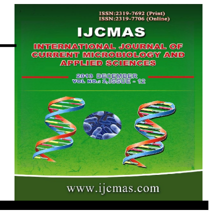

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 2 Number 12 (2013) pp. 338-348**
http://www.ijcmas.com

Original Research Article

Spectrophotometric determination of chromium and copper content from Manjara Dam of Maharashtra, India

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Keywords

Seasonal variations; Trace elements; UV Spectro-photometer; chromium and copper.

A B S T R A C T

Water has the central role in mediating global-scale ecosystem processes, linking atmosphere, lithosphere and biosphere by moving substances between them and enabling chemical reactions to occur. Natural waters are never pure water but a complex and ever-changing mixture of dissolved inorganic and organic molecules and suspended particles. Trace elements were found in rarer form in surface water. The present study was undertaken to determine the trace elements from Manjara Dam. The total concentrations of chromium and copper were determined using UV spectroscopic method. The concentration of selected trace elements was evaluated from three sampling sites named S1, S2 and S3. The study was carried out for two years of 2009 – 2010 and 2010 - 2011. The highest amount of chromium was recorded as 0.018 mg/L and lowest amount as 0.0013 mg/L and the highest amount of copper was recorded as 0.035 mg/L and lowest amount as 0.0086 mg/L. The observed values showed the seasonal variations during the entire study period.

Introduction

Water is a marvelous substance-flowing, swirling, seeping, constantly moving from sea to land and back again. It shapes the earth's surface and moderates our climate. Water is essential for life. It is the medium in which all living process occurs. Water dissolves nutrients and distributes them to cells, regulates body temperature, supports structures, and removes waste products. About 60 percent of your body is water. We could survive for weeks without food, but only a few days water.

An American family of four consumes more than 1,000 m^3 (264,000 gal) of water per year. Families in other countries subsist on a tiny fraction of that amount (Cunningham and Cunningham, 2003).

Water is the most important single commodity in human civilization but it is also reseponsible for most diseases due to contamination. Clean, fresh water is essential for nearly every human endeavor perhaps more than any other environment factor; the availability of water determines the location and activities of humans on the earth. Renewable water supplies are resources that are replenished regularly- mainly surface water and shallow groundwater. Renewable water is most plentiful in the tropics, where rainfall is heavy, followed by mid latitudes, where rainfall is regular. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health (Ramachandra et al., 2002).

Dams and canals are a fundamental basis of civilization; they can also be a source of environmental disaster and injustice. Some of the great civilizations (Sumeria, Egypt, China, and he Incan culture of South America) were organized around the large-scale redistribution of water from rivers to irrigated farm fields. More than half the world's 227 largest rivers have been blocked by dams or diversion structures with adverse effects on freshwater ecosystems. Of the 50,000 large dams in the world, 90 percent were built in the twentieth century, and half of those are in China, Economically speaking, at least one-third of those dams should never have been built.

Pollution control standards and regulations usually distinguish between point and non-point solution sources. Factories, power plants, sewage treatment plants, underground coal mines, and wells are classified as Point sources because they discharge pollution from specific locations, such as drain pipes, ditches, of sewer outfalls. These sources are discrete and identifiable, so they are relatively easy to monitor and regulate. It is generally possible to divert effluent from the waste streams of these sources and treat it before it enters the environment (Ramesh and Anbu, 1996).

Some toxic inorganic chemicals are naturally released into water from rocks by weathering processes. Humans accelerate the transfer rates in these cycles thousands of times above natural background levels through the mining, processing, using and discarding of minerals (Jackson, 1993).

Many metals, such as mercury, lead, cadmium, and nickel, are highly toxic in minute concentrations. Because metals are highly persistent, they accumulate in food chains and have a cumulative effect in humans. In natural environment though the average abundance of heavy metals is generally low, heavy metal exert their harmful effects in many ways (Mohapatra, 2006).

The hydrosphere accounts for a greater area of the earth's surface than the lithosphere and is divided into lakes, rivers, estuaries and oceans. Metals exist in hydrosphere as dissolved material and suspended particulates and are in deposited sediments. Sediments in rivers, lakes, estuaries and oceans account for the main sinks of heavy metals in the hydrosphere. In estuaries, heavy metals from the atmosphere and rivers accumulate, thus permitting chemical and physical reactions to occur before being washed out in the ocean (Cockerham and Shane, 1994).

