Analysis of Selected Heavy Metals Pollutants in Chamo Lake and Its Environmental Impacts

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Abstract— Metals are elements, present in chemical compounds as positive ions, or in the form of cations (+ ions) in solution. Metallic elements which have high atomic weight and density much greater (at least 5 times) than water are known as heavy metals. The aim of the study was to analyze some selected heavy metal pollutants, Copper (Cu), Iron (Fe), Zinc (Zn), Lead (Pb), Chromium (Cr) and Cobalt (Co) in the water of Chamo Lake. In the analysis work, the water samples were collected from four different sides of Chamo Lake randomly and analyzed their content of level concentrations of Cu, Cr, Co, Fe, Zn and Pb by using Atomic Absorption spectrometry. The pH and EC of the water sample was obtained by using pH-meter and electrical conductivity. The analysis showed that the Concentrations level of Copper (1.068 mg/L) and Lead (0.114 mg/L) were higher than their standard concentration 0.05 mg/L and 0.01 mg/L respectively and the concentration of Zinc (2.34 mg/L), Iron (2.26 mg/L) and Chromium (0.023 mg/L) and Cobalt were lower than their standard concentration level 5.0 mg/L, 5-43mg/L, 0,05mg/L respectively. Therefore the Lake Chamo is slightly contaminated by the heavy metal pollutants Lead and Copper, when compare to Iron, Zinc and Chromium.

Keywords: Heavy metal, Atomic absorption Spectrometer, pH-meter, Electrical conductivity, Chamo Lake

I. INTRODUCTION

Metals are elements, present in chemical compounds as positive ions, or in the form of cations (+ ions) in solution. Metallic elements which have high atomic weight and density much greater (at least 5 times) than water are known as heavy metals. Heavy metals are among the most serious environmental pollutants due to their high toxicity, abundance and ease of accumulation by various plant and animal organisms. Persistent increase of heavy metals in harbor sediments can be attributed to the contribution of effluent from waste water treatment plants, industries, mining, power stations and agriculture (Guevara-Ribaet al., 2004). Heavy metals are extremely persistent in the environment. They are non-biodegradable and non-thermo degradable and therefore readily accumulate to toxic levels (Guevara-Ribaet al., 2004). They are released into the environment from natural in water as well as anthropogenic activities.

Heavy metals occur naturally in the ecosystem with larger variations in their concentration. Even though some heavy metals form the part of our daily life activities; they are subjected to powerful toxic. Some heavy metals like iron, cobalt, copper, manganese, molybdenum, and zinc are essential to the human body to maintain the metabolism, but their excessive levels can be damaging the organism. However, there has been a growing awareness of the need for sound management of water resources and in particular to control the dumping of waste in the environment. With industrialization and urban activities happening at a faster pace, the study of heavy metal contamination becomes more relevant in this regard (Thomas and Abbas, 2015).

In natural aquatic ecosystems, metals occur in low concentrations, normally at the nanogram to microgram per liter level. In recent times, however, the occurrence of metal contaminants especially the heavy metals in excess of natural loads has become a problem of increasing concern. This situation has arisen as a result of the rapid growth of population, increased urbanization and expansion of industrial activities, exploration and exploitation of natural resources, extension of irrigation and other modern agricultural practices as well as the lack of environmental regulations (Kiflom and Tarekegn, 2015).

Heavy metals anthropogenic origins; there exists a general belief that presumes absence of permanent alteration or contamination of these Lakes. However, rivers and lakes that flow into some of these lakes are heavily loaded with contaminants of natural and anthropogenic origin such as discharges from factories have wide environmental dispersion with the tendency to accumulate in selective tissues of the living organisms and have overall potential to be toxic even at relatively low levels of exposure. In the aquatic ecosystem, heavy metals may bioaccumulated in various organs of aquatic organisms, especially fish, which in turn may enter the human metabolism through consumption causing serious health hazards. There are many lakes that are used for recreation, irrigation for commercial Fisheries and industrial purposes (Gebremariam and Pearce, 2003). Despite the growing influences from natural and domestic sources (Gebremariam and Pearce, 2003; Guevara-Ribaet al, 2004).

