ASSESSMENT OF PHYSICAL-CHEMICAL WATER QUALITY IN LAKE SIMBI NYAIMA REGION AND THE CHEMICAL COMPOSITION OF THE MINERAL MINED ON ITS SHORE.

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A project report submitted to the department of chemistry in the school of Physical Sciences in the partial fulfilment for the degree of Analytical Chemistry of Jomo Kenyatta University of Agriculture and Technology.

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DECLARATION

This proposal is my original work except for the quotations and summaries which have been duly acknowledged and has not been presented for award of a degree or for any similar purpose in any other university.

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DEDICATION

This project is dedicated to my family members, Simbi Nyaima and JKUAT fraternity.

ACKNOWLEDGEMENT

I would like to thank God for His faithfulness during the whole project period and for the successful project completion.

I thank my supervisor Professor Nyagah, my family, my friends and the whole JKUAT fraternity.

ABREVIATIONS

RFM – retained fetal membrane

NTU – Nephelometric turbidity units

LWA – Lake water A

LWB – Lake water B

WWA - Well water A

WWB – Well water B

Ppm – parts per million

Ppt – parts per trillion

ABSTRACT

Lake Simbi Nyaima is a crater lake in Kendu-Bay Homa-bay County. However, despite the fact that the lake is a crater lake, there is a myth which explain the existence of the lake. The lake is believed by the locals to be a village that sunk as a judgement from an old rainmaker. By interpretation, Simbi Nyaima means a village that sunk. The village was Simbi and 'Nyaima' means sunk. Thus the believed properties of the lake water, its minerals

The lake serves 250 000 people, the basin has approximately 500 people. The soil is volcanic alluvial, clay and black cotton. Vegetation is acacia, balanitis and Strega weed. The birdlife includes: flamingos, little grebe, little egret and Egyptian goose.

Fig 1: Lake Simbi Nyaima.

CHAPTER 1

MAIN TEXT

1.1 INTRODUCTION

Lake Simbi Nyaima is a Crater Lake in Kendu-bay, Karachuonyo Constituency in Homa Bay County. The lake is approximately 3.5km from Lake Victoria and has a diameter of about 1km and area of about 3.142km^2. It neither have an inlet nor an outlet but it is believed to have an underground connection with Lake Victoria. The tropical climate experiences both a rainy season (March to November) and dry season (December to February). The Lake water, well water and the mineral mined on its shore are used in different domestic purposes and religious activities:

- The lake water is believed to cure many diseases like measles and relieves dogs off fleas when the dogs are washed therein or with its water.
- Some churches use the lake water internally to treat some diseases, they boil the lake water and gives it to their patients and members to drink.
- The mineral mined on its shore (called bala in luo local dialect) is used to cook vegetables and beans by most people. It helps soften vegetables and beans.
- The mineral mined on its shore is also used to assist a cow in afterbirth (placenta) removal in case of birth complications.
- Though the lake water is not widely used by the villagers around the lake, wells have been bored around the lake, approximately2m from the lake shore, and the water from these wells used to: water animals, clean utensils, clean clothes and in bathing.

The lake water has these properties:

- The water has some worms which majority of birds feed on, including the regular flamingo visitors from Lake Nakuru which do visit the lake approximately twice a year and stay in the lake region for approximately two months.
- The lake water has a sky blue color.
- The lake water often has a bad smelling gas of a rotten egg odor.
- The lake water has a 'slippery' texture identical to that of a water with dissolved detergent.
- The lake water is much denser than the normal water, this suggests the presence of dissolved mineral mater in the lake water.

The mineral mined from the lake shore is grey to whitish grey in color.

Fig 2: Flamingos at Lake Simbi Nyaima.

Fig 3: Lake Simbi Nyaima.

1.2 PROBLEM STATEMENT

Growing up in the place, believing the tales and the myths surrounding the lake formation and the lake water and lake shore mineral properties.

The lake water coloration and the often lake odor, the animal living in the lake and the plants in the lake.

The inability of fish and other large water body animals like hippopotamus to live in the lake.

1.3 PROJECT DESCRIPTION

1.3.1 BACKGROUND

The water quality of Lake Simbi Nyaima and the wells dugged around it and the chemical composition of the mineral mined on its shore need to be studied comprehensively because of their extensive use in the Simbi area and as far as Nyanza Province. Therefore, water quality and mineral composition should be ensured so that no contaminant exceed levels that would affect human and animal health. However, this study area has had limited research conducted about its water quality and mineral composition. Thus this study. This study will help to propose a solution to the county government which can help in further research to be carried on the Simbi region.

1.3.2 HYPOTHESIS

i. What is the physical and chemical characteristic of the lake water and the well water?
ii. What is the chemical composition of the mineral mined from the lake shore?
iii. What is responsible for the palatability ability of the lake shore mineral?
iv. What is responsible for the measles healing property of the lake water?
v. What are the effects of internal consumption of boiled lake water?
vi. What are the effects of feeding a cow with lake shore mineral and its effect on retained placenta removal?
vii. What are the effects of using lake shore wells for domestic use?
viii. Which gas is responsible for the often bad smelling lake odor?
ix. What are the properties of lake water, lake shore wells water and the lake shore mineral?

1.3.3 OBJECTIVES

1.3.3.1 SPECIFIC OBJECTIVES

i. To characterize the lake water and well water based on the two water quality parameters (e.g physical and chemical).
ii. To determine the chemical composition of the mineral mined on the shore of the lake.

1.3.3.2 OTHER OBJECTIVES

- To determine the effect of cooking with the lake shore mineral which is used to enhance the palatability of food.
- To determine the effect of bathing with the lake water for the purpose of believed measles treatment.
- To determine the effect of consuming the boiled lake water, which is believed to enhance healing.
- To determine the effect of feeding a cow with the lake shore mineral and its effect on retained placenta removal.
- To determine the effects of using the lake shore wells water on domestic use.
- To determine the gas responsible for the often bad lake odor.
- To propose a solution to the county government for the sake of further research on the Simbi Nyaima region.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic. These metals have been extensively studied and their effects on human regularly reviewed by international bodies such as the WHO. All these exposures are preventable.

These metallic elements that are able to induce toxicity even at lower levels of exposure are considered systematic toxicants. Occupying the top position on the list of hazardous substances, the following sections provide insight into the mechanisms through which these metals exert their toxicity within the body of living organisms.

2.1.1 LEAD

Lead is a chemical element with symbol Pb (from Latin plumbum) and atomic number 82. It is a heavy metal, that is, denser than most common materials. It is one of the most abundant natural substances on earth. Owing to its physical properties including low melting point and high malleability, it has widespread industrial use.

In terms of usage, it ranks fifth on the list of metals. Its use is associated with more than 900 industries, including mining, smelting, refining, battery manufacturing, and so on. In addition to industry, it has applications in fertilizers and pesticide used for agriculture purposes, and in improving the octane rating of gasoline in vehicular traffic systems. As a result of rapid industrialization, increase in the effluent discharge from industrial units located in close proximity to rivers has resulted in an increase in its amount in water bodies. Along with this, application of sewage sludge directly or as part of irrigation from contaminated water bodies, as an exhaust product of leaded gasoline due to increased traffic activities in urban settings and increased use as part of fertilizers and pesticide for agricultural purposes has resulted in the pollution of soils, which has had a serious environmental impact. Together, these (agricultural, industrial, and municipal) activities have resulted in the contamination of groundwater resources.

Lead is a cumulative toxicant that affects multiple body systems and is particularly harmful to young children. Lead in the body is distributed to the brain, liver, kidney and bones. It is stored in the teeth and bones, where it accumulates over time. Human exposure is usually assessed the measurement of lead in the blood. Lead in the bone is released into blood during pregnancy and becomes as source of exposure to the developing fetus. There is no known level of lead that is considered safe.

Lead exposure can have serious consequences for health of children. At high levels of exposure, lead attacks the brain and central nervous system to cause coma, convulsions and even death.

2.1.2 CADMIUM

Cadmium is a chemical element with symbol Cd and atomic number 48, a heavy metal of considerable environmental and occupational concern. This soft, silvery-white metal is chemically similar to the two other stable metals in group 12, zinc and mercury. Like zinc, it demonstrates oxidation state +2 in most of its compounds, and like mercury, it has a lower melting point than the transition metals in groups 3 through 11. The average concentration of cadmium in Earth's crust is between 0.1 and 0.5 parts per million (ppm). the highest concentration of cadmium compounds in the environment is accumulated in sedimentary rocks, and marine phosphates contain about 15 mg cadmium/kg.

Cadmium occurs as a minor component in most zinc ores and is a byproduct of zinc production. No significant deposits of cadmium-containing ores are known. The only cadmium mineral of importance, greenockite (CdS), is nearly always associated with sphalerite (ZnS). This association is caused by geochemical similarity between zinc and cadmium, with no geological process likely to separate them. Thus, cadmium is produced mainly as a byproduct of mining, smelting, and refining sulfidic ores of zinc, and, to a lesser degree, lead and copper.

Cadmium has no known function in higher organisms, but a cadmium-dependent carbonic anhydrase has been found in some marine diatoms. The diatoms live in environments with very low zinc concentrations and cadmium performs the function normally carried out by zinc in other anhydrases. This was discovered with X-ray absorption fluorescence spectroscopy (XAFS).

The highest concentration of cadmium is absorbed in the kidneys of humans, and up to about 30 mg of cadmium is commonly inhaled throughout human childhood and adolescence. Cadmium is under preliminary research for its toxicity in humans, potentially affecting mechanisms and risks of cancer, cardiovascular disease, and osteoporosis The most dangerous form of occupational exposure to cadmium is inhalation of fine dust and fumes, or ingestion of highly soluble cadmium compounds. Inhalation of cadmium fumes can result initially in metal fume fever but may progress to chemical pneumonitis, pulmonary edema, and death.

Cadmium is also an environmental hazard. Human exposure is primarily from fossil fuel combustion, phosphate fertilizers, natural sources, iron and steel production, cement production and related activities, nonferrous metals production, and municipal solid waste incineration.

Cadmium is one of six substances banned by the European Union's Restriction on Hazardous Substances (RoHS) directive, which regulates hazardous substances in electrical and electronic equipment but allows for certain exemptions and exclusions from the scope of the law. The International Agency for Research on Cancer has classified cadmium and cadmium compounds as carcinogenic to humans. Although occupational exposure to cadmium is linked to lung and prostate cancer, there is still a substantial controversy about the carcinogenicity of cadmium in

low environmental exposure. Recent data from epidemiological studies suggest that intake of cadmium through diet associates to higher risk of endometrial, breast and prostate cancer as well as to osteoporosis in humans.

Cadmium exposure is a risk factor associated with a large number of illnesses including kidney disease, early atherosclerosis, hypertension, and cardiovascular diseases. Although studies show a significant correlation between cadmium exposure and occurrence of disease in human populations, a necessary molecular mechanism has not been identified. One hypothesis holds that cadmium is an endocrine disruptor and some experimental studies have shown that it can interact with different hormonal signaling pathways. For example, cadmium can bind to the estrogen receptor alpha, and affect signal transduction along the estrogen and MAPK signaling pathways at low doses.

Exposure to cadmium is commonly determined by measuring cadmium levels in blood or urine. Blood cadmium reflects recent exposure (from smoking, for example). Cadmium in urine (usually adjusted for dilution by calculating the cadmium (creatinine ratio) indicates accumulation, or kidney burden of the cadmium. Although the mechanisms of cadmium toxicity are poorly understood, it has been speculated that cadmium causes damage to cells primarily through the generation of ROS, which causes single-strand DNA damage and disrupts the synthesis of nucleic acids and proteins.

2.1.3 MANGANESE

Manganese is a chemical element with symbol Mn and atomic number 25, is not found as a free element in the nature, it is often found in minerals in combination with iron.

Manganese phosphating is used for rust and corrosion prevention on steel. Ionized manganese is used industrially as pigments of various colors, which depend on the oxidation state of the ions. Permanganate of alkali and alkaline earth metals are powerful oxidizers. Manganese dioxide is used as the cathode (electrode acceptor) material in zinc – carbon and alkaline batteries.

In biology:

- Manganese(ii) ion function as cofactors for a large variety of enzymes with many functions. Manganese enzymes are particularly essential in detoxification of superoxide free radicles in organism that must deal with elemental oxygen.
- Manganese also helps in oxygen evolving complex of photosynthetic plants.
- It helps in born formation by improving mineral density of the born, including that of the spine.
- It helps in blood sugar control by enhancing insulin hormone production.
- It helps in antioxidant action and anti-inflammatory activity, speed metabolic rate since it's needed to speed up the metabolic processes.

While the element is a required trace mineral for all known living organisms, it also acts as a neurotoxin in larger amounts. Especially through inhalation, it can cause manganism, a condition in mammals leading to neurological damage that is sometimes irreversible.

2.1.4 ZINC

Zinc is a chemical element with symbol Zn and atomic number 30. It is the first element of group 12 of the periodic table. It is chemically similar to magnesium. Both elements exhibit only one normal oxidation state (+2) and Zn^{2+} and Mg^{2+} ions are of similar size. Zinc is the 24th most abundant element on the Earth's crust and has five stable isotopes.

Zinc is an essential mineral, including prenatal and postnatal development. It is responsible for a number of functions in the human body: it helps stimulate the activities of at least 100 different enzymes. However, only a small intake of zinc is necessary to reap the benefits. The Recommended Dietary Allowance (RDA) for zinc in the united states is 8mg a day for women and 11mg a day for men. Zinc deficiency causes growth retardation, delayed sexual maturation, infection susceptibility and diarrhea. Consumption of excess zinc may cause ataxia, lethargy and copper deficiency.

2.1.5 CHROMIUM

Chromium is a chemical element with symbol Cr and atomic number 24. It is the first element in group 6. It is a steely-grey, lustrous, hard and brittle transition metal. Chromium boasts a high usage rate as a metal that is able to be highly polished while resisting tarnishing. Chromium is also the main additive in stainless steel, a popular steel alloy due to its uncommonly high specular reflection. Simple polished chromium reflects almost 70% of the visible spectrum, with almost 90% of infrared light being reflected. The name of the element is derived from the Greek word chrōma, meaning color, because many chromium compounds are intensely colored.

It is extremely hard, and is the third hardest element behind carbon (diamond) and boron. And the 13th most abundant element in Earth's crust with an average concentration of 100 ppm. Chromium compounds are found in the environment from the erosion of chromium-containing rocks, and can be redistributed by volcanic eruptions.

2.1.6 MAGNESIUM

Magnesium is a chemical element with symbol Mg and atomic number 12. Magnesium is the ninth most abundant element in the universe. It is produced in large, aging stars from the sequential addition of three helium nuclei to a carbon nucleus. When such stars explode as supernovas, much of the magnesium is expelled into the interstellar medium where it may

recycle into new star systems. Magnesium is the eighth most abundant element in the Earth's crust and the fourth most common element in the Earth (after iron, oxygen and silicon), making up 13% of the planet's mass and a large fraction of the planet's mantle. It is the third most abundant element dissolved in seawater, after sodium and chlorine. It is a shiny gray solid which bears a close physical resemblance to the other five elements in the second column (group 2, or alkaline earth metals) of the periodic table: all group 2 elements have the same electron configuration in the outer electron shell and a similar crystal structure.

Magnesium is the eleventh most abundant element by mass in the human body and is essential to all cells and some 300 enzymes. Magnesium ions interact with polyphosphate compounds such as ATP, DNA, and RNA. Hundreds of enzymes require magnesium ions to function. Magnesium compounds are used medicinally as common laxatives, antacids (e.g., milk of magnesia), and to stabilize abnormal nerve excitation or blood vessel spasm in such conditions as eclampsia.

