

Original Research Article

Status of some traces metals in water samples from Manjara Dam of Maharashtra, India

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Water is essential resources for sustainable life and environment which we have always thorough to be available in abundance and free gift of nature. 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 zinc and iron 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 observed values showed the variations especially during entire the research work.

Introduction

The trace pollutants are the contaminants that occur in minute quantities. Their concentrations usually fall in the order of 0.1 mg/L. In spite of their miniature existence, they seem to have high potential for causing terrible health effects and thus pose a great threat to public health (Kudesia and Ritu, 2003).

About 90 elements are found in the earth's crust out of which a mere 9 elements (viz., Al, Fe, Ca, Mg, O, Si, Na, K and Ti) only account for over 99 percent by weight.

The remaining 81 elements together, which account for hardly 0.14 percent by weight, constitute the so called "trace elements". These elements, notwithstanding their low abundance in nature, play a vital role in plant and animal nutrition (Dara, 2002).

Trace elements present in natural waters (ground, surface waters) and their sources are associated with either natural processes or man's activities. Most trace elements, especially heavy metals, do not exist in

soluble forms for a long time in waters. They are present mainly as suspended colloids or are fixed by organic and mineral substances (Ramesh and Anbu, 1996).

Several trace elements (few mg or less) are found in polluted water. As mentioned earlier, the heavy metals have a great affinity for sulphur and attack sulphur bonds in enzymes, thus immobilizing the latter. Other vulnerable sites are protein carboxylic acid (COOH) an amino (-NH₂) groups. Heavy metals bind to cell membrane, affecting transport processes through the cell wall. They also tend to precipitate phosphate biocompounds or catalyze their decomposition (De, 1994).

Metals are non-biodegradable. Unlike some organic pesticides, metals cannot be broken down to less harmful components. Detoxification by organisms consists of 'hiding' active metal ions within a protein such as metallothionein (binding covalently to sulphur), or depositing them to an insoluble form in intracellular granules for long term storage or excretion in the faeces (Santra, 2005).

Heavy metals are the metals with specific gravity greater than 4 or 5 and are highly toxic. Metals have a range of average effects, including nervous system, kidney damage, and creation of mutation and induction of tumours (Meenakshi, 2005). Zinc occurs in nature as blended, sulphide, silicate, zinc, spar, zincite (ZnO) etc. Sea water contains 9.21 µg zinc. The human body contains 300 mg zinc, 65 percent of it in muscle, 20 percent in bone, 6 percent in plasma, 2.8 percent in erythrocytes and about 53 percent in liver. Zinc salts are relatively non-toxic but heavy doses causes vomiting, renal damage, cramps etc. Inhalation of air containing ZnO at 1

to 34 mg/m³ causes metal fume fever and pneumonitis in humans (Kudesia and Ritu, 2003).

Residues in freshwater and marine fish are generally much lower than those found in algae and invertebrates. Zinc in muscle tissue from 15 species of omnivorous and carnivorous fish collected from industrial and agricultural areas of the lower Great Lakes were 16 to 82 and 3 to 9 mg kg⁻¹ wet weight, respectively. The majority of fish cannot be used as biological indicators of zinc contamination in the environment. In the absence of contaminated food, rate of uptake depends directly on exposure duration and level in water (Moor and Ramamoorthy, 1983).

Zinc is an essential and beneficial element for human bodies. However, concentrations above 5mg cause bitter taste and opalescence in alkaline waters. In drinking water, the zinc concentration ranges from 0.06 to 7.0 mg/L. Zinc enters the domestic water supply form the deterioration of galvanized iron and dezincification of brass besides industrial waste (De, 1994).

Zinc is in essential element found in all humans and animals and is a constituent of many enzymes. Zinc-deficient diet in animal's results in prevention of growth, loss of hair, cutaneous lesions and adverse effects on the gonads. As little as 0.3 mg/L of Zn²⁺ in water is toxic to some snails and fish, where as some aquatic insects and worms may tolerate up to 500 mg/L. The toxicity to fish depends not only on concentration but also on temperature, acidity (pH) and dissolved oxygen. The normal human intake is 10 to 15 mg/day. Zinc probably opposes the effect of cadmium in the body. High Zn/Cu rations in diet (as in fats) may lead in some manner to increased blood cholesterol

levels and therefore to increased heart disease (Jadhav, 1995).