Analyzing showed significantly elevated levels of arsenic, copper, barium, cadmium, chromium, lead, mercury, nickel, and thallium in samples of slurry and lake water. A heavy metal is any metal or metalloid of environmental concern. The term originated with reference to the harmful effects of cadmium, mercury and lead, all of which are denser than iron. It has since been applied to any other similarly toxic metal, or metalloid such as arsenic, regardless of density. Commonly encountered heavy metals are chromium, cobalt, nickel, copper, zinc, arsenic, selenium, silver, cadmium, antimony, mercury, thallium and lead. “A metal of relatively high density or of high relative atomic weight (especially one i.e poisonous) one mercury or lead.” It has been includes density, atomic weight, atomic number, or periodic table position. Density criteria range from above 3.5 g/cm^3 to above 7 g/cm^3. Atomic numbers of heavy metals are generally given as greater than 20; sometimes this is capped at 92 (uranium). Hawke’s suggested referring to heavy metals as "all the metals in Groups 3 to 16 that are in periods 4 and greater. The term "heavy metals" was in use as far back as 1817, when Gmelin divided the elements into nonmetals, light metals and heavy metals. Light metals had densities of 0.860–5.0 gm/cm^3; heavy metals 5.308–22.000 gm/cm^3. In 1868, Chapman speculated on the adverse effects of the

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heavy metals "arsenic, lead, copper, zinc, iron and manganese" in drinking water. Heavy metals are found naturally in the lakes and rivers, and become concentrated as a result of human caused activities. Note Lead is the most prevalent heavy metal contaminant in the lakes. The present study focuses on the some levels of selected toxic heavy metals (Cu, Fe, Pb, Zn, Cr and Co) in water sample collected from Chamo Lake which is located in Rift Valley of Ethiopia.

A. Problem Statement

Chamo Lake water risk exposure of heavy metals from dirty materials of urban and industrial effluents. This may results in bio-accumulation of heavy metals in man using water and eating fish from this Lake since its tributaries pass through populated residential areas, towns, industrial and agricultural sites. The analysis of some of heavy metals that include Lead, Iron, Copper, Zinc, Chromium and Cobalt are therefore justified to provide precautionary use of the water, as well as provide a basis to Environmental Protection Agency (EPA) towards management of discharge.

B. Objectives

1) General Objective

The aim of this project was to analyze some selected heavy metals pollutants in Chamo Lake.

2) Specific objective

- To analyze of some selected heavy metals pollutants in Chamo Lake.
- To study concentration level of Cu, Pb, Cr, Zn, Fe and Co in the water sample from Chamo Lake.
- To comparative study of the six selected heavy metal (Cu, Fe, Pb, Zn, Cr and Co) pollutants in Chamo Lake.

C. Significance of Study

Aquatic environment gets contaminated with a variety of pollutants generated from diverse sources (industries, agricultural and domestic). Among the pollutants pesticides, heavy metals, and detergents are the major cause of concern for aquatic environment because of their toxicity, persistency and tendency to accumulate in organisms. Heavy metals are a group of 19 elements which have many similar physical and chemical properties and are remarkably varying from the remaining 97 known elements. Among the 19 heavy metals lead, cadmium, and mercury do not have any biological significance or beneficial use and known to be extremely toxic. Other metals are chromium, copper, manganese nickel, tin and zinc once dispersed in the biosphere these metals cannot be recovered or degraded. Hence environmental effects of metal pollution are said to be permanent. Metal pollution has harmful effect on biological systems and does not undergo biodegradation. Toxic heavy metals such as Pb, Co, Cd and Hg can be differentiated from other pollutants, since they cannot be biodegraded but can be accumulated in living organisms, thus causing various diseases and disorders even in relatively lower concentrations.

II. LITERATURE REVIEW

A. Heavy Metals

Heavy metals can be considered as metallic elements of relatively high density and are usually poisonous at even minimal concentrations (Lenntech, 2004). They are intrinsic, natural constituents of the environment. Heavy metals consist of transition metals, metalliods, lanthanides and actineds. Some heavy metals such as Cu, Fe, Cr, and Ni are essential and are needed by plants, animals and human beings as they are necessary for biological ecosystems. On the other hand heavy metals such as Cd and Pb are non-essential and have no known biological role and are harmful even in low concentrations (Fernandes, 2008). In the last decade, investigation of heavy metals in water bodies, fish and sediments have been of great concern to scientists. This is because they are non-biodegradable; at certain consumption of foods contaminated by heavy metals (Opaluwa, 2012). Once consumed, these metals are normally incorporated in to the body, stored and accumulated by the human body causing discomfort of the digestive system; diarrhea and chronic problems (Dinesh and Kunwar, 2002). Monitoring of heavy metals in aquatic ecosystems can be done through measurement of their concentrations in water and sediments.

B. Sources of Heavy Metals in Nature

Heavy metals exist within the earth’s geological structure which makes up the the background levels for heavy metals. However, the concentrations of these metals may be increased through the introduction of heavy metals into the environment; natural sources and anthropogenic sources. The natural sources of heavy metals include weathering of heavy metal bearing rocks, windblown dust, volcanic eruptions, acid rain and dew (Harikumar, 2009, Bazrafshan, 2015). The major contributor to elevated levels of heavy metal concentration beyond the background levels has been anthropogenic sources which include waste from industries and municipalities, erosion of metals through oxidation and leached agricultural chemicals. Other sources include metal fabrication and scrapping industries mining, smelting, electroplating and non-point source surface runoffs (Milenkovic, 2005). Agricultural activities also produce heavy metals that can also find their way to the aquatic system through farm inputs like fertilizers, herbicides and pesticides which form part of agricultural drainage that are wash as surface runoff to water bodies (Marcovecchio, 2007). Sewage and industrial effluents are some of the high contributors of heavy metal contamination to rivers and lakes. These heavy metals once introduced into the environment eventually find their way into the aquatic ecosystem through being wash by rain water and runoffs where they are deposited in the surface water and eventually settle to the bottom sediments.

