# INTRODUCTION

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The hydrosphere refers to the layer of water on the surface of the earth in the form of oceans, lakes, rivers and other water bodies. Water covers 71% of total surface of the earth and therefore, earth is sometimes called a "water planet". In nature, water occurs on the land, below its surface, in atmosphere and in the biomass. The total volume of water available is, 97% in the vast oceans, 2% stored in the form of ice sheets and less than 1% is available as fresh water. Surface water on land is the most easily accessible source of water for human needs, including agriculture and industries.

Water is an important factor of environment in sustaining various forms of life of the biosphere. Plants absorb nutrients from soil moisture and ground water. Animals also use water for their metabolism, growth and reproduction. Water being universal solvent plays an important role in most of the biological processes of organisms. Water required for many purposes like domestic, industrial, navigation, recreation, agriculture, fishery etc. Fresh water occupies relatively a small portion of earth surface. The lotic and lentic water habitat covers an area of 2.9 million hectares (Jhingran, 1983).

India has vast water spread area in the form of rivers, lakes, streams, reservoirs etc. but this water area upto an extent of 70% has gone polluted (Basu, 1986). The study of seasonal conditions of pond life in Punjab by Prasad (1916) was perhaps the first attempt towards the study of aquatic ecosystem in India. The workers like Chacko (1949, 1950), Ganapati (1940, 1956, 1957, 1962), Krishnamurthi (1965), Michael (1968) and Vijayaraghavan (1971, 1973), have done some hydrobiological work on historic shallow water bodies like moats, templetanks and village ponds in South India. A few like David (1969), Jhingran (1963) have worked on the large brackish water lakes and reservoirs.

The hydrobiology of the river water have been studied by earlier workers. Diurnal fluctuations in population density of zooplankton in relation to some physico-chemical parameters from Godavari river Paithan, Maharashtra are well documented by Ahmed and Alireza (1991). Pandey, et.al; (1993) reported a preliminary study on the physico-chemical quality of water of the river Koshi at Purnia. Hydrobiological studies on seasonal variation in physico-chemical parameters of Sina river at Ahmednagar, Maharashtra was reported by Shaikh, et.al; (1997). Abundance of macrozoobentic organisms in relation to physico-chemical characteristics of river Ganga at Patna (Bihar) has been investigated during July1990 to June 1991 (Singh, 1997).

The knowledge of physicochemical parameters along with biological characteristics can provide clear idea of the trophic status of any water body. Several workers like Srinivasan (1946), Mathew

(1975), Jhingran, et.al; (1981) have studied natural reservoir and lakes. Physico-chemical parameters of Cauvery river system was studied by Ganbuganapathi, et.al; (1998). Observation on certain physico-chemical characteristics of water in relation to pollution of river Ramganga were made by Singh, et.al; (1998).

Few records on water quality and pollution in the rivers are also available and provided clear idea of present status of these rivers. Reddy and Venkateswarulu (1987), Deo and Ali (1993), Reddy, et. al; (1994), Bisht and Kumar (1993), Jayshree and Jothimani (1999), Lakshminarayana and Somashekar (2000) have studied the lotic water habitats.

Water pollution is one of the most important problems being faced by both developed and developing world together. Earth's water resources are limited, and erratic supply and pollution of water further restricts the availability of water for diverse human uses like drinking, cooking, cleaning, recreation, aquaculture and industry. Seventy percent of India's water resources are declared to be polluted (Agrawal, et. al; 1982). Millions of people either die or get decapitated directly/ indirectly due to water pollution, besides loss of man-hours and aquaculture potential. Most of the rivers in the world (more prominently in India) are full of filth and stench of polluted waters. Almost every kind of stagnant water body is slowly becoming polluted and thousands of reservoirs all over the world have either become extinct or are facing slow death and extinction. Water pollution is also one of the most investigated subject in past one hundred years with millions of scientists and technocrats all over the world monitoring, controlling or carrying out research on water pollution at any given moment.

Although the pollution of a particular water body can always be traced back to some source like an industry/ sewage/ agricultural run off. In general, water pollution is an inevitable fall out development in industry, urban centres and most importantly increase in world population. Our natural ecosystems have only a limited capacity to assimilate the waste waters of various kinds; the ecosystems have thus simply collapsed in the face of untreated amount of waste discharged in them. The entry of some of the artificial chemicals (synthesized by man) has further deteriorated their, health although technologically it is possible to control pollution to some extent, the only lasting solution to preserve the aquatic system in their natural state (Trivedy, et.al; 1987).