Iron is found in all natural waters both in oxidized (ferric) and reduced (ferrous) forms. In anoxic reducing environments, like ground waters, most of iron occurs in ferrous state (as ferrous bicarbonate under alkaline condition). Ferric iron is an important plant nutrient and considered to be quantitatively the most important trace metal for autotrophs because of its indispensability for many enzymes and redox processes. Some microorganisms (like *Creatrix* and *Leptothrix*) are capable of utilizing dissolved iron (ferrous state) as an energy source and convert ferrous into ferric hydroxide (Purohit and Saxena, 1990). The maximum permissible limits for manganese and iron in drinking water are 0.5 mg/L and 1.0 mg/L respectively. Any excess amount of manganese or iron beyond permissible limit can cause ailments and mental diseases. The National Environmental Research Institute has developed a simple technology where water is aerated by passing over a series of coke beds followed by slow sand filters for removing iron and manganese. Through catalytic oxidation, iron and manganese get precipitated and removed by filtration (Kudesia and Ritu, 2003).

The primary concern about iron in drinking water is its objectionable taste. The taste of iron can be easily detected at 1.8 mg/L in drinking water. The drinking water guideline of 0.3 mg/L is based on these aesthetic considerations rather than health concerns. Acute exposure to iron is characterized by vomiting, gastrointestinal bleeding, pneumonitis, convulsions, coma and jaundice (Bhosle, 2002).

Even small amounts of iron can lead to be

accumulation of large deposits in a distribution system. As well as being unacceptable to the consumer, such deposits can give rise to iron bacteria which in turn cause further deterioration in the quality of the water by producing slimes or objectionable odours (Trivedi and Gurdeepraj, 1992).

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 $18^{\circ} 25'$ to $18^{\circ} 55'$ N and $75^{\circ} 75'$ to $76^{\circ} 15'$ E Longitude. The construction of the dam was completed on 1981. It's catchment area is about 2371.59km² 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°C until analysis. The zinc concentration from the water sample was determined by Dithiozone method and iron was determined by Thiocyanate method.