Chromium is a grayish-white crystalline, very hard metallic chemical element with a high resistance to corrosion, used in chromium electroplating, in alloy steel, and in alloys containing nickel, copper, manganese and other metals. Chromium is found in the earth's crust from 10 – 200 ppm, chromium is a naturally occurring metal in drinking water. Chrome plating and chrome metallurgical and chemical operations may contaminate the atmosphere with chromium, in addition to fossil fuel combustion, solid waste incineration and cement plant emission. Other chromium salt usage is found in the leather industry, paints, pesticides, fertilizers, dyes, explosives, ceramics and papers leading to pollution. It found in two forms in waste water, hexavalent and trivalent (Rana, 2009).

Copper is a reddish-brown, malleable, ductile, metallic element, excellent conductor of electricity and heat. The most important copper ores are sulfides, oxides and carbonates. It is used in pipes, brass, domestic utensils, electrical industry, coins. Copper is very commonly found on the earth's crust as sulfides, oxides and rarely as metal. Consequently, it is found in surface water generally at concentrations below 20 µg/L. industrial sources of copper are smelting and refining, copper wire mills, coal burning industries, electroplating, tanning, engraving, photography, insecticides, fungicides, coal burning industries and iron and steel producing industries. Metal contamination of the environment arises not only from natural sources, but from industrial activity (Sachan et. al. 2007).

Study Area

The present study carried out on the Manjara dam which is situated at Dhanegaon, village of Kaij Taluka, Beed District, Maharashtra, India as shown in fig. 1 and 2.

The dam was constructed on Manjara River. The study area is bounded by Latitude $18^0 25^'$ to $18^0 55^'$ N and $75^0 75^'$ to $76^0 15^'$ E Longitude. The construction of the dam was completed on 1981. It's catchment area is about 2371.59km^2 while it's irrigational potential is 18222 hectare.

Materials and Methods

For the present investigation water samples were collected for two years during 2009 – 2010 and 2010 – 2011. The samples of water were collected in clean plastic bottles of 1 liter volume from each station at the depth of one to one and half feet below the surface of water from sampling station-1 (S1), sampling station-2 (S2) and sampling station-3 (S3) of the Manjara dam as shown in figure 4. Three samples were collected from each sampling site. The water sample was then filtered through a membrane filter when necessary. The pH of all the water samples were noted immediately and water was acidified further. This acidified water was then brought into laboratory and stored at 4^0C until analysis. The chromium concentration from the water sample was determined by s-Diphenyl Carbazide method and iron was determined by Neocuproine method.

Results and Discussion

p^H is a prime parameter for deciding acidic or alkaline water. Keeping this in view, we have analysed the p^H values. The p^H of Manjara dam water was recorded for two years i.e. February 2009 to January 2011 as shown in fig 1and 2. The minimum p^H was recorded as 8.11, 8.13 and 8.12 at site I, site II and site III respectively in the month of September 2009. While in 2010 the maximum p^H was recorded as 8.38, 8.40 and 8.39 at site I, site II and site III respectively in the month of September.

Pawar and Pulle (2005), studied the water quality of Pethwadaj dam, Nanded district of Maharashtra during January-December 2004. The high pH range 7.02-7.85 was recorded in summer and low ranged in winter. Davina and D'souza (1999),

