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AN EXPERIMENTAL STUDY ON THE LEVELS OF HEAVY METALS IN PALAIR RESERVOIR, KHAMMAM, TELANGANA, INDIA

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Abstract: *The quality of surface water has progressively worse in many countries in the past few decades. As a result of the growing population, urbanization, agriculture, and increasing industrialization, the inland water bodies are confronted with the increasing water demand, as facing with extensive anthropogenic emissions of nutrients and sediments, predominantly the lakes and reservoirs. To resolve this problem, it is necessary to carry out water quality assessment, planning, and management, in which water quality monitoring plays an important role. The heavy metals present in the water bodies which may affects the human health and the health of aquatic ecosystem. Water samples were collected form the selected sites of Palair reservoir, Khammam district of Andhra Pradesh.*

Keywords: *Water Samples, Physico-chemical parameters, water quality, Palair reservoir.*

Introduction:

Although heavy metals occur in the aquatic environment as a result of weathering and land drainage, in the recent years the increasing load of sewage discharge, dumping of industrial wastes, effluents and agricultural runoff have increased their levels in certain areas considerably. The same has number of studies on the concentration of water bodies in India (Rajan et al.,1989; Padma and Periakali, 1999, Manjunath and Shankar,2000) as well around the world, (Nicolaidou and Not,1990; Bilos et al.,1998 and Godwin Wesley et al., 2004).

The aquatic organisms can metabolically control the intake of metal ions up to the threshold level of concentration, but the same organism cannot control the excess metal (Brown et al., 1983) and the excess metals are accumulated in the body of the organism and may shoot up to a level higher than that of the ambient waters. (Godwin Wesley et.al., 2004).

Heavy metals are among one of the pollutants of freshwater, which pose severe threats to the biodiversity with the development of mining, smelting and other industrial activities. Heavy metal pollution not only affects the productivity of crops, but quality of water and also influences the quality of atmosphere, water bodies and threatens the health and life of animals and human beings by way of food chain. The pollution caused by heavy metals is long term and irreversible process. The metal species commonly found in the environment as a result of human activities includes, Copper, Zinc, Nickel, Lead, Cadmium, Cobalt, Mercury, Chromium and Arsenic. Some of these metals act as micronutrients at small concentrations in living organisms for their normal physiological activities, but accumulation in higher concentration becomes toxic to most life forms. (Lasat 2002; Cheng 2003). The negative effect of metals can occur on soil, micro flora, fauna, higher animals, plants and humans. Usually, the natural contamination of heavy metals originates from weathering of minerals, rocks and aquatic environments which results in the entry of heavy metals, into reservoir receives industrial effluents, wastes such as sewage sludge, mining effluents. Many of the metals are relatively strongly retained in the

surface water and soil and do not readily leach out-causing accumulation that may ultimately pose a threat to humanbeings, animals, plants and microbes. There is a pressing need to deal with excess metals present in soil, sediments and water bodies so as to protect the environment from the contaminants (Lasat 2002; Cheng 2003 and Shashikanth et al., 2008).

Wide range of pollutants such as particulates, heavy metals and petroleum hydrocarbons, which are primarily originated from transportation activities, can accumulate on the highway surface. Due to the impermeability of pavement, these pollutants will be delivered by highway runoff during wet weather into streams via drainage network in urban area or discharged directly to nearby waters or lands in rural area, causing quality deterioration of receiving waters and roadside soil contamination. The extent of such contamination is dominantly affected by surrounding land use, rainfall, traffic volume and other different random factors because highway runoff is a classic nonpoint pollution source. It is discontinuous in time, unconcentrated at specific location and strongly dependent on changes in climate conditions (Thomson et al., 1997). Highway runoff studies have been carried out in many countries and areas on various topics including quantity and quality investigation (Barrett et al., 1998; Wu et al., 1998; Drapper and Tomlinson 2000; Pagotto et al., 2000; Mangani et al., 2005), modeling (Kim et al., 2005), pollutant load estimation (Legret and Pagotto 1999; Kim et al., 2006), environmental impact assessment (Leitao 2005) and pollution control measure development (Lee et al., 2005), among which the quantity and quality investigation is the essential step and provides basic knowledge for others.
(Huayang Gan et al., 2008).

