Monitoring of Heavy Metals and Physico-Chemical Parameters of Soil, Near Sudha Dam Bhokar, Maharashtra

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Abstract: Soil is a major reservoir for contaminants as it possesses an ability to bind various chemicals. The purpose of this research work is to introduce to the reader the fundamental processes that control the mobility of metals in the soil environment. The metals selected for this research work are the metals most commonly found at sites and will be limited. A study was conducted to investigate to study accumulation of heavy metals in soil samples collected from the surface of the soil near Sudha dam area in Bhokar, Maharashtra. These chemicals can exist in various forms in soil and different forces keep them bound to soil particles. It is essential to study these interactions because the toxicity of chemicals may strongly depend on the form in which they exist in the environment. Another thing is that soil variability and some environmental properties (e.g. climate factors) may change equilibrium found in soil and cause leaching of trace toxic elements like heavy metals tightly bound to soil particles. The concentration of these metals was determined by UV-spectrophotometer. The concentration of heavy metals was found to be below the permissible limits.
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1. Introduction

Heavy metal pollution is a major environmental problem facing the modern world. Essential heavy metals such as copper and zinc are necessary for a wide range of physiological processes Cobbett and Goldsbrough (2002). Heavy metals and some trace elements are biologically toxic and can affect and threaten the health of human being owing to their accumulation and persistence in the compartments of the food chain. Soils may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition Khan et al., (2008) and Zhang et al., (2010).

In the past few decades, heavy metals accumulation in the environment has been attracting increasing attention from both researchers and policymakers because of their toxicity, persistence in the environment and subsequent accumulation in aquatic habitats Facchinelli et al., (2001), Loska and Wiechula (2003). Sediments play a major role in determining the pollution patterns of aquatic systems. They act as both carriers and sinks for contaminants, reflecting the history of pollution, and providing a record of catchment inputs into aquatic ecosystems Singh et al., (2005), Devesa-Rey et al., (2010). The metals of greatest concern in the sediments of the Yanghe River were found to be Cd and Zn. Almost the whole river was contaminated with either or both types of metal. We estimate that heavy metals pollution was one of major contributors to the emergency pollution events Jing (2014).

Aims and objectives of the present study are to analyze, through investigation of soil quality in all means. Earlier the soil quality evaluation was not under taken for the research purpose especially for elemental analysis.

2. Material and Methods

2.1 Study Area

Sudha dam constructed on Sudha River at Renapur village in the Bhokar taluka having district Nanded of Maharashtra state has been selected for carrying out this research work. The density of vegetation around the dam is thick and the soil is black, slightly rocky and occasionally red. It is situated at northern part of Nanded district. Bhokar is the Tehsil place in Nanded district of Maharashtra, the Sudha reservoir was constructed earlier and it is on the way to Kinwat road and at Bhokar towards eastern. The reservoir is situated 190 15’ latitude 730 43’ longitude. The catchments area of the reservoir is about 105.67 sq. km.

2.2 Sample Collection:

The soil samples were collected from a sub-surface of dam by using a corer and were brought to the laboratory in a plastic pouch in 2010. Determining

the pH, first the soil samples were mixed thoroughly, air dried and passed through a mesh sieve. The samples were used for subsequent physico-chemical analysis by following methods.

Fig.1: Google Image of Sudha dam Bhokar, Nanded

2.3 Determination of the metals and physico-chemical parameters of the soil samples:

The metal analysis was performed according to standard method APHA, (2000) and using U.V. Spectroscopy. All solution were prepare with deionized water. Stock solutions of all the metals, containing 1000 mg were used form the preparation of the standards for the calibration curve. The analysis has been used in the past to identify these metals. The soil is dried in an oven at 150^{o}C. By acid digestion of soil extract using standard methods for estimation of Iron by Thiocynate, Zinc by Dithiozone and Manganese by Persulphate method. Calcium (Ca) and magnesium (Mg) were determined by complex metric titration method Jackson M.L. (1973) which is popularly known and applicable largely. The chloride is an essential ion for the plant growth. The chlorides present in the samples were determined in 1:5 soils: water suspension by Argentometric method. The fluoride amount observed and carried out from the sample was determined in 1:5 soils: water suspension by SPANDS method on UV-Spectrophotometer.