Pollution by sewage and other organic wastes : Sewage is the wastewater generated from kitchens and toilets. It has only about 1% of solids (organic and inorganic) but may have large quantity of heavy metals, very high quantity of sewage is generated in urban areas. The sewage is discharged without any treatment and also increases the amount of suspended solids in water (causing turbidity), the pathogenic organisms which come with sewage may cause a number of diseases like jaundice, cholera, dysentery, typhoid, poliomyelitis etc. Sewage infested water produces foul odour and fish kills can be commonly seen in such waters. The nutrients of the sewage cause algal and other higher plants growth to explode, a situation called as eutrophication.

In recent years with increase in population growth, and intensive agriculture, ground water and surface water being exploited on increasing scale all over the country. In India, river water are mainly used to meet potable water needs of urban population and a number of studies on physicochemical and biological quality of these waters have been extensively carried out (Busulu, et. al; 1967, Chakrabarthy, et. al; 1977, Adwant, 1989, Khatavkar and Trivedi, 1992, Joshi and Bisht, 1993 and Gill, et. al; 1993). The pollution of river and stream water by industrialization, urbanization and growth of population and their wastes have been increased tremendously due to the inadequate treatment of these effluents before releasing into the river and streams. In India and other developing countries, the major national problems are over population, rapid industrialization and urbanization, inadequate food, housing, depletion of natural resources and pollution of our environment. The problem is an effect to improperly planned industrialization and urbanization (Nanda and Tiwari, 1999). Singh, et. al; (1999) studied the major sources of pollution in Damodar river in the Patratu to Rajrappa stretch, which have coal based industries and untreated domestic sewage discharges. They stated that, the industrial pollution has a major contribution in deteriorating the river quality.

The stability of river water for various beneficial purposes depends on the quality and quantity of contamination occuring in the habitat and its composite influence on the overall quality of water. The injudicious planning with little regard on 'Sustainable development' has culminated in the conversion of many aquatic habitats into waste dumping sites. These practices consequently exert pressure on the receiving system, significantly affect their physicochemical makeup as well as biological spectrum (Lakshminarayan, et. al; 2000).

In India, most of the cities and towns have piped water supply and are partially or fully sewered. The entire sewage of cities is ultimately released into the rivers. Industrial effluents are also released into the rivers directly or indirectly, thereby polluting the rivers to a greater extent (Singh et. al; 1998). Increasing pollution of rivers has become a matter of great concern over a period of last few decades, because of their vital role in several human uses all over the world. Numerous aspects of river pollution such as physicochemical properties of different river water (Ganapati and Chacko, 1951; Motwani, et.al; 1956; Deshmukh, et.al; 1964; Mohan, et.al; 1965; Mitra, 1982; Singh, et.al; 1982) have reported in India.

River Ganga has been investigated at different places (Pahwa and Mehrotra, 1966; Sikandar and Tripathi, 1984; Bhowmick and Singh, 1985 and Shukla, et.al; 1989).

The natural water resources of the country are shrinking fastly due to introduction of inorganic and organic wastes resulting into rapid and progressive eutrophication. According to survey conducted by NEERI, 70% of India's freshwaters are polluted because, these water sources have been freely used for the industrial and public wastewater disposal (Basu, 1986). All life, from microorganisms to man, require water but, deteriorating quality of water is a serious problem today. Because all water resources have reached to a point of crisis due to unplanned urbanization and mushrooming of industries, it is essential to formulate a sound public policy for water improvement. Kant and Vohra (1989) have rightly suggested that the management of any aquatic ecosystem is conservation of fresh water habitat with an aim to maintain the water quality or to rehabilitate the physicochemical and biological quality of water. It is also necessary to get timely information of pollution status of water body before any quality improvement programme of water is planned. However, the need for immediate evaluation and documentation of the water quality of our freshwater resources can hardly be overemphasized in south Bihar except the work of Bose and Sinha (1981), Sinha (1986), Bose and Lekra (1994), Kumar (1994, 1995, 1996).

Environment is degraded due to man's economic exploitation of nature, the crisis is due to greed, lack of insight and narrow scientism. It is due to ignoring the chemical nature of biosphere and spiritual nature of man. Man's ability to modify the environment (pollute the environment) increases faster than his ability to foresee the effects of the activity. The cycles in the ecosystems like energy cycle, material cycle and geochemical cycle are getting completely polluted. Inappropriate disposal and accidental release of toxic and hazardous substances into environment from chemical and industrial activities have created environmental and public health problems all over the world. River ecosystem and its monitoring are very important problems because of the uses of river waters for various purposes. River water pollution is another important discipline at the moment (Kataria, 1994).