Heavy metal concentrations in aquatic ecosystems are usually monitored by measuring its concentration in water, sediments and biota (Camusso et al.,1995) which generally exist in low levels in water and attain considerable concentration in sediments and biota (Namminga and Wilhm 1976). Heavy metals including both essential and non-essential elements have a particular significance in ecotoxicology, since they are highly persistent and all have the potential to be toxic to living organisms (Storelli et al., 2005 and Mohammad Ebrahimpour et al.,2008).

Heavy metals do not exist in soluble forms for a long time in waters; they are present mainly as suspended colloids or are fixed by organic and mineral substances (Kabata-Pendias and Pendias 2001). In aquatic ecosystems, water contamination by heavy metals is one of the main types of pollution that may stress the biotic community (Baldantoni et al., 2004 and Mohammad Ebrahimpour et al., 2008).

Heavy metals are regarded as serious pollutants of the environment because of their environmental persistence and tendency to concentrate in aquatic organisms (Harte et al., 1991). Metal uptake by fish from contaminated water may differ depending on its ecological needs and metabolism, as well as other factors such as salinity, temperature, contamination gradients of water, food, sediment and interacting agents (Canlı et al., 1998; Heath 1987; Canlı and Furness 1993; Goyer 1991). Heavy metals are taken up through different organs of the fish in relation to the affinity between them (Karadede and Unlu 2000; Yılmaz 2003; Henry et al., 2004; Yılmaz 2005). Marine organisms, including fish may accumulate heavy metals through direct absorption or via their food chain and pass them to human beings by consumption, causing several chronic or acute diseases (Chen et al., 2000; Calza et al., 2004; Al-Yousuf et al., 2000). Therefore, fish have been extensively used in marine pollution monitoring programs (e.g., OECD 1991; UNEP 1993). Two main objectives are pursued in these programs, (1) to determine contaminant concentrations in fish muscle with a view to assess the health risk for humans, and (2) to use fish as environmental indicators of aquatic ecosystems quality (Adams 2002, AyseBaharYılmaz et al., 2008). All heavy metals exist in surface waters in colloidal, particulate, and dissolved phases, although dissolved concentrations are generally low (Kennish, 1992). The colloidal and particulate metal may be found in

1) hydroxides, oxides, silicates, or sulfides; or 2) adsorbed to clay, silica, or organic matter. The soluble forms are generally ions or unionized organometallic chelates or complexes. The solubility of trace metals in surface waters is predominately controlled by the water pH, the type and concentration of ligands on which the metal could adsorb, and the oxidation state of the mineral components and the redox environment of the system (Connell et al., 1984 and North Carolina State University water quality group, Copy right,1976.).

The behaviour of metals in natural waters is a function of the substrate sediment composition, the suspended sediment composition, and the water chemistry. Sediment composed of fine sand and silt will generally have higher levels of adsorbed metal than will quartz and detrital carbonate-rich sediment. Metals also have a high affinity for humic acids, organo-clays, and oxides coated with organic matter (Connell et al., 1984 and North Carolina State University water quality group, Copy right, 1976.).

Objective of the work:

Reservoirs have been used as ideal natural laboratories to study a number of processes that are important in understanding hydrobiological processes including evaporation, chemical exchange between water and atmosphere, and diversity of living organisms like planktons, flora and fauna.

Fresh water surveys not only provide data essential for the development of fish stocking and management policies but also provide knowledge of individual water and their characters. The plankton constitutes the basic food source of any aquatic system, which supports fish and other animals. For any scientific utilization of water resources, the study of plankton and physico-chemical characteristics of water are therefore of primary interest. Virtually all the dynamic features of the rivers such as the colour, clarity, and water taste, zooplankton and fish production depend to a large degree on the phytoplankton. This monitoring method through biological organisms is based on the simple principle of tolerance of the organisms to the environmental changes.

Research Methodology:

The present study carried out in Palair reservoir, Khammam district of Andhra Pradesh. India, for two years starting from August 2004 to July 2006. In the present study various parameters like physico-chemical parameters of water and biological parameters like zooplankton were studied.

