ till the end point where the pale-pink color appears. Record the volume of $KMnO_4$ used.

(ii). Bacteriological Analysis

Bacteriological analysis is the technique used to detect the presence of coliforms (fecal and total) and presence of E-coli in water by measuring portions of water samples to be placed in test-tubes containing a culture medium and then, the tubes are incubated for a standard time and temperature.

1) Procedures

First of all, you sterilize all sample bottles and other needed materials in incubator at 180oc for 24 hours. We took 3 samples from different locations from the lake with sterilized bottles marked from 1 to 3. The analysis was done in laboratory where the surrounding was sterilized with the flame from gas burner and wet cotton with alcohol to clean working table and hands in order to kill bacteria. Next is to pipette 10ml of the sample with sterilized pipette and dilute it with 90ml of distilled pour the sample in a cylinder to mix very well. Each sample has 2 petri dishes one for total coliforms and another one for fecal coliforms. Filtration done by dropping the sample into the funnel with membrane filter at the bottom and Millipore on the top of the filter. When 100ml of the sample is over, the Millipore is removed with sterilized holder and pressed in the petri dish carefully filled with MacConkey broth to the bottom to prevent drying during incubation then, the lid was closed and marked with sample 1, F. C (fecal coliforms) and T. C (total coliforms). The same procedure was repeated for all samples followed by incubation. Fecal coliforms were incubated at 44°C for 24 hours and Total coliforms at 37°C for 24 hours.

Figure 7. *Incubator.*

2) Colony counting

After incubation, the results found as number of colonies per 100ml of the sample.

Number of colonies (Cfu) = (No. of counted colonies* volume filtered)/100

3) E-coli confirmations

We took 3 labelled tubes containing peptone water and 0.2 to 0.3ml of Kovac's reagent was added. Sterilized wire loop was used to transfer fecal coliforms previously found into the confirmation media containing peptone water and reagent to be incubated at 37°C for 24 hours. The production of a red color indicates the indole and confirms the presence of *E. coli*.

3.3. Determination of the Effects to Both Human Life and the Environment

The Comparison of the Results with the Water Quality Standard was done to determine effects of polluted water to both human life and the environment.

We took the average of the samples and comparing to the World Health Organization Standards.

Table 2. *Analyzed parameters in south lake Cyohoha and WHO.*

Analyzed Parameters	SAMPLES	WHO STANDARDS [21]
Tca (mg/l)	23.86	30mg/l
TMg (mg/l)	12.4	30mg/l
Total coliforms (Cfu/100ml)	30533.33	0 Cfu/100ml
Fecal coliforms (Cfu/100ml)	950	0 Cfu/100ml
E-coli (Cfu/100ml)	Present	0 Cfu/100ml
Manganese (mg/l)	0.174	0.01mg/l
TH (0F)	15.6	300F
Organic matter (mg/l)	10.26	3mg/l
Iron (mg/l)	0.313	0.3mg/l

Water quality is described by the chemical, physical, and biological characteristics of water that determine its suitability for a variety of uses and for the protection of the health and integrity of aquatic ecosystems [10]. Every aquatic ecosystem has a natural tendency to adapt and.

Compensate for changes in water quality parameters through the dilution and biodegradation of some organic compounds [9].

The quality of this lake is not safe since it contains manganese, E-coli, fecal coliforms and total coliforms exceeding the recommended standards which can cause forgetfulness and nerve damage, lung embolism and bronchitis, reproductive problems and death to human being. Iron in drinking water does not create health hazard but it imparts a bad taste. However, Iron concentration can be reduced in water by using a water filter, water softeners, carbon softeners and sediment filters to remove iron and minerals like manganese.

3.4. Data Collection from the Surrounding People

The data collection was performed by interviewing the people on site and the nearest the hospital, we discussed with the laboratory technician about water related diseases that affect people located in the area and we interviewed different people to know the reason why they use that lake for their domestic activities, we found that treated water is not sufficient enough to serve all community, some people are poor and they cannot afford fund for safe water while others depend on their cultural beliefs.