C. General Characteristics of Toxic Heavy metal

Heavy metals are not biodegradable and tend to accumulate in living organisms, causing various diseases and disorders. Therefore, the removal of hazardous heavy metals cation in waste water has received much attention in recent years. Because of their dangerous tendency to bio-accumulation, there is an increase in the concentration of toxic chemical in a biological organism over time, compared to the chemical's concentration in the environment. (Lee, 2010; Ouyang, 2011) and numerous researchers have been focused on synthetic of novel materials including controlled size and shape, which is important for their chemical and physical properties, On the basis of this, Heavy metals are generally present under their cationic form (Pb^{2+}, Cd^{2+}, Cu^{2+}, Zn^{2+}, Cr^{6+}, Fe^{2+}…etc). A heavy metal contamination of the aquatic environment leads toxic to aquatic life organism (like fish) when presents at high level.

D. Environmental impact and heavy metal toxicity

The universal problem is the environmental pollution and most important pollutants are the heavy metals in aquatic environment because of their toxicity and accumulation by aquatic organisms. Metals in general terms are essential to be present for healthy functioning of the body. They play a critical role in maintaining structures of proteins and enzymes. Deficiency and excess of certain metals causes inappropriate functioning and toxicity. Heavy metals are defined as any metal which exceed the permissible limit or is present in undesired quantity in the body affecting the body's functioning and leading to its damage acting as a pollutant. A pollutant is any substance in the environment, which causes objectionable effects, impairing the welfare of the environment, reducing the quality of life and may eventually cause death. Many metals are reported to be toxic in low levels e g. Lead (Pb) and Mercury (Hg). The eight most common pollutant listed heavy metals by Environment Protection Agency (EPA) are: As, Cd, Cr, Cu, Hg, Ni, Pb and Zn (Athar and Vohora, 2001) in list of heavy metals lead, mercury and cadmium are considered to cause public health hazards. Heavy metals are found to have toxic, carcinogenic and mutagenic effects on organisms which get directly or indirectly get exposed to them. It has been speculated that heavy metals disturb the metabolism, ionic balance and cell division. Heavy metal pollution of lakes has a seriously detrimental impact on people and ecosystems that rely on such bodies of water.

E. Some Selected Heavy Metals under Study

1) Chromium

Chromium is an essential nutrient metal, necessary for metabolism of carbohydrates (Farag, 2015). Chromium enter the aquatic ecosystem through effluents discharged from leather tanneries, textiles, electroplating, metal finishing, mining, dyeing and printing industries as well as ceramic, photographic and pharmaceutical industries etc. (Arunkumaret al., 2000). Poor treatment of these effluents can lead to the presence of Cr (VI) in the surrounding water bodies, where it is commonly found at potentially harmful levels to fish (Li et al, 2011; Pacheco et al, 2013). In surface waters, depending on physicochemical characteristics, the most stable forms of chromium are the oxidation states trivalent Cr (III) or (Cr^{3+}) and the hexavalent Cr (VI) or (Cr^{6+}). Hexavalent chromium (Cr^{6+}) is considered to be toxic (i.e. carcinogenic) because of its powerful oxidative potential and ability to cross cell membranes. Fish assimilate Cr by ingestion or by the gill up take tract and then accumulates in fish tissues, mainly liver, creating at higher concentrations than those found in the environment (Pacheco et al, 2013).

2) Lead

The major sources of lead in the environment are automobile exhaust, industrial wastewater, wastewater sludge and pesticides (Balba, 1991). Lead enters the aquatic environment through erosion and leaching from soil, dust fallout, combustion of gasoline and industrial waste discharges, runoff fallout deposit from streets and other surfaces as well as precipitation. Lead is toxic and a major hazard to human and animals. Lead has two quite distinct toxic effects on human beings, physiological and neurological. Several effects of lead toxicity have been reported on the exposure of fish to lead. These include behavioral deficits in fish within a day of exposure to sub lethal concentration, a deficit in metabolism and survival, decrease in growth rate and development, a deficit in behavior and learning, increased mucus formation in fish and the level at 50 µg/g in the dietaryassociated with reproductive effects in some carnivorous fish (Eisler, 1997).

