HEAVY METAL CONTENT IN WATER AND SEDIMENT

Introduction:
Out of 105 elements discovered and confirmed so far, over 65 are metals. Owing to their high thermal and electrical conductivity, high density, high melting and boiling points, malleability, ductility and other distinctly useful properties, metals find extensive use in human civilization. According to a rough estimate, 0.5 million tones of Zn and 310 million tones of Cu have been mined so far, used for domestic and industrial purposes and thus dispersed in to biosphere (Dara, 2002).

From the environmental pollution point of view, heavy metals have been divided 1) Non- Toxic but accessible 2) Toxic but non accessible 3) Toxic and accessible.

It is third category of potentially toxic and relatively accessible metals that have attracted more attention from the points of view of environmental pollution and public health. These toxic metals occur in very small quantities in the earths crust (less than 1000ppm) and hence are called ‘Trace metals’. These are further subdivided on the basis of their densities, those having densities below 5 g/cm\(^3\) are called ‘light metals’ and those with densities above 5 g/cm3 are designated as “Heavy metals”. Thus, metals like Hg, Cu, Cd, Zn, Ni etc. are generally known as “toxic heavy metals”. Although the toxic heavy metals are present in the earth crust in trace contents, anthropogenic activities such as industrial processing and use of metals, alloys and metallic compounds disperse them into the environment, thus assign up to their natural background contents (Dara, 2002).

The fresh water ecosystem occupies a very small area in comparison to marine ecosystem. Now a day’s degradation of these fresh water resources due to water pollution has become a serious problem for entire world. The effect of heavy metal on fresh water ecosystem has become global concern. These metals are persistent
and once released the environment for a prolonged period. The heavy metals have been recognized as serious pollutants in aquatic ecosystem with effect on organisms and which ultimately affect the ecological balance (Kelkar, 2001).

These heavy metals are well known pollutants, which are often encountered in many ponds, Lakes, rivers and dams of India and the most important aquatic fauna being subjected to stress caused by these heavy metals (Lohar, 2000). Toxic substances in nature occur as heavy metals, pesticides, halogen detergents, oil etc. with rapid evaluation in industrial and agricultural sectors, these discharge of a large number of pollutants in the form of heavy metals and pesticides has increased day to day. Heavy metals have a unique property of accumulation in organisms from very low concentration in water from lakes, rivers and dams (Kulkarni, 2000).

Water pollution by heavy metals is directly or indirectly altered by human activities. Large drinking water sources namely rivers, dams and lakes are contaminated with heavy metals pollutant from various sources, more than 2000 chemical contaminants have been identified in drinking water, many of which are pharmacologically active, and several of them are either carcinogenic or mutagenic (Kelkar, et al., 2001). According survey report of ATSDR (2001) 70% of the available water in India is polluted by heavy metals and other chemicals.

Input of heavy metals due to water pollution is of prime concern in industrialized and urbanized area, use of metal containing fertilizers, toxic insecticides and pesticides produced the pollution problem by way of agriculture runoff. In urbanized area, air pollutant interacts with water at their inter-phase and pollutes the water sources. This type of pollution is more conspicuous in case of dam water sources as they have become convenient means of disposal of industrial and domestic waste water (Asthán et al., 1998).

The residence time of heavy metals in an aquatic system depends upon many factor like the oxidation state of the metal, the
availability of the organic complexing ligands in the water body, the quantity and size of particulate material in the aquatic system and so on (Rao et al., 2003)

Heavy metal pollutants are a major problem in aquatic environment because of their toxicity, their persistency and tendency to accumulate in organisms and undergo food chain amplification. Heavy metals can affect the aquatic organism as toxic substances in water and sediment or as a toxicant in the food chain (Zyadah, 1995). Heavy metals, which occur naturally in trace amounts in aquatic environments, are essential for the normal metabolism of aquatic organisms hence, such certain metals are accumulated by the organisms for their physiological functions and use them as structural components (Krishna et al., 1991). Aquatic organisms may be adversely affected by heavy metals in the environment. The toxicity is largely a function of the water chemistry and sediment composition in surface water system. Slightly elevated metal contents in natural waters may cause several effects in aquatic organisms (Connell et al., 1984).

The massive growth of industry leads to over deposition of industrial wastes containing different chemical substances in the water of streams, lakes, rivers, dams thereby polluting the water in different ways, these waste threaten the aquatic fauna. The non-biodegradable substances have a tendency to accumulate in the bio system. Heavy metal salts constitute a very serious type of pollution in freshwater bodies because they being stable compounds and are not easily removed by oxidation, precipitation or other processes and affect the activity of the animals (Costa, 1966). The toxic metals of global concern today are mercury, lead, copper, zinc etc. organic and inorganic salts of mercuric are well known toxicants (Shivhare et al., 1996).

Heavy metals like selenium, lead, mercury, cadmium and aluminum are nonessential elements and are not required by the organisms. These are the common constituents of the earths crust
and hence the process of mining, refining, extracting, synthesis and
their use in industries and for domestic purpose result in
environmental contamination. Many heavy metal and their salts have
important applications in various industries and their presence in
the effluents is very apparent. Discharge of such metal containing
effluents into the aquatic environment and drainage of residues of
mining, there is manifold increase in the contents of these metals in
the aquatic media. As a result, the organisms tend to accumulate
these metals in excess, leading to severe metabolic disturbances,
which may ultimately result in the gradual elimination of the affected
species. Sublethal concentrations have equally serious effect on the
aquatic biota drastically altering growth, reproduction, fecundity and
other biological phenomenon (Harper et. al., 1979; Bently and Redi
1981; Chen and Yang 2001; Chindan et. al., 2003).

The problem of water pollution by trace metal is now well
known to be crucial all over the world and especially in a developing
country like India, everybody is facing the problem of ever widening
threat of water pollution due to modern technology, industrialization
and civilization (Mohan and Yogesh, 2003). A continuous and
indiscriminate massive discharge of industrial, domestic and
agricultural waste is bound to deteriorate its quality. Thus, there is a
need for biological monitoring studies to evaluate the toxic
concentrations of various chemical compounds so that some
preventive measure can be taken to ensure the safety of the
environment (Trivedi et. al., 1995).

Wastewater is the source of aquatic pollution, which contains
toxic substances in the form of pesticide residue, heavy metal salts,
oil, radioactive substances etc. The introduction of these
innumerable pollutants individually or in combination in natural
water causes ecological abnormalities. The indiscriminate and
widespread use of these chemicals for various purposes has caused
irreparable environmental damage and ecological crisis (Patil and
Kallanagouda 1997).
It is estimated that about 20,000,000 tones of organic chemicals are disposed into the environment throughout the world annually. It is well known that any chemical produced on an industrial scale ends up in the aquatic environment. It is now well recognized that the aquatic environment is the ultimate sink for all pollutants. It is also a known fact that the environmental pollutants pose greater problems to the aquatic organisms than to other. The non-target species may form the important compounds of the food chain and consumption of such species by human would severally affect the human population too. The freshwater habitants are more prone to hazard of pollutants with the recognition that crabs, fish and non-target organisms are very sensitive to a wide variety of toxic chemicals or metals. These different kinds of non-target organisms are not equally susceptible throughout the life cycle. Toxicity of various heavy metals to freshwater invertebrates and fishes has been studied several workers (Ahsanullah et al., 1981; Murthi and Shukla, 1984; Nagabhushanam et al., 1986).

Industrial effluents contributing to aquatic contamination contain very toxic substances. No doubt, presence of pollutants degrades the water quality and impairs its utility for drinking purpose and other aquatic animals, which serves as food for human being. The indiscriminate release of liquid waste of organic and inorganic nature changes physico-chemical characteristics of water and causes hazard to flora and fauna including important member of food chain of man and aquatic ecosystem (Baryan, 1976). In India, many industries are established on the bank of rivers where hazardous waste effluents are being discharged into these systems thereby causing severe pollution problems (Mudri and Godbole, 1967; Eja et al., 2003; Gopal et al., 2004 Davydova, 2005).

