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ORIGINAL RESEARCH ARTICLE

Seasonal Variation of Heavy Metal Distribution of Water and Sediments in Krishnagiri Dam, Krishnagiri District, Tamil Nadu, India

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ABSTRACT

Dams near urban centers are under increasing developmental pressure for residential, industrial and commercial facilities, increasing population and economic growth create high demand for real estate in sub-urban localities is suitable becomes exhausted, pressure intensifies to develop lakes for residential housing, manufacturing plants, business office complexes and similar uses. In the present study, hydro biological characteristic features of the Krishnagiri reservoir Dam, the dates for the present study were collected from 3 sampling stations for the period of 6 months in both premonsoon and monsoon seasons. Totally 5 metals were estimated (Cu, Zn, Cd, Pb, Fe). Among which Fe showed high values followed by Cu, Cd and Zn. The sample analysis was done by microwave assisted digestion and Atomic Absorption Spectrophotometer (AAS).

Keywords: Dams, Heavy metals, Microwave assisted digestion and Atomic Absorption Spectrophotometer.

1. INTRODUCTION

Dams are one of the most productive ecosystems, comparable to tropical evergreen forests in the biosphere and play a significant role in the ecological sustainability of a region. They are an essential part of human civilization meeting many crucial needs for life on earth such as drinking water, protein production, water purification, energy, fodder biodiversity, flood storage, transport, recreation, research-education, sinks and climate stabilizers. The values of lakes though overlapping, like the cultural, economic and ecological factors, are inseparable; the geomorphologic, climatic, hydrological and biotic diversity across continents has contributed to aquatic diversity. Across the globe, they are getting extinct due to manifold reasons, including anthropogenic and natural processes. Burgeoning population, intensified human activity, unplanned development, absence of management structure, lack of proper legislation, and lack of awareness about the vital role played by these ecosystems (functions, values, etc.) are the important causes that have contributed to their decline and extinction. With these, aquatic environment are permanently destroyed and lose any potential for rehabilitation. This has led to ecological disasters in some areas, in the form of large-scale devastations due to floods, etc.

Aquatic environment form the transitional zone between land and water, where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on it [1]. They are usually formed in the depressions (subjected to flooding) and ground water seeps. Enhanced appreciation of lakes in the recent past has led to the signing of many international agreements for protecting them, among which the Ramsar convention is the most important.

Aquatic ecosystems are transitional zones between land and water is efficient in filtering sediments. They can intercept run-off from land before it reaches the water and help in filtering nutrients, wastes and sediments from floodwaters. In certain lakes, plants are so efficient in removing wastes that artificial wastewater treatment systems use aquatic plants for the removal of pollutants from water. Lakes remove nutrients (especially nitrogen and phosphorus), particulates and total biological oxygen demand from flooding waters for plant growth and help prevent eutrophication or over-enrichment of other forms of natural

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waters [2]. However, overloading an aquatic environment with nutrients, beyond its threshold, impairs its ability to perform basic functions.

2. MATERIALS AND METHODS

2.1. Sampling design

Totally three sampling sites were fixed to study about the hydrological features of Krishnagiri reservoir during four seasons Premonsoon Monsoon, post Monsoon and summer respectively period from June-2010-2011.

2.2. Collection of samples

To study the hydro biological features of Krishnagiri reservoir the samples were collected from three different zones.

2.3. Selection of sampling sites

Totally 3 sampling sites have been selected in this water body of which one is from east of the reservoir (road side) other one is west which collects municipal waste and the area 3 covers north of the dam where the human settlements is more situated on the south of the dam where normal human activities takes place.

Site: 1

This site is located on the east (road side) of the reservoir. This site is deep infested with a number of green algae particularly in all the seasons. Human activity at this site is limited to occasional bathing, cloth washing and the inlet areas where the chemplast industrial wastes are mixed into the dam. Water is drawn from this area for irrigation and gardening purposes.

Site: 2

It is the farthest site located at the north region of the water body. This site is used for fishing. At this site the human activity is the term of bathing, clothing, washing and fishing is common. There is an outlet to receive the domestic and run off.

Site: 3

It is located on the south side of the reservoir near this site where maximum bathing and cloth washing was observed. The water here was generally supplied for irrigation.

2.4. Sediment

Sediment samples were collected in polythene bags using grab sampler. The samples were brought to the laboratory and shade dried at room temperature. To carry out the metal analyses, large stones and debris were removed and sieved through a mesh (0.5mm), ground well and stored in polythene bags for trace metal analyses.