Magnesium is the third-most-commonly-used structural metal, following iron and aluminum. The main applications of magnesium are, in order: aluminum alloys, die-casting (alloyed with zinc), removing sulfur in the production of iron and steel, and the production of titanium in the Kroll process. Magnesium is used in super-strong, lightweight materials and alloys. For example, when infused with silicon carbide nanoparticles, it has extremely high specific strength.

Overdose from dietary sources alone is unlikely because excess magnesium in the blood is promptly filtered by the kidneys, and overdose is more likely in the presence of impaired renal function. In spite of this, mega dose therapy has caused death in a young child, and severe hypomagnesemia in a woman, and a young girl who had healthy kidneys. The most common symptoms of overdose are nausea vomiting, and diarrhea; other symptoms include hypotension, confusion, slowed heart and respiratory rate, deficiencies of other minerals, coma, cardiac arrhythmia, and death from cardiac arrest.

2.1.7 CALCIUM

Calcium is a chemical element with symbol Ca and atomic number 20. It is the fifth most abundant element in Earth's crust and the third most abundant metal, after iron and aluminium. The most common calcium compound on Earth is calcium carbonate, found in limestone and the fossilized remnants of early sea life; gypsum, anhydrite, fluorite, and apatite are also sources of calcium. The name derives from Latin calx "lime", which was obtained from heating limestone. Lead alloy, in making automotive batteries.

Calcium is the most abundant metal and the fifth-most abundant element in the human body. As electrolytes, calcium ions play a vital role in the physiological and biochemical processes of organisms and cells: in signal transduction pathways where they act as a second messenger; in neurotransmitter release from neurons; in contraction of all muscle cell types; as cofactors in

many enzymes; and in fertilization. Calcium ions outside cells are important for maintaining the potential difference across excitable cell membranes as well as proper bone formation.

Calcium is an essential element needed in large quantities. The Ca^{2+} ion acts as an electrolyte and is vital to the health of the muscular, circulatory, and digestive systems; is indispensable to the building of bone; and supports synthesis and function of blood cells. For example, it regulates the contraction of muscles, nerve conduction, and the clotting of blood. As a result, intra- and extracellular calcium levels are tightly regulated by the body. Calcium can play this role because the Ca^{2+} ion forms stable coordination complexes with many organic compounds, especially proteins; it also forms compounds with a wide range of solubilities, enabling the formation of the skeleton.

Excess intake of calcium may cause hypercalcemia. However, because calcium is absorbed rather inefficiently by the intestines, high serum calcium is more likely caused by excessive secretion of parathyroid hormone (PTH) or possibly by excessive intake of vitamin D, both which facilitate calcium absorption. It may also be due to bone destruction that occurs when tumours metastasize within bone. All these conditions result in excess calcium salts being deposited in the heart, blood vessels, or kidneys. Symptoms include anorexia, nausea, vomiting, memory loss, confusion, muscle weakness, increased urination, dehydration, and metabolic bone disease. Chronic hypercalcemia typically leads to calcification of soft tissue and its serious consequences: for example, calcification can cause loss of elasticity of vascular walls and disruption of laminar blood flow—and thence to plaque rupture and thrombosis. Conversely, inadequate calcium or vitamin D intakes may result in hypocalcemia, often caused also by inadequate secretion of parathyroid hormone or defective PTH receptors in cells. Symptoms include neuromuscular excitability, which potentially causes tetany and disruption of conductivity in cardiac tissue.

Because of concerns for long-term adverse side effects, including calcification of arteries and kidney stones, both the U.S. Institute of Medicine (IOM) and the European Food Safety Authority (EFSA) set Tolerable Upper Intake Levels (ULs) for combined dietary and supplemental calcium. From the IOM, people of ages 9–18 years are not to exceed 3 g/day combined intake; for ages 19–50, not to exceed 2.5 g/day; for ages 51 and older, not to exceed 2 g/day. The EFSA set the UL for all adults at 2.5 g/day, but decided the information for children and adolescents was not sufficient to determine ULs.

2.1.8 IRON

Iron is a chemical element with symbol Fe (from Latin: ferrum) and atomic number 26. It is a metal that belongs to the first transition series and group 8 of the periodic table. It is by mass the most common element on Earth, forming much of Earth's outer and inner core. It is the fourth most common element in the Earth's crust.

The body of an adult human contains about 4 grams (0.005% body weight) of iron, mostly in hemoglobin and myoglobin. These two proteins play essential roles in vertebrate metabolism, respectively oxygen transport by blood and oxygen storage in muscles. To maintain the necessary levels, human iron metabolism requires a minimum of iron in the diet. Iron is also the metal at the active site of many important redox enzymes dealing with cellular respiration and oxidation and reduction in plants and animals.

Iron is required for life. The iron–sulfur clusters are pervasive and include nitrogenizes, the enzymes responsible for biological nitrogen fixation. Iron-containing proteins participate in transport, storage and used of oxygen. Iron proteins are involved in electron transfer.

Iron deficiency is the most common nutritional deficiency in the world. When loss of iron is not adequately compensated by adequate dietary iron intake, a state of latent iron deficiency occurs, which over time leads to iron-deficiency anemia if left untreated, which is characterized by an insufficient number of red blood cells and an insufficient amount of hemoglobin. Children, pre-menopausal women (women of child-bearing age), and people with poor diet are most susceptible to the disease. Most cases of iron-deficiency anemia are mild, but if not treated can cause problems like fast or irregular heartbeat, complications during pregnancy, and delayed growth in infants and children.

Overdoses of ingested iron can cause excessive levels of free iron in the blood. High blood levels of free ferrous iron react with peroxides to produce highly reactive free radicals that can damage DNA, proteins, lipids, and other cellular components. Iron toxicity occurs when the cell contains free iron, which generally occurs when iron levels exceed the availability of transferrin to bind the iron. Damage to the cells of the gastrointestinal tract can also prevent them from regulating iron absorption, leading to further increases in blood levels. Iron typically damages cells in the heart, liver and elsewhere, causing adverse effects that include coma, metabolic acidosis, shock, liver failure, coagulopathy, adult respiratory distress syndrome, long-term organ damage, and even death. Humans experience iron toxicity when the iron exceeds 20 milligrams for every kilogram of body mass; 60 milligrams per kilogram is considered a lethal dose.

2.1.9 COPPER

Copper is a chemical element with symbol Cu (from Latin: cuprum) and atomic number 29. It is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. Copper is used as a conductor of heat and electricity, as a building material, and as a constituent of various metal alloys, such as sterling silver used in jewelry, cupronickel used to make marine hardware and coins, and constantan used in strain gauges and thermocouples for temperature measurement. Copper is one of the few metals that can occur in nature in a directly usable metallic form (native metals)

Copper is essential to all living organisms as a trace dietary mineral because it is a key constituent of the respiratory enzyme complex cytochrome c oxidase. In mollusks and crustaceans, copper is a constituent of the blood pigment hemocyanin, replaced by the iron-complexed hemoglobin in fish and other vertebrates. In humans, copper is found mainly in the liver, muscle, and bone. The adult body contains between 1.4 and 2.1 mg of copper per kilogram of body weight.

2.1.10 POTASSIUM

Potassium is a chemical element with symbol K (from Neo-Latin kalium) and atomic number 19. Although potassium is the eighth most abundant element on earth and comprises about 2.1% of the earth's crust, it is a very reactive element and is never found free in nature. Potassium is an essential mineral micronutrient and is the main intracellular ion for all types of cells, while having a major role in maintenance of fluid and electrolyte balance. Potassium is necessary for the function of all living cells, and is thus present in all plant and animal tissues.

Potassium is the major cation (positive ion) inside animal cells, while sodium is the major cation outside animal cells. The difference between the concentrations of these charged particles causes a difference in electric potential between the inside and outside of cells, known as the membrane potential. The balance between potassium and sodium is maintained by ion transporters in the cell membrane. The cell membrane potential created by potassium and sodium ions allows the cell to generate an action potential—a "spike" of electrical discharge. The ability of cells to produce electrical discharge is critical for body functions such as neurotransmission, muscle contraction, and heart function.

Even though potassium is of a vital role to the body, high intake can affect the body. Gastrointestinal symptoms are the most common side effects of potassium supplements, including nausea, vomiting, abdominal discomfort, and diarrhea. Hyperkalemia is the most serious adverse reaction to potassium. Hyperkalemia occurs when potassium builds up faster than the kidneys can remove it. It is most common in individuals with renal failure. Symptoms of hyperkalemia may include tingling of the hands and feet, muscular weakness, and temporary paralysis. The most serious complication of hyperkalemia is the development of an abnormal heart rhythm (arrhythmia), which can lead to cardiac arrest.

2.1.11 NITRATES

Nitrate is a polyatomic ion with the molecular formula NO_3^- and a molecular mass of 62.0049 u. Almost all inorganic nitrate salts are soluble in water at standard temperature and pressure. A common example of an inorganic nitrate salt is potassium nitrate (saltpeter). A rich source of

inorganic nitrate in the human body comes from diets rich in leafy green foods, such as spinach and arugula.

NO_3^- (inorganic nitrate) is the viable active component within beetroot juice and other vegetables. Nitrate and water are converted in the body to nitric oxide, which could reduce hypertension. Anti-hypertensive diets, such as the DASH diet, typically contain high levels of nitrates, which are first reduced to nitrite in the saliva, as detected in saliva testing, prior to forming nitric oxide. However, Nitrate poisoning can occur through enterohepatic metabolism of nitrate due to nitrite being an intermediate. Nitrites oxidize the iron atoms in hemoglobin from ferrous iron(II) to ferric iron(III), rendering it unable to carry oxygen. This process can lead to generalized lack of oxygen in organ tissue and a dangerous condition called methemoglobinemia. Although nitrite converts to ammonia, if there is more nitrite than can be converted, the animal slowly suffers from a lack of oxygen.

2.1.12 PHOSPHATES

Phosphate is a chemical derivative of phosphoric acid. The phosphate ion is a polyatomic ion with the empirical formula PO_4^{3-} and a molar mass of 94.97 g/mol. It consists of one central phosphorus atom surrounded by four oxygen atoms in a tetrahedral arrangement. The phosphate ion carries a -3 formal charge and is the conjugate base of the hydrogen phosphate ion, HPO_4^{2-}, which is the conjugate base of $H_2PO_4^-$, the dihydrogen phosphate ion, which in turn is the conjugate base of H_3PO_4, phosphoric acid. A phosphate salt forms when a positively charged ion attaches to the negatively charged oxygen atoms of the ion, forming an ionic compound. Many phosphates are not soluble in water at standard temperature and pressure. The sodium, potassium, rubidium, cesium, and ammonium phosphates are all water-soluble. Most other phosphates are only slightly soluble or are insoluble in water. As a rule, the hydrogen and dihydrogen phosphates are slightly more soluble than the corresponding phosphates. The pyrophosphates are mostly water-soluble. Aqueous phosphate exists in four forms:

- In strongly basic conditions, the phosphate ion (PO_4^{3-}) predominates.
- In weakly basic conditions, the hydrogen phosphate ion (HPO_4^{2-}) is prevalent.
- In weakly acidic conditions, the dihydrogen phosphate ion ($H_2PO_4^-$) is most common.
- In strongly acidic conditions, trihydrogen phosphate (H_3PO_4) is the main form.

In biology, adding phosphates to—and removing them from— proteins in cells are both pivotal in the regulation of metabolic processes. Referred to as phosphorylation and dephosphorylation, respectively, they are important ways that energy is stored and released in living systems.

2.1.13 FLUORIDES

Fluoride is an inorganic, monatomic anion with the chemical formula F^-, whose salts are typically white or colorless. Fluoride is classified as a weak base since it only partially associates in solution, but concentrated fluoride is corrosive and can attack the skin. Fluoride is the simplest fluorine anion. In terms of charge and size, the fluoride ion resembles the hydroxide ion. Fluoride ions occur on earth in several minerals, particularly fluorite, but are present only in trace quantities in bodies of water in nature.

Fluorine is estimated to be the 13th most abundant element in the earth's crust and is widely dispersed in nature, almost entirely in the form of fluorides. Fluoride is naturally present at low concentration in most fresh and saltwater sources and may also be present in rainwater. Seawater fluoride levels are usually in the range of 0.86 to 1.4 mg/L, and average 1.1 mg/L (milligrams per litre). For comparison, chloride concentration in seawater is about 19 g/L. The low concentration of fluoride reflects the insolubility of the alkaline earth fluorides, e.g., CaF_2. Fluoride can be present in rain, with its concentration increasing significantly upon exposure to volcanic activity or atmospheric pollution derived from burning fossil fuels or other sorts of industry.

2.1.14 TURBIDITY

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Turbidity in open water may be caused by growth of phytoplankton. Human activities that disturb land, such as construction, mining and agriculture, can lead to high sediment levels entering water bodies during rain storms due to storm water runoff. Areas prone to high bank erosion rates as well as urbanized areas also contribute large amounts of turbidity to nearby waters, through storm water pollution from paved surfaces such as roads, bridges and parking lots. Some industries such as quarrying, mining and coal recovery can generate very high levels of turbidity from colloidal rock particles.

In drinking water, the higher the turbidity level, the higher the risk that people may develop gastrointestinal diseases. This is especially problematic for immunocompromised people, because contaminants like viruses or bacteria can become attached to the suspended solids. The suspended solids interfere with water disinfection with chlorine because the particles act as shields for the virus and bacteria. Similarly, suspended solids can protect bacteria from ultraviolet (UV) sterilization of water. In water bodies such as lakes, rivers and reservoirs, high turbidity levels can reduce the amount of light reaching lower depths, which can inhibit growth of submerged Aquatic plants and consequently affect species which are dependent on them, such as fish and shellfish. High turbidity levels can also affect the ability of fish gills to absorb dissolved oxygen.

2.1.15 SALINITY

Salinity is the saltiness or amount of salt dissolved in a body of water, called saline water. The concentrations of dissolved gases like oxygen and nitrogen are not usually included in descriptions of salinity. However, carbon dioxide gas, which when dissolved is partially converted into carbonates and bicarbonates, is often included. Silicon in the form of silicic acid, which usually appears as a neutral molecule in the pH range of most natural waters, may also be included for some purposes (e.g., when salinity/density relationships are being investigated).

Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by a water (or by a groundwater). A plant adapted to saline conditions is called a halophyte. A halophyte which is tolerant to residual sodium carbonate salinity are called glasswort or saltwort or barilla plants. Organisms (mostly bacteria) that can live in very salty conditions are classified as extremophiles, or halophiles specifically. An organism that can withstand a wide range of salinities iseuryhaline.

2.1.16 PH

PH is a scale of acidity from 0 to 14. It tells how acidic or alkaline a substance is. More acidic solutions have lower pH. More alkaline solutions have higher pH. Substances that aren't acidic or alkaline (that is, neutral solutions) usually have a pH of 7. Acids have a pH that is less than 7. Alkalis have a pH that is greater than 7.

PH is a measure of the concentration of protons (H^+) in a solution.

2.1.17 DISSOLVED OXYGEN

Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids or it is the amount of gaseous oxygen (O_2) dissolved in the water. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water.

Non-compound oxygen, or free oxygen (O_2), is oxygen that is not bonded to any other element. Dissolved oxygen is the presence of these free O2 molecules within water. The bonded oxygen molecule in water (H_2O) is in a compound and does not count toward dissolved oxygen levels.

Phytoplankton require dissolved oxygen for respiration when there is no light for photosynthesis. Oxygen enters the water by direct absorption from the atmosphere, by rapid movement, or as a

waste product of plant photosynthesis. Water temperature and the volume of moving water can affect dissolved oxygen levels. Oxygen dissolves easier in cooler water than warmer water.

Adequate dissolved oxygen is important for good water quality and necessary to all forms of life. Dissolved oxygen levels that drop below 5.0 mg/L cause stress to aquatic life. Lower concentrations cause greater stress. Oxygen levels that go below 1-2 mg/L for a few hours may result in large fish kills.