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

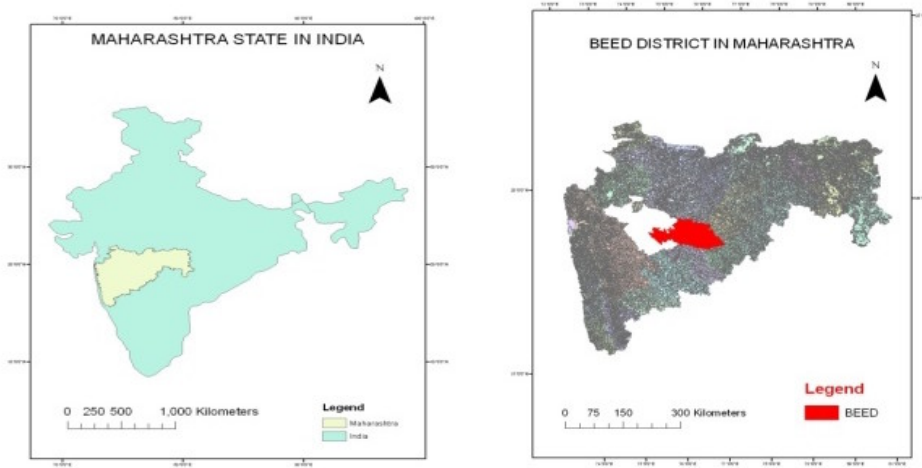


Fig.2 Location of Dhanegaon in Kaij Tehsil of Beed district

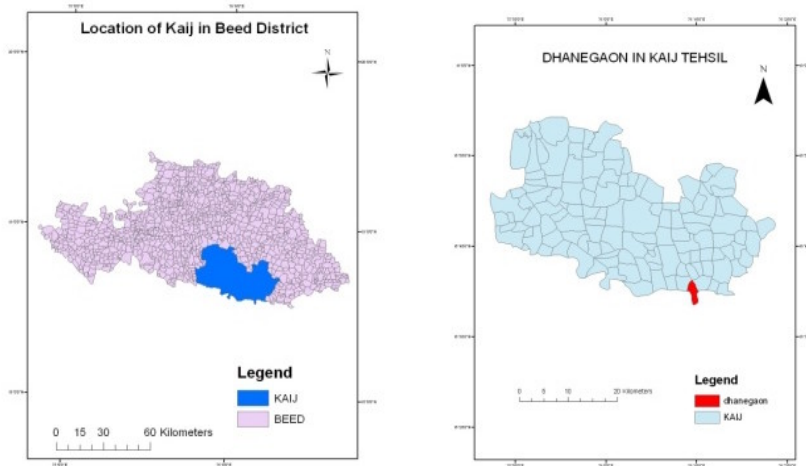
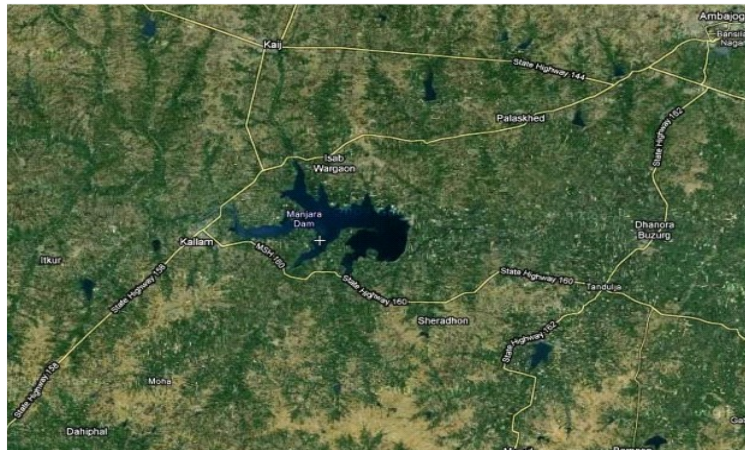


Fig. 3 Satellite image of Manjara dam



Results and Discussion

Occurrence of Zn and Fe metals in surface water has drawn world wide attention due to its considerable impact on human physiology. In this view, metals contamination study of zinc and Iron along with other physical parameter like pH has been carried out to determine the status of drinking water from Manjara dam, Kaij Taluka of Beed district, Maharashtra State. In continuation of our work trace elements, here we are mainly focus on trace elements such as zinc and iron in surface water of Manjara dam. The data of the trace elements are given in the Table – 1 and 2.

During the entire study period, the minimum pH 7.31 was recorded in the month of May 2010 at site S1, while the maximum pH 8.40 was recorded in the month of Sept 2010 at site 2 as shown in table 2.

In case of zinc concentration the minimum zinc concentration 0.87 mg/L was recorded in the month of Sept 2009 at site S1, while the maximum zinc concentration 1.48 mg/L was recorded in the month of May 2010 at site 2 as shown in table 1 & 2. Zinc tends to be found in only trace amounts in unpolluted surface waters and groundwater's. However, it is often found in domestic supplies as a result of corrosion of galvanized iron piping and tanks and dezincification of brass fittings. The concentrations usually found in drinking water are unlikely to be detrimental to health. Zinc has a threshold taste at approximately 5 mg/L and can also cause opalescence above this value (Trivedi and Gurdeepraj, 1992).

Rao *et al.*, (2005), investigated the heavy metal transport in Kolleru lake basin. The

water samples were collected from different joining into the lake, also from the lake in two different seasons during the year. They reported the maximum concentration of zinc 3.96 mg/L at Neravali sampling station in rainy season and minimum 0.08 mg/L at Kolleru Lake in summer season.