3. RESULTS AND DISCUSSION

The present investigation also provides the evidence of deterioration of Dam water quality as measured by the selected heavy metal concentrations (**Table 1**). Totally 5 metals were estimated namely Cd, Cu, Zn, Pb and Fe. Among these metals, the zinc is an essential micronutrient for growth metabolism and enzyme activities of various algae, Cyanobacteria and other organisms [3]. However, it is a proven inhibitor of algal growth at higher concentrations. But as the bioaccumulation of heavy metals, indicates that some of them [4] can be dangerous in the sense of metal transfer through food chain in aquatic ecosystems. As far as Zn is concerned, it showed highest concentration than the other metals estimated in the study area.

Cadmium a non-essential element is considered to be one of the most toxic metals. It is found frequently present at elevated concentrations in the aquatic ecosystem, generally as a result of industrial pollution. As a consequence aquatic organisms including fish are exposed to elevated levels of Cd. Exposure to Cd causes anemia, hepatic renal and cardiovascular diseases. After absorption in the gastrointestinal tract Cd is transferred to the liver than to kidneys and finally excreted in urine [5]. The metals were distributed with varying concentration in the different parts of the Dam. But the patterns of distribution of most metals are similar. As an exception to such trends, Fe was mostly accumulated in all the stations during monsoon season.

In the study area, concentration of metals such as Fe > Cu > Cd > Zn > Pb showed their type of trend. Maximum concentration of Cd reached during Premonsoon season (0.42 μg/g) at station 1, whereas lowest concentration was noticed at station II during monsoon season (0.21μg/g). In the case of Zn maximum concentration (0.32 μg/g) was noticed during Premonsoon season at station II and lowest concentration (0.2 μg/g) was noticed during monsoon season (0.2 μg/g) at station III. The metals distributed in the study area showed significant variation in the case of Cu at station I during premonsoon season (0.01) while in monsoon season it showed as 0.05 level of significance. Lead and Iron showed high significance value during premonsoon season and Cd showed significance at station III during monsoon season. The result of the heavy metals in the study area showed the trends with Fe > Cu > Cd > Zn > Pb.

However considerable amount of Cd accumulates in the liver and kidney, mostly bound to an inducible low molecular weight protein called metallothioenin (M+) [6]. Like other metal, cadmium tends to be absorbed by suspended particles and in the bottom sediments. For this reason, even in polluted rivers, the Cd levels in the water phase may be decreased. Irrigation water containing suspended solids contains very high Cd concentration [7].

Next to Cd, Pb in water present mainly through lead processing industries and use of lead pipe etc. Natural and untreated water supply contains about 0.01 to 0.03 mg/l of lead. Kopp and Kromer [8] reported that only 2% of samples from rivers and lakes in United States had lead concentration in excess of 0.05 mg/l. Problems exist, however, in areas with soft and slightly alkaline water, which may dissolve lead from the lead pipes, plastic pipes in which lead has been used as a stabilizer [7]. Lead concentration in the present study varied from 0.21 to 0.30 μg/g during monsoon and 0.38 to 0.42 μg/g during premonsoon.

Heavy metals produce toxic effects and endanger the life of aquatic fauna of which fishes are the most sensitive group. Cu when absorbed through gills, result in considerable tissue damage and become fatal to fish life [9]. Cu is an essential trace element and widely distributed in nature. The $CuSO_4$ mixed with lime is used as a fungicide. Cu in the Dam sample ranged from 0.31 μg/g to 0.86 μg/g during monsoon season. It was found to be high in the station I and low in the station III (0.31 mg/g).

Metals in water and sediment occur as complex and diverse mixture of soluble and insoluble form, such as ionic species, inorganic, organic complexes and associated with colloids and suspended particulate matter [10]. Metals are probably the most harmful insidious pollutant because of its non-biodegradable nature and their potential to cause adverse effects to organisms at concentration higher than permissible limit [11]. Zn is an essential trace metal that is presumably homeostatically controlled. In recent year, the environmental pollution by heavy metal gives greater attention to many researches so that extensive work has been carried out to study the toxicity of heavy metals in the environment as well as in the flora and fauna [12].

Table 1: Seasonal distribution of heavy metals in the study area during 2010-2011

Metals (μg/g)	Season	Stations		
		I	II	III
Cu	Premonsoon	0.49^{***}	0.28	0.20
	Monsoon	0.86^{*}	0.40	0.31^{**}
Zn	Premonsoon	0.22^{ns}	0.32^{ns}	0.24^{ns}
	Monsoon	0.31^{**}	0.29^{ns}	0.20^{**}
Cd	Premonsoon	0.42^{*}	0.39^{ns}	0.38
	Monsoon	0.30^{**}	0.21^{*}	0.26^{***}
Pb	Premonsoon	0.09^{ns}	0.10^{**}	0.08^{***}
	Monsoon	0.16^{*}	0.07^{***}	0.03^{ns}
Fe	Premonsoon	2.64^{*}	2.11^{***}	2.68^{ns}
	Monsoon	4.46^{*}	2.83^{ns}	3.54^{ns}

**** P < 0.001 ns – not significant; ** P < 0.01 * P < 0.05*

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