4. Results and Discussion

4.1. Source Pollution in South Lake Cyohoha

This lake is located between two countries where the pollutions are coming from agriculture activities; runoff carries much fertilizer into the lake and cause more turbidity into the lake.

This one can led to the increase of much nutrient to the lake which affects the aquatic animals and also human life.

Table 3. *Analyzed parameters in south lake Cyohoha.*

Analyzed Parameters	Sample 1	Sample 2	Sample 3	WHO standards [21]
Tca	10.0	11.2	8	30mg/l
TMg	6.2	3.6	7.8	30mg/l
Total coliforms	8700	18100	11200	0 Cfu/100ml
Fecal coliforms	200	2450	200	0 Cfu/100ml
E-coli	present	Present	Present	0 Cfu/100ml
Manganese	0.146	0.245	0.131	0.01mg/l
TH	16.2	15.0	15.6	30 0F
Organic matter	9.8	12.0	9.0	3 mg/l
Iron	0.30	0.35	0.29	0.3 mg/l

4.2. Level of Pollutants

1) pH

The PH is important variable in water quality evaluation; it influences many biological and chemical processes within a watercourse. Depending on the values, it ca affect human lives. Such that eye irritation and other skin disorders are associated with values of PH greater than 11.

The water having PH range 10 to 12.5 can cause hair to swell and insensitive individual's Gastrointestinal irritation may occur.

Table 4. *Results of pH.*

Sample	PH
1	8.5
2	8.5
3	8.6

2) TURBIDITY

Turbidity is the turbidity of water caused by a variety of particles and is another key parameter in the analysis of drinking water. It is also related to the content of diseases caused by organisms in the water, which may come from soil runoff.

Table 5. *Turbidity of samples.*

Sample	Turbidity (NTU)
1	17.5
2	10.7
3	12.7

All 3 water samples studied are shown below. The standard Recommended maximum turbidity limit, set by WHO for drinking water is (5) Nephelometric turbidity units (NTU). Lowest turbidity values of 10.7 NTU and highest Value of 17.5 NTU were found for samples 2 and 1 respectively in the table below. The results indicate that the turbidity of all the samples studied was higher than the maximum standard limit of 5 NTU.

3) COLIFORMS

Most coliform bacteria are not likely to cause illness. However, these bacteria are used as indicators in water tests because their presence indicates that diseases-causing organisms (pathogens) could also be in water. Feces and sewage wastes are mainly the source of the diseases causing organisms. There are many coliforms in water according to the results in the table below.

Table 6. *Coliforms results.*

Sample	Total Coliform	Fecal Coliform	*E. coli*
1	8700	200	Present
2	18100	2450	Present
3	11200	200	Present

4) MANGANESE

Manganese is the pollutant that is found in water and it has to be analyzed to check the concentrations that water contains. The standard of manganese in water is 0.3mg/l and our results of manganese in the table below are higher than the standard, this cause the health effect to the population.

Table 7. *Manganese results.*

Sample	Manganese
1	16.2
2	15.0
3	15.6

5) Organic Matter

The organic matters found in water are mainly come from the dead animals and plants. They are highly made of carbon compounds. Those organic matters are degraded or broken down by bacteria. They affect the water quality in terms of color, test and smell. They also contribute to increase of heavy

metals they are with. The standard of organic matter is 3mg/l and the results below are much higher than the standard.

Table 8. *Organic matter results.*

Sample	Organic matter
1	9.8
2	12.0
3	9.0

6) IRON

Iron is not hazardous to health, but it is considered as a contaminant. Essential for good health, iron helps transport oxygen in the blood, standard of iron is 0.3mg/l. The results of our sample s meet with the standard, thus iron has no effect to human health.