Lead is one of the seven metals of antiquity and was perhaps discovered by accidental dropping of galena (Pbs) into campfire. The average lead content of igneous rocks is about 15 ppm and hence it is categorized as a rare element. Fortunately it is concentrated as sulfide deposits in many parts of the world which is easily mined and smelted. In nature, lead occurs mainly as galena (Pbs), although carbonate and chloride ores also exist. Ancient people used lead for ornaments, dishes, trays as a core for bronze statues; as sinkers for fishing nets etc. Greeks and Romans used lead extensively for sweetening the bitter taste of the food cooked in bronze pots, storing olive oil, preparing wine etc. It is believed now that one of the main reasons for the fall of the Roman empire was endemic lead poisoning due to over exposure to Pb. Sweetening of wine with lead salts caused an endemic disease called "lead colic" (Dara, 1995).

Lead is considered as a general protoplasmic poison which is cumulative, slow acting and subtle. It produces a variety of symptoms similar to other heavy metals, it has affinity for sulfur. It interacts with carboxyl and phosphoryl groups. The major biochemical effect of lead (Pb) is its interference with heme synthesis leading to hematological damage. Pb inhibits several important enzymes involved in the overall process of heme synthesis. The effect of lead to disruption of the synthesis of haemoglobin and other respiratory pigments such as cytochromes, which require heme. Higher levels of Pb in the blood can cause kidney dysfunction, and brain damage because it is toxic to the central and peripheral nervous system (Dara, 1995).

One of the most insidious effect of inorganic lead is its ability to replace Ca in bones and accumulate there as a reservoir of long term release. This lead is subsequently remobilized along with phosphate from the bones and exert toxic effects when transported to soft tissue (Dara, 1995).

Zinc and cadmium, being chalcophile element tend to be found in sulfide deposits. Igneous rock contains 80 ppm of zinc and 0.13 ppm of Cd. During weathering process, these elements are mobilized easily and find their ways into oceans. Where their concentrations average about 20 ppb for Zn, whereas soil contains about 50 ppm of Zn. Since Zn is essential to plant as nutrient, they contains relatively high concentration of Zn, for instance in plant ash its concentration can be as high as 1400 ppm, Zn forms 0.004% of the earth crust. It occurs as sulphide, carbonate, oxide and silicate minerals in nature. The essentiality of Zn for higher forms of plant life was established only in 1926. Since then lot of original work on the function of Zn in the nutrition and growth of higher animals and zinc metabolism followed.

The role of Zn as an essential nutrient is well established now. A number of enzymes including aldolase, alkaline phosphatase, carboxyl peptidase, lactic acid dehydrogenase are dependent on Zinc. Zinc is also present in co-factors of other enzymes such as arginase and diaminase. thus, it takes part in the synthesis of DNA, proteins and insulin. Hence zinc is essential for the normal functioning of the cells including protein synthesis, carbohydrate metabolism, cell growth and cell division. Zinc influences growth rate, the integrity of the skin, the development and function of the reproductory organs. It also helps in wound healing capacity. Any toxic effects attributed to zinc may have been due to other associating metals such as Cd, Pb and As. Some cases of occurrence of acute renal failure following ingestion of $ZnCl_2$ have been reported and in such cases the possible co-existence of other metals was not documented. Themetic action of Zn may be protective mechanism. However, dehydration, electrolyte, imbalance, dizziness, lethargy and muscular uncoordination may follow. zinc play a vital role in plant nutrition, it being a component of number of metalloenzymes. Zn is less toxic to fishes as compared to Hg, Cd, Cr and As. They accumulate in gills, gut and liver. Zn in benthic invertebrates in unpolluted water may lie in the range of 20 to 200 mg/kg. Zn at about 40 ppm levels in water may impart a metallic taste (Dara, 1995).

Metallic nickel has been known for over two centuries. Nickel constitutes about 0.008% of the earth crust. Important nickel deposits occurs as sulphides (chacopyrite, pentlandite and pyrrhotite). Soil contains 40 ppm nickel on an average. Nickel and its salts are used in several industrial applications such as electroplating, storage batteries, automobiles electrodes, coins, cooking utensils, pigments, paints, printing fabrics. Equal part of Al and Ni is employed as catalyst for hydrogenation of oils and of other organic compound with gaseous hydrogen.

Fairly recent studies indicated that nickel is essential in animal nutrition. Significant concentrations of Ni have been shown to be present in RNA and DNA. Nickel is shown to be essential for some microorganisms and animals but not to plants. It is associated with the synthesis of vitamin B-12. It is toxic at higher concentrations. Land plant tissue contain about 4 times more nickel than in animal tissue (Dara, 1995).