In sediment heavy metal are elements (Properties of metals satisfied) of high atomic number they have high utilities in industrial application from papers to automobiles, by their heavy characteristic properties. They found in the deep bowels of the earth as ores
(complexes of mixture). The metals are segregated from these ores, leaving behind the tailings that find their way into the environment as toxic pollutants. They get into the water bodies directly from point sources as sewage and non point sources such as runoff and atmospheric deposition that are transported from long distance. Heavy metals affect every content of the food web, from producer in the trophic contents to the higher order carnivore (Shinde, 2006).

Higher content of sedimentation can affect aquatic insect by altering biochemical conditions, food resources, respiratory diffusion gradients and habitat space. Avoidance of sediment regions was due to the loss of interstitial space between stone and behavior revealed that the flow of running water, usually means of dams and reservoirs has influenced nearly all of the world’s major river systems (Williamms and Feltmate, 1992)

Contaminant of sediment is a serious problem especially in country as densely populated as India. More ever rapid urbanization and industrialization have severally argument the growing burden of chemical contaminants upon the soil. Major classes of organic contaminant of aquatic and terrestrial ecosystems are polycyclic aromatic hydrocarbons (PAHs). These compounds affect micro-flora and pose a serious threat to human health due to their genotoxic, mutagenic and or carcinogenic potential (Raj and Sharma, 1995). The U.S. environmental protection agency has listed 16 PAHs as priority pollutants due to their detritus properties. The PAHs are highly recalcitrant and their biological transformation mediated by bacteria and fungi represents a potential route for their ultimate removal from the soil environment. The biodegradation of PAHs is reported to be influenced significantly by various environmental factors (Gupta, 1996; Fatma, 1997).

The movement of water and solutes by diffusion and convention within the soil profile involves a complex series of process which are important to agriculture and environment. Disposal of Industrial as well as domestic sewage on land is a common practice.
One of the major problems with land disposal of sludge is the likely introduction of heavy metals into the soil. Heavy metals movement and accumulation in soil have been reported in a comprehensive manner. Out of the metals present in soil a small amount is taken up by the edible part of vegetation, thus introducing the metals into food chain (Jenne, 1968). Another major effect of such disposal is the possibility of ground water pollution, depending upon soil conditions, mobility of metals, applied dose etc.

Hence the present study is aimed to investigate some of the important heavy metals contents such as Zinc, Chromium, Cadmium, Mercury and Lead, along with sediments of the Jaikwadi dam.
Material and Methods:

For analysis of heavy metals in water and sediments, samples were collected from Jaikwadi dam in three different seasons. Water, samples were collected in plastic containers, which were thoroughly cleaned with nitric acid and rinsed several time with distilled water. Analysis was carried out to determine the concentration of various metals like zinc, chromium, cadmium, lead and mercury by using atomic absorption spectrophotometer (AAS). Heavy metals were estimated by using standard method as described by APHA and AWWA (1992) while sediments samples were collected, pre-cleaned, acid washed PVC corer, transferred to clean ploy-bag and brought to the laboratory. These samples were washed with metal free double distilled water and dried in hot air oven at 110°C for 5 to 6 hours and grinded to powder in a glass mortar and stored in pre cleaned polythene bags; 500mg of the sample was taken and digested with a mixture of 1 - 2 ml Conc. H₂SO₄. A few drop of HF was added to achieve complete digestion on and the sample is filtered and marked up to 25ml with metal free double filtered distilled water for the estimation of Zn, Cr, Cd, Pb and Hg using Atomic Absorption Spectrophotometer (AAS) [Elico SL 167, 2006].
RESULTS:

Metal content in water

Zinc (µg/l):

Zinc (Zn) is an essential and beneficial element for human bodies. However, above 5 mg/l, cause bitter taste and opalescence in alkaline waters. The zinc concentration of U.S. drinking water ranges from 0.06 to 7 mg/l with a mean of 1.3 mg/l. zinc enters the domestic supply from deterioration of galvanized Fe and dezincification of brass, besides industrial waste.

In monsoon, during the first year study period (2004-05) the zinc content in water was ranged between 1.17 ± 0.07 to 1.22 ± 0.08. The lower level of zinc was recorded in September but in July it was reported to be at higher level. During second year (2005-06) it was ranged between 1.21 ± 0.05 to 1.26 ± 0.10. The low level of zinc was recorded in June and high level was reported in August.

In winter, (2004-05) zinc content in water was ranged between 0.76 ± 0.06 to 0.84 ± 0.05. The lower level was recorded in January but in October it was reported to be at higher level. In second the year (2005-06) it was ranged between 0.74 ± 0.06 to 0.86 ± 0.09. The lower level of zinc was recorded in December but in November it was reported to be at higher level.

In summer, during the first year study period (2004-05) zinc content in water was ranged between 1.66 ± 0.09 to 1.71 ± 0.10. The lower level of zinc was recorded in March and higher content was reported in May. In second year (2005-06) the zinc content in water was ranged between 1.73 ± 0.06 to 1.86 ± 0.13. The lowest value was recorded in March while highest in May.

In the present study in both the year (2004-06) zinc content reported was higher in summer and lower in winter compared to two other seasons (Table1; Fig. 1).

Chromium (µg/l):

Chromium salts are used extensively in metal finishing and plating application, in anodizing aluminum and in the manufacture
of paints, dyes, explosives and ceramics. Chromium is toxic to human, animals and aquatic life. It can produce lung tumor when inhaled and readily induces skin sensitization.

In monsoon, chromium content in water was ranged between 3.98 ± 0.02 to 4.04 ± 0.13. The lower content of chromium was recorded in August and higher in September in the year 2004-2005. In second year, the chromium content was ranged between 3.90 ± 57.57 to 4.00 ± 25.93. The lower level of zinc was reported in July and higher level in August.

In winter, it was ranged between 1.67 ± 0.04 to 1.74 ± 0.01. The low level of chromium was recorded in October and high in January in the year 2004-2005. During the second year study period (2005-06) the chromium content was ranged between 1.60 ± 85.96 to 1.78 ± 19.81. The lower level was recorded in October and higher level in December.

In summer, during the fist year study period (2004-05) the chromium content in water was ranged between 1.92 ± 0.03 to 1.97 ± 0.11. The lower level was recorded in February and higher level in March. In second year (2005-06) it was ranged between 1.91 ± 61.91 to 2.1 ± 21.68. The lower level of chromium was recorded in February while higher in April.

In the present study (2004-05) the chromium level was recorded higher in monsoon during both the years but it was at lower level in summer during 2004-05 and in winter 2005-06 (Table 2; Fig.2).

**Cadmium (µg/l):**

Cadmium is extensively used in the manufacture of batteries, paints and plastics. In addition, it is used to plate iron product, such nuts and bolts for corrosion prevention electroplating industries. It is from plating operation that most of the cadmium riches the water environment.

In monsoon, during the fist year study period (2004-05) cadmium content in water was ranged between 2.27 ± 0.03 to 2.30 ±
0.01. The lower level of cadmium was recorded in August and higher in September. In second year it was ranged between 2.20 ± 62.01 to 2.33 ± 80.03. The lower content was recorded in August but in July it was reported to be at higher level.

In winter, the cadmium content was ranged between 2.34 ± 0.005 to 2.38 ± 0.02. The lower level was recorded in October and higher January during the 2004-2005. In second year (2005-2006) the cadmium content was ranged between 2.30 ± 50.04 to 2.34 ± 60.03. The lower content of cadmium was recorded in January but in November it was reported to be at higher content.