Fig.1 Location of Beed district in Maharashtra state of India

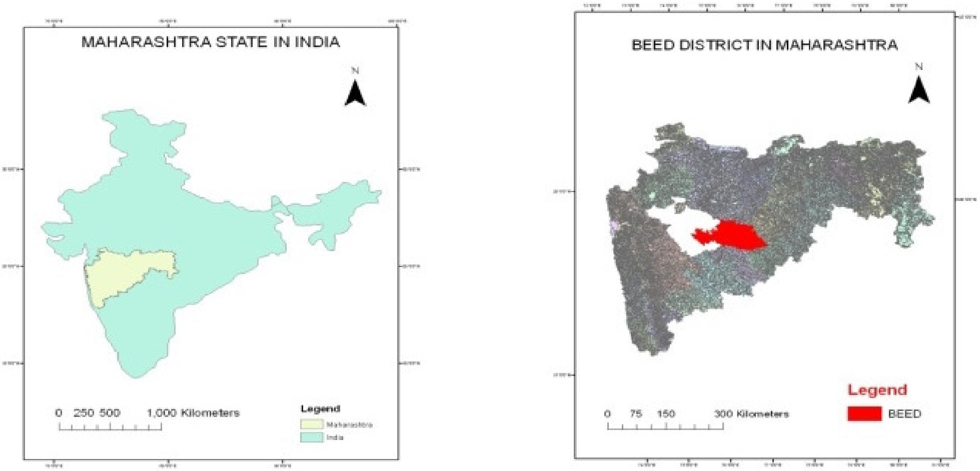


Fig.2 Location of Dhanegaon in Kaij Tehsil of Beed district

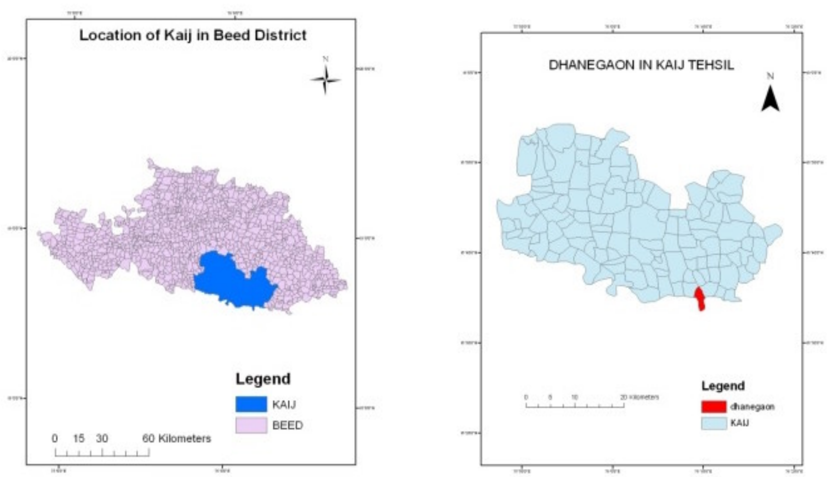
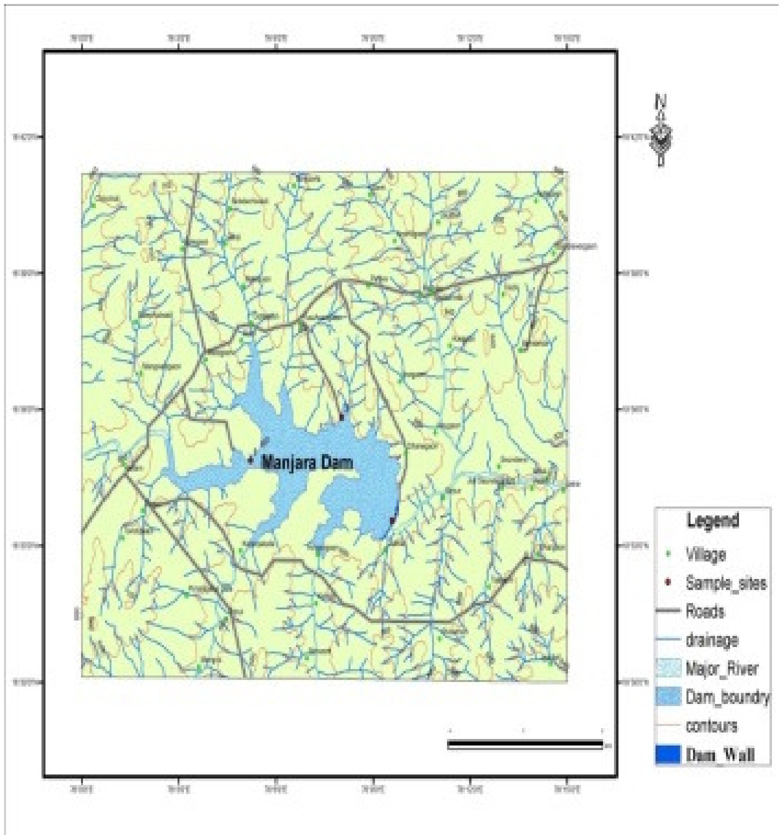


Fig.3 Satellite image of Manjara dam

Fig.4 Location of sampling stations at Manjara dam



studied the impact of the tourism industry on ground water in Calangute, Goa. They found pH season wise in 1997 which was ranged as 5.45 to 6.03 and it is undesirable. Thomas and Azis (2000), studied the water quality of tropical reservoir in Kerala during February 1991 to January 1992. They recorded the pH of water ranged from 6.10 to 7.53 and 5.10 to 7.49 in surface and bottom water respectively.