Jain and Syed (1995), analyzed heavy metal concentration in water and sediments were determined in a shallow, highly eutrophic lake receiving domestic raw sewage. They observed the highest value of zinc in surface water was recorded 0.095 mg/L in winter 1993 at station I and II respectively. The concentration of zinc in bottom water was highest 0.157 mg/L in summer 1994 at station II and lowest 0.058 mg/L in post monsoon at station II.

Kaushik *et al.*, (1999), analyzed water samples collected from three lentic water bodies (Motijheel, Surajkund and Ranital) of Gwalior region (Madhya Pradesh), from July 1990 to June 1991 for some heavy metal content. Zinc concentrations are varied from 0.062 to 0.120 mg/L. The highest values are recorded during summer season in Motijheel, but averagely highest values are recorded in Surajkund. All the values of the three water bodies of the Gwalior region are found below the limit 5 mg/L.

Mwachiro and Durve (1997), carried out work on the concentration of heavy metals in the water of the reservoir Bari near Udaipur, Rajasthan. The accumulation of the metal ion in the different organs of the fish *Cirrhinus Mrigala*. The concentration of zinc in the lake water oscillated between 0.061 and 0.082 mg/L. The maximum was at the surface of station II in summer, while the minimum was at the

Table.1 Various concentrations of trace metals found at sampling sites S1, S2 and S3 during Feb. 2009 – Jan 2010

| Months | pH | | | Zinc (mg/L) | | | Iron (mg/L) | | |
|--------|------|------|------|-------------|------|------|-------------|------|------|
| | S1 | S2 | S3 | S1 | S2 | S3 | S1 | S2 | S3 |
| Feb | 7.51 | 7.55 | 7.55 | 1.05 | 1.13 | 1.09 | 0.22 | 0.28 | 0.21 |
| Mar | 7.45 | 7.48 | 7.47 | 1.10 | 1.17 | 1.14 | 0.26 | 0.29 | 0.24 |
| Apr | 7.40 | 7.43 | 7.41 | 1.13 | 1.18 | 1.16 | 0.29 | 0.34 | 0.27 |
| May | 7.35 | 7.39 | 7.37 | 1.16 | 1.24 | 1.20 | 0.30 | 0.35 | 0.30 |
| Jun | 7.47 | 7.51 | 7.49 | 1.13 | 1.20 | 1.15 | 0.29 | 0.30 | 0.27 |
| Jul | 7.69 | 7.72 | 7.69 | 1.00 | 1.14 | 1.06 | 0.16 | 0.21 | 0.20 |
| Aug | 7.94 | 7.98 | 7.91 | 0.98 | 1.04 | 1.00 | 0.09 | 0.15 | 0.15 |
| Sept | 8.11 | 8.13 | 8.12 | 0.87 | 0.95 | 0.92 | 0.07 | 0.13 | 0.12 |
| Oct | 8.10 | 8.11 | 8.10 | 0.88 | 0.98 | 0.94 | 0.08 | 0.11 | 0.10 |
| Nov | 7.79 | 7.83 | 7.82 | 0.93 | 1.02 | 0.99 | 0.14 | 0.17 | 0.11 |
| Dec | 7.72 | 7.76 | 7.74 | 1.00 | 1.06 | 1.04 | 0.19 | 0.21 | 0.17 |
| Jan | 7.60 | 7.62 | 7.61 | 1.02 | 1.10 | 1.07 | 0.22 | 0.25 | 0.19 |

All the values are mean of three readings.