Electrical conductivity (EC) of the soil was determined in 1:5 soils: water suspension with the help of Conductivity meter. Soil pH of the soil was determined in 1:5 soils water suspensions with the help of a pH meter. Organic carbon (OC) content of the soil samples was determined by titrometric method, the Walkley and Black widely useful and represented as % of OC. Organic matter (OM) content of the soil samples were determined and calculated from organic carbon by multiplying it by Von Bemmlen factor. Soil alkalinity is due to presence of soil minerals producing sodium carbonate upon weathering. It was determined by titrating the soil suspension with a strong acid using methyl orange as an indicator.

3. Results & Discussions

The study of the Sudha dam soil is important for the purposes of agriculture and its uses of the dam water. The selected different parameters of the soil from Sudha dam area have been studied. The acquired outcomes are shown in table.

The highest concentration of pH was found 7.80 at sampling site S5. The minimum concentration of pH was recorded 7.23 at sampling site S3. The average concentration of pH was recorded 7.39. The pH can affect the availability of nutrients in the soil. Electrical conductivity indicates the amount of soluble ions (salt) in soil. The highest concentration of electrical conductivity was found 104.5 uS/cm at sampling site S6. The minimum concentration of electrical conductivity was recorded 72.7 uS/cm at sampling site S3. The average concentration of electrical conductivity was recorded 87.6 uS/cm. Higher EC indicates accumulation of salts in the soil. The pH range depends upon the available minerals/salts in the soil. The soils of the various farms are found to be slightly alkaline in nature. The pH ranged from 6.54-7.66. The concentration of electrical conductivity was 92-654 uS/cm at Nanded city Yannawar et al., (2013).

The estimated Organic Carbon the highest concentration of Organic Carbon was found 0.26% at sampling site S7. The minimum concentration of Organic Carbon was recorded 0.12% cm at sampling site S1. The average concentrations of Organic Carbon was recorded 0.20% and were the organic matter the highest concentration of Organic Carbon was found 0.20% at sampling site S5. The minimum concentration of Organic Carbon was recorded 0.21% cm at sampling site S1. The average concentration of Organic Carbon was recorded 0.36% respectively. The organic matter utilized by plants & microorganisms. The percentage of organic carbon was highest (0.285 %) in site S1 and lowest (0.12%) in site S2 and the percentage of organic matter was highest (0.491 %) and lowest (0.206 %) at same sites. The organic carbon is low as compared with standard value of <0.5 % Katyayan (2008).

The chloride content in soil was highest concentration of alkalinity was found 2.4 m eq/100g at sampling site S2. The minimum concentration of alkalinity was recorded m 1.5 eq/100g cm at sampling site S4. The average concentration of alkalinity was recorded 2 m eq/100g 12.17% and the estimated calcium carbonate the highest concentration of calcium carbonate was found 4.2 % at sampling site S2. The minimum concentration of calcium carbonate was recorded 1.9 % cm at sampling site S1. The average concentrations of calcium carbonate were recorded 3.2 %.

The observed calcium the highest concentration of calcium was found 764. mg/gm at sampling site S6. The minimum concentration of calcium was recorded 533. mg/gm at sampling site S4. The average concentrations of calcium were recorded 669. mg/gm and were the magnesium the highest concentration of magnesium was found 92.2 mg/gm at sampling site S6. The minimum concentration of magnesium was recorded 56.4 mg/gm cm at sampling site S4. The average concentration of magnesium was recorded 85.0 mg/gm respectively. High concentration of Ca & Mg increases pH of the soil. The calcium was detected in the range of 0.81 to 1.146 mg/gm. The magnesium was ranged between 0.03 to 0.13 mg/gm at the disposal site of Nanded city Shaikh et al., (2012).