In the present investigation, the chromium concentration was estimated during three different seasons i.e. pre – monsoon, monsoon and post – monsoon from February 2009 to January 2011. During the entire study period (February 2009 – January 2011), the highest amount of chromium was recorded as 0.018 mg/L and lowest amount as 0.0013 mg/L. The highest value of chromium was noted in the month of May 2010 at site II and the lowest value of chromium was noted in the month of October 2009 at site I. The monthly mean concentrations of chromium were shown in figure 3 and 4.

Virha et. al. (2011), found the mean concentration of chromium between 0.047 mg/L and 0.087 mg/L in water of upper lake of Bhopal during 2006 – 2007. The highest level of chromium was found in winter season at site 2 and 5 due to idol immersion in this season.

Lohani et. al. (2008), recoeded the chromium concentration from the five

Chart.1 Levels of p^H observed from Manjara dam water during Feb. 2009 to Jan. 2010

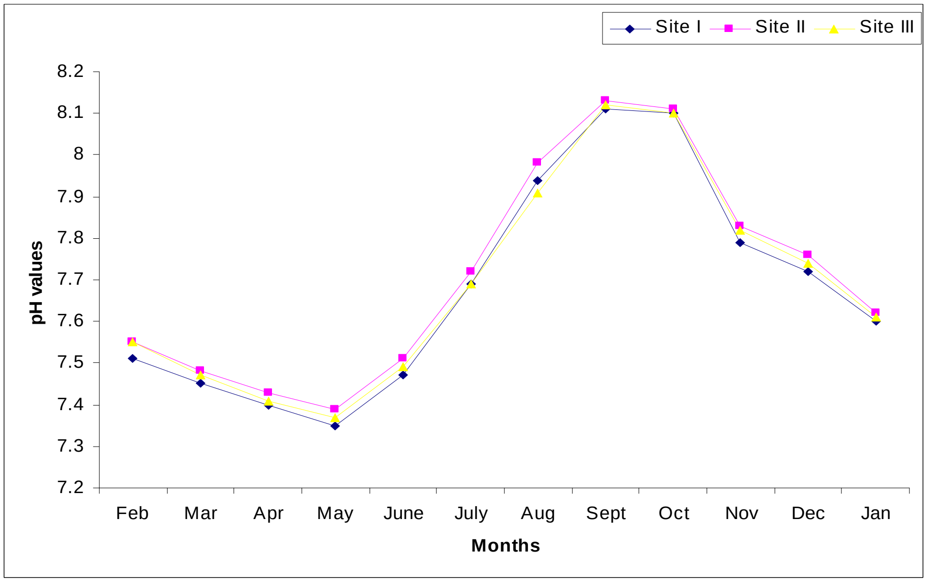


Chart.2 Levels of p^H observed from Manjara dam water during Feb. 2010 to Jan. 2011.