3) Zinc

Zinc is the second most abundant trace element after Fe and is an essential trace element and micronutrient in living organisms, found almost in every cell and being involved in nucleic acid synthesis and occurs in many enzymes (Sfakianakis et al, 2015). Zinc is a very common environmental contaminate and usually out ranks all other metals and it is commonly found in association with lead and cadmium (Finkelman, 2005). Major sources of zinc to aquatic environment include the discharge of domestic wastewater, manufacturing processes involving metals and fallout atmosphere. Zinc is an essential element for human, animal and certain types of plant. It is also necessary for a healthy immune system, cell division and synthesis of protein and collagen which is great for wound healing and health skin. However, a higher amount of it can cause anemia, pancreas damage and lower levels of high density of lipoprotein cholesterol (Finkelman, 2005). Zinc toxicity is modified by water chemical factors including dissolved oxygen concentration, hardness, pH and temperature of the water (Nussey, 1998) and can also be changed through other heavy metals compounds and alkaline earths metals. High temperature tend to increase zinc toxicity, while increase in water hardness, alkalinity and organic chelatorscan reduce its acute lethality and low dissolved oxygen content in water increases the toxicity of zinc (Chapman, 1978).

4) Copper

Copper is one of the world's most widely used metals. According to (Weiner, 2008) the most common copper-bearing ores are sulfides, arsenates, chlorides and carbonates. It reaches aquatic systems through anthropogenic sources such as industry, mining, plating operations, usage of copper salts to control aquatic vegetation or influxes of copper containing fertilizers (Nussery, 1998). Copper is an essential trace element to plants, animals and even humans, and although the concentration of copper is usually low in nature, it occurs in adequate quantities for growth in all aquatic environment. The toxicity of copper in aquatic organisms is largely attributable to Cu^{2+} that forms complexes with other ions. A reduction in water dissolved oxygen, hardness, temperature, pH and chelating agents can increase the toxicity of copper (Nussey, 1998).

5) Iron

Iron (III)-O-arsenite, pentahydrate may be hazardous to the environment; special attention should be given to plants, air and water. It is strongly advised not to let the chemical enter into the environment because it persists in the environment. Iron occurs as particulate ferric hydroxide or in the form of organometallic compound in natural system. Fe (III) oxide

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and Fe (II) are ubiquitous in anoxic environment and they affect the distribution, transport, and biogeochemistry of chemical contaminants by sorption onto Fe (III) oxides and by control of oxidation and Reduction reactions. Due to its high abundance within the earth's crust, iron is ubiquitous in all fresh water environments and often reaches significantly higher concentrations in water and sediments than other trace metals (Mendilet al., 2010). It becomes toxic at high concentrations for aquatic organisms. High iron concentrations in waters were also shown to damage DNA of route and plants (Gill, 2014). High concentration of iron was mainly due to anthropogenic input via urban-industrial release, waste from municipalities as well as agricultural activities.

6) Cobalt

Cobalt is a hard ferromagnetic, silver-white lustrous and brittle element. It is a member of group VIII of the periodic table. Cobalt is stable in air and unaffected by water, but is slowly attacked by dilute acids. Cobalt is relatively low abundance in natural waters, from which it is precipitated as the highly insoluble cobalt sulfide (CoS). Cobalt is an element that may enter air and water and settle on land through wind-blown dust and enter surface water through run-off when rainwater runs through soil and rock containing cobalt. The toxicity of cobalt is low and it is considered as an essential element, which is required in the normal human diet in the form of vitamin B12 (cyanocobalamin). For this reason, Co has been used in the treatment of anemia (Gil et al., 2008). However, the ingestion or inhalation of large doses of this analyte may lead to toxic effects (Gil et al., 2008).

III. MATERIALS AND METHODS

A. Description of the Study Area

Lake Chamo is located in the Southern Nations Nationalities and Peoples Region (SNNPR) of southern Ethiopia. It is located in the Great Rift Valley at an elevation of 1,235 meters to the south of Lake Abaya and city of Arbaminch and east of the Guge Mountain. Lake Chamo has a surface area of 551 km^2 and a maximum depth of 16m.The rivers draining in to Lake Chamo are listed as: Sile, Argoba, Wezeka, Sego, in addition to the overflow from Lake Abaya which confluences with River Kulfoand eventually drains to Lake Chamo. This lake is located within the Main Ethiopian Rift Valley (MERV), which extends from the Southern Afar to the Konso highland in the southern Ethiopia. Lake Chamo is one of the three large lakes in Ethiopian next to Lake Tanaand Abaya. The area in the past has been affected by global climatic change with a shift to a decrease in precipitation peaks and with consequent impact on the lakes. Therefore, its salinity increases progressively which affects greatly the lake biota (Ababu, 2005).