Heavy Metals –A Analyst 300model

Atomic Absorption Spectroscopy. Perkin elmer (USA) Company.

Acid digestable metal ions used in finding of heavy metals**.** (Co,Cd.Zn,Cu) .

Zooplankton:

Biological examination of water was done by collecting 20-25 litres of water from each site. The water was collected by sampler and filtered through net. In total around 100 litres of water were collected from each lake, each month, from which the zooplankton studies were made. The zooplanktons copepods, cladocerans, rotifers, ostracods and certain larvae were drained out from the planktonic sampler which had been accumulated in the sample cylinder. They were fixed 4 % formalin and identified to the genus level with the help of fresh water biology Edmondson (1965). Counting of organisms was done using Sedgwick- Rafter counter and the dilution technique and the population density of each organism is represented per litre of water.

Result and Discussion:

HEAVY METALS

Heavy metals are elements having atomic weights between 63.546 and 200.590 (Kennish, 1992), and a specific gravity greater than 4.0 (Connell et al., 1984). Living organisms require trace amounts of some heavy metals, including cobalt, copper, iron, manganese, molybdenum, vanadium, strontium, and zinc. Excessive levels of essential metals, however, can be detrimental to the organism. Non-essential heavy metals of particular concern to surface water systems are cadmium, chromium, mercury, lead, arsenic, and antimony (Kennish, 1992).

All heavy metals exist in surface waters in colloidal, particulate, and dissolved phases, although dissolved concentrations are generally low (Kennish,

1992). The colloidal and particulate metal may be found in 1) hydroxides, oxides, silicates, or sulfides; or 2) adsorbed to clay, silica, or organic matter. The soluble forms are generally ions or unionized organo metallic chelates or complexes. The solubility of trace metals in surface waters is predominately controlled by the water pH, the type and concentration of ligands on which the metal could adsorb, and the oxidation state of the mineral components and the redox environment of the system (Connell et al., 1984).

The behavior of metals in natural waters is a function of the substrate sediment composition, the suspended sediment composition, and the water chemistry. Sediment composed of fine sand and silt will generally have higher levels of adsorbed metal than will quartz, feldspar, and detrital carbonate-rich sediment. Metals also have a high affinity for humic acids, organo-clays, and oxides coated with organic matter (Connell et al., 1984).

The water chemistry of the system controls the rate of adsorption and desorption of metals to and from sediment. Adsorption removes the metal from the water column and stores the metal in the substrate. Desorption returns the metal to the water column, where recirculation and bio assimilation may take place. Metals may be desorbed from the sediment if the water experiences increase in salinity, decreases in redox potential, or decreases in pH.

Heavy metals in surface water systems can be from natural or anthropogenic sources. Currently, anthropogenic inputs of metals exceed natural inputs. Excess metal levels in surface water may pose a health risk to humans and to the environment.

Heavy metals are among one of the pollutants of freshwater, which pose severe threats to the biodiversity with the development of mining, smelting and other industrial activities. Heavy metal pollution not only affects the productivity of crops, but quality of water and also influences the quality of atmosphere, water bodies and threatens the health and life of animals and human beings by way of food chain. The pollution caused by heavy metals is long term and irreversible process. The metal traces commonly found in the environment as a result of human activities includes, Copper, Zinc, Nickel, Lead, Cadmium, Cobalt, Mercury, Chromium and Arsenic. Some of these metals act as micronutrients at small concentrations in living organisms for their normal physiological activities, but accumulation in higher concentration becomes toxic to most life forms. (Lasat 2002; Cheng 2003). The negative effect of metals can occur on soil, micro flora, fauna, higher animals, plants and humans. Usually, the natural contamination of heavy metals originates from weath-ering of minerals, rocks and aquatic environments which resulting in the entry of heavy metals, into reservoir are disposal of industrial effluents, wastes such as sewage sludge, mining effluents. Many of the metals are relatively strongly retained in the surface water and soil and do not readily leach out-causing accumulation that may ultimately pose a threat to humans, animals, plants and microbes. There is a pressing need to deal with excess metals present in soil, sediments and water bodies so as to protect the environmental from the contaminants (Cheng 2003).