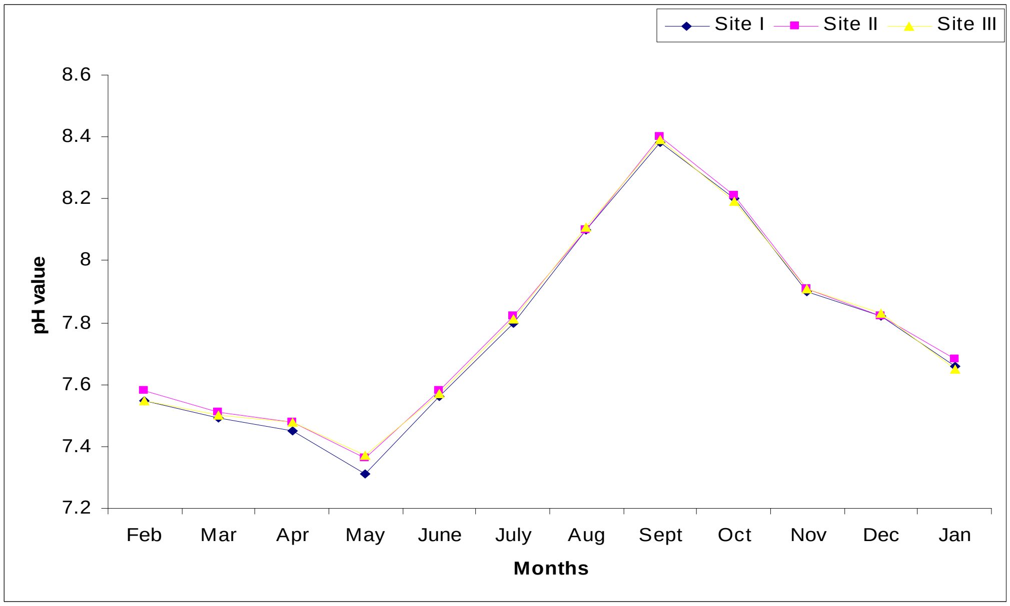


Chart.3 Monthly mean values of chromium of Manjara dam water during Feb. 2009 to Jan. 2010.

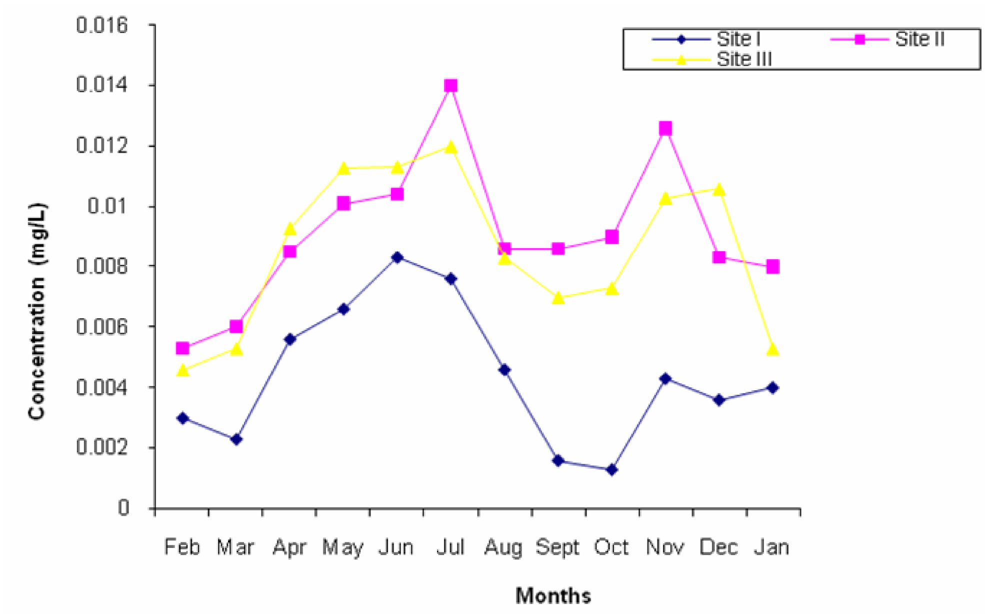


Chart.4 Monthly mean values of chromium of Manjara dam water during Feb. 2010 to Jan. 2011

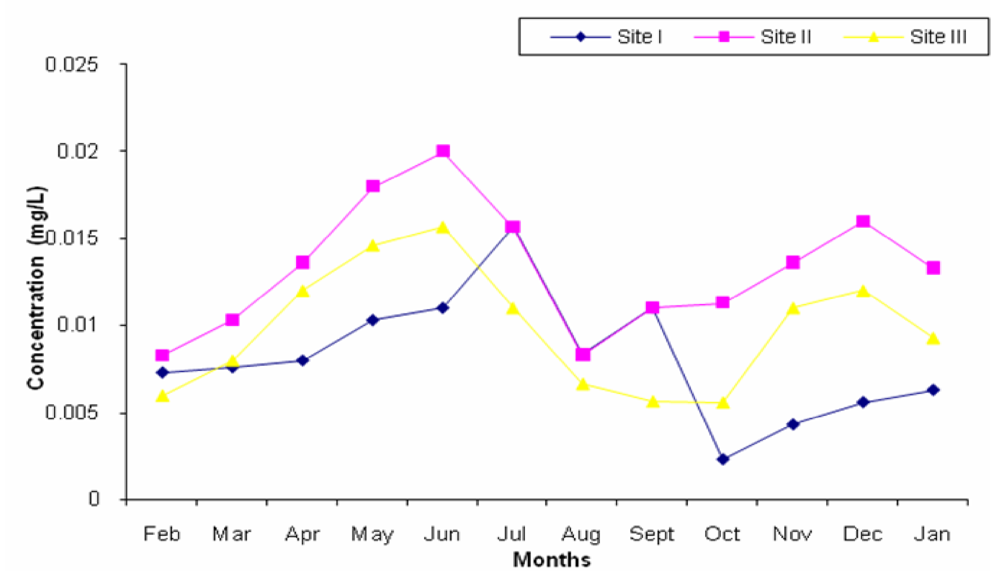


Chart.5 Monthly mean values of copper of Manjara dam water during Feb. 2009 to Jan. 2010