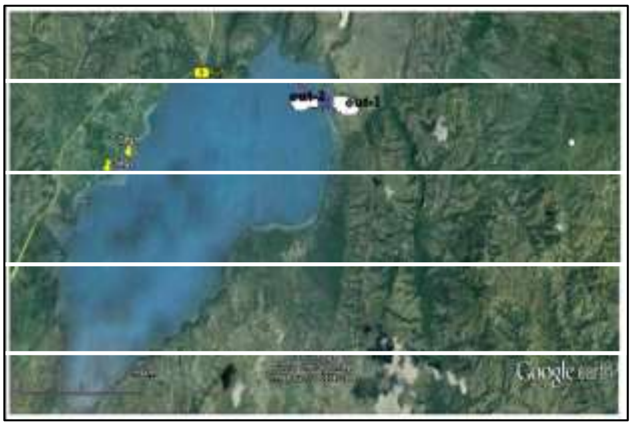

Fig. 1: Map of Lake Chamo

B. Instruments and Chemicals

1) Instruments and Apparatus

The instrument used was fully automated PC-controlled double-beam atomic absorption spectrometer with each six hollow cathode lamps namely Cobalt, Zinc, Chromium, Cupper, Iron and Lead were used throughout the experiment, pH-meter and Conductometery measurement. And also the common laboratory apparatus which were used during the study include: Different sized beakers, Erlenmeyer flasks, funnels, graduated cylinders, volumetric flasks, droppers, glass pipettes, fridge, spatula, measuring cylinders, vinyl gloves, bottles and analytical balance.

2) Reagents and Chemicals

All the reagents and chemicals use in this present study were analytical grade. HNO_3 (69%), concentrated HCl (30%), hydrated Pb $(NO_3)_2$, $FeCl_3.6H_20$, Cu $(NO_3)_2.3H_20$, Cr $(NO_3)_3.9H_2O$, Zinc metal (Zn), Co $(NO_3)_2.6H_2O)$ and Deionized water were used.

3) Collections of Water Samples

The availability of water samples were collected during the month of May from four different side of Chamo Lake. This was performed at the internal of 50 cm with 50 m distance from first point to station in order to get representative sample and was collected in to the container bottle. Four bottles with 1L capacity ware used to collect samples of water. The sampling bottles were cleaned before used. During the sampling period the bottles were rinsed with the lake water for collecting the samples. The collected water samples from Chamo Lake were taken and transported to the laboratory. The samples were put in fridge until the work was started for further treatment.

4) Preparation of Stock Standard Solutions for Calibration

Calibration curves were prepared for each of the selected heavy metals pollutants by running a range of concentration of freshly prepared standard solution in their respective linear ranges. For stock solution preparation for each of selected heavy metals their gram was weighted and dissolved in a beaker by deionized water, then diluted to 1 liter volumetric flask (stock solutions of 1000 ppm for each metals): 3.79 gram of Copper nitrate $(Cu(NO_3)_2.3H_20)$, 1 gram of Zinc metal, 1.6 gram of Lead nitrate $(Pb(NO_3)_2)$, 7.5 gram of Chromium nitrate $(Cr(NO_3)_3.9H_2O)$, 4.8 gram of Iron (III) chloride $(FeCl_3.6H_2O)$, 4.8 gram of Cobalt nitrate $(Co(NO_3)_2.6H_2O)$ done by the above procedure.

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The linear dynamic range, the calibration samples were prepared using appropriate dilution of the stock Zinc, Copper, Chromium, Cobalt, Iron, Cobalt and Lead (stock solutions of 1000 ppm for each metals). In analysis procedure stock standard solutions containing 1000 mg/L were used for preparing intermediate standards of 50 ppm and working standards. Also the working standard solutions were prepared freshly by appropriate diluted the intermediate solution by deionized water: Cu (0.25, 0.5, 0.75, 1, 1.25) ppm, Pb (0.1, 0.2, 0.3, 0.4, 0.5) ppm, Fe (0.5, 1, 1.5, 2, 2.5) ppm, Zn (0.5, 1, 1.5, 2, 2.5) ppm, Cr (0.02, 0.04, 0.06, 0.08, 0.1) ppm and Co (1,1.5,2,2.5,3) ppm were prepared by dilution method in order to obtain the corresponding their absorbance by AAS.

5) Digestion of Water Samples

Digestion of water took place after composite sample was prepared from the Lake. First of all, mark in about 20 mL of the beaker was made using marker. 50 mL from the bottles water samples were digested in a beaker covered with a watch glass by adding 2 mL of concentrated (69-72%) HNO_3 and 2.5 mL of concentrated (30%) HCl and was heated on a hot plate at 90 ^{0}C until the solution was reached up to the mark (20mL). Then the beaker was removed and cooled. The digested water samples would be filtered through Whatman filter paper No.42 in to a 100 mL volumetric flask and was filled up to the mark with deionized water by addition of 2ml of nitric acid to get a clear solution, then a portion of this solution was taken for requiring concentrations of each selected heavy metal pollutants determinations.