Aqueous aluminium chemistry is complex. The amount of Al in solution from normal weathering is a small proportion of the total Al in the environment but, perturbations of normal weathering can substantially increase Al mobility (Hendershot, et.al; 1996). Aluminium is relatively insoluble at pH 6 to 8, but solubility increases under more acidic and more alkaline conditions in the presence of complexing ligands, and at lower temperatures (Driscoll and Postek, 1996). Aluminium forms both weak and strong complexes with organic material such as humic and fulvic acids that tend to keep Al in solution but, make it less toxic to organisms. Finally there is an exchangeable fraction of Al with soils, sediments and precipitated organic material (Driscoll and Postek, 1996). Respiratory effect of Al predominate in moderately acidic water (pH - 5.0 to 6.0). A plausible mechanism of the respiratory effects of Al is the precipitation or polymerization of Al as acidic, Al rich water passes into the gill micro environment, which is made more basic by ammonia released at fish gills.

The acute U.S. national Ambient Water Quality Criteria (NAWQC, USEPA, 1988) for Al is 750 μg $L^{-1}$,Al (28 μm), which is intended to protect all, but 5% of the exposed aquatic species in short exposure (USEPA, 1985). The chronic value intended to protect against significant toxicity in long term exposure is 87 μg $L^{-1}$ Al (3.2 μm). Both criteria are based on acid soluble Al rather than dissolved Al. These values were derived from the available literature at the time, but it is likely that consideration of more recent studies would results in significantly different values. Furthermore enough data now may be available to derive at least a hardness based criteria if not even a criterion that considers the complexation of Al to biological surface such as fish gills (Meyer, 1999; Meyer, et.al; 1999).

Investigating the biological effect of Aluminium has become a major focus of aquatic research, much of this interest stems from work on the biological effect of acidic precipitation because, Al becomes more soluble and hence potentially more toxic to aquatic biota at acidic pH. Starting around 1980, it becomes widely accepted that Al was major factor affecting the success of aquatic organism and communities in acidic habitat (Cronan and Schofiel, 1979; Drablos and Tollan, 1980; Muniz and Levistad, 1980). Al can be a major factor responsible for the demise of biotic communities

(Dillon, et.al; 1984 Campell and Stokes, 1985; Schindler, 1988; Charles, 1991;Last and Watling, 1991; Scheuhammer, 1991).

In general, aquatic invertebrates are not very sensitive to Al compared with fish. The toxic effect of Al are usually to be ionoregulatory, in the same manner as are $H^+$ ions. Respiratory effects of Al for aquatic invertebrates are uncommon. Field studies have generally demonstrated the hardness of aquatic invertebrates to Al, and aquatic insect populations may be affected indirectly, if their predators (e.g. fish) are influenced by Al. Aquatic invertebrates tend to accumulate Al on ionoregulatory surfaces but do not biomagnify Al (Gensemer, 1999).

Aluminium is a gill toxicant to adult fish, causing both ionoregulatory and respiratory effects, depending on water pH and Al concentration. In a survey of Swedish streams of different acidities and Al concentrations, predators such as *Isoperla grammatica* (*plecoptera*) consistently had about one third the concentrations of Al (Herrmann and Frick, 1995). Adverse effects of Al on animals eating invertebrates from water with high Al concentrations are considered unlikely due to the lack of Al bioaccumulation by aquatic invertebrates, unless Al uptake is accompanied by low Ca and P availability in the diet (Scheuhammer, 1991; Miles et.al; 1993; Ormerod and Rundle, 1998).

Wren and Stephenson (1991) summarized data regarding Al in aquatic invertebrates and found no evidence of biomagnification of Al in aquatic system. Otto and Svensson (1983) showed that larval *Potamophylax cingulatus* (Trichoptera) do not accumulate Al, and lost it. If they were transferred from an alkaline stream (pH 7.7) to more acidic stream of pH 4.8 and 6.8 *Prosimulisum fuscum* (Diptera) and *Leptophlebia cupida* (Ephemeroptera) transplanted from a stream of pH 6 to more acidic stream (pH 4.5 to 5.8, 50 to 100 μm Ca) for 4 to 10 days also lost body Al, as well as body Ca (Hall, et.al; 1988). In these study, Al is likely desorbed from the insects into the acidic water. Aluminium was lost quickly from the guts and kidneys of snails exposed for 30 days to a range of 78 to 285 $\mu g.L^{-1}$ (Elangovan, et.al; 1997).

**Toxicity and Bioaccumulation :**

With an early use of metals, there was little concern about environmental contamination. The salts of metals were utilizing into commercial and industrial applications. Then it becomes evident that, metallic salts possess certain biocidal properties. In the last few years there has been a great deal of concern about heavy metals pollution. Effects of metals on different organisms are reported by many workers. A great deal of research still has to be done on the effects of metals on different organisms. The invertebrates appear to have a particularly high capability for concentrating metals along with other foreign materials found in their environment.