In summer, (2004-05) the cadmium content was recorded in the range between 1.94 ± 0.04 to 1.98 ± 0.02. The lower level of cadmium was recorded in April however in March it was reported to be at higher level. In second year (2005-06) the cadmium content in water ranged between 2.02 ± 10.08 to 2.05 ± 30.09. The lower level was recorded in March and higher in April.

In the present study (2004-2006) the cadmium content was higher in monsoon and lower in summer compared to two other seasons (Table 3; Fig.3).

**Lead (µg/l):**

Lead concentration in surface and ground raw water ranged from traces to 0.04 mg/l, averaging about 0.01 mg/l. industrial and mining sources may contribute to some localized Pb pollution. Use of Pb pipes in water supplies may provide high Pb at consumer’s point. In most cases, higher Pb concentration is expected at the consumers tap than that of water treatment.

In monsoon, during the study period of 2004-05 the lead content in water was ranged between 18.36 ± 0.07 to 18.38 ± 0.09. The lower content of lead content was recorded in August while higher in September. During second year (2005-06) it was ranged between 18.34 ± 0.04 to 18.47 ± 0.04. The lowest value of lead was recorded in July while highest content in September.
In winter, the lead content was ranged between $16.93 \pm 0.07$ to $16.98 \pm 0.15$. The lower level of lead in water was recorded in October while higher level in December (2004-2005). During second year it was ranged between $16.93 \pm 0.07$ to $17.00 \pm 0.19$. The lower content of lead was recorded in October but higher in November.

In summer, 2004-2005 it was ranged between $14.26 \pm 0.05$ to $14.34 \pm 0.06$. The low level was recorded in March and high in April. In second year (2005-2006) it was ranged between $14.30 \pm 0.04$ to $14.42 \pm 0.07$. The lower level was recorded in March while higher in April.

In the present study (2004-2006) the lead content was higher in monsoon and lower in summer compared to two other seasons (Table 4; Fig. 4).

**Mercury (µg/l):**

Mercury detected in surface water is predominantly in the form of inorganic mercury. Maximum concentration reported by USEPA that 30% water had content above 0.5 µg/l. The principal target organ of inorganic Hg is kidney with neurological and renal distribution.

In monsoon, during the first year study period (2004-05) the mercury content in water was ranged between $15.21 \pm 0.03$ to $15.64 \pm 0.31$. The lower level of mercury was recorded in July and higher in September. During second year (2005-2006) it was ranged between $15.17 \pm 0.02$ to $15.36 \pm 0.18$. The lower level of mercury was recorded in August but in June it was reported to be higher level of mercury.

In winter, the mercury content in water was ranged between $17.23 \pm 0.03$ to $17.37 \pm 0.20$. The lower level of mercury was recorded in October and higher in January (2004-05). During second year it was ranged between $17.30 \pm 0.01$ to $17.10 \pm 0.06$. The lower level was recorded in January while higher level of mercury was reported in December.
In summer, during the first year study period (2004-05) the mercury content in water was ranged between 18.22 ± 0.03 to 18.17 ± 0.05. The lower level of mercury was recorded in February and higher level in March during both the year of study period. (In second year (2005-2006) it was ranged between 18.18 ± 0.07 to 18.23 ± 0.03). Thus the mercury content was recorded higher in summer and lower in monsoon compared to two other seasons (Table 5; Fig. 5).

Metal content in sediment:

Zinc (µg/gm):

In monsoon, during the first year study period (2004-05) zinc content in sediment was ranged between 0.64 ± 0.04 to 0.69 ± 0.06. The lower level of zinc was recorded in July and higher level was reported in August. In second year (2005-06) it was ranged between 0.64 ± 0.05 to 0.65 ± 0.10. The lower level of zinc was recorded in August but in July it was reported to be at higher level.

In winter, it was ranged between 0.19 ± 0.05 to 1.16 ± 1.59. The lower content of zinc level in sediment was recorded in November but in October it was reported to be at higher level (2004-05). During second year the zinc content was reported between 0.15 ± 0.04 to 0.24 ± 0.03. The lower content of zinc was recorded in December but in October it was reported to be at higher content.

In summer, (2004-05) the zinc content in sediment was ranged between 1.54 ± 0.05 to 1.59 ± 0.05. The lower content of zinc was recorded in March and higher in April. During second year (2005-06) zinc content in sediment was ranged between 1.52 ± 0.08 to 1.60 ± 0.04. The lower level was recorded in March whereas higher in April. Therefore the zinc content in sediment was recorded higher in summer and lower in winter compared to two other seasons (Table 6; Fig. 6).

Chromium (µg/gm):

In monsoon, during the first year (2004-05) chromium content in sediment was ranged between 10.12 ± 0.04 to 10.17 ± 0.06. The
lower level of chromium was recorded in September but August it was reported to be at higher level. In second year (2005-06) chromium content in sediment was ranged between 10.14 ± 0.03 ± 10.20 ± 0.02. The lower level was recorded in July but in June it was recorded to be at higher level.

In winter, chromium content in sediment was ranged between 5.05 ± 0.03 to 5.11 ± 0.03. The lower content was recorded in November and higher in January during the period of first year (2004-2005). In second year (2005-2006) it was ranged between 5.11 ± 0.01 to 5.20 ± 0.1. The lower content of chromium was recorded in October while higher in December.

In summer, it was ranged between 9.59 ± 0.00 to 9.73 ± 0.06. The lower level of chromium was recorded in April and higher in May during the first year (2004-05). In second year the chromium content in sediment was ranged between 9.63 ± 0.08 to 9.73 ± 0.11. The lower level of chromium was recorded in May but in April it was reported to be at higher level. Chromium content in sediment was reported in higher in monsoon while lower content was recorded in winter compared to two other seasons (Table 7; Fig. 7).

**Cadmium (µg/g):**

In monsoon, during the first year (2004-05) cadmium content in sediment was ranged between 5.26 ± 0.05 to 5.34 ± 0.07. The lower level of cadmium in sediment was recorded in June and higher in July. In second year (2005-2006) it was ranged between 5.28 ± 0.03 to 5.35 ± 0.08. The lower content was recorded in June while higher in September.

In winter, the cadmium content in sediment was recorded in the ranged between 4.19 ± 0.05 to 4.30 ± 0.04. The lower level of cadmium was recorded in January but in December it was reported to be at higher level during (2004-05). In second year the cadmium content in sediment was ranged between 4.22 ± 0.07 to 4.29 ± 0.07. The lower level of cadmium was recorded in October while higher in January.
In summer, during the first year study period the (2004-05) cadmium content in sediment was ranged between 1.49 ± 0.01 to 1.60 ± 0.07. The lower level of was recorded in March and higher in February. In second year (2005-2006) it was ranged between 1.47 ± 0.05 to 1.61 ± 0.07. The low content was recorded in March and high in February. Hence, cadmium content in sediment was reported was higher in monsoon and lower in summer compared to two other seasons (Table 8; Fig. 8).

**Lead (µg/g):**

In monsoon, during the first year (2004-05) lead content in sediment was ranged between 24.35 ± 0.06 to 24.43 ± 0.05. The lower level was recorded in July and higher in September. During second year (2005-06) lead content in sediment was ranged between 24.35 ± 0.06 to 24.40 ± 0.08. The lower level of lead was recorded in September but in July it was reported to be at higher level.

In winter, (2004-05) lead content in sediment was ranged between 16.84 ± 0.05 to 16.87 ± 0.06. The lower level of lead was recorded in February and higher in March. In second year (2005-06) it was ranged between 10.45 ± 0.05 to 16.90 ± 0.11. The lower level was recorded in April while in February it was reported to be higher level.

In summer, during the first year (2004-05) the lead content was ranged between 20.24 ± 0.06 to 20.28 ± 0.04. The lower level was recorded in May but in March it was reported to be at higher level. During second year (2005-06) it was ranged between 20.25 ± 0.03 to 20.29 ± 0.08. The lower level of lead was recorded in April and higher in May. The lead content in sediment (2004-06) was recorded higher in monsoon and lower in winter compared to two other seasons (Table 9; Fig. 9).