6) Determination of heavy metals pollutants by AAS

The prepared working standard solutions of selected heavy metals were taken in to AAS room in order to measures their absorbance at own wavelength: Copper at (324.8 nm), Iron at (248 nm), Chromium at (357 nm), Zinc at (214 nm), Lead at (283 nm), Cobalt at (283 nm) and the digested sample of Chamo lake also has taken and measured at each wavelength for selected heavy metals by Atomic absorption spectrometer.

IV. RESULTS AND DISCUSSIONS

A. Physicochemical Variables of Water Sample

In this project work, the conductivity of the water sample and the pH values were determined from the selected sites of Chamolake at room temperatures (25°C). Conductivity is a measure of the ability of aqueous solution to carry an electric current that depends on the presence and total concentrations of ions, their mobility, valance and on the temperature. The level of electrical conductivity of Chamo lake was recorded by conductometry instrument.

Parameters	Sample of Chamo Lake
pH- meter	7.6
Electrical conductivity	785.5µS/cm

Table 1: physiochemical variables of sample of Chamo Lake.

In the selected site value of conductivity determined in this study area was785.5 µS/cm. Thus, the clarity of water is determined by its Electrical conductivity value, and having high conductivity water is an indicator of the presence of suspended solids, ions and microorganisms. The pH values determined in this study was 7.6. According to (Ahmed and Rahman, 2000), water with a pH ranges from 5.6 to 6 are moderately acidic, water with a pH range from 6.1 to 6.5 are slightly acidic, water with a pH ranges from 6.6 to 7.1 are neutral or nearly neutral, water with a pH range from 7.2 to 7.8 are slightly alkaline and water with a pH ranges from 7.8 from 8.4 are moderately basic and water with a pH above 8.5 are strongly alkaline. Therefore, the value obtained from the study area was slightly alkaline.

Heavy metals	Absorbance	Sample of Chamo lake
Cu	0.014, 0.025, 0.037, 0.047, 0.057	0.050
Pb	0.001, 0.004, 0,007, 0.011, 0.015	0.002
Fe	0.056, 0.071, 0.269, 0.361, 0.457	0.414
Zn	0.028, 0.272, 0.469, 0.665, 0.871	0.811
Cr	0.001, 0.008, 0.014, 0.020, 0.026	0.003
Co	0.098, 0.189, 0.272, 0.374, 0.442	0.000