2.1.18 TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substances present in a liquid in molecular, ionized or micro-granular (colloidal solution) suspended form. Generally, the operational definition is that the solids must be small enough to survive filtration through a filter with two-micrometer (nominal size, or smaller) pores.

Total dissolved solids are differentiated from total suspended solids (TSS), in that the latter cannot pass through a sieve of two micrometers and yet are indefinitely suspended in solution.

Total dissolved solids are normally discussed only for freshwater systems, as salinity includes some of the ions constituting the definition of TDS. The principal application of TDS is in the study of water quality for streams, rivers and lakes, although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants.

2.1.19 CONDUCTIVITY

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. Compounds that dissolve into ions are also known as electrolytes. The more ions that are present, the higher the conductivity of water. Likewise, the fewer ions that are in the water, the less conductive it is.

Table 1: detailed summary of form(s), sources, entry routes, associated symptoms and pronounced health effects corresponding to different metals.

Metal	Form(s)	Sources	Route of entry	Symptoms		Health effects
				Acute	Chronic	

Lead, At. No: 82, At. Mass: 207.19	Pb^{2+}, Oxidation state: +2, +4	Application of lead in gasoline, fuel combustion, industrial processes, solid waste combustion, used in paints, used in ceramics and dishware, Lead is used in some types of PVC mini-blinds	Inhalation and ingestion	Nausea, vomiting, thirst, diarrhea/constipation, abdominal pain, hemoglobinuria, oligura leading to hypovolemic shock	Lead colic, lead palsy and lead encephalopathy	Anemia (less Hb), hypertension, kidney damage, miscarriages, disruption of nervous systems, brain damage, infertility, intellectual disorders
Cadmium At. No: 48, At. Mass: 112.41	Cd^{2+}, Cd^{+}, Cd^{2-}, Oxidation state: -2, +1, +2	Sedimentary rocks, marine phosphates, industrial processes, used in alloys, used in pigments, used in cigarettes	Inhalation, cigarette smoke and ingestion in food	Abdominal pain, burning sensation, nausea, vomiting, salivation, muscle cramps, vertigo, shock, loss of consciousness, convulsions, gastrointestinal erosion, pulmonary, hepatic or renal injury and coma	Depressive effect on levels of norepinephrine, serotine and acetylcholine	Prostatic proliferative lesions including adenocarcinomas, after systematic or direct exposure.

For antioxidants

Antioxidants	Mechanism of action	Health effects
Minerals (Fe, Cu, Zn)	Competes with intestinal absorption, Decreases replacement of essential ions, formation of insoluble metal-mineral complexes, induces production of metal binding proteins (MTs)	decreases GI absorption and as such its distribution, prevents redistribution and accumulation in tissues, reduces metal availability thereby decreases toxicity, Stabilizes cell membranes, decreases damage biological

		macromolecules, decreases teratogenic toxicity

2.2 THEORY OF THE ANALYTICAL METHOD TO BE USED

2.2.1 UV-VIS SPECTROMETRY

UV spectroscopy is an important tool in analytical chemistry. UV (Ultra-Violet) spectroscopy also called Electronic spectroscopy involves the promotion of the electrons from the ground state to the higher energy or excited state. UV spectroscopy is type of absorption spectroscopy in which light of ultra-violet region (200-400 nm) is absorbed by the molecule. Absorption of the ultra-violet radiations results in the excitation of the electrons from the ground state to higher energy state. The energy of the ultra-violet radiation that are absorbed is equal to the energy difference between the ground state and higher energy states (E =hf) (Skoog, 2014).

UV spectroscopy obeys the Beer-Lambert law, which states that: when a beam of monochromatic light is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solution is proportional to the incident radiation as well as the concentration of the solution (sertova, 2000). The expression of Beer-Lambert law is: A = log (I /I0) = Ecl Where; A = absorbance I0= intensity of light incident upon sample cell I = intensity of light leaving sample cell C = molar concentration of solute L = length of sample cell (cm.) E = molar absorptivity from the Beer-Lambert law it is clear that greater the number of molecules capable of absorbing light of a given wavelength, the greater the extent of light absorption. This is the basic principle of UV Spectroscopy (Garry D, 2004).

Quantitative analysis in UV-spectroscopy is usually based on absorption of radiation which depends on direct applicability of beer- lambert law: A=log p0/p= abc; where a is directly proportional to concentration of absorbing species c and the path length b. A calibration curve is used to determine the concentration of unknown sample; this calibration curve is obtained by plotting absorbance vs concentration.

2.2.2 ATOMIC ABSORPTION SPECTROSCOPY (AAS)

Atomic absorption measures the amount of light at the resonant wavelength which is absorbed as it passes through a cloud of atoms. As the number of atoms in the light path increases, the amount of light absorbed increases in a predictable way. By measuring the amount of light absorbed, a quantitative determination of the amount of analyte element present can be made. The use of special light sources and careful selection of wavelength allow the specific quantitative determination of individual elements in the presence of others. (Welz and Sperling, 1999). Beer-Lamberts law is applied. This law defines the logarithmic dependence between the transmission, (T), of light through a substance and the product of the absorption coefficient (α) of the substance of specific wavelength (ℓ). This can be expressed as a simple relationship; $A=\alpha\ell$
Where A is absorbance and c is the concentration of the absorbing species.

Thus, if the path length and the molar absorptivity are known and the absorbance is measured, the concentration of the substance can be deduced (Welz and Sperling, 1999). The technique typically makes use of a flame to atomize the sample, but other atomizers such as a graphite furnace or plasmas, primarily inductively coupled plasmas, are also used. A liquid sample is normally turned into an atomic gas in three steps; desolvation, vaporization, atomization. Hollow cathode lamps are the most common radiation source in atomic absorption spectroscopy. Inside the lamp, filled with argon or neon gas, is a cylindrical metal cathode containing the metal for excitation, and an anode. When a high voltage is applied across the anode and cathode, gas particles are ionized. As voltage is increased, gaseous ions acquire enough energy to eject metal atoms from the cathode. Some of these atoms are in excited states and emit light during de-excitation with wavelength characteristic to the metal (Skoog *et al.* 2007).

2.3 EMPERICAL REVIEW

2.3.1 THE LAKE SHORE MINERAL ON COOKING

The lake shore mineral in cooking is identical to the Magadi soda. Both 'softens' the food which can be beans or vegetables over a short period of time. Thus it is used to make food more palatable as the Magadi soda.

The salt of Magadi soda has sodium bicarbonate which renders the salt alkaline. The salt, trisodiumhydrogendicarbonate dehydrate, also sodium sesquicarbonate, ($Na_2CO_3.NaHCO_3.2H_2O$), is a non-marine evaporate salt.

Fig 4: Lake shore mineral.

2.3.2 THE LAKE WATER ON BELIEVED MEASLES TREATMENT

The lake water is applied externally and is believed to heal many skin problems like measles. Measles is a childhood infection caused by a virus. Measles is a highly contagious illness caused by a virus that replicates in the nose and throat of an infected child or adult. There are two types of measles: common measles (rubeola) and German measles (rubella).

MEDICATIONS

- Fever reducers: Over the counter medications such as acetaminophen (tylenol, others), ibuprofen (Advil, Children's Motrin, others) or naproxen (Aleve) to help relieve the fever that accompanies measles
Aspirin is not encouraged to be given to children or teenagers who have measles symptoms. Though aspirin is approved for use in children older than age 3, children or teenagers recovering from chicken pox or flu-like symptoms should never take aspirin. This is because aspirin has been linked to Reye's syndrome, a rare but potentially life threatening condition, in such children.
- Vitamin A: children with low levels of vitamin A are more likely to have a more severe case of measles. Giving vitamin A may lessen the severity of the measles.

2.3.3 THE BOILED LAKE WATER CONSUPTION EFFECT

Boiling is the rapid vaporization of a liquid which occurs when a liquid is heated to its boiling point, the temperature at which the vapour pressure of the liquid is equal to the pressure exerted on the liquid by the surrounding atmosphere.

Metals in the water like sodium, have a high boiling point than that of water, thus boiling water does not evaporate this metals away but nonmetals like chlorine and fluorine have low enough boiling point that they could boil away into gases with the water

Thus the boiled lake water has some retained elements or compounds which are not evaporated on boiling which are thus consumed which can be hazardous on consumer's health.

2.3.4 THE LAKE SHORE MINERAL ON ANIMAL FEED AND RETAINED PLACENTA REMOVAL

Most cows will pass the afterbirth (placenta, cleansing and calf bed) within six hours of calving. Some cows take up to 24 hours. If the placenta is retained longer than this, the condition is classified as retained placenta or retained fetal membrane (RFM). The control of retained

placenta needs to focus on the causative factors like abortions, premature calving, calving difficulties and vitamins and mineral deficiencies.

In recent literature reviews, both selenium deficiency and serum concentrations of Ca, Mg, Mo and Zn were all associated with a high incidence of RFM. In both instances supplementation with the respective deficient mineral can help reduce retention.

Although these vitamins and minerals can be supplemented, correct pasture based diet formulation could prevent need for additional supplementation.

The lake shore mineral is essential for bodily functions including muscle and nervous function, water balance, proper development and functioning of circulatory and skeletal systems.

The three main causes for placenta retention are:

- When the womb stops contracting or doesn't contract enough for placenta to separate from the wall of the womb. This is called uterine atony.
- When all parts of the placenta is firmly stuck to the wall of the womb. This is called adherent placenta. In rare cases, this happens because part of the placenta has deeply embedded itself in the womb. This is called placenta accrete as is more likely if the placenta embeds itself over a previous caesarean section scar. If the placenta has grown all the way through the wall of the womb it is called placenta percreta.
- When the placenta comes away from the womb, but becomes trapped behind a semi-closed cervix. This is called trapped placenta.

TREATING RETAINED PLACENTA

A voluntary surgeon should preferably be called to any cow with RFM that shows clinical signs of fever, depression, or reduction in milk yield as these cases may have secondary problems or require antimicrobial therapy. If the cows show no signs of ill health, treatment can be left until four days after calving.

 Many commonly used treatments have no proven efficacy. In a review on the subject manual, removal has been shown to be detrimental on subsequent fertility and intraurine antibiotics have been ineffective. Systematic are only indicated if the cow has a fever, they have not shown to prevent metritis when used routinely in cows with uncomplicated retained foetal membranes. Prostaglandins and oxytocin were both ineffective in treating the condition.

2.3.5 THE LAKE SHORE WELL WATER ON DOMESTIC USE

Since the wells are bored a few meters (approximately 2m) from the lake, there may be leaching of some elements from the lake water to well water and some elements/ minerals can dissolve into the wall water from the lake shore or lake region thus altering the well water composition which may be hazardous for the domestic use.

2.3.6 THE BAD SMELLING LAKE WATER

The lake being a crater lake, that is, a lake formed on the crater of a volcanic mountain. The volcanic magma contains dissolved gases, which provide the driving force that causes most volcanic eruptions. As magma rises towards the surface and pressure decreases, gases are released from the liquid portion of the magma (melt) and continuous travel upward are eventually released into the atmosphere. Large eruptions can release enormous amounts of gas in a short time. However, even if the magma never reaches the surface, gases can often escape continuously into the atmosphere from the soil, volcanic vents, fumaroles, and hydrothermal systems.

By far the most abundant volcanic gas is water vapor, which is harmless. However, significant amounts of carbon dioxide, hydrogen sulfide and hydrogen halides can also be emitted from volcanoes. Depending on their concentrations, these gases are all potentially hazardous to people, animals, agriculture and properties.

- Carbon dioxide: carbon dioxide constitutes approximately 0.04% of air in the earth's atmosphere. In an average year, volcanoes release between about 180 and 440 tonnes of carbon dioxide. In volcanic areas where CO_2 emissions occur it is important to avoid small depressions and lower areas that might be CO_2 traps since CO_2 is denser than air. At its higher concentrations it can quickly lead to headaches, dizziness, increased heart rate and difficulty in breathing.
- Sulfur dioxide: sulfur dioxide is a colorless gas with a pungent odor that irritates skin and the tissues and mucous membranes of the eyes, nose and throat.it can cause acid rain, and its high concentration can produce volcanic smog causing persistent health problems for downwind populations. During very large eruptions, SO_2 can be injected to altitudes of greater than 10km into the stratosphere, and here it is converted to sulfate aerosols which reflects sunlight and therefore have a cooling effect on the earth.
- Hydrogen sulfides: it is colorless, flammable gas with a strong, offensive odor. It is sometimes referred to as sewer gas. Air mixtures with as little as 0.000001% H_2S are associated with a rotten egg smell. At mixing ratios above 0.01% H_2S becomes odorless and very toxic, causing irritation of the upper respiratory tract and, during long exposure pulmonary edema. Exposure to 500 ppm can cause a human to fall unconscious in 5 minutes and die in an hour or less.
- Hydrogen halides: when magma ascends closer to the surface, volcanoes can emit the halogen fluorine, chlorine and bromine in the form of hydrogen halides. These are all strong acids and have high solubility; therefore, they rapidly dissolve in water droplets within volcanic plumes or the atmosphere where they can potentially cause acid rain.

CHAPTER 3

PROJECT WORK PLAN

3.1 WATER QUALITY PARAMETERS

Lake Simbi Nyaima water is extensively used, also water from the wells bored around it is extensively used by the population around the lake. Therefore, water quality in this area was considered of paramount importance.

3.1.1 Parameters

All parameters that were covered in this study includes: Physical (Conductivity, Salinity, dissolved oxygen, pH, Turbidity and Total Dissolved Solids) and chemical (Ca, Cu, Cr, Cd, Mn, Mg, K, Pb, Zn, Fe, F^-, NO_3^- and PO_4^{3-}) properties.

3.1.2 Monitoring Time and Frequency

Sampling was conducted twice, that is, on 11/02/2019 and on 10/03/2019. The second sampling was conducted after a rainfall. There were five samples involved, that is, lake water (A and B) and well water (A and B) sample. Samples B are the samples of first sampling and samples A samples of second sampling.

3.1.3 Sampling Methodology, Preservation and analytical

Samples were taken from the shore, 2m from the shore since there is no boat in that lake, 30mm below the surface. Techniques for sample collection and preservation of water were adapted from US Environmental Protection Agency (1983) as shown below (in two categories):

- Category 1: lake water A and B
- Category 2: well water A and B

Table 2: Sampling Methodology and preservation

Parameters	Containers	Preservation condition	Maximum Preservation condition
F^-	Plastic or glass	4^0C and H_2SO_4 @pH <2	20 days
NO_3^-	Plastic or glass	-	16 days
PO_4^{3-}	Plastic or glass	4^0C and H_2SO_4 @pH <2	18 days
Pb	Plastic or glass	HNO_3 @pH <2	30 days
Cd	Plastic or glass	HNO_3 @pH <2	30 days
Cr	Plastic or glass	HNO_3 @pH <2	30 days
Cu	Plastic or glass	HNO_3 @pH <2	30 days
Mn	Plastic or glass	HNO_3 @pH <2	30 days
Zn	Plastic or glass	HNO_3 @pH <2	30 days
Fe	Plastic or glass	HNO_3 @pH <2	30 days
Ca	Plastic or glass	HNO_3 @pH <2	30 days
K	Plastic or glass	HNO_3 @pH <2	30 days
Mg	Plastic or glass	HNO_3 @pH <2	30 days

Table 3: Water Quality Parameter and Analytical Method

Parameters	Analytical Technique	Instrument
PH	Instrumental	Multiparameter photometer
Turbidity		SGZ-B portable turbidity meter
Dissolved Oxygen (DO)		Multiparameter photometer
Total Dissolved Solids (TDS)		
Conductivity		
Salinity		
Nitrates	UV/Vis Absorption Spectroscopy	Shimadzu UV/Vis Absorption spectrometer
Phosphates		
Fluorides		Multiparameter photometer
Calcium	Atomic Absorption Spectroscopy	AA - 7000Shimadzu automated Atomic absorption spectrometer
Magnesium		
Copper		
Zinc		
Iron		
potassium	Flame Photometry	Shimadzu flame photometer
manganese		Shimadzu AAS

	Atomic Absorption Spectroscopy	
Cadmium		AA - 7000Shimadzu automated Atomic absorption spectrometer
Chromium		
Lead		

3.2 MINERAL CHEMICAL COMPOSITION PARAMETERS

Lake Simbi Nyaima mineral is extensively used. Therefore, its chemical composition is paramount to help determine the level of a contaminant in the mineral.