The observed sodium the highest and lowest concentration of sodium was found 71.8 mg/L at sampling site S5 and 31.4 mg/L at sampling site S4. The average concentrations of sodium was recorded 46.5 mg/L. The potassium the highest and lowest concentration of magnesium was found 7.6 mg/L at sampling site S4 and 4.12 mg/L S2. The average concentration of potassium was recorded 5.742 mg/L respectively. The sulphate concentration was observed maximum and minimum concentration of sulphate was found 297.6 mg/L at sampling site S5 and 115.2 mg/L at sampling site S3. The average concentration of sulphate was recorded 206.614 mg/L and the observed phosphorus the highest and lowest concentration of sodium was found 0.93 % at sampling site S3 and 0.36 % at sampling site S4. The average concentrations of sodium was recorded 0.662% respectively. The concentration for available phosphorus detected in the range of 0.33 to 3.72 % with an average 1.1305 %. As soil pH is increased from very acid values (pH 3) to near neutrality (pH 7) phosphorous availability therefore increases steadily (Cresser, 1993).

The observed heavy metals are highest and lowest concentration of Fluoride was found 4.9 mg/L at sampling site S5 and 3.5 mg/L at sampling site S2. The average concentrations of Fluoride was recorded 4.18 mg/L. The Iron highest and lowest concentration was found 9.64 mg/L at sampling site S6 and 4.35 mg/L S5. The average concentration of Iron was recorded 6.77 mg/L respectively. The Zinc concentration was observed maximum and minimum concentration of zinc was found 9.58 mg/L at sampling site S5 and 5.56 mg/L at sampling site S7.

Table 1. Sselected different parameters of the soil from Sudha dam

Sr. No	Parameters	Sampling Sites							
		S_1	S_2	S_3	S_4	S_5	S_6	S_7	Mean
1	pH	7.48	7.31	7.23	6.94	7.80	7.70	7.27	7.39
2	Ec (uS/cm)	92.3	86.5	72.7	79.5	101.	104.	76.4	87.6
3	Organic carbon (%)	0.12	0.23	0.13	0.21	0.19	0.25	0.26	0.20
4	Organic Matter (%)	0.21	0.39	0.26	0.34	0.48	0.42	0.41	0.36
6	Alkalinity (m eq/100g)	2.1	2.4	1.6	1.5	2.2	1.9	2.3	2
7	Calcium Carbonate	1.9	4.2	4.5	2.6	2.9	3.4	2.9	3.2
8	Chloride (%)	2.10	1.87	1.65	1.42	1.13	1.49	1.77	1.63
9	Calcium (mg/gm)	584.	763.	705.	533.	764.	689.	642.	669.
10	Magnesium (mg/gm)	74.2	84.3	116.	56.4	82.4	92.2	88.7	85.0
11	Sodium (mg/L)	48.1	34.8	35.3	31.4	71.8	62.7	41.5	46.5
12	Potassium (mg/L)	4.7	4.12	3.9	7.6	7.2	5.9	6.8	5.74
13	Sulphate (mg/L)	173.	182.	115.	184.	297.	237.	255.	206.
14	Phosphorus (%)	0.48	0.76	0.93	0.36	0.84	0.79	0.48	0.66
15	Fluoride (mg/L)	3.9	3.5	4.8	4.3	4.9	4.1	3.8	4.18
16	Iron (mg/L)	8.32	7.64	4.78	5.81	4.35	6.89	9.64	6.77
17	Zinc (mg/L)	6.22	6.98	8.22	7.89	9.58	8.14	5.56	7.51

The average concentrations of zinc were recorded 7.51% respectively. Shaikh et al., (2012) investigated the fluoride ranged from 9.45 mg/L to 27.76 mg/L and Iron from 3.4 to 68 mg/L. In some samples it is above the permissible limit i.e.4.5 ppm (Agriculture dept.). The average fluoride and iron content were 18.58 and 23.62 mg/L. Metals such as Fluoride, Iron, and Zinc were found within the permissible limits according to WHO (2006). Soil Zn may augment due to agrochemical treatments (Nziguheba and Smolders 2008; Ramos-Miras et al. 2011) but, in this study, it exposed low concentrations. Hence we can assume that agrochemical inputs are not important.

4. Conclusions

From the outcomes of the research work, it can be concluded that the pH of all the soil samples were

slightly neutral. The organic carbon and calcium carbonate are low in all the soil samples. Natural variation of heavy metals in soil is seen more clearly. The concentration of heavy metals was found to be below the permissible limits. Increase the use of the natural pesticides to avoid side effects of other pesticides.