Table.2 Various concentrations of trace metals found at sampling sites S1, S2 and S3 during Feb. 2010 – Jan 2011.

| Months | pH | | | Zinc (mg/L) | | | Iron (mg/L) | | |
|--------|------|------|------|-------------|------|------|-------------|------|------|
| | S1 | S2 | S3 | S1 | S2 | S3 | S1 | S2 | S3 |
| Feb | 7.55 | 7.58 | 7.55 | 1.17 | 1.21 | 1.30 | 0.23 | 0.28 | 0.22 |
| Mar | 7.49 | 7.51 | 7.50 | 1.23 | 1.31 | 1.34 | 0.24 | 0.31 | 0.24 |
| Apr | 7.45 | 7.48 | 7.48 | 1.32 | 1.39 | 1.41 | 0.27 | 0.33 | 0.25 |
| May | 7.31 | 7.36 | 7.37 | 1.41 | 1.48 | 1.47 | 0.29 | 0.36 | 0.27 |
| Jun | 7.56 | 7.58 | 7.57 | 1.34 | 1.43 | 1.39 | 0.26 | 0.31 | 0.25 |
| Jul | 7.80 | 7.82 | 7.81 | 1.33 | 1.39 | 1.34 | 0.18 | 0.23 | 0.20 |
| Aug | 8.10 | 8.10 | 8.11 | 1.09 | 1.18 | 1.17 | 0.14 | 0.22 | 0.18 |
| Sept | 8.38 | 8.4 | 8.39 | 1.03 | 1.11 | 1.10 | 0.12 | 0.18 | 0.13 |
| Oct | 8.20 | 8.21 | 8.19 | 1.03 | 1.14 | 1.13 | 0.15 | 0.19 | 0.13 |
| Nov | 7.90 | 7.91 | 7.91 | 1.06 | 1.16 | 1.17 | 0.18 | 0.21 | 0.17 |
| Dec | 7.82 | 7.82 | 7.83 | 1.10 | 1.16 | 1.22 | 0.19 | 0.26 | 0.20 |
| Jan | 7.66 | 7.68 | 7.65 | 1.11 | 1.18 | 1.26 | 0.21 | 0.26 | 0.22 |

All the values are mean of three readings.

bottom of station I in monsoon. The zinc accumulation in the organ of fish revealed highest value (1.904 mg/g) in the vertebral bones and the lowest accumulation (0.606 mg/g) was in the brain. Heavy metals primarily affect liver and kidney which are involved in the cleansing processes of the body fluids and tissues.

While in case of iron concentration the minimum iron concentration 0.07 mg/L was recorded in the month of Sept 2009 at site S1, while the maximum iron concentration 0.36 mg/L was recorded in the month of May 2010 at site 2 as shown in table 1 & 2.

Iron is the fourth most abundant element in the earth's crust (5%). It is used principally for structural materials, primarily steel, an iron carbon alloy. Iron also is used in magnets, dyes, pigments, abrasives, and polishing compounds (e.g., jeweler's rouge). As well as being an essential nutrient for erythropoiesis, iron is important to the proper functioning of myoglobin, heme enzymes, and metalloflavoprotein enzymes. Surface waters generally contain less than 1 mg/l of iron. Some ground waters and acid surface drainage may contain much higher levels of iron. Water containing more than 2 mg/L iron cause staining of clothes (while washing) and porcelain, and imparts a bitter astringent taste.

Dwivedi and Tiwari (1996), carried out work on seasonal variation in heavy metal content of river Ganga at Varanasi. In their study, iron concentration was detected at very high concentration, with minimum values being observed at University ghat, the entry point of river (76 to 158 µg/L) and maximum values in the river stretch from Harishchandra to Rajghat, the exit point (304.8 to 422.6 µg/L).

Israili and Khurshid (1991), determined the heavy metal concentration in water and sediments of river Yamuna have been studied from Delhi to Allahabad (a stretch of about 840 kms). They reported the iron content of river water ranged from minimum (75.15 µg/L) at downstream of Delhi to maximum (712.0 µg/L) at downstream of Agra which is followed by Mathura downstream (317.5 µg/L).

The variations in the concentration of selected heavy metals from Manjara dam water were investigated. The major sources of metals were domestic and agricultural runoff. The study was carried out at three sampling sites of the dam. The release heavy metals the dam is important mainly where the dam water is utilized as a source for drinking and irrigational water. During our entire study period, it was observed that, the concentration of metals was higher during the month of May and lower during the month of September. It was also noted that the concentration of metals in water is related to pH of water.

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