The effect of heavy metals on aquatic organisms is currently attracting widespread attention, particularly in studies related to pollution. Heavy metals are being introduced into aquatic environments through industrial and urban effluents, soil leaching and rain fall. Though many metals play a vital role in the physiological processes of plants, animals and human, yet excess concentrations of metals is harmful from the days of Aristotle, the great Greek genius about 2000 years ago, toxicological tests of some sort have been conducted. He studied fresh water animals in marine conditions and observed their responses. The question of the effect of a material on an organism was regulated to the curiosity of physiologists until a formed discipline known as "Toxicology" arose in the early 1800's in response to the development of organic chemistry (Zapp, 1980).

Toxicological studies on fish were made nearly a hundred and fifty years ago by Penny and Adams. In 1919, Kathleen Carpenter began studying the river of West Wales for effect of zinc and lead on fishes.

The present literature shows that, most of the studies on toxicity were carried on fishes and other invertebrates. Effects of environmental hazards of toxic substances and heavy metals in particular on phytoplankton and their productivity have been studied (Brungs and Mount, 1978). While Nuzzi (1972) and Jayaraj and Deshpande (1987) have studied effects of heavy metals on plankton and their primary production. Five commercially important fishes of Saudi Arabia from Jizan, Red sea coast have been analyzed during 1991 for certain heavy metals (Cu, Hg, Cd, Cr, Pb and Zn) in different organs of fish tissues viz. liver, kidney, gut, gills and muscle. All the heavy metals analyzed were found to be accumulated more in liver and kidney, while least concentrations of different metals were found in muscle tissue (Al-Mohanna, 1994). The toxic effects of metals have been reported in population eating contaminated sea food (Skerfving, 1972 and 1988). Dietary exposure has been responsible for many incidents of metal poisoning, especially that of Mercury (Airey, 1983; Skerfving, 1988, Watanbe et.al; 1987). Industrial activities around the upper Benue river and the lakes is low and there is no information on other activities with the potential for polluting the Benue river as it flows from neighbouring Cameroon. However, an unconfirmed report (Egila, et.al; 1991) indicates high level of lead in the upper Benue river. There is yet report of systematic study to assess the levels of metals in fish found in these waters (Eromosele, et.al; 1995).

The studies on metal concentration have been carried on other invertebrates. Regulation of excess metal concentration in animal tissues is accomplished through several means such as temporary absorption, storage and release by hepatopancreas, losses across the gill (Narayanan, et.al; 1988); through antennal gland, urine and faeces (Bryan, 1968,Bryan, et.al; 1986) and in the form of metal binding protein such as metallothionein (Olafson, et.al; 1979, Miramand, et.al; 1981, Engel Brouwer, 1984, White and Rainbow, 1984). In the wake of health consciousness among the consumers, ability of important seafood organisms to regulate their internal metal concentration during depuration has assumed added significance. This is essentially so in the mud crab *Scylla Serrata* which is a choice seafood item having a good pull in the international sea food markets (Narayaman, et.al; 1999). An investigation of Cd, Cr, Cu, Fe, Ni, Pb and Zn accumulation was carried out in the benthic micro invertebrates and in some selected species of western Yamuna canal. The levels of these 7 heavy metals were found to vary from NT (non traceable) to 18.0, NT, to 74.0, NT to 74.0, NT to 4270.0, NT to 100.0, NT to 39.0, NT to 400 μg/ g dw respectively (Shrama, et.al; 2000). Heavy metals can be burried in landfills or washed into sediments. After getting entry into aquatic bodies, these metals may precipitate, absorb on solid surface, remain soluble/ suspended in water or may be taken up by fauna and flora (Leland, 1977, Oehme, 1978, Reimers, et.al; 1975). Only a few reports are available on the concentration of trace metals in freshwater benthic macro invertebrates (Sarnic and Bell, 1969; Byrne and Delon, 1986).

In India wide use of metals in different chemical forms by the industrial, agricultural and domestic sectors has resulted in a great deal of concern about the release of toxic metals in the environment. Increasing awareness of ecological hazards to human life arising from the discharge of toxic metals from urban and industrial sources have involved considerable interest in the study of levels and fate of metals in the aquatic environment. In India use of Hg, Cd, Al, Zn, Ni, Cu, Pb, Mn, Fe etc. in various compound forms (Pesticides, Insecticides and fungicides) and subsequent waste discharge on leaching to water bodies is common (Kumaraguru, et.al; 1979, Panda and Misra, 1981). The concentration of certain heavy metals such as Cu, Cd, Cr, Ni, Hg, Pb in water samples from river Khan near Indore, river Kshipra near Ujjain and river Chambal near Nagda, Kota showed lower concentration of Fe, Zn, Cu, Pb, Cd, Hg in the water in following order Fe > Zn > Cu> Cr> Cr> Pb> Hg (Srinivasulu and Pandey, 1991).