**Mercury (µg/g):**

In monsoon, during the first year (2004-05) mercury content in sediment was ranged between 11.26 ± 0.04 to 11.34 ± 0.07. The lower content of mercury was recorded in October and higher content
In December. In second year (2005-06) the mercury level was ranged between $11.25 \pm 0.05$ to $11.29 \pm 0.07$. The lower level of mercury was recorded in January but in October it was reported to be at higher level.

In winter, (2004-05) the mercury content in sediment was ranged between $10.48 \pm 0.03$ to $10.50 \pm 0.02$. The lower level of mercury was recorded in February and higher level in March during both the year study period while in second year (2005-06) it was ranged between $10.45 \pm 0.04$ to $10.51 \pm 0.02$. It was low in February and high in March.

In summer, during the first year (2004-05) mercury content in sediment was ranged between $13.27 \pm 0.06$ to $13.35 \pm 0.07$. The lower level of mercury was recorded in July and higher in September. In second year (2005-2006) it was ranged between $13.29 \pm 0.04$ to $13.36 \pm 0.14$. The lower content of mercury was recorded in September but in August it was reported to be at higher level. The mercury content in sediment (2004-06) was recorded higher in monsoon and lower in summer compared to two other seasons (Table 10; Fig.10).
DISCUSSION:

Metal contents in water and Sediment:

In aquatic environments, metals have been termed as conservative pollutants because once added to the environment, they prevail for-ever. Further, the seriousness and persistence of heavy metals in water compounded by the fact that generally they are water soluble, non-degradable and strongly bounded to many biochemicals, especially polypeptides and proteins besides other materials which loss electron rich functional groups such as sulfahydryl and amino (Gurd and Wilcox, 1956).

Further, the heavy metal salts, being stable compounds are not readily removed by oxidation, precipitation, and other processes and affect the activities of the animals. Hence, the pollution of the fresh water environments by heavy metal contamination is major concern since it may lead to deterioration of natural habitats by depleting ecologically sensitive species or by eliminating commercial species (Marshall, 1985) and also pose a serious health hazard to humans.

For having the more and good quality food from the freshwater animals, environmental condition or the natural habitat of an organism should be free from pollution. The habitat of the aquatic animal is constantly affected by several environmental conditions and man-made activities. In recent years, water pollution has become a serious problem along with increasing human population and industrialization. However, water is one of the basic needs of human life but man has always polluted it. Almost all the industrial waste product both treated and untreated is being disposed off into nearby water reservoirs. These wastes generally contain toxic substances in the form of salts of heavy metals, radioactive elements, and synthetic biocides, oils, organic molecules and other group of miscellaneous substances. Most of the rivers have been receiving domestic and industrial effluents and runoff from agricultural land for several decades. Man has brought-out significant changes in the
natural environment by both ways intentionally and accidentally, sometime causes disasters (Khan, 2005).

Some trace metals have a variety of biochemical functions and play an important role in the growth and development of living organism in excess adversely affects the organism. The trace metals are known to be non biodegradable and highly toxic to most organisms. Even if there smaller concentration exist in natural waters these are common aquatic pollutants. Metals enter into the body of an organism along with nutrients, food and water which results in their accumulation in tissues causing important physiological dies function and may lead to death. Traces of heavy metals contaminate aquatic ecosystem and pose a serious threat to the environment because of their persistence and toxicity. Industrial, agricultural and domestic waste pollutes the water bodies with heavy metals which reach to the human body through food chain. A good amount of the discharged metals accumulate in body tissue of benthic organism and are often considered as potential indicator of pollution depends on their availability and magnitude of accumulation (Mohan et al., 2003).

Increase in heavy metals in water produces histological or morphological changes in tissue, changes in physiology, such as suppression of growth and development, changes in circulation, change in biochemistry, such as enzyme activity and blood chemistry, change in behavior and respiration (Kulkarni, 2000). Many organisms are able to regulate the metal concentrations in their tissues. Fish and crustacean can excrete essential metals such as Zn, Cr, Cd, Pb and Hg that are present in excess. Some can also excrete non-essential metals, such as mercury and cadmium, although this is usually met with less success (Connell, et al., 1984). Research has shown that aquatic plants and bivalves are not able to successfully regulate metal uptake (Connell, et al., 1984). Thus, bivalves tend to suffer from metal accumulation in polluted environments. In aquatic water bodies such as dams and lakes,
bivalves often serve as bio-monitor organism in areas of suspected pollution (Kennish, 1992).

There are several reports, on heavy metal pollution by various authors. Forstner (1978), found high content of lead and zinc in the European lakes under the influence of civilization. A survey carried out by Govardhan (1990), in order to study the heavy metal pollution in the different Himalayan lakes revealed that those lakes were highly contaminated with various heavy metals. Welch (1952), pointed out that the zinc, cadmium, lead etc. are well known toxic heavy metals that occur in various waste including municipal effluents and urban run-off apart from industrial effluents causing either acute or chronic effects on organisms in an aquatic environment. Kelkar et al., (2001) and Pondhe (2002) pointed out the main sources of pollution for river Damodar and Godavari are the discharge of uncontrolled and partially treated industrial effluents containing toxic metals. Studies have revealed the effect of discharge of these industrial effluents on the receiving surface water bodies (Desai, 1995 and Baruah et al., 1983).

The pollutant that enters into aquatic ecosystem create extensive damage to the life and activities of the living organisms and even to mass mortality (Anandan, 1994). Assessment of metal in water and sediment become necessary enabling us to drawn certain baseline information for monitoring metals like Zn, Cr, Cd, Pb and Hg which are toxic to water and fish (Srivastava, 1985). The heavy metals were higher in waste waters due to the presence of major sources of metal pollution, intensive human activities and discharge of municipal wastes and industrial effluents (Govindasamy and Azariah, 1999). Heavy metals pollution has persisted as an issue of concerns in the late 1950s especially after Itai-Itai (AMAP, 1997) and Minamata (Ministry of Environment of Japan 2002) tragedies in Japan.

Among all the toxicant, industrial pollutants occupy prime importance as they release heavy metals into the environment.
Toxicity of any metal is regarded with its degree of harm to any organism. Some of the metals like Hg, Pb, Cd, Cu, and Zn are highly toxic at very low concentration and it depends upon the solubility of metal in water. Accumulation of metal also depends on environmental factors e.g. temperature, salinity, dissolved oxygen etc. among invertebrate, molluscs and crustaceans are considered as excellent indicator organisms (Mohan et al., 2003).

Zinc is very common substance that occurs naturally. Many foodstuffs contain certain content of zinc. Drinking water also contains certain amount of zinc which may be higher when it is stored in tank. Industrial sources or toxic waste sites may contain the zinc amount in drinking water to reach that can cause health problems. Zinc occurs naturally in air, water and soil but it content are rising unnaturally, through human activates. Most of zinc is added during industrial activities, such as mining coal, waste combustion and still processing. Some soils found in areas where zinc has to be mined or refined or sewage sludge from industrial area and it also used as fertilizer (Bhosle, 1998). Although human could handle proportionally large content of zinc. Too much zinc can still cause eminent health problems, such as stomach cramps, skin irritation, vomiting, nausea and anemia. High levels of zinc can damage the pancreas and disturb the protein metabolism and cause arteriosclerosis. Extensive exposure to zinc chloride can cause respiratory disorders (Forstner and Wittmann, 1983 and Viessman, 1993).