In this study, some heavy metals concentrations (Zn, Co, Cu and Cd) and other physicochemical parameters were studied during August 2004 to July 2006 in Palair reservoir, Khammam district.

Water quality parameters were collected on monthly basis. All the physico chemical parameters are analysed by titrimetric methods except temperature, pH and TS, whereas heavy metals were analysed by Atomic Adsorption Spectrometer (AAS). Heavy metals have shown within the permissible limits. All other physico-chemical parameters are within the permissible limit. The measured concentration of metals levels showed considerable difference associated with the season.

CADMIUM

The Cadmiumlevels in the present investigation of Palair reservoir during 2004 to 2006 are ranged in between 0.39 mg/l to 0.12 mg/l at station-I, 0.40 mg/l to 0.13 mg/l at station-II ,0.36 mg/l to 0.09 mg/l at station-III and 0.42 mg/l to 0.11 mg/l in monsoon season.

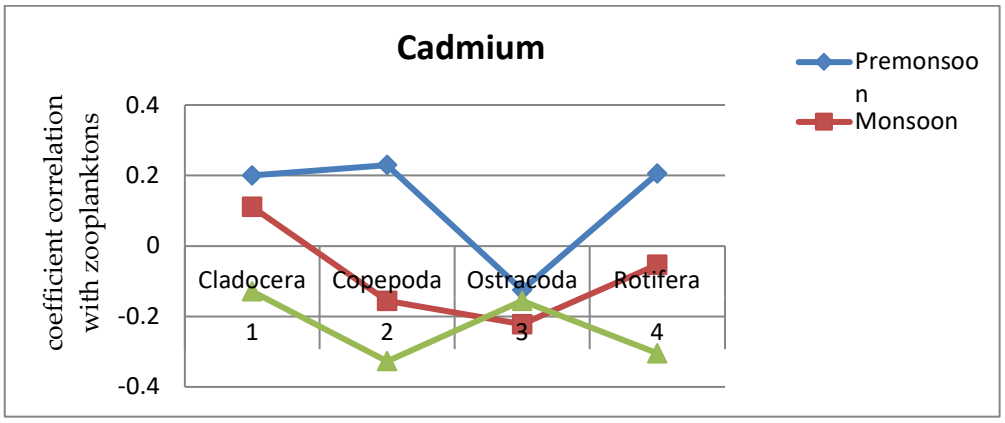

Fig 1: Cadmium Vs Zooplanktons Correlation Coefficient for the Year of 2004-2006 in different stations.

Cladocerans are positively correlated to Cadmium in all seasons except in post monsoon season and remaining zooplanktons are negatively correlated except Copepods and Rotifers in pre monsoon season in Palair reservoir as shown in fig 1.

COBALT

Cobalt is the heavy metal having atomic weight 58.93 and specific gravity greater than 4. This is the essential heavy metal which is required in trace amounts by living organisms in the reservoir

The Cobaltvalues in Pre monsoon season was recorded maximum 0.023 mg/l,0.12 mg/l,0.018 mg/l and 0.016 mg/l and minimum values were recorded 0.008 mg/l,0.008 mg/l,0.007 mg/l and 0.003 mg/l at Station I, II, III&IV respectively. The maximum values were recorded during February 2006 at station I, III&IV, February 2005 at station-II in the pre monsoon season, but the minimum values were recorded in May 2005 at station I&II and in May 2006 at station III and April 2005 at station-IV.