The wide spread contamination of aquatic ecosystems with heavy metals is the increasing concern to environmental scientists (Enk and Mathis, 1977). Reddy and Venkateshwarlu (1985 and 1987), Venkateshwarlu (1986) and Whiton (1980 and 1984) reported the heavy metals concentrations in river waters. Heavy metal pollution in 3 rivers of Andhra Pradesh, viz. Moosi, Godavari and Tungabhadra has been investigated, taking into consideration some important metals and algal flora present in these environments. In general, the metal concentration were higher in the river, Tungabhadra except iron which was more in the river Godavari (Venkateshwarulu, et.al; 1994). Reliable measurements of the concentrations of dissolved trace metals in rivers are needed for calculating oceanic chemical mass balances, understanding continental weathering and freshwater chemistry and evaluating anthropogenic, chemical perturbations. In Andhra Pradesh, Krishna river has tributaries in this area pointing to possible pollution (Syama Sundar, et.al; 1994). Heavy metals in Betwa river evaluate the water quality status, different heavy metals like Cu, Cr, Cd, Zn & Mn that carried by river water and silt sediments. Heavy metals within permissible limits are useful and essential to phytoplankton as well as to human life for survival functions. The heavy metal concentration in surface waters were lower than that in the sediments (Kataria, 1994). Dora and Ray (1987) investigated water quality of Subernarekha river in the Bihar state and reported Cu from 0.03 to 3.0 mg/l and Zn from 0.001 to 4.0 mg/l due to disposal of waste water. The concentration of metallic elements are alarming due to the disposal of wastes from copper complex. The level of pollution of Ganga river, and reported copper, lead and nickel ranged from 0.01 to 0.1 mg/l, Fe from 0.1 to 1.0 mg/l, Zn, Cd from 0.1 to 1.0 mg/l (Sengupta, et.al; 1988).

Garg, et.al; (1992) studied the trace metals analysis in river Ganga at Kanpur and reported Pb from 0.047 to 0.168, Fe from 0.008 to 0.189, Cr from 0.13 to 0.226 Zn from 0.005 to 0.178 mg/l due to discharge of industries in downstream. Srikanth, et.al; (1993) determined Pb, Cd, Ni and Zn contamination in and around the Hussain Sagar lake at Hyderabad. Results indicate a uniformly high degree of metal contamination in the lake. The concentration of various toxic heavy metals, like Pb, Cd, Ni and Zn was elevated and are above the levels of an unpolluted system. In general, ground water samples around the Hussain Sagar lake collected within 1 Km radius showed consistently higher concentration of Pb, Cd, Ni and Zn. The concentration of Zn, Cu, Ni, Cd, Cr, Pb, Mn and Fe was found with higher concentration as compared with WHO standard for drinking water (Agrawal and Gopal, 1996). Concentration of dissolved trace metals(Zn, Cu, Pb and Cd)were determined at the site along the Clutha river, NewZealand, these metals increased consistently with distance down river between 40% and 100% for a given metal was found in the dissolved fraction. High concentration of the metals with essentially constant Cu, Zn, Pb, Cd ratios of 755: 716: 223: 1 (Molar basis) indicates that, the same weathering process/ sources may be occuring throughout the catchment (Jonathan, et.al; 1996). The concentration of trace metals namely Zn, Pb, Mn, Cd, Cu, Co, Fe and Ni in the water of river Beas in Himachal Pradesh have been studied. The heavy metals manganese and iron fairly exceeding permissible limits of drinking standards (Singh, et.al; 1996). Most of the heavy metals are toxic to organism as well as human if exposed to high levels, urban runoff is well known to transport metals and other contaminants at elevated concentration (Helsel and Cohn, 1979; Wilber and Hunter, 1979; Morrison and Revett, 1987). The concentration of five heavy metals namely Cu, Cd,. Cr, Fe and Pb were studied in the river Ganga at Varanasi. Levels of all the metals were highest during the summer season. It also shows that all metals existed below the maximum allowable limit recommended by ISI and WHO (Devi Smriti and Tiwari, 1998). Concentration of metallic elements like Fe, Pb, Mn, Al, Zn, Cu in Kerwan dam water flow was studied, among these metallic elements, Fe and Pb were found more than permissible limit. It indicates the trends of heavy metals pollution in Kerwan river and its dam water in Bhopal district (M.P.) is increasing day by day (Shrivastava and Jain, 1998).