3.2.1 Parameters

All parameters that were covered in this study include: Copper, Iron, Zinc, Manganese, Calcium, Magnesium, Potassium, Chromium, Cadmium and lead.

3.2.2 Monitoring Time and Frequency

The samples were collected on 11th February, 2019. During the dry season.

3.2.3 Sampling methodology, Preservation and analytical Method

Samples were collected from the shore on the surface using the collecting plate. Techniques for sample collection and preservation were adapted from US Environmental Protection Agency (1983) as shown below:

Table 4: sampling methodology, preservation and analytical method.

parameters	Analytical method	Instrument
Calcium	Atomic Absorption Spectroscopy	AA - 7000Shimadzu automated Atomic absorption spectrometer
Magnesium		
Copper		
Zinc		
Iron		
potassium	Flame Photometry	Shimadzu flame photometer
manganese	Atomic Absorption Spectroscopy	Shimadzu AAS
Cadmium		AA - 7000Shimadzu automated Atomic absorption spectrometer
Chromium		
Lead		

3.3 STUDY AREA

Simbi Nyaima Lake located on the gently sloping Simbi Mountain, the lake believed to be mythically formed by the locals despite the crater lake features lake the displays was studied to confirm the beliefs on the lake water and the lake shore mineral.

3.4 PROJECT MONITORING

The project took two months for accomplishment, February and March, and the monitoring were as shown below:

Table 5: Project monitoring table

Planned submission: 1 week		Expected time to complete the project (2 months)						
Project Component	Time	1	2	3	4	5	6	7
Literature Review		■	■					
Data Collection				■				
Data Analysis / Model development					■			
Policy Recommendation						■		
Write Up							■	■

3.5 REAGENTS

The reagents used are of analytical grade

- Nitric acid
- Hydrochloric acid
- Perchloric acid
- 50% w/v Magnesium nitrate
- Deionized water
- SPADS reagent
- Stannous chloride
- Distilled water
- Anhydrous potassium chloride
- Magnesium chloride hexahydrate
- Manganese chloride tetrahydrate

- Lead nitrate
- Calcium chloride
- Cadmium chloride
- Zinc sulfate heptahydrate
- Copper (ii) sulfate pentahydrate
- Ammonium molybdate $(NH_4)_6Mo_7O_{24}.4H_2O$
- Ammonium metavandadate NH_4VO_3
- Anhydrous potassium dihydrogen phosphate (KH_2PO_4)
- Lanthanum

3.6 PROJECT BUDGET

Table 6: Project budget

Item	Quantity	Unit	cost	total
Transport	-	-	-	1800
Internet	-	-	-	1000
Samples containers	-	-	-	100
Labels	-	-	-	50
Miscellaneous	-	-	-	1000
total				3950

CHAPTER 4

METHODOLOGY

4.1 SAMPLE PREPARATION

4.1.1 METALS DIGESTION

4.1.1.1 DIGESTION ACID

Nitric acid and perchloric acid were mixed in the ration 5:1, nitric to perchloric. That is, for the whole sample, 20ml perchloric acid and 100ml nitric acid.

4.1.1.2 LAKE SHORE MINERAL

1.00g of the lake shore mineral, dried from oven, was accurately measured into a 100ml beaker and 10ml of digestion acid added to the beaker. 50ml of distilled water was added to the mixture. And the mixture heated on a hot pan for 10 minutes. The solution was filtered using a 42mm whiteman filter paper into a sample bottle and the filtered solution stored in the fridge at 4^0C.

In calcium and magnesium test, lanthanium was added to the samples, in dropwise to the sample to release magnesium and calcium from their compounds for the test.

4.1.1.3 WATER SAMPLES

10ml of each water sample was accurately measured into a 100ml beaker and 10ml of digestion acid added to the sample. 30ml of distilled water was added to the mixture. And the mixture heated on a hot pan for 10 minutes. The solution was filtered using a 42mm whiteman filter paper into a sample bottle and the filtered solution stored in the fridge at 4^0C.

In calcium and magnesium test, lanthanium was added to the samples, in dropwise to the sample to release magnesium and calcium from their compounds for the test

4.1.2 FLUORIDE TEST

9 ml of each water samples were well filtered into four test tubes. And 1ml SPADNS reagent added to the sample.

4.1.3 NITRATES TEST

10ml of each water samples were well filtered into four test tubes and 1 drop of hydrochloric acid added to each test tube.

4.1.4 PHOSPHATES TEST

A nitric acid-sulfuric acid digestion sample preparation step was used to digest 100mL of sample whereby 1mL of nitric acid and 5mL of sulfuric acid were added to 100mL of sample and heated on a hot plate for 90 minutes to reduce the volume to 10mL. The remaining volume was topped to mark in a 100mL volumetric flask with distilled water.

4.1.5 PHYSICAL PARAMETERS TEST

Water samples were well shaken, and about 50ml poured into a 100ml beaker and the physical parameters electrodes inserted into the beaker to measure physical parameters.

For turbidity, the water samples were shaken and about 10ml of each water sample used in the turbidity instrument.

4.2 STANTARD PREPARATION

4.2.1 METALS STANDARD

4.2.1.1 Pb, Mn, Cd, Cr STANDARD

A standard lead, manganese, cadmium and chromium solution of 1000ppm was prepared by dissolving: 3.6077g of analytical grade manganese chloride tetrahydrate, 2.8290g of analytical grade potassium dichromate, 2.0360g analytical grade cadmium chloride and 1.5980g analytical grade lead nitrate, in 1000mL volumetric flask then filled to the mark with distilled water. An intermediate 50ppm standards solution was prepared, from which standards of 0.10, 0.20, 0.40, 0.80, 1.20, 1.60, and 2.0 ppm were prepared by serial dilution.

4.2.1.2 Zn, Fe, Cu, Ca, Mg STANDARD

A standard zinc, iron, copper, calcium and magnesium solution of 1000ppm was prepared by dissolving: 3.9291g of copper (ii) sulfate pentahydrate, 4.3980g analytical grade zinc sulfate heptahydrate, 4.8400g analytical grade iron (ii) chloride hexahydrate, 2.7693 analytical grade calcium chloride and 3.9160g analytical grade magnesium chloride hexahydrate, in 1000mL volumetric flask then filled to the mark with distilled water. An intermediate 50ppm standards solution was prepared, from which standards of 0.10, 0.20, 0.40, 0.80, 1.20, 1.60, and 2.00 ppm were prepared by serial dilution.

4.2.1.3 POTASSIUM STANDARD

A standard potassium solution of 1000ppm was prepared by dissolving 1.9070g analytical grade anhydrous potassium chloride in 1000mL volumetric flask then filled to the mark with distilled water. An intermediate 50ppm potassium solution was prepared, from which phosphate standards of 10, 20, 30, 40, and 50 ppm were prepared by serial dilution.

4.2.2 PHOSPHATE STANDARD

4.2.1 PHOSPHATE REAGENT

Vanadomolybdophosphoric acid colorimetric method was used to determine the concentration of phosphates in the samples. Vanadate-molybdate reagent was prepared by mixing 25g of ammonium molybdate $(NH_4)_6Mo_7O_{24}.4H_2O$, in 300mL of distilled water and ammonium

metavandadate NH_4VO_3, in 300mL distilled water and 330mL of concentrated hydrochloric acid. The two solutions were mixed and made to 1L with distilled water. Since total phosphates were determined, an acid hydrolysis step was done to convert polyphosphates to orthophosphates.

4.2.2 PREPARATION OF PHOSPHATE STANDARDS

A standard phosphate solution of 1000ppm was prepared by dissolving 1.4316g of anhydrous potassium dihydrogen phosphate (KH_2PO_4) in 1000mL volumetric flask then filled to the mark with distilled water. An intermediate 50ppm phosphate solution was prepared, from which phosphate standards of 0.10, 0.20, 0.40, 0.80, 1.60, 3.20, 6.40 and 10ppm were prepared by serial dilution.

4.2.3 NITRATE STANDARD

A standard nitrate solution of 1000ppm was prepared by dissolving 2.6708g analytical grade lead nitrate in 1000mL volumetric flask then filled to the mark with distilled water. An intermediate 50ppm nitrate solution was prepared, from which nitrates standards of 1.00, 2.00, 3.00, 4.00, and 5.00 ppm were prepared by serial dilution.

CHAPTER 5

RESULTS AND DISCUSSION

CALCULATION METHODS

To determine the actual concentration of a chemical parameter in the samples, this method was used:

Assuming x ppm spectrometer results obtained, since ppm means mg/l then:

- *If x mg is in 1000 ml*
  Therefore, what of 50 (volume of the digested and diluted liquid sample)
- *$\underline{X\ mg\ x\ 50ml}$ = 0.005x mg*
     1000 ml
- *This gave the mass of the chemical parameter in the 50 ml water sample. But since the digestion and dilution were done using acids and distilled water which had no analyte in them, then the calculated mass gives the mass of the analyte in the water sample (10 ml water sample used)*
- *Hence the concentration of the analyte in the water sample in ppm:*
  If 0.005x mg is in the 10ml water sample
  What of 1000ml water sample
  That is, $\underline{0.005x\ mg\ x\ 1000ml}$ = 5x ppm
          10ml
- *Thus 5 times the analyte concentration gave the actual concentration of the analyte in the water sample in ppm.*

And for the lake shore mineral:

Assuming x ppm spectrometer results obtained, since ppm means mg/l then:

- *If x mg is in 1000 ml*
  Therefore, what of 60 (volume of the digested and diluted mineral sample)
- *$\underline{X\ mg\ x\ 60ml}$ = 0.006x mg*
     1000 ml
- *This gave the mass of the chemical parameter in the 60 ml digested and diluted mineral sample. But since the digestion and dilution were done using acids and distilled water which had no analyte in them, then the calculated mass gives the mass of the analyte in the mineral sample (1.00g mineral sample used)*
- *Hence from the mass of the analyte in the sample, percentage mass was calculated as shown*
  $\underline{Mass\ of\ the\ analyte\ in\ the\ sample}$ x 100%
  Mass of the mineral sample
  Hence $\underline{0.006x\ mg}$ x 100%

1000mg
This gives 0.0006x %

Hence the analyte percentage in the sample given by 0.0006 by the analyte concentration from the spectrometer.

5.1 PHYSICAL PARAMETERS

5.2 CHEMICAL PARAMETERS

5.2.1 CHROMIUM

Table 8: chromium results

| Samples	Absorbance			Avg.	Concentration			Avg.
Blank	-0.0006	-0.0003	-0.0004	-0.0004	0.0000	0.0000	0.0000	0.0000
Std. 1	0.0016	0.0013	0.0023	0.0017	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0091	0.0092	0.0088	0.0090	0.2000	0.2000	0.2000	0.2000
Std. 3	0.0136	0.0142	0.0133	0.0137	0.4000	0.4000	0.4000	0.4000
Std. 4	0.0297	0.0299	0.0300	0.0299	0.8000	0.8000	0.8000	0.8000
LW A	0.0033	0.0030	0.0032	0.0032	0.1066	0.0988	0.1040	0.1040
LW B	0.0024	0.0019	0.0019	0.0021	0.0831	0.0701	0.0701	0.0753
WW A	0.0017	0.0021	0.0019	0.0019	0.0648	0.0753	0.0701	0.0701
WW B	0.0026	0.0027	0.0032	0.0028	0.0883	0.0910	0.1040	0.0936
Mineral	0.0221	0.0228	0.0222	0.0224	0.5977	0.6159	0.6003	0.6055
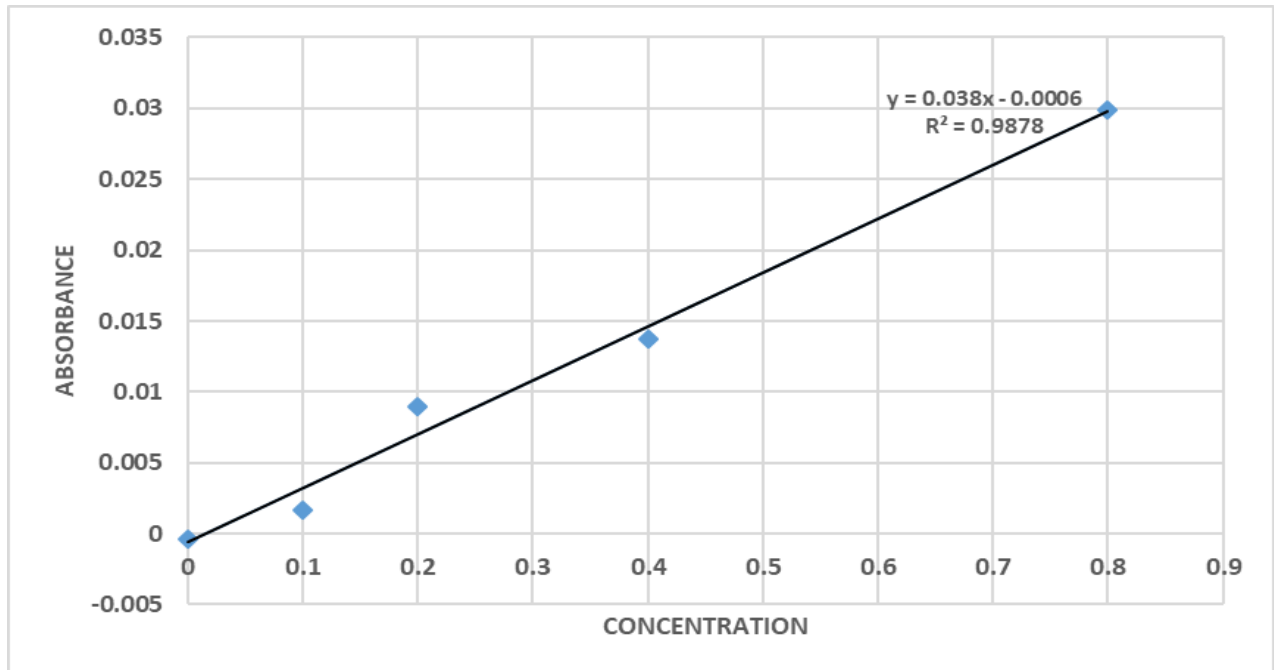
Calibration curve

- Lake water A: 0.5200 ppm
- Lake water B: 0.3765 ppm
- Well water A: 0.3505 ppm
- Well water B: 0.4680 ppm
- Lake shore mineral: 0.003633%

The lake shore mineral being a earth mineral, is richer in the chromium than the LW and the WW. Both the LW and the WW have comparable chromium concentration though LW is slightly concentrated in chromium than the WW.