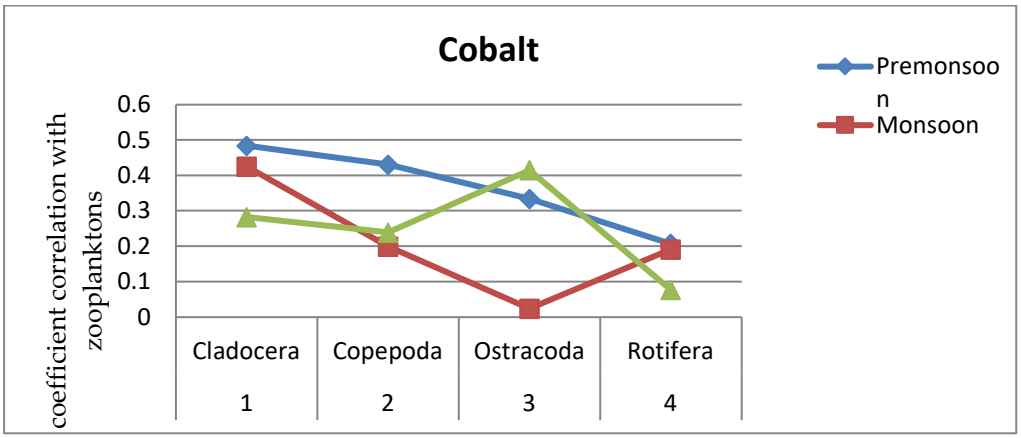

Fig 2: Cobalt Vs Zooplanktons Correlation Coefficient for the Year of 2004-2006 in different seasons.

Cladocerans, Copepodes, Ostracodes and Rotifers are positively correlated to Cobalt in all seasons in Palair reservoir as shown n fig 2.

COPPER

The Copper values in Pre monsoon season was recorded maximum 0.086 mg/L,0.084 mg/L,0.087 mg/L and 0.096 mg/L and minimum values were recorded 0.61 mg/l,0.68 mg/l,0.071 mg/l and 0.071 mg/l at Station I, II, III & IV respectively. The maximum values were recorded during February 2005 at except station-IV (Feb 2006) in the pre-Monsoon season, but the minimum values were recorded in May 2006 at all stations.

The Copperlevels in the present investigation of Palair reservoir during 2004 to 2006 are ranged in between 0.12 mg/l to 0.058 mg/l at station-I, 0.14 mg/l to 0.042 mg/l at station-II ,0.14 mg/l to 0.029 mg/l at station-III and 0.15 mg/l to 0.07 mg/l in monsoon season.

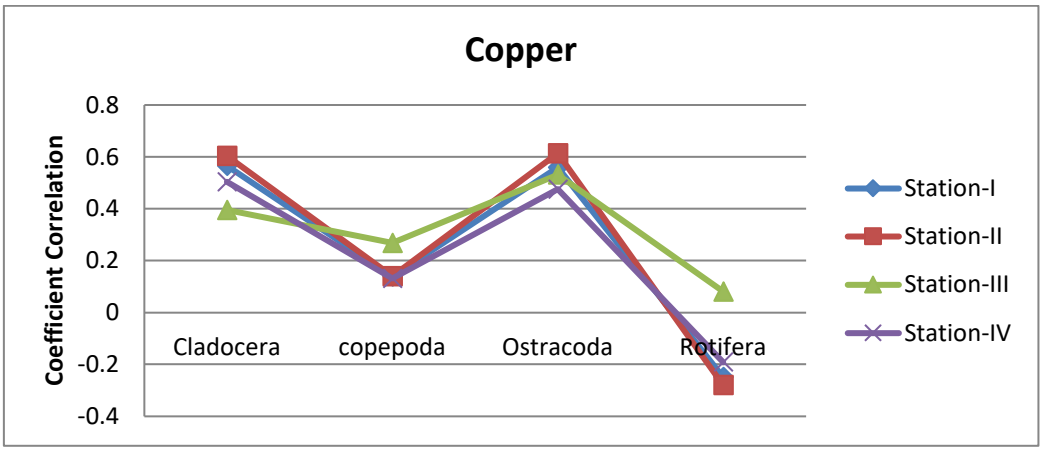

Fig 3: Copper Vs Zooplanktons Correlation Coefficient for the Year of 2004-2006 in different stations.

Cladocerans, Copepodes and Ostracodes are positively correlated to Copper in all stations and Rotifers are negatively correlated to Copper except in Station-III in Palair reservoir is shown in fig 3.

ZINC

The Zinclevels in the present investigation of Palair reservoir during 2004 to 2006 are ranged in between 0.39 mg/l to 0.12 mg/l at station-I, 0.40 mg/l to 0.13 mg/l at station-II ,0.36 mg/l to 0.09 mg/l at station-III and 0.42 mg/l to 0.11 mg/l in Monsoon season.