Trace metals of the textile mill effluents, sediments and waters of river Khan and Kshipra showed high concentration of Zn, Fe, Cu, Pb, Cd and Hg in the sediments and effluents, while lower values in the water. The concentration of metals were found in the following order : Effluents Fe > Zn > Cu > Cr > Cd > Pb > Hg; sediments : Fe > Zn > Cu > Cr > Pb > Cd > Hg ; water : Fe > Zn > Cu > Cr > Pb > Cd > Hg. Higher concentrations were usually obtained in the upstream regions. Pure textile dyes are the major source of all these metals (Ganasan, 1991). Heavy metals are known to adversely affect the aquatic environment, hence Zn, As and Cr in the polluted water and sediments in the Rivers Ganga (Kanpur to Varanasi), Yamuna (Allahabad), Ramganga (Moradabad to Bareilly) and Gomti (Kooraghat To Jaunpur) have been studied. It is revealed that pollution load of Ganga and Gomati river were maximum in respect of Zn, As, Cr (Singh and Mahaver, 1997).

Distribution of heavy metals in sediments sample were studied from 44 locations of polluted urban river Sumida (Shingashi), which runs through the Tokyo area and pours into the Tokyo Bay. Analytical results of Cr, Ni, Cu, Zn and Pb showed that, most of the samples from upstream to downstream of the river were heavily polluted (Fukushima Kazuo, et.al; 1986). Sediment samples from 56 points of the Rushikulya river estuary were analysed. The concentration of Hg was highest in samples from the effluents channel followed by the samples from the adjoining areas (Shaw, et.al; 1989). Analysis of the composition of heavy metal pollution in Japanese river sediments was studied by Mirai Masaya, et.al; (1996). The chemical form of Pb, Zn, Cr, Co, Ni and Cu have been determined in the bed sediments of Jhansi river Assam, India. Almost a similar trend throughout the stretch with no significant spatial variation has been observed (Baruah, et.al; 1997).

**Mollusca in India :**

Mollusca is the second largest phyla of invertebrates. The molluscs in India are playing a living/ vital role yet shedding many of their past association and reported miraculous properties but, assuming newer and vastly more utilitarian roles. The trade in shells as raw material for the traditional handicraft products appear still to exist. The Ancient time infants drinking spot fashioned out of chank lingers among some of the poorer classes, while the richer strata are supplied with carved shell ash trays of nautilus, reading lamps/ window pane, oyster lamp shades.

Apart from the well established fisheries along various coastal area many clams, oysters, mussels, squids and other minor shell fishes constitute smaller fisheries of local importance in many other regions. Oysters, mussels and clams from regular fisheries of considerable local importance along the east and west coast. The meat is widely eaten considered delicious by those, who develop a taste for it. As mentioned earlier,. The resources of molluscs that can sustain regular and very productive fisheries as well as of scientific interest are abundant in our water. Great as the industrial use of molluscs is, perhaps the significance of molluscs in future would be greater as a potential source for human consumption and also in scientific researchers (Muley, 1985).

The freshwater molluscs are abundant in Indian inland waters. Among these, lamellibranch and gastropod molluscs are widely distributed. The fresh water lamellibranch embrace the genera like *Lamellidens, Parreysia, Indonaia, Corbicula, Pseudodon, Balawantia, Physunio* and *Unio*. Of the fresh water gastropods, those belonging to Prosobranchiata are common.

**Bioaccumulation in Molluscs :**

Zinc concentration in a population of mussels (*Mytilus edulis*) from the moderately polluted Tyne estuary (U.K.) showed a marked positive skewness (Lobel and Wright, 1983). Females of bivalve *Donax trunculus* showed higher concentration of Mn and Zn than males. Difference were high for Mn which also shows large monthly fluctuations. Both metals increased during gonadic maturation. Some high values of Mn found when gonads were resting, suggested the influence of sharp environmental variations in the area where bivalves had been collected (Marina, et.al; 1984). Accumulation of Cd, Cu, Pb and Zn in the tissue of *Mytilus edulis* and *M. planulatus* was examined under cyclic conditions of exposure in order to establish whether the rate of accumulation of heavy metal is proportional to time exposed to the elevated concentration. When exposed to a single metal, the accumulation of Pb, Zn was directly proportional to the time, but that of Cu was not under simultaneous exposure to all metal, both Pb and Cd were accumulated in direct proportional to the exposure time while Cu, Zn were not. Accumulation of the three metals Cd, Cu and Zn was influenced by presence of other metals (Eliott, et.al; 1985). Oxygen uptake in the brown mussel, *Perna indica* under sublethal stress of Hg, Cu and Zn (Hg ranging from 1 to 10, Cd from 25 to 400, Zn from 10 to 100 ppb),induce in the rate of oxygen uptake. All these metals thus function as respiratory depressants (Baby, et.al; 1986).