In the present study, the Zinc level in water sample was ranged between 0.23 ± 0.02 to 1.77 ± 0.05 µg/l. The lower level was recorded in winter and higher level was reported in summer. The zinc content was higher in summer. In summer, the water volume of the dam was reduced substantially, it is likely that the heavy metal concentration increases with the anthropogenic input or it may be due to the natural and anthropogenic activities, agricultural runoff, domestic activities, wastewater discharges, effluent discharges and another
non-point sources opened into water bodies. These agreements were according to Dons and Beck (1993), Fernandes et al. (1994). The sources of zinc are metallurgic industry, pyrite mines, galvanic industry, incineration plants and anti corrosive products, paints, plastic and rubber, anthropogenic activity, wastewater discharges, effluent discharges and another non-point sources. (Nicholos, 1991).

Wadhawan et al., (1991) carried out the analysis of zinc content in the lake Kailana, Bulsamand and Ranisar near Jodhpur and observed the high content 0.25 mg/l and low 0.07 mg/l. Brij Mohan et al., (1991), found heavy metal pollution in aquatic environment of Kadarabad drain modinagar and observed a range between 3.8 mg/l to 8.2 mg/l. Zinc containing effluents discharged into the aquatic environment have effective toxicity to aquatic organisms as described by Anadu et al. (1989). Moni and Dhas (1989) reported less toxicity of zinc in hard waters than in soft waters as toxicity is antagonized by ions such as calcium and magnesium.

Shanti et al. (1990) estimated the seasonal variation of zinc content in the estuarine water recorded the maximum amount in summer and rainy season while minimum in winter. Similar observation was recorded for the drinking water sample collected from Jodhpur city (Prachaland and Seenayya, 1989 and Wadhawan et al., 1991).

Chromium contamination is frequently studied and there are many research reports which are extremely important due to existence of several sources of chromium contamination in the environment like manly anthropogenic activities, domestic wastewaters, industrial effluents etc and so on (Rashed, 2001).

In the present study, the chromium content in water sample was ranged between 0.68 ± 0.17 µg/l to 4.00 ± 0.02 µg/l. It was lower in summer and higher in monsoon. The major sources of chromium are the electroplating and metal finishing industries and publicly owned treatment plants relatively minor sources (other than localized contamination) are iron and steel foundries, inorganic
chemical plants, tanneries, textile manufacturing, and runoff from urban and residential areas. Similar observations were made by Towill et al. (1978) and Ecological Analysts (1981). Nicolay et al., (2006) observed that river are dominant pathway for metals transport and that the existence of heavy metals in aquatic environments has lead to serious concerns about their influence on plant and animal life.

Chromium is necessary in low concentration to human beings (trace metals). High contents may cause many diseases and injuries to the human health besides, they tend to be bioaccumulation in upper contents of the food chain. Bioaccumulated, an increased the content of chemical compound in a biological organism over period of time, compared to the chemical content in the environment (Khan, 2005). According to WRI (2006), human beings are exposed to metals through inhalation of air pollutants, consumption of contaminated drinking water and food and exposure to contaminated soils or industrial waste. Food sources, such as vegetables, grains, fruits, fish and shellfish may become contaminated by accumulating metals from surrounding water. Therefore, Davydova (2005) considered that metals can exert detrimental effects not only on human health but also on the whole environment. Tassaduae et al. (2003) observed that the physical and chemical characteristics of river water showed seasonal fluctuations, interacting with one another and having combined effects of animals and plants. Rivers are important sensor of the kind of human activities that are developed around.

Amongst heavy metals, cadmium is estimated to be one of the five toxic heavy metals found in the aquatic environment. Cadmium is a natural, usually minor constituent of surface and groundwater. It may exist in water as the hydrated ion, inorganic complexes such as carbonates, hydroxides, chloride and sulphates or as organic complexes as humic acids (OECD 1994). Cadmium may enter aquatic systems through weathering and erosion of soils and bedrock, atmospheric deposition, direct discharge from industrial
operations, leakage from landfalls and contaminated sites, and the dispersive use of sludge and fertilizers in agriculture. Much of the cadmium entering fresh water from industrial sources may rapidly by adsorbed by particulate matter, and thus sediment may be a significant sink for cadmium emitted to the aquatic environment (WHO 1992).

During the present study, it has been observed that the cadmium content in water was ranged from 1.95 ± 0.02 to 2.29 ± 0.01 µg/l. The lower content of cadmium was recorded in summer and higher content was recorded in monsoon. The possible sources of cadmium in river water system are contributed by domestic wastewater released from residential area, impetuously use of pesticides, fertilizers used in palm oil estates along the rivers bank and local air pollution caused by open burning (Lund 1971; Mortvedt 1987; Schroeder et al., 1967). The increase in traffics is correlated strongly with the existing of cadmium compounds to the environment. Cadmium compounds have been used as lubricating agents and in rubber tyre. The content of cadmium in lubricant oil was between 1.20 to 2.26 mg/l, while in rubber tyre ranges from 20-90 mg/l (Laggerweff and Specht 1970).

This further showed that cadmium in dissolved form in water existed more in the dam than with the soil. The possible sources of cadmium in all 14 major river viz. Godavari to Kaveri are contributed by domestic wastewater, sewages released, untreated effluent from domestic sources, industrial, residential area, impetuously use of pesticides, fertilizers, fungicides, herbicides etc. (Schroeder et al., 1967; Mathias and Cummings, 1973; Mortvedt 1987; Pondhe and Jadhav 2002 and Patil et al., 2005).

Perusal of literature shows that in lakes and dams ranged from 1.28 to 1.90 ppm in contrast to the contents of generally less than 0.1 ppm cited above for fresh waters (Cook and Morrow 1995). Partitioning of cadmium between the adsorbed in sediment state and dissolved in water state is therefore an important factor in weather
cadmium emitted to waters is or is not available to enter the food chain and affect human health. Dams, Rivers, lakes and ponds containing excess cadmium can contaminate surrounding land, either through irrigation for agricultural purposes, dumping of dredged sediments or flooding. It has also been demonstrated that rivers can transport cadmium for considerable distance up to 50 km, from the source (WHO, 1992).

Fresh water ecosystem receives cadmium from many sources such as phosphate fertilizers, incinerator waste, coal and oil combustion and mining and industrial use of cadmium. Cadmium content in fresh water system shows seasonal variations due to release industrial wastes. Studies conducted by Forstner and Muller (1974) showed 220 µg/g cadmium in up stream and down stream at the confluence of Exz and Ncker river in F.R.G., Kneip et al., (1974) also showed high content of cadmium in aquatic ecosystem of marshes and coves along the eastern side of Hudson river, New York. There are evidences that high value of cadmium is associated with the sediments, increasing from the mouth of river towards the estuary and open sea. Muntau (1981) studied the distribution of cadmium along with other metals in water, sediment and biota of Lake Maggiore in north Italy. Houda and Remaele (1982) found very high level of cadmium in the sediment of river Vesdre in Belgium in an area of 2 to 4 km. from a factory that was a source of cadmium pollution. Sediment in aquatic environment also plays a very important role. The benthic organisms are most likely members to be affected by metals in sediment, because the benthic environment is main repository of particulate materials that wash in to aquatic system. Invariably sediment near sewer out fall contains high metal content because of discharge from municipal and industrial wastes (Klein and Goldberg 1970). The content of heavy metals in the water has been estimated by many workers (Senjupta et al., 1978, Koch et al., 1980, Inza et al., 1997). The release of metals from water and their effect on aquatic environment and human being have been
documented by Copeland and Ayres, (1972). Satyanarayan et al., (2002) found that the metal pollution in harbor and coast of Vishakhapatnam and Tuticorin are due to untreated domestic sewage, industrial effluents and land run off. This was later confirmed by Ganesha and Kanna (1995), metal pollution in harbor sediments of Paradip port East coast of India was reported by Mahapatra et al., (1996). Seasonal variations in the metals like cadmium in estuarine water are reported by Brayana and Uysal, (1978); Sastri, et al., (1981), Metayer, et al., (1985); Athalye and Gohkale, (1994); Pillai and Valsala, (1995); Chakrabarty and Vass 1999; Chang and Wang 2000; Anderson et al., (2001) and Huang, (2001). Many workers demonstrated that urban and industrial activitates increased metal content in polluted areas and are potential sources of contamination in aquatic environment (Waldichaeh, 1974; Nriagu, 1979; Mhatre et al., 1983; Ayyadurai et al., 1983; Singh and Singh, 1990; Yousef 1990; Storelli et al., 2000 and Zelewski et al., 2001). Metal content of aquatic organism are typically several orders of magnitude higher than that in the water, this is because they are progressively concentrated at higher trophic levels (Patil, 1993).