Table 2: Absorbance of standard solutions and a sample of Chamo Lake

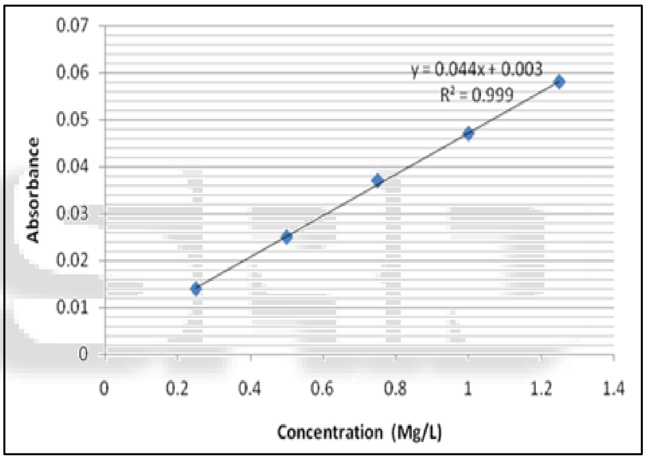

Fig. 2: Absorbance versus Concentration of Copper from calibration curve

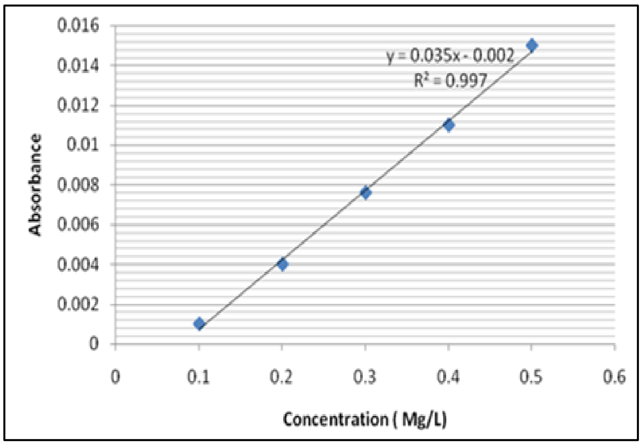

Fig. 3: Absorbance versus Concentration of Lead from calibration curve

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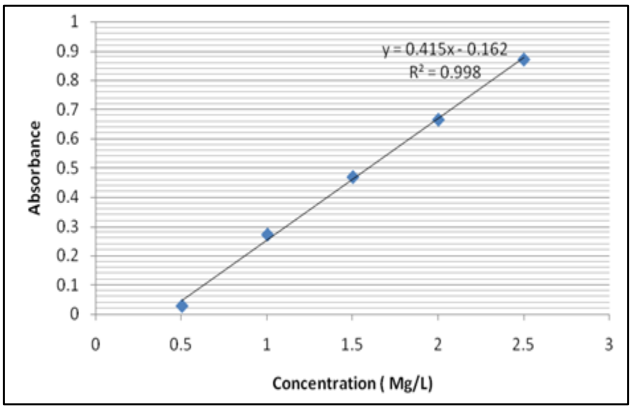

Fig. 4: Absorbance versus Concentration of Zin from calibration curve

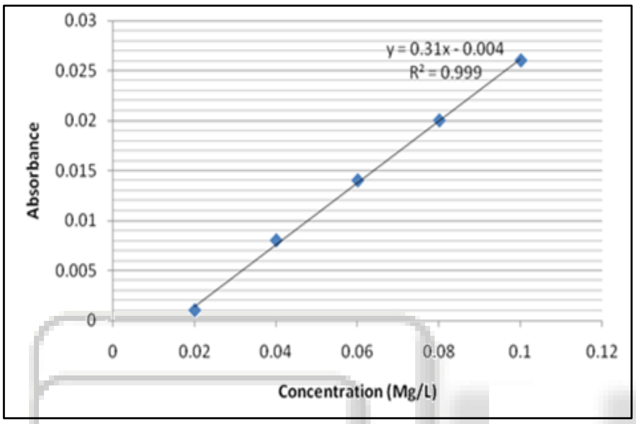

Fig. 5: Absorbance versus Concentration of Chromium from calibration curve

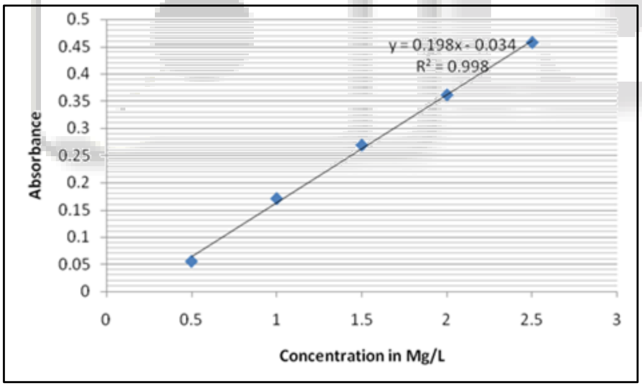

Fig. 6: Absorbance versus Concentration of Iron from Calibration curve

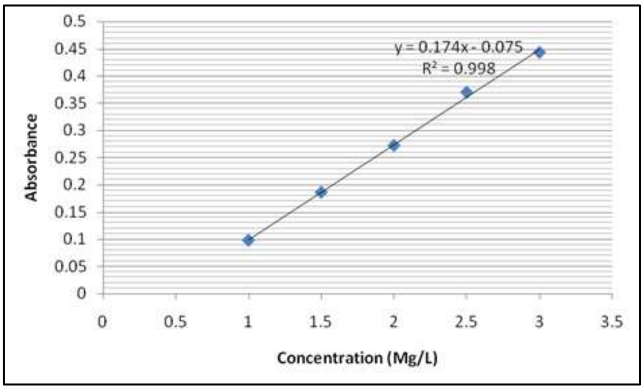

Fig. 7: Absorbance versus Concentration of Cobalt from Calibration curve

From Calibration curves for Cr, Cu, Zn, Pb, Fe and Co were obtained by using suitable standard solutions prepared from stock solutions. Calibration standards for the elements analyzed were prepared in concentration ranges expected for the analyte in the samples analyzed. In addition, the calibration standards were prepared by taking in to consideration the optimum working ranges of the elements. The determination coefficient (R^2) values that are closer to the absolute value of 1 indicate that there is a strong relationship between the variables being determined whereas values closer to zero (0) indicate that there is no linear relationship between absorbance and concentration (Mwangi, 2013). The determination coefficients of the elements were determined using prepared standards concentration versus their corresponding absorbance. These curves were obtained by plotting absorbance readings against corresponding concentrations of the metals investigated with optimized instrument conditions. The concentration of each selected heavy metals are listed in the table below.

Number	Heavy metal	Concentration (mg/L)	Literature standard concentration (mg/L)
1	Cu	1.068	0.05
2	Pb	0.114	0.01
3	Zn	2.34	5.0
4	Fe	2.26	5-43
5	Cr	0.023	0.05
6	Co	0	0.02

Table 3: Concentration of selected heavy metal pollutants in Chamo Lake water sample.