The concentration of Hg, Zn, Pb and Cu were determined in *M. edulis* from 48 locations in south west Iceland as well as in moored mussels. Data on metal content of soft tissues were examined in relation to both, tissue weight and shell length. The data reveal Pb and Hg contamination in mussels from the vicinity of Reykjavik leaded petrol, paints and diffuse urban uses are considered as sources of these anomalies. A comparison is made with published mussels watch results (Olafsson, J. 1986). *Mytilus edulis planulatus* (Lamark) were collected from Howden south east Tasmania in autumn 1981. Interaction effects of Cd, Cu and Zn during accumulation by mussels, *Mytilus edulis* exposed for ten days to all three metals The presence of Cu resulted in depressed Cd accumulation, while Zn accumulation increased. Cd tend to enhance Zn accumulation but Cu accumulation was only affected to any great extent when Zn was also present (Eliott, et.al; 1987). Zn, Cu, Mn, Fe were determined in the soft tissues (Mantle, gill and adductor muscle) of *Crassostrea cucullata*. The concentration of zinc was higher than other metals analyzed. Gill and mantle exhibited higher concentration of metals than adductor muscles (Mitra and Choudhary, 1994). Accumulation of Fe and Mn in the tissues of bivalve *L. corrianus* exposed to the concentration as observed in Patalganga river environment. The accumulation of metals in the hepatopancreas was more as compared to gill and adductor muscles (Ingle, et.al; 1997). Bioaccumulation of some heavy metals to edible molluscan species in two water areas of Calcutta, Howrah, West Bengal. Accumulation of heavy metals (Cu and Pb) were studied in the molluscs *Bellamya bengalensis* and *L. marginalis*. Lead concentration varied from 134.80 to 1.33 µg/ g in the bivalve species, it accumulated a high amount of Cu in the monsoon and Pb in the post monsoon period (Gupta and Banerjee, 1998). Concentrations of Zn, Cu, Mn, Fe, Cd and Pb were measured in the soft tissues and shells of snails *Lymnaea* (Radix) *perregra* and *L. stagnalis* occuring in Liwiec and Muchawka river waters of different purity. It has been shown that an inflow of sewage treatment plant water to the river causes an increase of metal concentrations both in soft tissues and shells of the two snail species. Snails occuring in environment with a higher inflow of metals had a low share of soft tissues in their bodies when compared to those inhabiting unpolluted environment. Out of two snail species studied *L. peregra* accumulated higher concentrations of metals than *L. stagnalis* (Krolak-Elzbieta, 1998).

The accumulation of Cd, Cu and Pb and their effects on asportate and alanine aminotransferase in digestive gland, gills, foot and soft body in the clam *Ruditapes philippinarum* were examined. They were exposed at various concentrations. The highest concentration of Cd and Cu was found in digestive gland and that of lead in gills and the lowest values were observed in the foot (Blasco and Puppo, 1999). Total contents and speciation of selected heavy metals includes Al, Fe, Co, Ni, Pb, Zn, Cu, Cr were measured in sediment samples and mussels *Mya arenaria* and *Astarte borealis* collected in the Horsund Fjord off splitsbergen (Norwegian sea) and bay of Gdensk (Baltic sea). The investigation aimed at differences in the accumulation of heavy metals in mussels inhabiting sediments characterized by varying metal bio-availability. The contents of Cd, Pb, Zn, Cu and Cr in mussels collected off splitsbergen were generally lower than those in mussels from Baltic sea (Pempkowiak, et.al; 1999). The effect of a metal mixture on Cd bioavailability and uptake in the freshwater mussel *Pyganodon grandis* were investigated in a limnocorral experiment in a precambrian shield lake, during the summer of 1992 (Stewart, 1999). The Australian freshwater mussel *Hydridella deprssa* sequesters elements in calcium phosphate (cap) granules that form extensive aggregations in its tissues. Elements contained in these granules were determined by X-ray microanalysis of river and lake from the Hawkeshbury-Nepean river. Trace elements particularly Al, Cu, Zn and Pb were also important in lake and river site differentiation. The granules play a major role in element dynamics in freshwater mussel tissues and provides a focal structure of direct analysis of element accumulation by these bivalves (Byrne and Avesk, 2000).

The present study deals with the heavy metal load in the freshwater lamellibranch molluscs inhabiting in the Krishna river at station Sangli, Haripur and Ankali. The bivalves, *Lamellidens corrianus* (Lea), *L. marginalis* (Lamarck) and *Indonaia caeruleus* are selected in the present study. These three different species of molluscs were subjected for detection of heavy metals such as nickel, zinc, lead and aluminium from various soft tissues. The soft tissues selected are mantle, gill, siphon, foot, hepatopancreas and gonads.

In the present study, an effort has been made to work out the extent of pollution in Krishna river by industrial water, domestic sewage and heavy metal load in water, sediment and bivalve tissues.