The natural lead content of lakes, rivers, and dam’s water world wide has been estimated to be 1-10 ppm. Although higher values have been recorded where contamination has occurred particularly from industrial sources, such situation are relatively rare, since there are number of natural mechanism that control the levels. The contents in water prior to its distribution are generally lower than at source since lead is particularly removed by most conventional water treatment processes. The level in drinking water can be much higher owing to the use of lead services pipes running from the street to a dwelling, from lead, plumbing and or lead lined storage tank, particularly high lead levels can result when the water is aggressive soft or has low pH (Webb, 1988). Welch (1980) and Wetzel (1983) concluded that lead wastes was the most important factor brings about eutrophification and algal growth. Beside Gupta
and Saxena (1997), Mohapatra and Singh (1999) and Sharama et al., (2000) contributed to the lead evaluation in fresh water.

In the present study, the Lead content was in water was ranged between $14.31 \pm 0.04$ to $18.37 \pm 70.01 \mu g/l$. While it was lower in summer and higher in monsoon. The lead concentration was increased and by excess released free metal ions into the water bodies from kitchen utensils and solubility of old paintwork from building during acidic wet deposition (Lim Sun Hoo et al., 2003). The discharge of lead in Labu River System and Godavari river or Yamuna river has mainly originated from lead containing domestic wastewater such as from metabolic wastes, corrosion of household plumbing systems, local scale open burning, surface runoff of pesticide in agricultural estates and wet deposition (Laws 1971; Waite 1984 and Pondhe and Jadhav, 2002). Extensively open burning of diffused battery and newspaper is a primarily factor which polluted the local atmosphere with lead (Lim Sun Hoo et al., 2003).

Mercury and copper metals occur in nature, and added to the aquatic environment by natural process of weathering and erosion. However, in recent years mercury and copper are being discharged into the environment in ever increasing quantities from mining operations, refining processes, chlorine alkali plants, pulp and paper, plastic industries, electronic industries, hospitals, agricultural practices, drugs and burning of fossil fuel etc. (Sharma, 1993)

Mercury is among the most toxic of the heavy metals, has complex behavior in the environment, and may persist for decade following abatement of the source. Mercury’s environmental persistence is due in part to its high affinity for particulates and organic matter. Even, if mercury content in sediment and water decreased over time, content in organism may not decreased due to the slow rate of elimination of the highly bioavailability methyl-mercury form. The physical properties, biodiversity and toxicity of mercury are governed by speciation into both organic and inorganic
forms. Elemental mercury, bivalent inorganic mercury and mono methyl mercury are the three most important form of mercury occurring in natural aquatic environments (Battelle, 1987).

Mercury that is discharged into the environment may be metallic mercury, inorganic mercury compounds or they may be alkyl, alkoxy–aryl or other organic mercury compounds. Once discharged into the environment the mercury compounds are capable of a wide variety of transformation (Jensen and Jernelov, 1969). Further, relative toxicity of various mercury compounds depends on the chemical nature and degree of mobility in the environment and the extent, to which they accumulate in the three oxidation state viz., metallic, mercurous and mercuric salts. The organic mercury compounds includes methyl mercury and phenyl compounds. Natural processes form the methyl mercury compounds. The inorganic mercury is relatively less toxic than its metallo-organic compounds. Certain bacteria have been found to convert mercuric ion to mono or di-methyl mercury (De. 1989).

In the present study the mercury content in water was ranged between 15.24 ± 0.08 to 18.21 ± 0.02 µg/l. It was lower in monsoon and higher in summer. Human activities prevail in the vicinity of dam and domestic animals always graze and wander around dam. The passage through natural influx also exists for the domestic discharge, sewage water into the pond, which is arriving from the village might have contributed mercury in the water and sediments. The water body receives much water in monsoon due to heavy rainfall and gets flooded. However, in summer the level of water considerably decreases. From monsoon (July) to winter (March) much vegetation exists in the water body which likely to contribute much of the pollution problems in the Jaikwadi dam. Similar observations were reported by Patil (1993), Patil and Mane (1998) and Patwari (2002). Mercury enters into water bodies naturally as well as through industrial effluents. It is a potent hazardous substance. Both inorganic and organic forms are highly poisonous.
and methyl mercury gives off vapours. Mercury was responsible for the Minamata epidemic that caused several deaths, in Japan and Sweden. The tragedy occurred due to consumption of heavily mercury contaminated fish (27 to 102 ppm, average 50 ppm) by the villagers. The source of mercury to the bay was a single chloride producing plant, using the HgCl$_2$ as a catalyst. In Sweden, many rivers and lakes are already polluted due to widespread use of mercury compounds as fungicides and algaecides in paper and pulp industries and in agriculture. Chloral alkali plants seem to be the chief source of mercury containing effluents (SEP, 2000). Paper and pulp industries of Japan and Canada also cause mercury pollution. Effluents of industries making switches, batteries, thermometers, fluorescent light tubes and high intensity street lamps contain mercury (ATSTR, 2000b).

From the effluents mercury compounds enter the water body and at their bottom, these are metabolically converted into methyl mercury compounds by anaerobic microbes. Hammond (1971) observed the biotransformation of mercury to methyl mercury by microorganism of intestinal tract of animals. Methyl mercury is highly persistent and thus accumulates in food chain. Methyl mercury is soluble in lipids and thus after being taken by animals, it accumulates in fatty tissues. Fish may accumulate the methyl mercury ions directly may be nearly 3000 times more in fish than in water. In Minamata bay, all the mercury in seafood is as organic methyl mercury compounds. The symptoms of Minamata include malaise, numbness, visual disturbance, dysphasia, ataxia, mental deterioration, convulsions and final death. Mercury readily penetrates the central nervous system of children born in Minamata causing teratogenic effects (MEJ, 2002). Methyl mercury penetrates through placenta. Swedish fish eaters have high mercury content in blood. In Drosophila, methyl mercury (0.25 ppm) treatment brought chromosomal disjunction in gametes (Ministry of Environment of Japan 2002).
Sediment in aquatic environment plays a very important role. The benthic organisms are most likely members to be affected by metals in sediments, because, the benthic environment is the main repository of particulate materials that wash into aquatic system. Invariably sediment near sewer outfall contains high metal concentration because of discharge of municipal and industrial wastes (Klein and Goldber, 1970). The importance of metals in sediment under appropriate conditions could leach out of the sediment for many years. The concentration of heavy metals in water and sediment has been estimated by many workers (Sengupta et al., 1978; Koch et al., 1980 and Inza et al., 1997). The released of pollutants and metals from sediment and their effect on aquatic environment and human being have been documented by Copeland and Ayres (1972). Satynarayan et al., (1994) found that the metal pollution in harbor and coast of Vishakhapatnam and Tuticorin are due to untreated domestic sewage, industrial effluent and land runoff. This was confirmed by Ganeshan and Kannan (1995). Metal pollution in harbor sediments of Paradip port East coast of India was reported by Mahapatra (1996). Seasonal variations in the metals like mercury, cadmium, chromium, zinc, lead and many other trace metals in estuarine water, sediment and soft tissue of estuarine animals are reported by Brayan and Uysal, (1978), Sastri, et al., (1981), Metayer, et al., (1985), Athalye and Gohkale (1994), Pillai and Valsala, (1995), Chakrabarthy and Vass, (1999), Chang and Wang (2000). Many workers demonstrated that urban and industrial activities increased metal content in polluted areas and they are potential source of contamination of the aquatic environment (Waldichaeh, 1974; Nriagu, 1979; Mhatre et al., 1983; Ayyadurai et al., 1983; Yousef 1990). Metal concentrations in aquatic organism are typically several orders of magnitude higher than that in the water, this is because they are progressively concentrated at higher trophic levels.
Sediments are important sources for the assessment of man-made contamination in aquatic systems (Gaur et al., 2004). Moreover, sediments contamination causes very noxious effects to the whole ecosystem (Jardim, 2004). The comparison between some trace and heavy metal concentrations in aquatic system present different dynamics, help to better understand the processes involved in these ecosystems and significantly help in the context of environmental management plans. It is necessary to mention that there is strong relationship between water column and sediment, as water characteristics influences the sediment (Isidori et al., 2004).