We observed that the level of Copper concentration (1.068 mg/L) and Pb concentration (0.114 mg/L) in the analysis of Chamo Lake sample was obtained. From this, it could be observed that Cu and Pb level found in the study area were greater than standard concentration value given which is 0.05 mg/L and 0.01 mg/L respectively. This shows that high traffic density found near the study are a played a significant role in the level of Pb and copper in the Chamo water. From this Chamo Lake water has relatively high concentration of Pb and Cu and its effect on the aquatic systems. Because of Pb and Cu are very toxic heavy metals even at low concentration. This may be also due to the Chamolake is used for tourism and fishery, the waste from car wash and other disposal. From this result the lake was contaminated by copper and lead so this cause impact on environment aquatic species (especially fish) and animals which drink this lake.

We also discussed that the level of Iron concentration, Zinc concentration, and Chromium concentration in the analysis of Chamo Lake sample were obtained as in table 3 above. From this, it could be observed that Fe, Zn and Cr level found in the study area were lower than the standard concentration value given which is (5-43 mg/L, 5.0 mg/L and Cr 0.05 mg/L) respectively. Because low concentration of Fe and Zinc was may be due to low anthropogenic input via urban-industrial release, waste from municipalities as well as agricultural activities. Also low concentration of Chromium is due to there is no leather tanneries and pharmaceutical industries around Chamo Lake area to increase the concentration of chromium in lake water.

It also seen that in the analysis of Chamo Lake the absorbance of Cobalt measured in the instrument was around zero reading as above table 2, this show that the concentration of Cobalt in Chamo Lake sample is zero, because Cobalt is of relatively low abundance in natural waters, from which it is precipitated as the highly insoluble cobalt sulfide (CoS).

Generally concentration the selected heavy metal lake water samples obtained by calculating from calibration curves were in order of Zn>Fe>Cu>Pb>Cr>Co. The distribution patterns of some heavy metals concentration in sample of Chamo Lake was below to the standard concentration, for the element Chromium, Iron and Zinc due to these it has no effect on the aquatic environment and human being who used these lake. But related to the concentration of Lead and Copper it has some effect on the aquatic species (for fish) and on human being who used this lake for different purpose (irrigation and washing their body).

V. CONCLUSION AND RECOMMENDATION

A. *Conclusion*

In this study, the water samples were collected from Chamo Lake selected sampling sites. The physicochemical variables of water sample such as pH and EC of ChamoLake was evaluated by using pH-meter and Conductometry. There results were below or within the range of the recommended standard limit for Lake. This work focused on the analysis of the selected heavy metals pollutants: Pb, Cr Fe, Cu, Zn and Co concentrations in Chamo Lake water, Arba Minch, GamoGofa. The concentrations of Cr, Pb, Cu, Fe, Zn and Co were determined from Chamo Lake by using AAS technique. The results showed that the highest concentrations of Pb and Cu but the lowest concentration were Cr, Co, Fe, and Zn were found from the work areas. The presence of these heavy metals with moderate high concentrations in the water sample indicates that can be a chance of damage to water and animal kingdom including human beings because of its toxicity. Hence continual assessment and enlightenment is highly essential. The presence of low concentrations in the water samples indicates that there is no environmental impact at around Chamo Lake area.

In summary of the obtained results, it has emerged that the highest levels of the selected heavy metals in the work area was detected in the water samples collected from Chamo lake. This is due to the highest traffic densities present near to the Arba Minch town and the Lake Chamo was used for tourism and fishery, the waste from car wash and other disposal. The total concentrations of heavy metals (Cu and Pb) in the Chamo water were above the critical maximum levels which toxicity is possible. From this point view Chamo Lake was contaminated by these heavy metals concentration. Therefore, treatment requires removing those toxic heavy metal contaminations, because the transport flows and the factories are increasing day to day.

B. *Recommendation*

Based on this research project the following suggestions are recommended in order to monitor and protect the aquatic environment, due to the anthropogenic activities increases through the time.

– There is need for continuous monitoring as not thrown dirt materials in to lake and keeping as not sewages flood from house holding lake area which to increases the levels of the heavy metal concentrations in ChamoLake because the lake is serving as place of tourism and source of water for irrigation and fish for the local inhabitants.
– This study was focused on only six heavy metals pollutants. Hence, it is recommended to perform research works on other more heavy metals pollutants Lake of Chamo
– Seasonal variation may have an influence on the level of the studied analytes water samples. Therefore, further researches under takings are recommended by taking seasonal variation into consideration.
– Further studies are recommended in the study area water samples with respect to heavy metals including Mercury, Arsenic and others that are not addressed in these the present study.

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