5.2.2 IRON

Table 9: iron results

Samples	Absorbance			Avg.	Concentration			Avg.
Blank	0.0022	0.0027	0.0030	0.0026	0.0000	0.0000	0.0000	0.0000
Std. 1	-0.0005	-0.0017	-0.0002	-0.0008	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0060	0.0063	0.0047	0.0057	0.2000	0.2000	0.2000	0.2000
Std. 3	0.0158	0.0149	0.0149	0.0152	0.4000	0.4000	0.4000	0.4000
Std. 4	0.0541	0.0564	0.0559	0.0555	1.2000	1.2000	1.2000	1.2000
Std. 5	0.0827	0.0838	0.0834	0.0833	1.6000	1.6000	1.6000	1.6000
LW A	0.0851	0.0845	0.0840	0.0845	1.6797	1.6687	1.6595	1.6687
LW B	0.0601	0.0589	0.0587	0.0592	1.2203	1.1983	1.1946	1.2038
WW A	0.0397	0.0402	0.0393	0.0397	0.8455	0.8547	0.8363	0.8455
WW B	0.0797	0.0785	0.0785	0.0789	1.5805	1.5584	1.5584	1.5658
Mineral	0.0697	0.0687	0.0697	0.0694	1.3967	1.3784	1.3967	1.3912
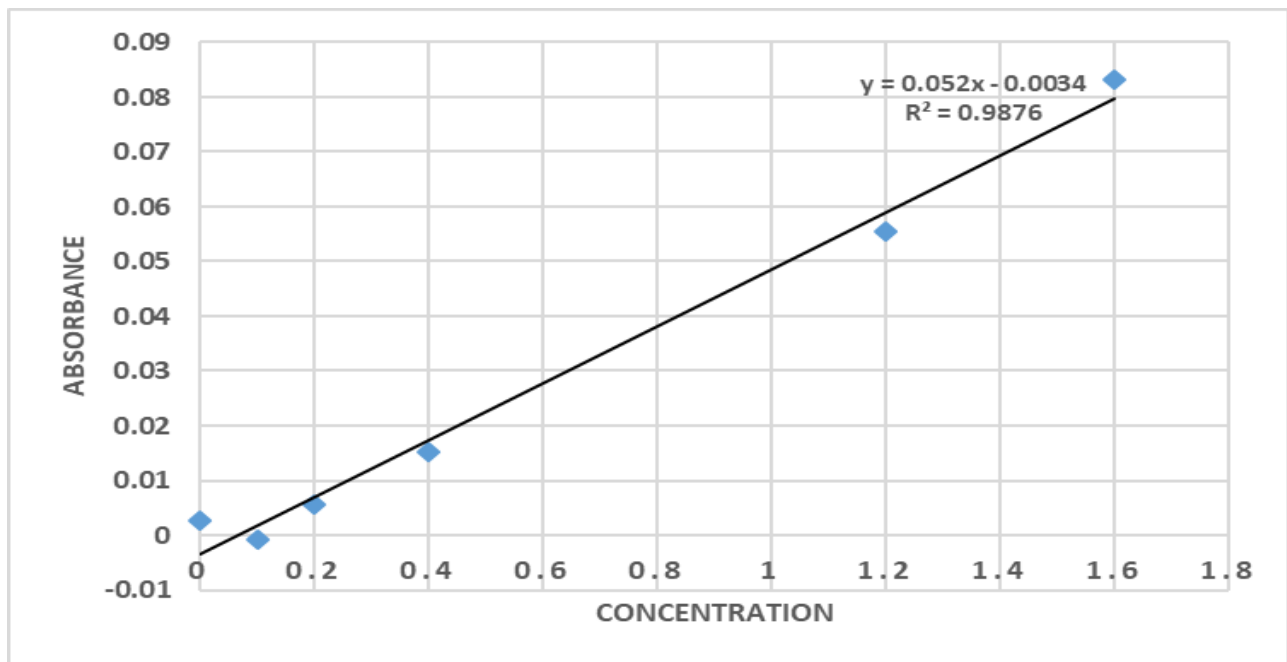
Calibration curve

- Lake water A: 8.3435 ppm
- Lake water B: 2.9245 ppm
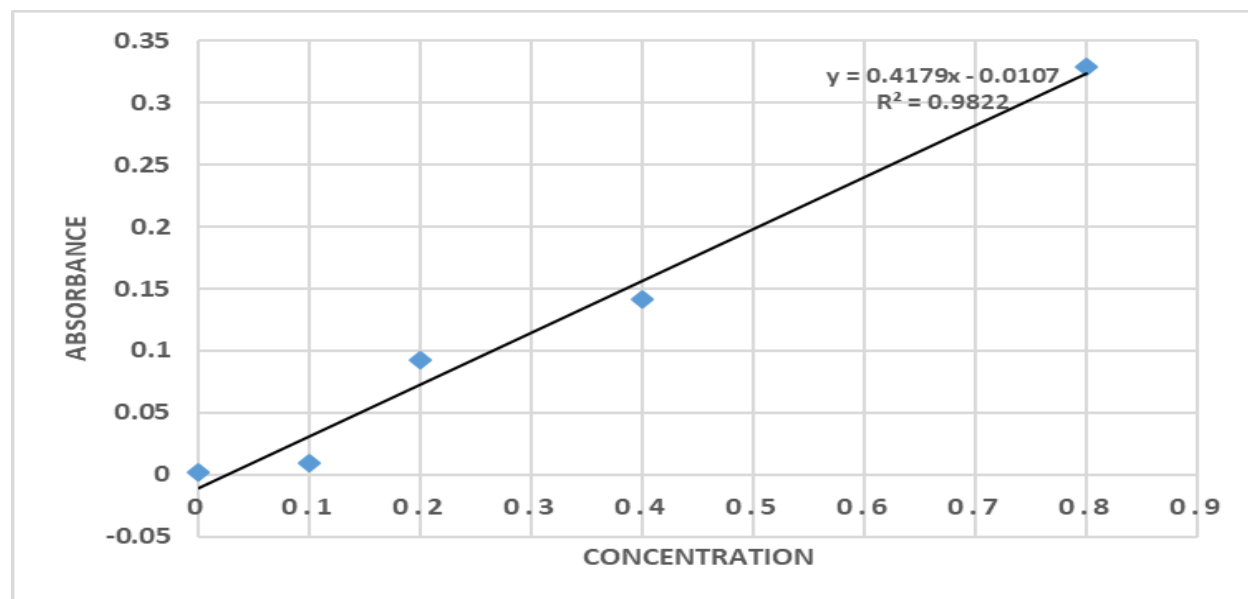- Well water A: 2.7790 ppm

- Well water B: 7.8290 ppm
- Lake shore mineral: 0.0083472%

The lake shore mineral is rich in iron, which favours its use as an animal feed, thus helps the animal in blood formation, which can also help in the RFM removal. which also supplies iron when the mineral is used in cooking.

5.2.3 CADMIUM

Table 10: Cadmium results

Samples	Absorbance			Avg.	Concentration			Avg.
Blank	0.0017	0.0007	0.0015	0.0013	0.0000	0.0000	0.0000	0.0000
Std. 1	0.0092	0.0092	0.0092	0.0092	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0931	0.0937	0.0909	0.0926	0.2000	0.2000	0.2000	0.2000
Std. 3	0.1412	0.1406	0.1423	0.1414	0.4000	0.4000	0.4000	0.4000
Std. 4	0.3288	0.3311	0.3271	0.3290	0.8000	0.8000	0.8000	0.8000
LW A	0.0010	0.0018	0.0035	0.0021	0.0473	0.0491	0.0531	0.0498
LW B	0.0043	0.0042	0.0031	0.0039	0.0549	0.0547	0.0521	0.0540
WW A	0.0033	0.0052	0.0055	0.0047	0.0526	0.0570	0.0577	0.0558
WW B	0.0053	0.0042	0.0029	0.0041	0.0572	0.0547	0.0517	0.0545
Mineral	0.0058	0.0052	0.0062	0.0057	0.0584	0.0570	0.0593	0.0581

$y = 0.4179x - 0.0107$
$R^2 = 0.9822$

Calibration curve

- Lake water A: 0.2490 ppm
- Lake water B: 0.2700 ppm
- Well water A: 0.2790 ppm
- Well water B: 0.2725 ppm
- Lake shore mineral: 0.0003486%

All the five samples have comparable concentration of cadmium. Thus, the concentration of cadmium around the Simbi region is low, but is greater than the lead which was the other tested heavy metal.

5.2.4 LEAD

Table 11: lead results

Samples	Absorbance			Avg.	Concentration			Avg.
Blank	0.0018	0.0016	0.0013	0.0016	0.0000	0.0000	0.0000	0.0000
Std. 1	0.0018	0.0015	0.0014	0.0016	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0029	0.0023	0.0027	0.0026	0.2000	0.2000	0.2000	0.2000
Std. 3	0.0049	0.0045	0.0047	0.0047	0.4000	0.4000	0.4000	0.4000
Std. 4	0.0082	0.0080	0.0083	0.0082	0.8000	0.8000	0.8000	0.8000
Std. 5	0.0127	0.0123	0.0125	0.0125	1.2000	1.2000	1.2000	1.2000
Std. 6	0.0158	0.0158	0.0156	0.0157	1.6000	1.6000	1.6000	1.6000
Std. 7	0.0209	0.0210	0.0212	0.0210	2.0000	2.0000	2.0000	2.0000
LW A	0.0001	0.0004	0.0000	0.0002	-0.0440	-0.0138	-0.0540	-0.0339
LW B	-0.0003	-0.0007	-0.0004	-0.0005	-0.0843	-0.1246	-0.0943	-0.1044
WW A	0.0003	0.0003	0.0003	0.0003	-0.0238	-0.0283	-0.0283	-0.0283
WW B	0.0000	0.0003	-0.0002	0.0000	-0.0540	-0.0283	-0.0742	-0.0540
Mineral	0.0042	0.0039	0.0039	0.0040	0.3690	0.3388	0.3388	0.3489

Calibration curve

The graph shows $y = 0.0097x + 0.0008$ and $R^2 = 0.995$
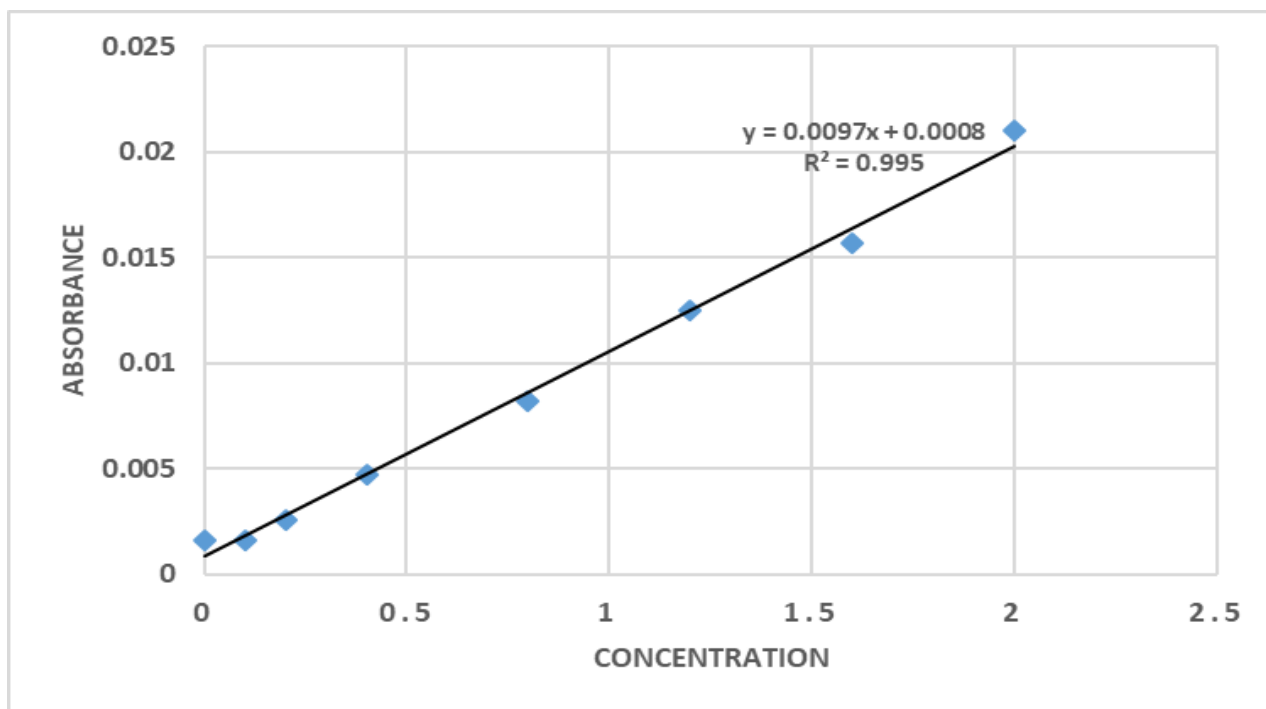
- Lake water A: below detection limit
- Lake water B: below detection limit
- Well water A: below detection limit
- Well water B: below detection limit
- Lake shore mineral: 0.0020934%

The LW and the WW lead concentration are below the detection limit. Since no waste water, industrial waste and industrial activities which can release lead to the environment are involved around the place, the LW and WW does not contain detectable lead.

5.2.5 CALCIUM

Table 12: calcium results

Samples	Absorbance			Avg.	Concentration			Avg.	df	Avg. Con
Blank					0.0000	0.0000	0.0000	0.0000	1	0.0000
Std. 1	0.0054	0.0055	0.0061	0.0061	0.2000	0.2000	0.2000	0.2000	1	0.2000
Std. 2	0.0084	0.0085	0.0086	0.0085	0.4000	0.4000	0.4000	0.4000	1	0.4000
Std. 3	0.0164	0.0167	0.0166	0.0166	0.8000	0.8000	0.8000	0.8000	1	0.8000
Std. 4	0.0293	0.0301	0.0299	0.0298	1.6000	1.6000	1.6000	1.6000	1	1.6000
Std. 5	0.0370	0.0376	0.0381	0.0376	2.0000	2.0000	2.0000	2.0000	1	2.0000
LW A	0.0078	0.0073	0.0076	0.0076	0.3314	0.3032	0.3201	0.3201	100	32.0100
LW B	0.0101	0.0104	0.0106	0.0104	0.4613	0.0782	0.4895	0.4782	100	47.8200
WW A	0.0185	0.0189	0.0191	0.0188	0.9356	0.9582	0.9695	0.9526	100	95.2600
WW B	0.0325	0.0332	0.0326	0.0328	1.7262	1.7657	1.7319	1.7432	100	174.3200
Mineral	0.0315	0.0323	0.0318	0.0319	1.6697	1.7149	1.6867	1.6923	100	169.2300
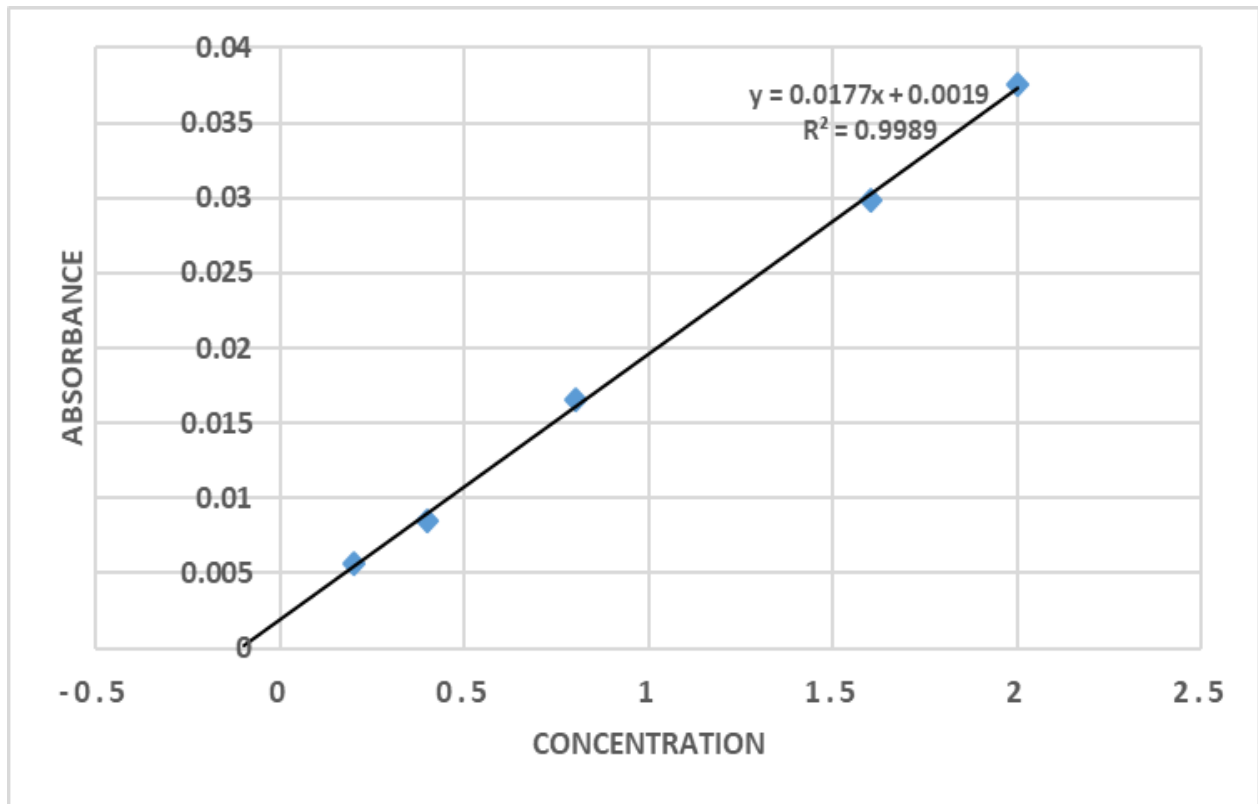
Calibration curve