The acute problem of water and soil pollution has been caused by continuous growth in the anthropogenic impact on the natural environment. Heavy metals (HM) occupy one of the first places in the list of the most frequently occurring toxic contamination. Their compounds are not subject to destruction in the water body i.e. they can only change their migration forms and are referred to conservative substances toxic for hydrobionts and man. Depending on the ambient conditions HM can have different degrees of oxidation or act as various inorganic and organic compounds, or distributed between certain components of aquatic ecosystems and bottom sediments. Heavy metal mobility, toxicity and acceptability for hydrobionts changes appreciably, and, correspondingly, their ecological role in the water body changes. (Natalie Pliesovska et al., 1997)

The study carried out on river basin and dams are revealing the impact of HM migration on the dam’s water quality and mass exchange in the “water column-bottom sediments” systems. The total content of sediment was determined by atomic observation method of stage-by-stage extraction (APHA AND AWWA, 1992 and Tessier et al., 1993). The concentration of HM in the obtained solutions was determined by the atomic absorption method with the electro-thermic atomization (Sedych et al., 1996).
Once introduced into the aquatic environmental pollutants undergo a variety of interactions, which may lead to their activation or more probably to detoxification. The fate of chemicals is mainly influenced by their stability. Stable compounds may persist for a long time in the environment and therefore, in terms of acute toxicity they are not so toxic. Less stable compounds changes into more toxic forms or bind to biological molecules within organisms causing damage. Pollutants, introduced into the environment, are distributed in water, sediment and biota. Pollutions in water exist in solution, suspension or when they are absorbed. Mixing or settling of sediment also affects the amount of them in water (Phillips, 1977).

Zinc is a lustrous bluish white metal. It is brittle at ordinary temperatures, but it becomes ductile and malleable when heated between 1100°C and is a fairly reactive metal that will combine with oxygen and other non metals and will react with acids to release hydrogen (Singh et.al., 1991). It is one of the most abundant essential trace elements in the human body. It is a constituent of all cells, and several enzymes depend upon it as a cofactor (Forstner and Wittmann, 1983). High content of zinc in *Siganus rivulatus* are reported that majority of zinc are from dietary sources rather than water (Moore and Ramamoorthy, 1981; Pourang, 1995 and Kargin, 1996).

However, the present study revealed that the zinc content in sediment was ranged between 0.52 ± 0.08 µg/gm to 1.56 ± 0.01 µg/gm. while it was lower in winter and higher in summer. The zinc content was high in summer in water and sediment may be due to the anthropogenic activities, domestic wastewaters, industrial effluents, pesticides. Similar results was observed by Rashed, (2001) Ravera, (2004) and Cetesb, (2005) while The zinc content in water and sediment showed same trend but the sediment accumulated less heavy metals than water, it has been also reported by Bower (1979), Fabris et.al.(1994), Lau et.al., (1996;1998), Besada et.al., (2001), Chindah and Braide (2003) and Eja et.al., (2003).
Sediment is the major depository of metals, holding more than 99% of total amount of a metal present in the aquatic system (Odiete, 1999). The observed low concentrations of Zn, Cd and Cu in this present study are consistent with the findings of Obire et al., (2003) who worked on the creeks but contrary to the reports of Chindah and Braide (2003) who observed higher levels of Cd and Pb in this aquatic body. This observation is also different from the findings of Lau et al., (1998), in the sediment of Hg Sarawak Kanan, Malaysia and Eja et al., (2003) in great Kwa river Estuary, Calabar.

Most rock and soils contain small amount of chromium. The Cr in which the metal exists in the trivalent form. Hexavalent chromium also exists naturally. In it’s naturally, occurring state in a highly insoluble form but can be converted into more soluble form due to weathering, oxidation and bacteria. Because of low solubility, the levels found in water are usually low, however there are examples of contamination of water. Effluent containing chromium compound have discharged in to river and produced environmental problem (Chavan, 2002).

According to Tassadue et al., (2003), the physical and chemical characteristics of river water showed seasonal fluctuations, interacting with one another and having a combined effect on animals and plants. Rivers are important sensor of the kind of human activities that are developed around. Nocolau et al., (2006) observed that rivers are dominant pathway for metals transport and that the existence of heavy metals in aquatic environments has led to serious concerns about their influence on plant and animal life.

In the present study, the chromium content in sediment was ranged between 6.35 ± 0.03 µg/gm to 10.16 ± 0.01 µg/gm. The chromium content was higher in monsoon and lower in winter. Chromium content in sediment was high may due to dumping of wastes, domestic waste, human activities and agricultural runoff from the nearby villages. Similar results were obtained by Nocolau et al. (2006), Obire et al. (2003) and Chavan (2002). Metals are either
necessary in low concentration to the human beings (trace metals) or extremely toxic for them in any concentration (heavy metals). Increase in chromium adversely effects on respiratory and dermatology (Viessman and Hammer, 1985). Effect that have been observed in humans are chronic tonsillitis, chronic pharyngitis, minor renal impacts, runny nose and ulceration of nasal septum, stomach pains, cramps, ulcers and lung cancer (ATSDR, 2000a).

Cadmium in soils is derived from both natural and anthropogenic sources. Natural sources includes underlying bedrock or transported parent material such as glacial till and alluvium. Anthropogenic input of cadmium to soils occurred by aerial deposition and sewage sludge, manure and phosphate fertilizer application. Cadmium is much less mobile in soils than in air and water. The major factors governing cadmium speciation, adsorption and distribution in soil are pH, soluble organic matter content, hydrous metal oxides content, clay content and type, presence of organic and inorganic legends and competition from other metal ions (OECD, 1994).

In the present study, the cadmium content in sediment was ranged between $4.39 \pm 0.01 \mu g/gm$ to $1.42 \pm 0.01 \mu g/gm$ while it was lower in summer and higher in monsoon. The use of cadmium-containing fertilizers in bed(Agricultural field) of Godavari river may wash in rainy season and goes to Dam to produced sources of cadmium in water or sediment of dam and sewage sludge was arising from different tributaries also primary reason for the increase in the cadmium content of soils (Pondhe, 2002). Atmospheric cadmium emission deposition on to soils has also responsible significantly for concentration of cadmium (Cook and Morrow 1995, Mukunoki and Fujimoto 1996). Indeed, recent study have documented that atmospheric emission have a significant impact upon the cadmium content of soil (Bak et al., 1997).