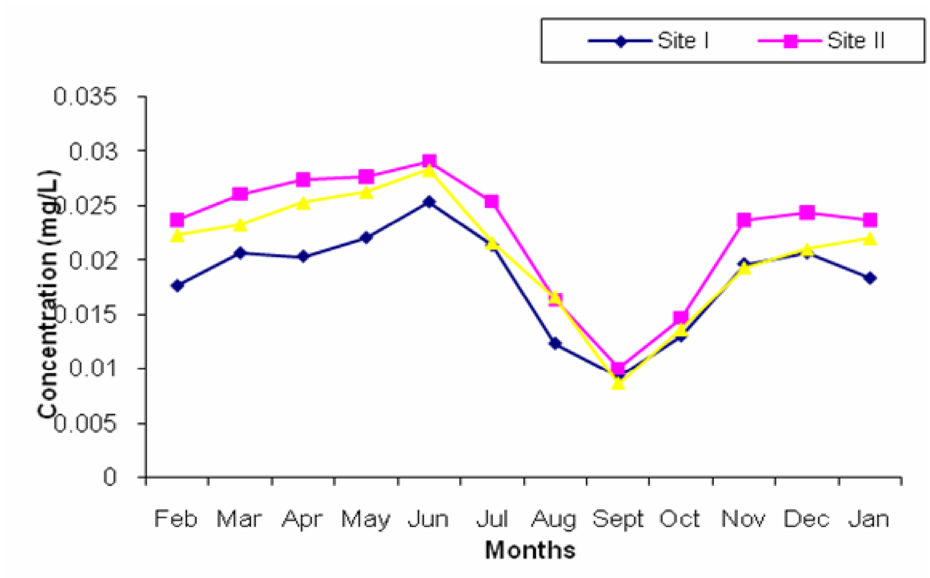
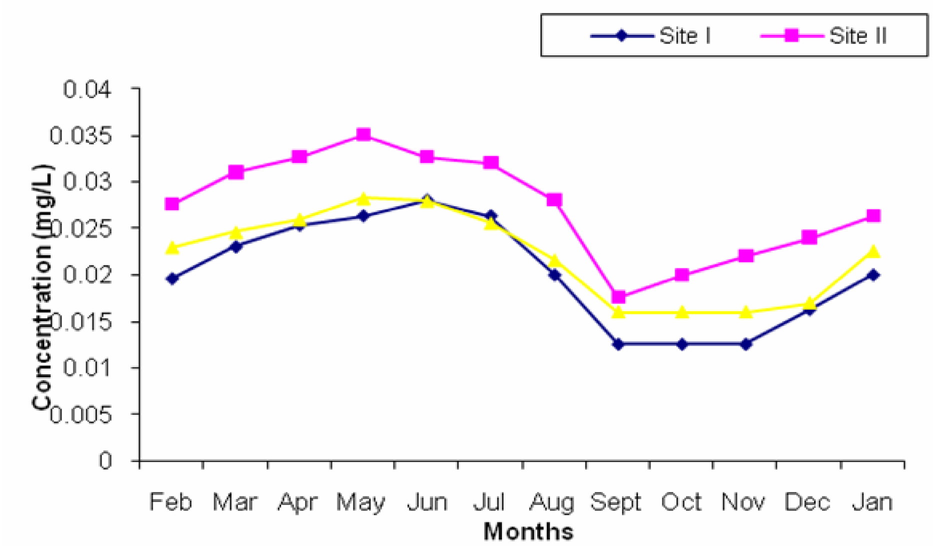


Chart.6 Monthly mean values of copper of Manjara dam water during Feb. 2010 to Jan. 2011



sampling sites from river Gomti of Lucknow city region during pre-monsoon period and post-monsoon period. During the research work they observed the maximum concentration of chromium was 0.24 mg/L at site S3 in the month of May while minimum chromium concentration was 0.009 mg/L at site S3 in the month of December.