- Lake water A: 160.0500 ppm
- Lake water B: 239.1000 ppm
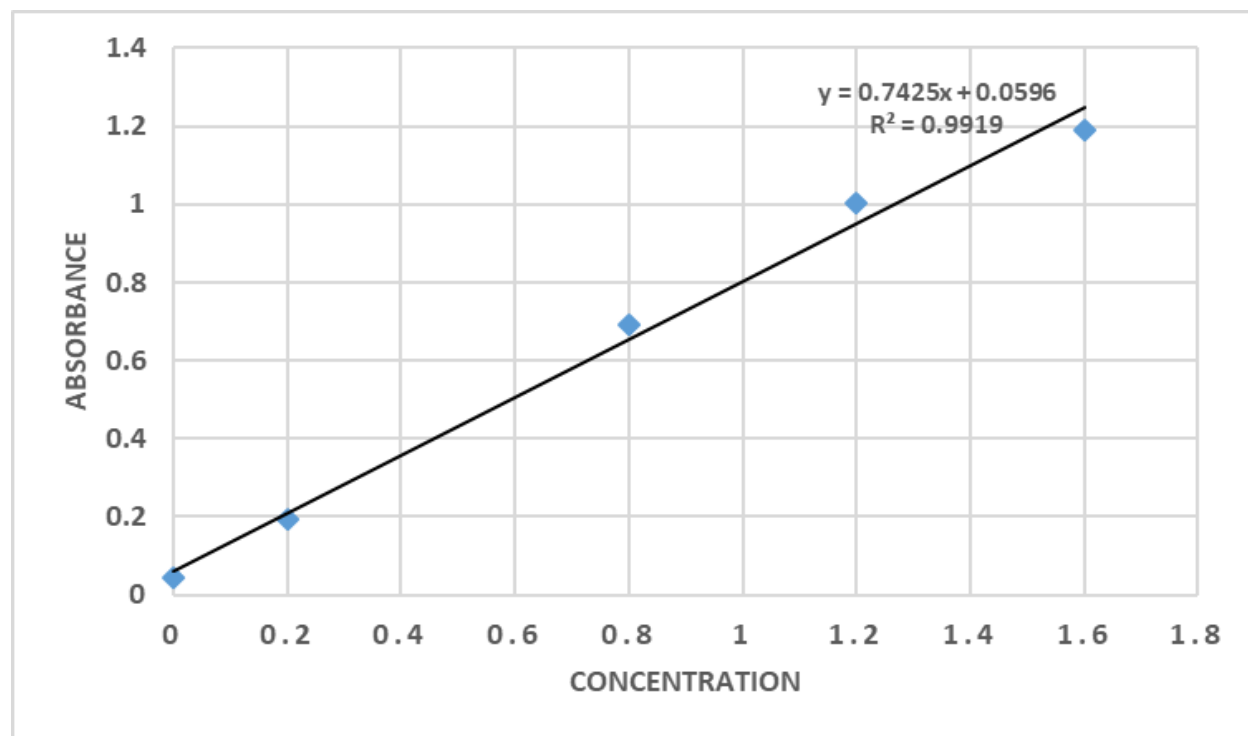- Well water A: 476.3000 ppm

- Well water B: 871.6000 ppm
- Lake shore mineral: 1.0158%

The WW is richer in calcium than the lake water, despite the lake water embedment on the calcium rich mineral. This can be contributed by the domestic use of the WW, where calcium rich foods plates may be washed around the well, thus providing a calcium rich surface runoff back to the well.

5.2.6 MAGNESIUM

Table 13: Magnesium results

| Samples	Absorbance			Avg.	Concentration			Avg.	df	Avg. Con
Blank	0.0424	0.0422	0.0419	0.0422	0.0000	0.0000	0.0000	0.0000	1	0.0000
Std. 1	0.1906	0.1925	0.1919	0.1907	0.2000	0.2000	0.2000	0.2000	1	0.2000
Std. 2	0.6875	0.6913	0.6916	0.6901	0.8000	0.8000	0.8000	0.8000	1	0.8000
Std. 3	1.0018	1.0074	1.0057	1.0050	1.2000	1.2000	1.2000	1.2000	1	1.2000
Std. 4	1.1876	0.1924	1.1920	1.1907	1.6000	1.6000	1.6000	1.6000	1	1.6000
LW A	0.0834	0.0855	0.0852	0.0852	0.0065	0.0093	0.0089	0.0082	100	0.8200
LW B	0.1682	0.1696	0.1698	0.1692	0.1231	0.1250	0.1243	0.1245	10	1.2450
WW A	0.1033	0.1045	0.1046	0.1041	0.0338	0.0355	0.0356	0.0349	100	3.4900
WW B	0.1291	0.1313	0.1307	0.1304	0.0693	0.0723	0.0715	0.0711	100	7.1100
Mineral	1.8063	1.8085	1.8074	1.8076	2.3769	2.3793	2.3778	2.3780	100	237.8000

Calibration curve

- Lake water A: 4.1000 ppm
- Lake water B: 62250 ppm
- Well water A: 17.4500 ppm
- Well water B: 35.5500
- Lake shore mineral: 1.42685%

The LW is rich in magnesium than the WW, this can be caused by the presence of living organisms in the LW (water weed identical to algae) besides the rich lake share mineral which embeds the LW. These absorbs magnesium from the lake bed mineral and which is later absorbed by the water when the plant die

5.2.7 POTASSIUM

Table 14: potassium results

| Samples	Std. Con		Concentration		Avg. Con
Blank	0.0000	0.0000	0.0000	0.0000	0.0000
Std. 1	10.0000	19.0000	21.0000	20.0000	20.0000
Std. 2	20.0000	34.0000	34.0000	34.0000	34.0000
Std. 3	30.0000	49.5000	50.0000	50.5000	50.0000
Std. 4	40.0000	64.9000	64.9000	65.2000	65.0000
Std. 5	50.0000	75.0000	74.9000	75.1000	75.0000
LW A		28.0000	28.0000	28.0000	28.0000
LW B		28.1000	28.1000	28.1000	28.1000
WW A		22.4000	22.4000	22.4000	22.4000
WW B		22.2000	22.3000	22.2000	22.2000
Mineral		40.3000	40.3000	40.0000	40.2000
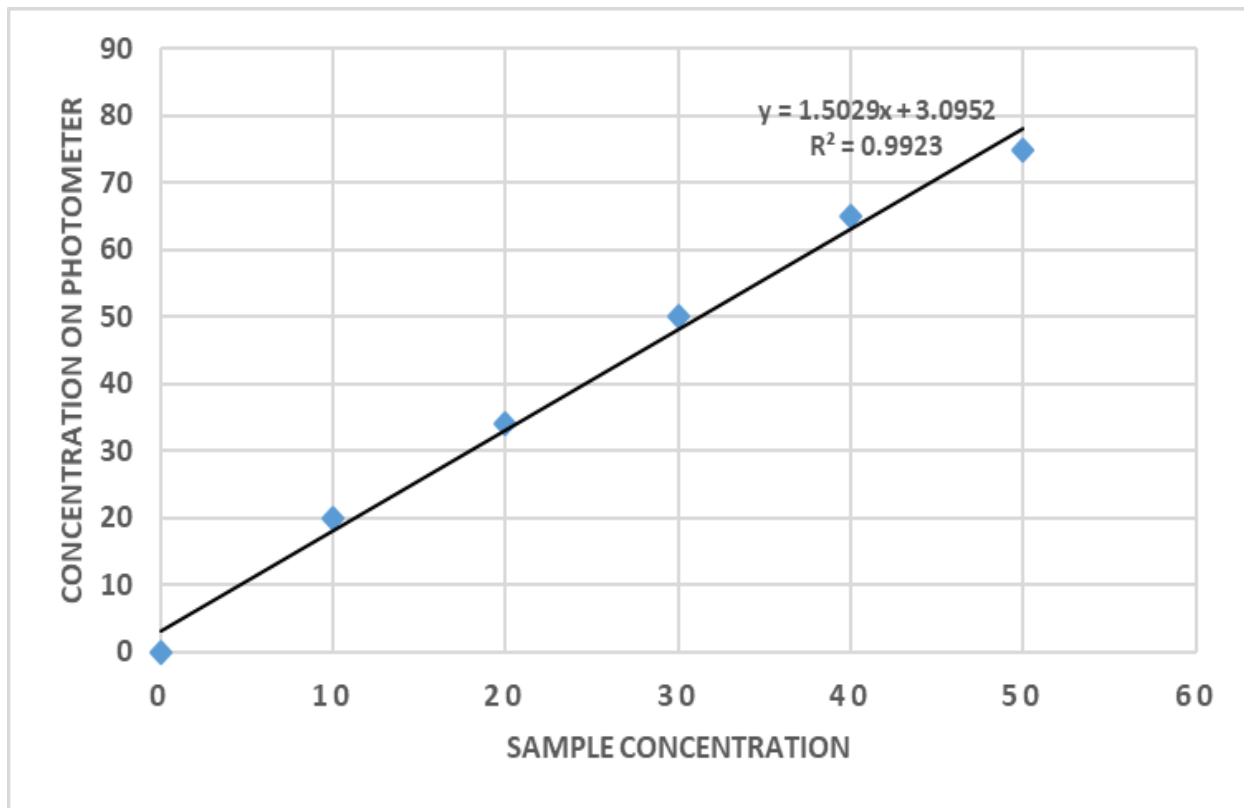
Calibration curve

- Lake water A: 140.0000 ppm
- Lake water B: 140.5000 ppm
- Well water A: 112.0000 ppm
- Well water B: 111.0000 ppm
- Lake shore mineral: 0.2412%

The LW is richer in potassium than the WW, this can be contributed by the highly concentrated potassium lake shore mineral, which dissolves some potassium into the LW thus leading to high concentration of potassium in the LW than in the WW.

5.2.8 COPPER

Table 15: Copper results

| Samples	Avg. Abs	Avg. Con	df	Concentration
Blank	0.0014	0.0000	1	0.0000
Std. 1	0.0152	0.1000	1	0.1000
Std. 2	0.0281	0.2000	1	0.2000
Std. 3	0.0538	0.4000	1	0.4000
Std. 4	0.1033	0.8000	1	0.8000
Std. 5	0.1653	1.2000	1	1.2000
Std. 6	0.1947	1.6000	1	1.6000
Std. 7	0.2485	2.0000	1	2.0000
LW A	0.0119	0.0552	1	0.0552
LW B	0.0102	0.0413	1	0.0413
WW A	0.0093	0.0340	1	0.0340
WW B	0.0086	0.0283	1	0.0283
Mineral	0.0692	0.5200	1	0.5200
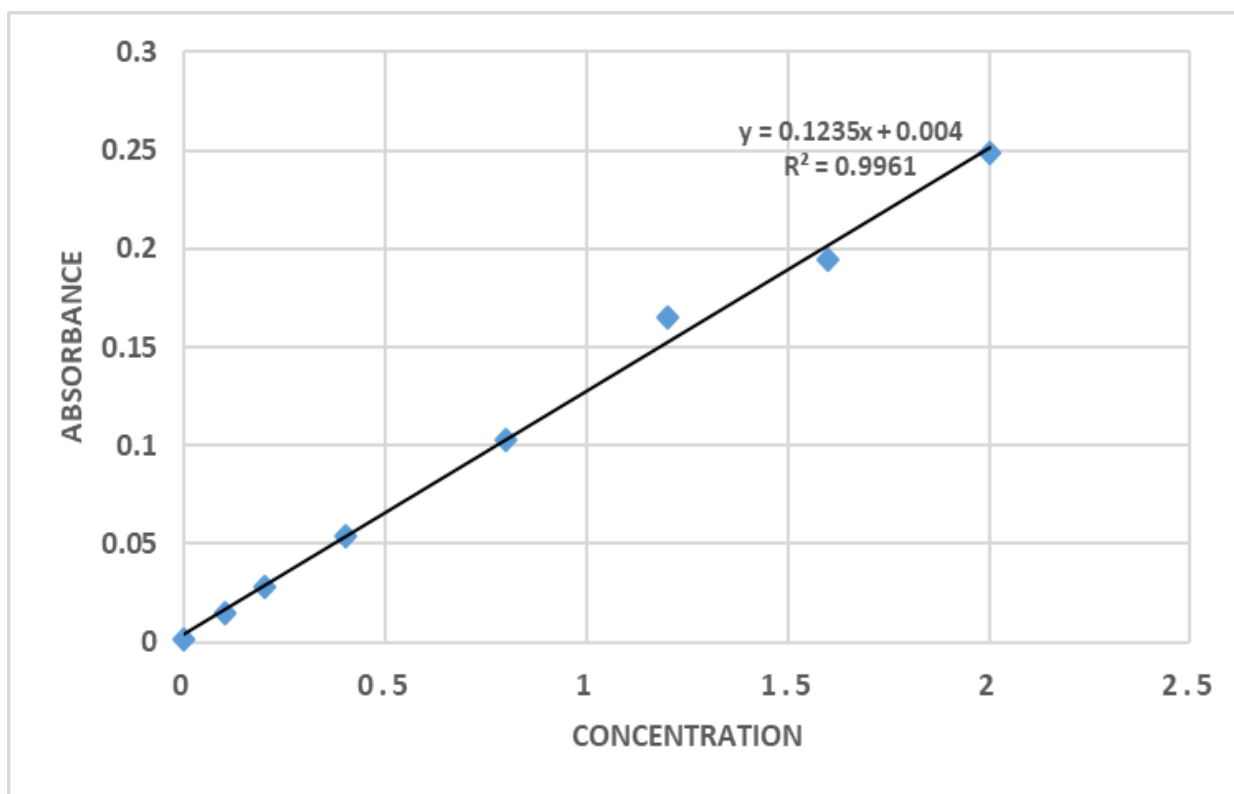
Calibration curve

- Lake water A: 0.2760 ppm
- Lake water B: 0.2065 ppm
- Well water A: 0.1700 ppm
- Well water B: 0.1415 ppm
- Lake shore mineral: 0.00313320%

Due to rich copper mineral, the LW is richer in copper than the WW, that is, the LW has a greater dissolved copper than the WW.