The control point and non-point sources of water pollution in our nation’s rivers, sediments contaminated with metals and other
pollutants may be pollution sources to overlaying waters and benthic food chains for years to come (Lyman et al., 1987). Heavy metals from industrial and wastewater treatment plant effluents can form stable complexes with inorganic and organic compounds (Nienke and Lee 1982, Moore and Ramamooorthy, 1984). Rivers, lakes and ponds containing excess cadmium can contaminate surrounding land, either through irrigation for agricultural purpose, dumping of grudged sediments or flooding. It has also been demonstrated that rivers can transport cadmium for considerable distances up to 50 km, from the source (WHO, 1992). Nevertheless, studies of cadmium contamination in major aquatic systems over the past 20-30 years have conclusively demonstrated that cadmium level in the water bodies have decreased significantly since the 1960s and 1970s (Elgersma et al., 1995; Mukunoki and Fujimoto, 1996). Studies on the Rhine River basin indicated that the point source cadmium discharges to the Rhine River decreased from 130 11 mt per year over 11 year time span, a reduction of over 90% (Elgersma et al., 1992). In the present study the concentration of cadmium was more than the water. As sediments serve as the ultimate depository for much of the particulate matter that moves through watersheds, sediments are a well studied environmental matrix (Moore and Ramamooorthy, 1984; Kamman et al., 2005). Harland et al., (2000) found that the metal content in the soil to depend on organic matter and particle size content. Zelewski et al., (2001) reported that metal content in soil ranged from 8 ppm to 86 ppm.

Lead is a soft, malleable and stable metal, which is often used in the manufacturing storage batteries and as an anti-knocking additive in gasoline. Major sources of lead included mining, smelting and refining of leads. In water lead tends to accumulate in aquatic organism through the food chain and by direct uptake (Hansan et al., 1994).

According to EPA (2006), the health effect of lead exposure has been extensively studied. When lead enters the body, it travels
through the blood to the soft tissues, such as brain, liver, and kidneys. In adults, most lead taken into the body is excreted, with a small amount of stored in bone and teeth, where it may accumulate with repeated exposure. Chronic exposure to lead may cause a variety of adverse health effects including adults, including brain and kidney damage, poor reaction time, joint weakness, anemia, memory impairment, and possibly increased blood pressure. Lead is classified by EPA as a probable human carcinogen, based on evidence from rodent studies. Large doses of the lead have caused tumors in rats and mice. Nevertheless, there is not yet enough information to determine whether lead causes cancer in humans. Tomazelli (2003) studied Piracicaba River (Sao Paulo State, Brazil), obtained higher lead concentrations in the sediment. The concentrations ranged between 80.0 mg/kg and 233.0 mg/kg. The acceptable content of lead for river sediments is up to 72.0 mg/kg (Cetesb, 2005). The sediments in Ribeira do Iguape Basin presented higher concentration than those obtained by Aksoy et al., (2005) whose studies on Sulthan Marsh, a natural wetland sediment and water may be due to the washing of vehicles in the catchments, disposal of batteries, pipes, electrical appliances and industrial effluent (Ramamoorthy, 1981; Hadjmohammadi, 1988; Tomazelli, 2003 and Aksoy et al., 2005). Gaghate and Hasan (1999) reported that increase in Pb in soil may be sources of municipal solid wastes material because that contains various compounds like glass, electrical wires, batteries etc. Increase in lead content in water may cause hypertension reproductive disorders, neurological and metabolic problems. The high content of lead tolerate into
bloodstream, possibly along after the body was exposed to the lead (Rice, 1996).

Mercury, escapes in the wastewater from various sources settle down in the sediment of lakes and rivers. Plankton seems too pickup mercury just by getting it adhered to their surface. Other small organism apparently ingests the metal, some of them converting these relatively innocuous mercury compounds into more toxic methyl form. The bottom feeding animals feed upon the small organisms thereby increasing the concentration of mercury in themselves. Consumption of these mercury containing animals may cause severe disorders in the central nervous system, ultimately leading to death (Saha, 1972).

According to EPA (2006), mercury enters human's life more frequently than someone may imagine. It may be in the fluorescent lights in offices, in old cans of latex paint, in batteries, in dental fillings, and numerous other sources. Nevertheless, mercury does not degrade easily, it is not destroyed by consumption and therefore it is extremely dangerous to human health.

It has been observed that in the present study, the mercury content in sediment was ranged between 11.06 ± 0.02 µg/gm to 13.31 ± 0.04 µg/gm. The lower mercury content was recorded in summer and higher in monsoon. In monsoon the metal level increased may discharged waste water from different tributaries, agricultural runoff, mining and industrial manufacturing activities cause increase in heavy metal concentrations near by urban areas. The concentration of mercury correlated with the amount of solid discharged and decaying organic matter into soil. Human activities prevail in the vicinity of dam and domestic animals always grazie or wander around river. The passage through natural influx also exists for the domestic discharge, sewage water into the side bank of Godavari River, which is arriving from the village might have contributed mercury in the sediments. However in summer the content of sediment considerable decreased. From Monsoon to winter
much vegetation exists in the water body which likely to be contributes much of the pollution problems dam. Similar observations were reported by Gatoki et al., (2002), Pondhe (2002), Patwari (2002) and Zadpaide (2002) and Kamman et al. (2005).

High sediment contents of mercury near swear outfalls was recorded in canada (Ontario Research Water Resources Commission, 1970) found high mercury content in bottom sediments below the discharge from a chemical plant and several pulp and paper mills in Wisconsin, U.S.A. Considerable research has been directed to understand the toxicological effects and pathoghognomoical disorders due to metals.

Grimstone (1972) stated that the large portion of mercury lost in effluent is retained by sediment and subsequently released over a period of a year. Feick (1972) found that mercury could be released in considerable quantities from bottom sediments in fresh water by the addition of road salt calcium chloride, increased the soluble mercury content of the water by 2 to 5 orders of magnitude.

A large data exist due to the bioaccumulation of metals and much of the limitations exist due to the lack of standardized procedure for sampling, analytical methods, statistical treatment of data and data reporting (Tomazelli, 2003; Aksoy et al., 2005; Kamman et al., 2005 and Ravera, 2007). The trace metals can exist in a variety of chemical forms in natural water including free ions, inorganic complexes, and organic complexes and metal absorbed on or incorporated into particulate matter (Kamman, 2005) as well as the chemical composition of the natural water and sediments. Recent investigations (Anderson et al., 1978) have demonstrated that the toxicity and availability of trace metals is highly dependent on their chemical form. The investigators have shown that biosocial responses to dissolved trace metals is a function of the free metal ion concentration and is determined not only by the total dissolved metal concentration but also by the extent of metal complexation to both organic and inorganic ligands.
There are several reports on the chemical and physical processes in the sediment is widely believed to act as a filter for many metals passing from terrestrial to the marine setting (Schubel and Kennedy, 1984; Tam and Wong, 2000; Yuv, 2000 and Morillo et al., 2004) and to accumulate some metals in marine water bodies. Previous studies concentrated on the contaminated sediment describing metal concentration and or identifying sources of contamination. (Dashkalakis and O'Connor, 1995; Scheider and Davy, 1995; Angelidis and Aloupi, 1997; Pawar et al., 1999; Owen and sandhu, 2000; chen et al., 2001 and De Carlo and Anthony, 2002). However, the metal filtration process of marine sediment, both at the sediment and the water environment may be mobilized as a result of natural processes (e.g. weathering and erosion of geological formations) as well as by anthropogenic activities (Chen et al., 2001 and Racera, 2004).

The accumulation metals in marine sediment could pose problems because such metals may act as a source of contamination when the physico-chemical characters of environment are changed. Markiewicz- Patkowska et al., (2005) conducted laboratory-based experiments of the adsorption and releases of metals from soil materials to solution. Simpson et al., (2004) carried out laboratory experiments on metals across the sediment water interface. The result shows that some metal mobility increased as the groundwater and pH decreased and as the exposure duration increased and that man-made change in external parameters (e.g. pH, Ec and Salinity) may cause a mobilization of the accumulated metals in the estuarine sediment.

The heavy metals are known for their strong attraction to biological tissues. Metal ions once adsorbed into body are capable of reacting with a variety of binding sites and disturbing the normal physiology of organism leading to toxicity. Population explosion have increased the demand of water resources for a rapid industrialization due to which water has become highly polluted and hence including
man various organisms are presenting a potential threat for survival in their respective trophic level.