In Palair reservoir the Zinc levels in Post-Monsoon season were recorded maximum i.e. 0.34 mg/l,0.37 mg/l,0.33 mg/l and 0.38 mg/l. in the month of Oct 2005 at all except station-IV(Oct 2004) and they were recorded minimum in the Jan 2005 are 0.21 mg/l ,0.19 mg/l ,0.19 mg/l and 0.24 at all 4 stations respectively as shown in fig:3.20.1.

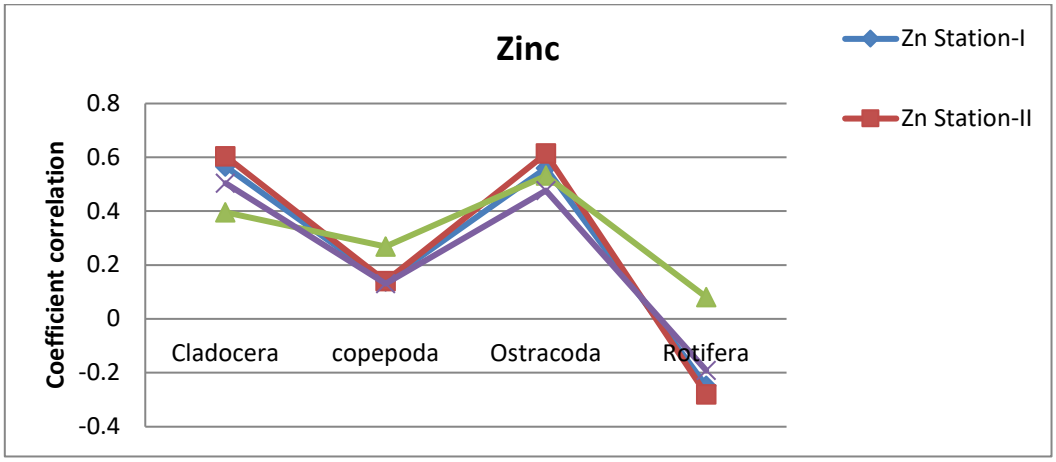

Fig 4: Zinc Vs Zooplanktons Correlation Coefficient for the Year of 2004-2006 in different stations.

In this study Cladocerans, Copepods and Ostreacodes are positively correlated to Zinc in all stations and Rotifers are negatively correlated to Zinc except in station-III in Palair reservoir as shown in fig 4.

Discussion:

Highest cadmium values were observed in monsoon season in palair reservoir. Similar findings by Ghulam Murtaza Mastoi et.al., 2008, in Manchar Lake, Sindh, Pakisthan.

In Palair reservoir higher Cobalt values were observed in post monsoon season. Coefficient correlation of Cobalt is positively correlated with Copper. Similar findings were observed by Ghulam Murtaza Mastoi et.al., 2008, in Manchar Lake, Sindh, Pakisthan.

Copper is most toxic to aquatic algae, and the algal cells are be killed at concentration as low as 0.5 mg/l.Copper level in Palair reservoir was found to be maximum in monsoon and post monsoon seasons. Though it passes as such

through the body as elemental copper but there a evidence of accumulation of trace levels in liver, This observations falls in the line with Shashikanth et.al., 2008, in Karanja reservoir, Bidar district, Karnataka.

The Zinc metal concentration was maximum in monsoon season followed by post monsoon season in the study period. Higher values of Zinc metal due to may be the precipitation and discharges of surface water into the reservoir. Similar findings were observed by Anil kumarGuptha et.al., 2005 in pond water Varanasi and Shashikanth et.al., 2008 in Karanja reservoir, Karnataka.

Conclusion:

Fresh water surveys not only provide data essential for the development of fish stocking and management policies but also provide knowledge of individual water bodies and their characters. The plankton constitutes the basic food source of any aquatic system, which supports fish and other animals. For any scientific utilization of water resources, the study of plankton and physico-chemical characteristics of water are therefore of primary interest. Zooplankton and fish production depend to a large degree on the phytoplankton.

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