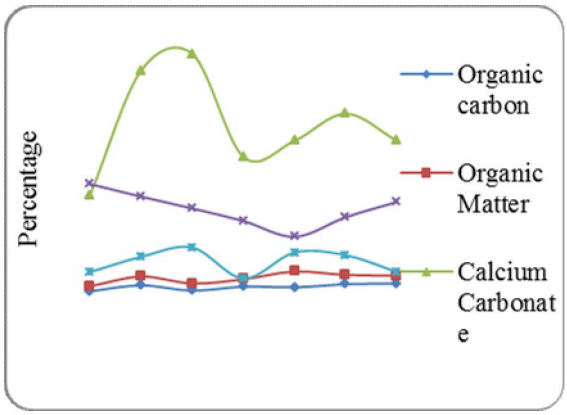

Fig.2: Noted OC, OM and Caco3 contents.

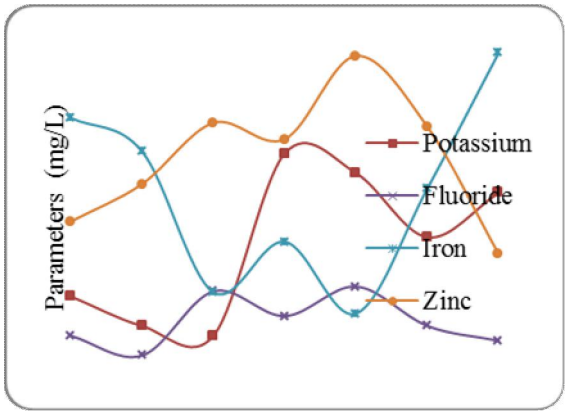

Fig.3: Variation in Fe, F, Zn & Potassium.

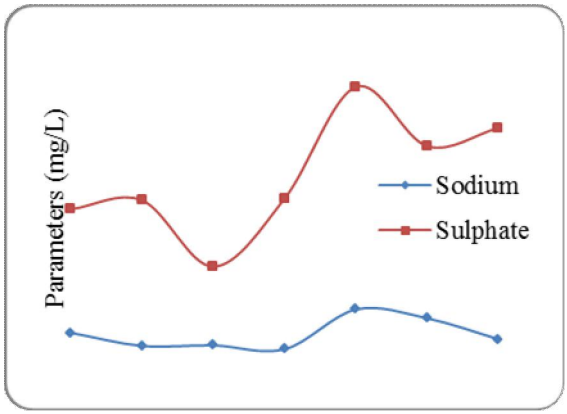

Fig.4: Perceived Sodium & Sulphate.

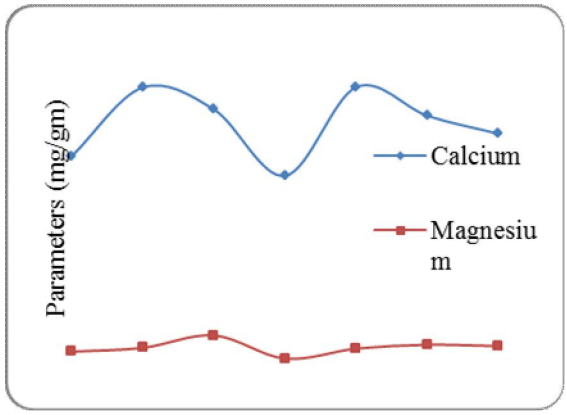

Fig.5: Variations in Ca & Mg contents.

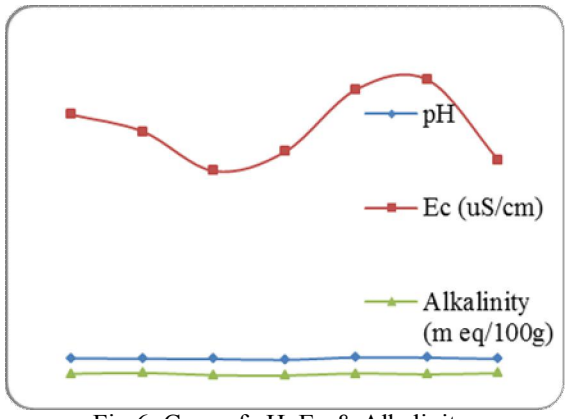

Fig.6: Cons of pH, Ec & Alkalinity.

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