5.2.9 ZINC

Table 16: Zinc results

Samples	Avg. Abs	Avg. Con	df	Concentration
Blank	0.0414	0.0000	1	0.0000
Std. 1	0.0428	0.1000	1	0.1000
Std. 2	0.0980	0.2000	1	0.2000
Std. 3	0.1864	0.4000	1	0.4000
Std. 4	0.3769	0.8000	1	0.8000
Std. 5	0.5506	1.2000	1	1.2000
Std. 6	0.6700	1.6000	1	1.6000
Std. 7	0.7989	2.0000	1	2.0000
LW A	0.0812	0.1543	1	0.1543
LW B	0.0166	0.0026	1	0.0026
WW A	0.0071	-0.0197	1	-0.0197
WW B	0.0266	0.0261	1	0.0261
Mineral	0.3585	0.8052	1	0.8052
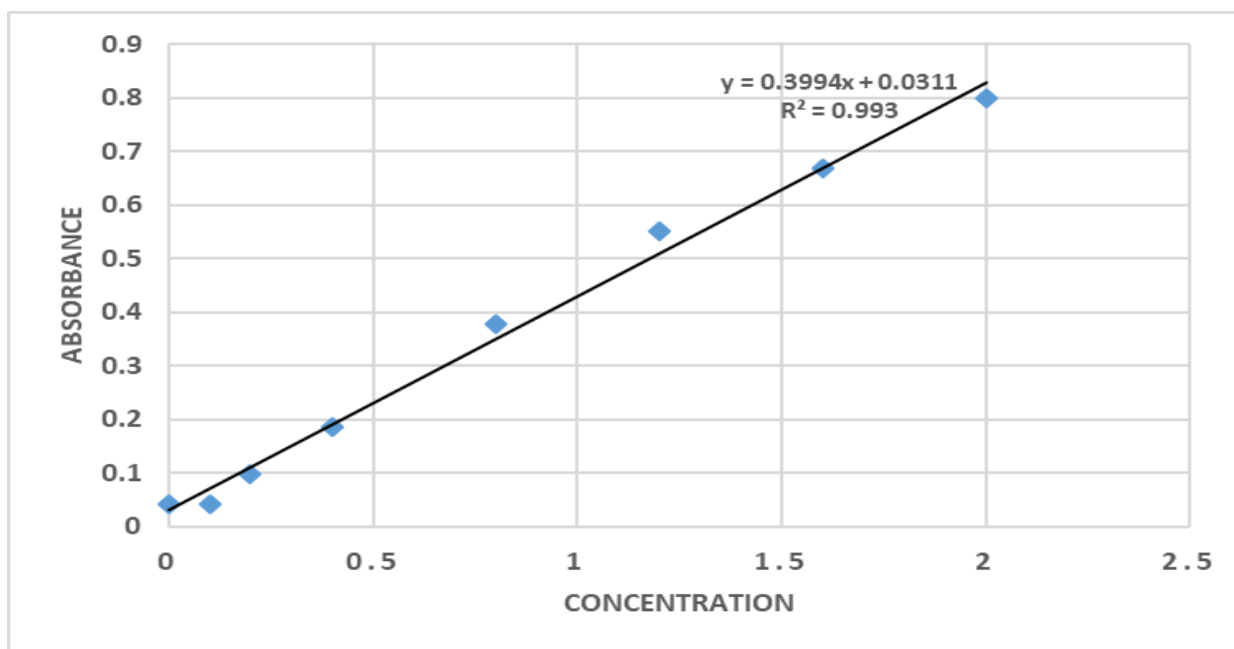
Calibration curve

- Lake water A: 0.7715 ppm
- Lake water B: 0.0130 ppm
- Well water A: below detection limit
- Well water B: 0.1315 ppm
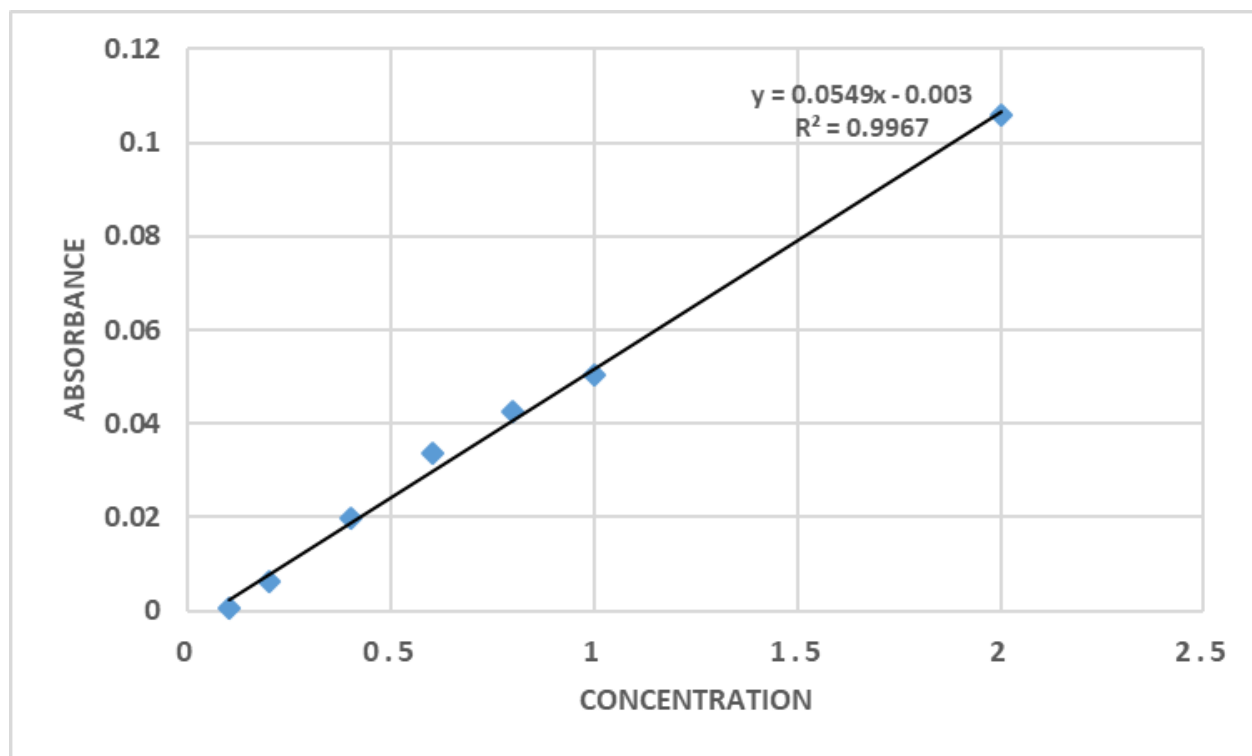- Lake shore mineral: 0.0048312%

Lake water is richer in zinc than well water. Due to the presence of the lake shore mineral which is highly rich in zinc. The richness of zinc in the mineral helps in RFM removal, this is by stabilization of cell membrane.

5.2.10 MANGANESE

Table 17: manganese results

Samples	Absorbance			Avg.	Concentration			Avg.
Blank	-0.0016	-0.0026	-0.0003	-0.0015	0.0000	0.0000	0.0000	0.0000
Std. 1	0.0058	-0.0020	-0.0018	0.0007	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0110	0.0045	0.0029	0.0061	0.2000	0.2000	0.2000	0.2000
Std. 3	0.0211	0.0216	0.0168	0.0198	0.4000	0.4000	0.4000	0.4000
Std. 4	0.0352	0.318	0.0336	0.0335	0.6000	0.6000	0.6000	0.6000
Std. 5	0.0398	0.0454	0.0421	0.0424	0.8000	0.8000	0.8000	0.8000
Std. 6	0.0529	0.0475	0.0511	0.0505	1.0000	1.0000	1.0000	1.0000
Std. 7	0.1082	0.1071	0.1023	0.1059	2.0000	2.0000	2.0000	2.0000

LW A	0.0317	0.0282	0.0362	0.0320	0.6323	0.5685	0.7143	0.6377
LW B	0.0267	0.0293	0.0313	0.0291	0.5412	0.5885	0.6250	0.5849
WW A	0.0313	0.0278	0.0301	o.0297	0.6250	0.5612	0.6031	0.5958
WW B	0.0266	0.0287	0.0259	0.0271	0.5394	0.5776	0.5266	0.5485
Mineral. 10df	0.3782	0.3810	0.3882	0.3825	6.9453	6.9963	7.1275	7.0236

Calibration curve

- Lake water A: 3.1885 ppm
- Lake water B: 2.9245 ppm
- Well water A: 2.7790 ppm
- Well water B: 2.7425 ppm
- Lake shore mineral: 0.0421416%

The LW is slightly richer in manganese than the WW, this can be contributed by the presence of the underlying lake shore mineral, which is rich in manganese thus contributing to the slight high concentration of manganese in the LW.

5.2.11 FLUORIDES

- Lake water A: 0.79 ppm

- Lake water B: 0.81 ppm
- Well water A: 0.79 ppm
- Well water B: 0.96 ppm

5.2.12 NITRATES

Table 18: Nitrates results

| Samples	Abs.		Avg.	Concentration		Avg.
Blank	0.0465	0.0467	0.0466	0.0000	0.0000	0.0000
Std. 1	0.1435	0.1435	0.1435	1.0000	1.0000	1.0000
Std. 2	0.2217	0.2218	0.2218	2.0000	2.0000	2.0000
Std. 3	0.2762	0.2759	0.2761	3.0000	3.0000	3.0000
Std. 4	0.3575	0.3576	0.3576	4.0000	4.0000	4.0000
Std. 5	0.3968	0.3964	0.3966	5.0000	5.0000	5.0000
LW A	0.0858	0.0856	0.0857			0.2875
LW B (.2DF)	0.7608	0.7613	0.7610			9.9497
WW A (.2DF)	0.7438	0.7441	0.7439			9.7050
WW B (.3DF)	0.8842	0.8942	0.8942			11.8543
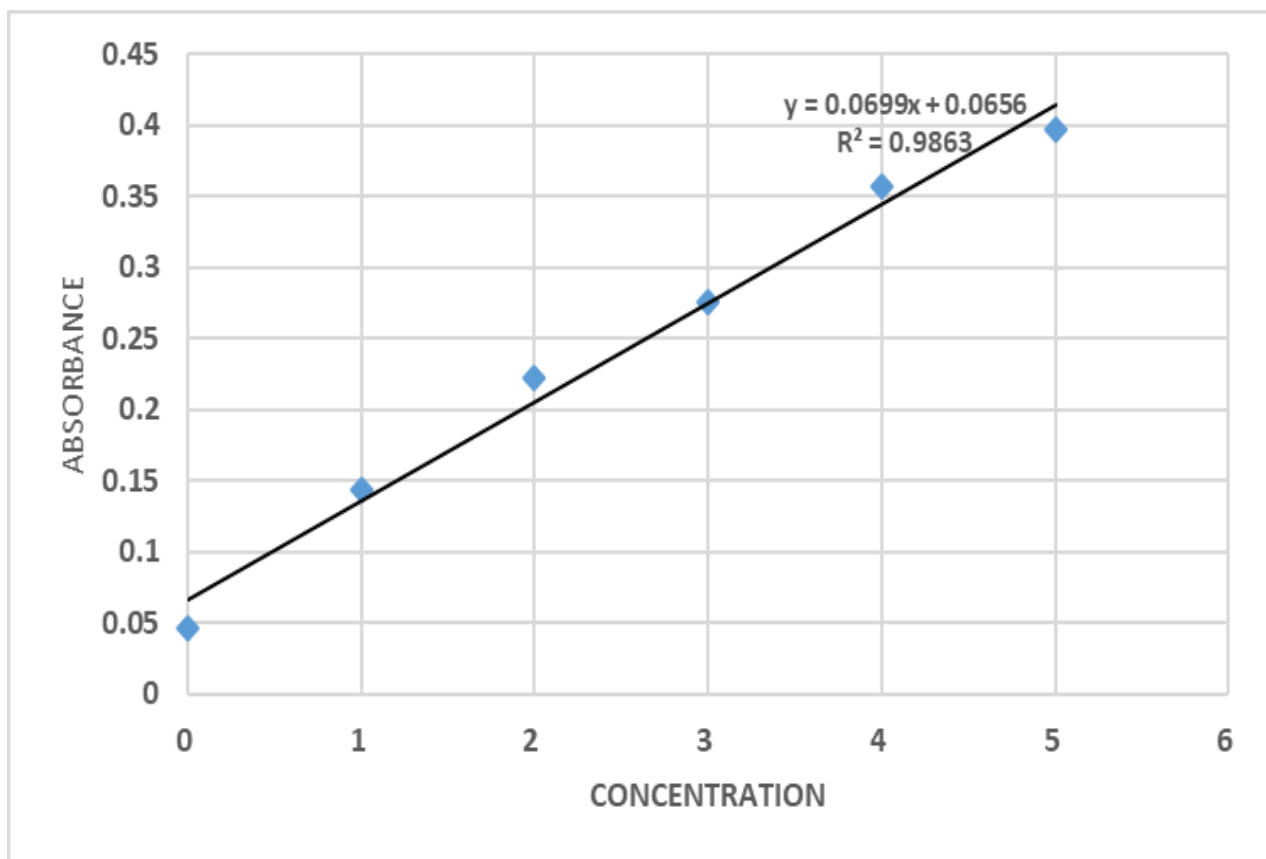
Calibration curve

- Lake water A: 0.2875 ppm
- Lake water B: 9.7497 ppm
- Well water A: 9.7050 ppm
- Well water B: 11.8543 ppm

The WW is richer in nitrates than the LW, this can be contributed by the surface runoffs of nitrates rich animal manures back into the well. As the animals visit the wells to be watered, the animals leave behind waste rich in nitrates which can then be washed back into the well making the WW richer in nitrates than the LW.