Table 9. *Iron sample results.*

Sample	Iron
1	0.30
2	0.35
3	0.29

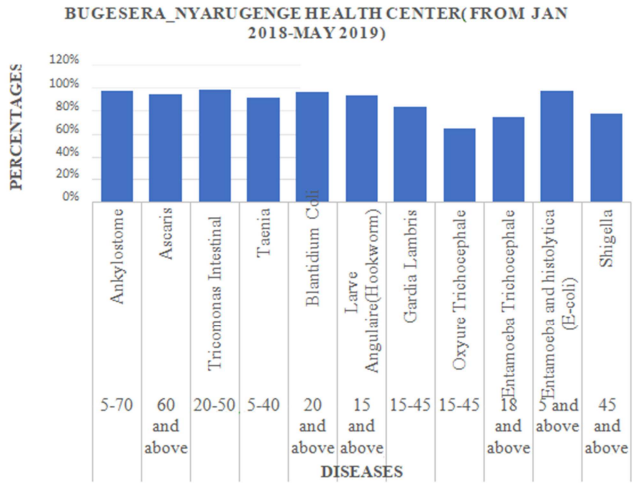

Figure 8. *Chart showing Water- borne diseases at Bugesera _ Nyarugenge health center.*

4.3. Water Related Diseases Found Around South Cyohoha Lake

One of the objectives was to find the diseases that can be caused by the use of water from the lake and their effects to health. These were achieved through visiting Nyarugenge Health Centre located in Bugesera district nearby the lake and many discussions were done with some of health center staffs. Interviews also were done to some people living there for more information and found that some of them are poor and the living conditions are very difficult for them to survive. There are also others who rely on their cultural beliefs and have perceptions about treated water.

Diseases found in Bugesera_ Nyarugenge health Centre

1) Ankylostome;
2) Ascaris;
3) Tricomonas intestinal;
4) Taenia (caused by fecal matter);
5) Blantidium;
6) Larvae angulure;
7) Hookworm;
8) Oxyre trichiuris;
9) Giardia lambris;
10) Oxyure trichocephale (children);
11) Entamoeba;
12) Entamoeba and histolytica (E-coli).

4.4. Proposed Solutions to Support the Population That Locate in That Area

Basing on the results found during the research, the findings show that the quality of some of the parameters like E-coli, fecal coliforms, total coliforms and manganese do not meet with the water quality standards. We suggest to the people using this lake for drinking and other domestic activities to apply some of the following precautions for their interests and for the country.

Make sure that Drinkable water and that for some domestic activities like food preparation is treated to remove or destroy contaminating microorganisms, pathogenic bacteria, nuisance bacteria, parasites, and other organisms. For example, Chlorination can be used for treatment.

Boil water before drinking if the treated water is not there. In case where boiled water is not available, drink filtered and adds some disinfectants i.e. Sur'Eau. Make certain the source of water before drinking it. Carry your own water bottle whenever you go or use bottled water.

The best strategy is not to treat an infection, but to avoid getting the infection. Sensible precautions include washing hands with soap after using toilet and defecation, never drinking water that has not been treated (if in doubt, do not drink), and avoiding bathing or swimming in water that is known to be polluted. Hospitalization if the symptoms are severe for some medicine.

5. Conclusion and Recommendation V.1. Conclusion

5.1. Conclusion

Conclusively, the main objective of the research was to determine surface water quality y parameters and their effects to human life. The research was carried out on the South Cyohoha Lake located in Bugesera District. The parameters were analyzed and we have found that, some of their concentrations are higher than the WHO standards. According to the results found, water from south lake Cyohoha is very polluted and have high effects to people who use that water for drinking, and cooking as the lake contains *E. coli*, coliforms and manganese exceed the water quality standards, where manganese equals 0.317mg/l while standard is 0.3mg/l, total coliforms are 30533.33Cfu/100ml and 950Cfu/100ml for fecal coliforms yet the standard must be 0Cfu/100ml. These affected people's life by causing different diseases such as Shigella, Taenia, Ascaris,

Entamoeba and many others as it was proven by Nyarugenge Health Center that locate in Bugesera district. Therefore, this lake should not be used for consumption since it is causing health troubles and the government should take measures to help these people who are in danger.