Gupta et. al. (2009), analysed metals from river Ganges at Allahabad during the year 2005 – 2006. In this investigation they recorded the minimum chromium concentration of 0.00 mg/L in the months of July and August and maximum concentration of 0 018 mg/L in the month of May and June. They also commented that, the minimum concentration of chromium was found in rainy season because rivers are heavily flooded and the drainage system was drastically affected which leads to decrease in the concentration of metals, whereas increase in the concentration of metals during summer season could be due to drought and decrease in water level.

Malik et. al. (2010), evaluated the chromium concentration from freshwater lake of Bhopal. In this investigation they noted the chromium concentration of 0.043 mg/L during summer season, 0.019 mg/L during rainy season and 0.039 mg/L during winter season of 2005 – 2006.

Rai (2009), investigated the chromium concentration from G. B. Pant sagar reservoir, in Singrauli industrial region during January 2005 to December 2005. He recorded the maximum chromium concentration of 34 mg/L in the month of June and below detectable limit in the month of September. He also mentioned that the metal concentration in the reservoir water and sediment were particularly high during pre-summer and summer season, March and June. Comparatively low values for metals were found during rainy season, in the month of September.

In the present study we also analyzed the copper content during three different seasons i.e. pre – monsoon, monsoon and post – monsoon from February 2009 to January 2011. During the study period (February 2009 – January 2011), the highest amount of copper was recorded as 0.035 mg/L and lowest amount as 0.0086 mg/L. The highest value of copper was noted in the month of May 2010 at site II and the lowest value of copper was noted in the month of September 2009 at site III. The monthly mean concentrations of copper were shown in the figures 5 and 6.

Majagi et. al. (2008), studied the concentration of heavy metals of Karanja reservoir of Bidar during October 2001 to September 2003. In this assessment they found the average copper values of 0.2108 mg/L, while minimum copper concentration was recorded as 0.021 mg/L during monsoon of 2003 and maximum copper concentration recorded was 0.814 mg/L during summer 2003.

Suratman et. al. (2009), investigated a preliminary study of the distribution of selected trace metals in the Besut river basin, Malaysia during August 2002, October 2002 and November 2002. The results for the copper content obtained in this study was ranged between 1.1 µg/L to 12.3 µg/L. They also mentioned that the high concentration of copper found at downstream station could be due to sewage effluents from domestic sources.

Ameh and Akpah (2011), evaluated the hydrogeochemistry of river Povpov I Itakpe, Nigeria. For this study total thirteen surface water samples were collected in the month of February 2009 (dry season) and May 2009 (onset of rain). During dry season mean copper concentration was recorded as 0.0629 mg/L with minimum concentration of 0.03 mg/L and maximum of 0.13 mg/L. While during onset of rain, water samples contain mean copper concentration as 0.09 mg/L with minimum of 0.00 mg/L and maximum of 0.41 mg/L.

Kaplan et. al. (2011), analysed some heavy metals from drinking water samples of Tunceli, Turkey in October 2009. In this study the copper content of the samples was in the range of 0.05 µg/L to 0.40 µg/L. The highest value of copper was noted as 0.40 µg/L in Esentepe quarter water reservoir.

Nsikak and Etesin (2008), worked on metal contamination in surface water of Iko river during 2003 – 2004. During this work the mean temporal variations of copper in surface water from Iko river during dry and wet seasons were recorded. The mean copper concentration recorded was 0.13 mg/L in dry season and 0.13 mg/L in wet season.

p^H is very important parameter which is responsible for solubilizing the metals in the water system. Basically metals are soluble in acidic conditions. The metals are also found in the slightly alkaline water in the insoluble form. In the present work the sampling station (S_1) showed the less concentration of nearly all the metals considered during the study. However everyday run-off contains less metal concentration when compared to that of sampling station (S_2). Because the running water has low concentration of trace metals as compared to the stored water in the dam. At the sampling station (S_2), the trace metals get deposited due to which slightly increase in all metals concentration was observed. Heavy metals present in the running water interact with organic matter and settle down resulting in high concentration. The vital parts of these metals were circulating the activities of various aquatic ecosystems especially of planktons. Higher concentration of metal ions in water may be due to slow leaching of laterite rock and from dead and decaying material. Heavy metals reduce enzymatic activity and the microbial and micro-faunal population in the soils.

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