5.2.13 PHOSPHATES

Table 19: Phosphates results

samples	Abs.			Avg.	Concentration			Avg.
Blank	0.0001	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
Std. 1	0.0098	0.0097	0.0098	0.0098	0.1000	0.1000	0.1000	0.1000
Std. 2	0.0145	0.0145	0.0144	0.0145	0.2000	0.2000	0.2000	0.2000
Std. 3	0.0177	0.0178	0.0178	0.0178	0.4000	0.4000	0.4000	0.4000
Std. 4	0.0291	0.0292	0.0292	0.0291	0.8000	0.8000	0.8000	0.8000
Std. 5	0.0487	0.0488	0.0489	0.0488	1.6000	1.6000	1.6000	1.6000
Std. 6	0.0919	0.0919	0.0918	0.0919	3.2000	3.2000	3.2000	3.2000
Std. 7	0.1663	0.1664	0.1663	0.1663	6.4000	6.4000	6.4000	6.4000
Std. 8	0.2833	0.2834	0.2832	0.2833	10.0000	10.0000	10.0000	10.0000
LW A (.2df)	0.3361	0.3359	0.3361	0.3360				12.2209
LW B (.2df)	0.3601	0.3601	0.3600	0.3601				13.1083
WW A	0.2306	0.2307	0.2305	0.2306				8.3270
WW B	0.2516	0.2516	0.2515	0.2516				9.1002
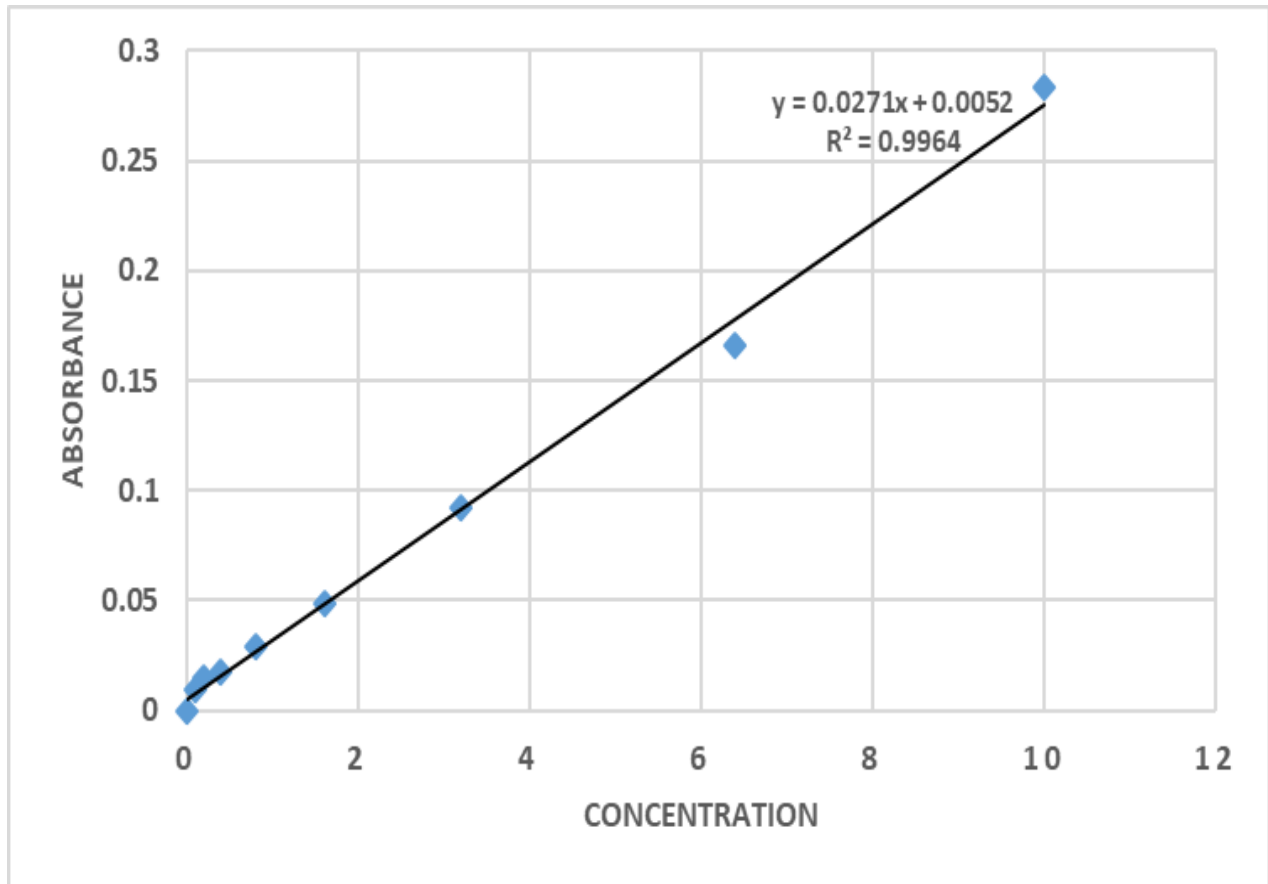
Calibration curve

- Lake water A: 51.1045 ppm
- Lake water B: 75.5415 ppm
- Well water A: 41.6350 ppm
- Well water B: 45.5010 ppm

The LW is high in phosphates than the WW, despite the phosphates rich surface runoff near the well from washing with phosphates rich detergents like sunlight soap. This can be attributed by the presence of living organisms in the LW, which dies, rots and release phosphates back into the LW.

Table 20: Research results

| parameters | ppm | | | | | % for |
	LW A	LW B	WW A	WW B	Mineral	mineral
Mg	4.1000	6.2250	17.4500	871.6000	1189.1000	1.4268000
Cu	0.2760	0.2065	0.1700	0.1415	3.1332	0.0031332
K	140.0000	140.5000	112.0000	111.0000	243.6000	0.2412000
Fe	8.3436	6.0415	4.2275	7.8290	8.3472	0.0083472
Ca	160.0500	239.1000	476.3000	871.6000	1015.3800	1.0153800
Mn	3.1885	2.9245	2.7790	2.7425	42.1416	0.0421416
Cr	0.5200	0.3765	0.3505	0.4680	3.6330	0.0036330
Cd	0.2490	0.2700	0.2790	0.2725	0.3485	0.0003486
Zn	0.7715	0.0130	-	0.1305	4.8312	0.0048312
Pb	-	-	-	-	2.0439	0.0020934
Fluoride	0.7900	0.8100	0.7900	0.9600		
Nitrates	0.2875	9.7497	9.7050	11.8543		
Phosphates	51.1045	75.5415	41.6350	45.5010		

COMPARISON BAR GRAPHS

Comparison in samples
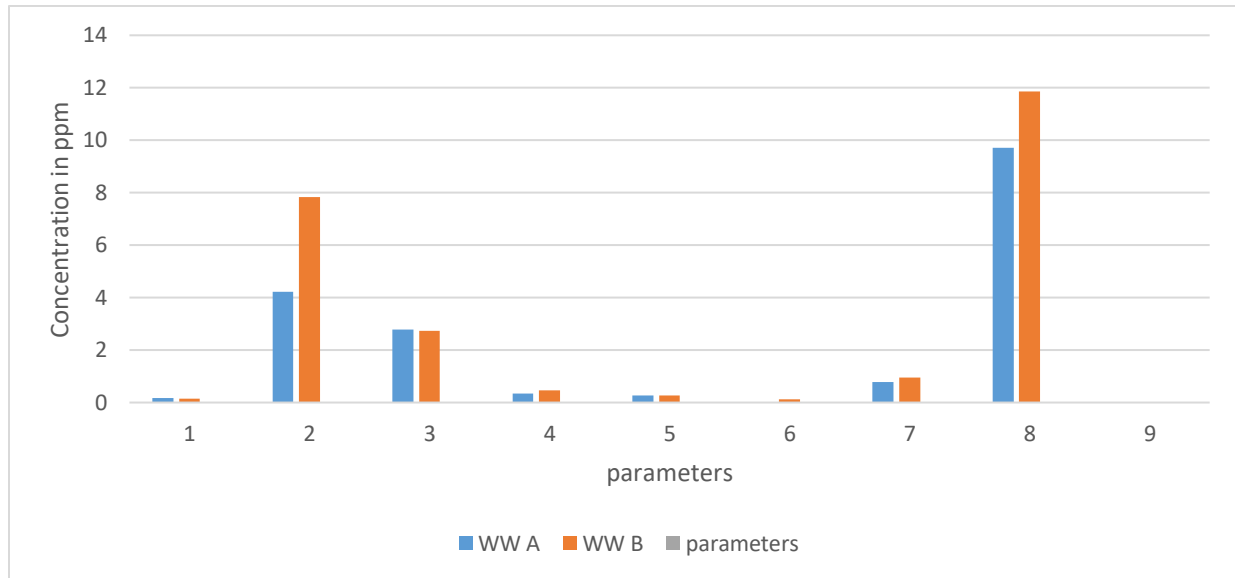
Graph 1: lake water A and B

Key:

1: Mg, 2: Cu, 3: Fe, 4: Mn, 5: Cr, 6: Cd, 7: Zn, 8: Fluoride, 9: Nitrates
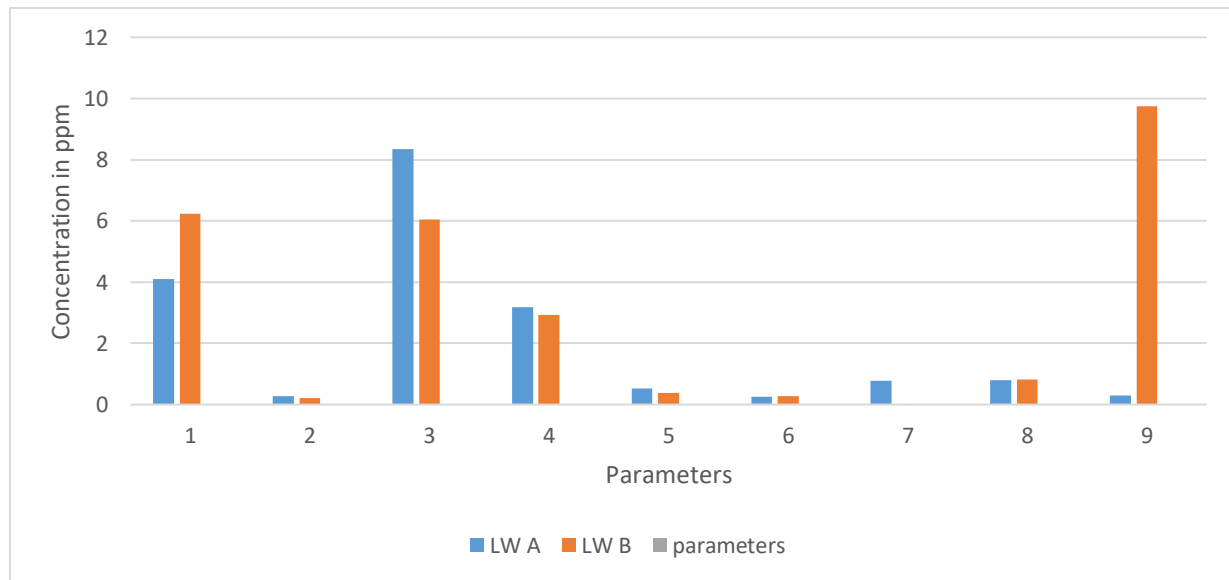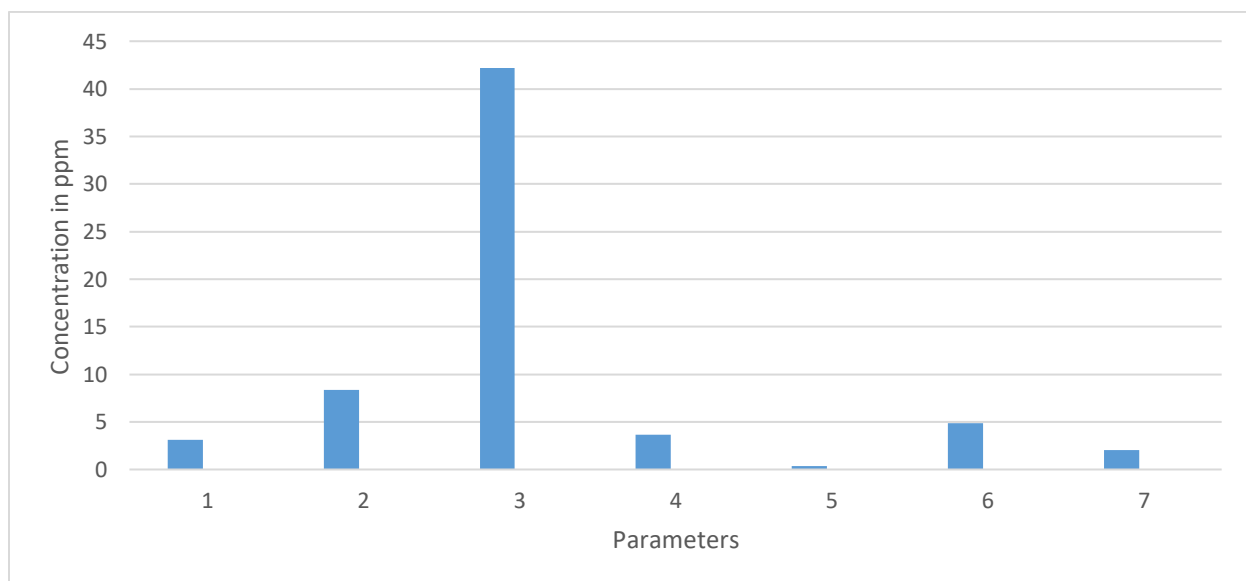

Graph 2: Well water A and B

Key:

1: Mg, 2: Cu, 3: Fe, 4: Mn, 5: Cr, 6: Cd, 7: Fluoride, 8: Nitrates
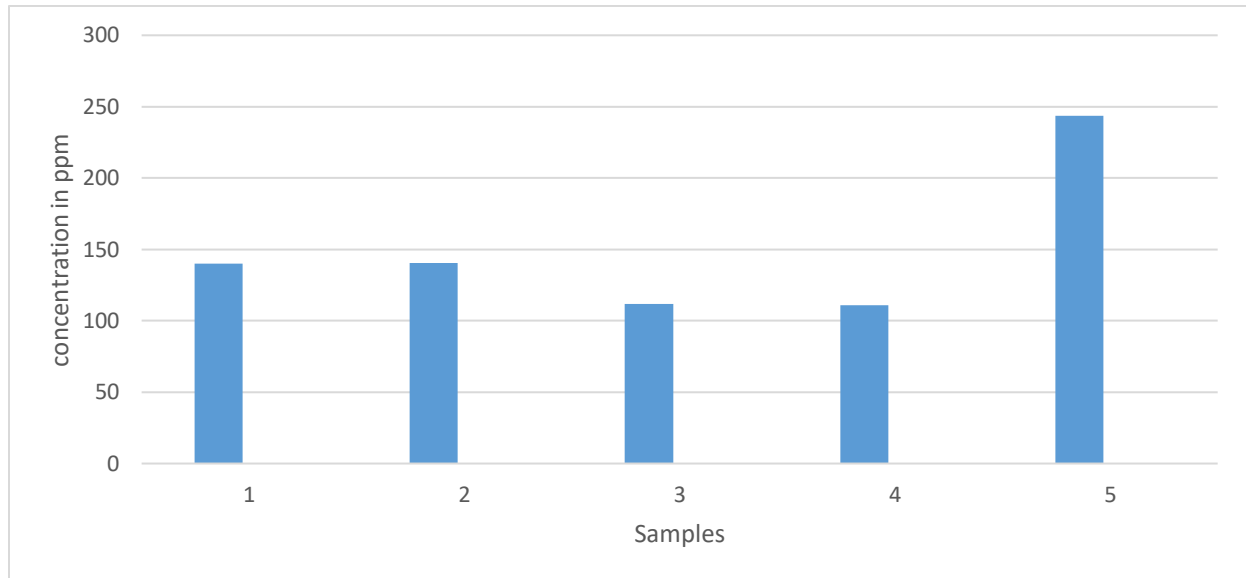

Graph 4: mineral

Key:

1: Cu, 2: Fe, 3: Mn, 4: Cr, 5: Cd, 6: Zn, 7: Pb

Graph 4: Potassium graph

Key:

1: LW A, 2: LW B, 3: WW A, 4: WW B, 5: Lake shore mineral

COMPARISON OF RESULTS WITH STANDARDS

Project results	standards
Fluoride 0.79, 0.81, 0.79 and 0.96 ppm	Fluoride 1.5 ppm
Cadmium 0.0498, 0.0581	Cadmium 0.05 ppm
Lead, mineral 2.0439 ppm	Lead 0.05 ppm
Copper, LWA 0.2760, Mineral 3.1332	Copper 0.05 ppm
Zinc 0.8, all below 1 ppm (for water samples) For mineral 4.8312 ppm	Zinc 1.5 ppm

RECOMMENDATIONS

- Chemical parameters:
  - Cadmium concentration of the LW B, WW A and WW B, exceed the maximum limit of 0.05 ppm.
  - Lead concentration in the lake shore mineral is 2.0439 ppm, which exceeds the 0.05 ppm

CONCLUSION

The project was successful the following were concluded:

- The lake water and well water were found to contain copper, manganese, iron, cadmium, zinc, chromium, magnesium, nitrates, phosphates, fluorides, potassium and calcium.
- Lake shore mineral was found to contains, copper, manganese, iron, cadmium, zinc, chromium, magnesium, lead, potassium and calcium.
- The lake shore mineral was found to contain 0.0020934% lead, which can be hazardous to human health, thus high concentration use of lake shore mineral should be avoided.
- The lake water is rich in iron which aids the body in blood development, however other chemical properties discourages its use.
- The richness of the lake shore mineral in manganese and zinc aid in RFM removal by stabilization of the uterine membrane. However, due to the mineral concentration in other metals like lead and cadmium, the lake shore mineral should not be used in high concentration.
- The lake being a creator lake, the hydrogen sulfide and sulfur dioxide emitted from the crater leads to the lake strong, offensive odor.
- The project report will be forwarded to the county government to assist in further study on the area.

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