5.2. Recommendation

Overall observations, it is recommended to examine the water quality on regular basis to avoid its destructive effects on public health. We would also like to recommend the people who live near south Cyohoha lake to use qualified water since some of them have access to treated water and have ability to pay for it but they don't drink it due to their cultural beliefs. We would also like to recommend the government to support people's life by providing quality water means in the area though there is Ngenda Water Treatment Plant but it is not large enough to serve the community successfully. The government also should reduce the price for water because some people are poor and are not able to get funds for treated water. Mass education also should be done to teach people how good treated water is in order to improve their understandings.

References

[1] Agency, C. E. (2009). Office of Environmental Health Hazard Assessment: Draft Public health Goal for Hexavalent Chromium Fact Sheet, 2009.

[2] Arora, Pooja. (2017). Physical, Chemical and Biological Characteristics of Water (e content Module).

[3] Ayenew. T. (2004). Environmental implications of changes in the levels of lakes in the Ethiopian Rift since 1970. Reg Environ Chang 4. 192-204.

[4] Behailu T. W.1, Badessa T. S.2* and Tewodros B. A.2. 2018. Analysis of physical and chemical parameters in ground water consumed within Konso area, Southwestern Ethiopia, Afr. J. Environ. Sci. Technol.

[5] Chatterjee, R., Lataye, D. H. (2020). Analysis of Water Quality Parameters and Their Variation for Surface Water Using GIS-Based Tools. In: Ghosh, J., da Silva, I. (eds) Applications of Geomatics in Civil Engineering. Lecture Notes in Civil Engineering, vol 33. Springer, Singapore. https://doi.org/10.1007/978-981-13-7067-0_23

[6] Chowdhury S, A. K. (2015). Arsenic contamination of drinking water and mental health, 1-28.

[7] Currie J, J. G. (2013). Something in the water: contaminated drinking water and infant health. Canadian journal of economics, 46 (3): 791-810.

[8] D. S. Christian, M. U. (2012). "Water Quality Monitoring in Rwanda," no., 1, p. 54.

[9] Dallas HF, e. a. (1998). Water quality for aquatic ecosystem: tools for evaluating regional guidelines, p. 240.

[10] DWAF. (1996). South African Water Quality Guidelines: Volume 7: Aquatic Ecosystems.

[11] Homberger., e. a. (1989). The relationship of catchment topography and soil hydraulic characteristics to lake alkalinity in the northeastern United State.

[12] Jackson, e. a. (2001). Water in Changing world, Issues in Ecology., p 1-16.

[13] M. Haseena et al. (2017). Water pollution and human health.," Environ. Risk Assess. Remediat. vol. 1, no. 3, pp. 1 6–1 9.

[14] MINITERE. (April, 2003). Republic of Rwanda, Ministry of Lands, Resettlement and Environment, national strategy and action plan for the conservation of biodiversity."

[15] Omer, N. H., 2019, 'Water Quality Parameters', in K. Summers (ed.), Water Quality - Science, Assessments and Policy, IntechOpen, London. 10.5772/intechopen.89657.

[16] science, L. s. (2008). Management and croping with drought in Bugesera region of Rwanda.

[17] UNEP, U. a. (2007). Management and croping with drought in Bugesera region of Rwanda.

[18] WHO. (2006). In water, sanitation and health world health organisation.

[19] WHO. (2002). Managing Water in the Home: Accelerated Health Gains from Improved Water Supply. Geneva: World Health Organization.

[20] WHO. (2010). water quality assessment.

[21] WHO. (2011). Drinking Water Quality Standard.