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"INVESTIGATION STUDY OF HEAVY METALS POLLUTION IN SOIL AND WATER IN AND AROUND AVARAGOLLA VILLAGE, DAVANGERE DISTRICT"

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Abstract –

The agricultural practices and solid waste disposal sites in the vicinity of Avaragolla village, Davangere District, Karn ataka, are responsible for the heavy metal pollution of the soil. The following directions were used to collect soil and water samples: East (E), West (W), North (N), South (S), N orthWest (NW), NorthEast (NE), South West (SW), and So uth East (SE). Surface water, ground water, & domestic wa ste water out from studied area were all sampled.

Atomic absorption spectrophotometers were used to measure the content of the heavy metals Cadmium (Cd), Chromium (Cr), Copper (Cu), Zinc (Zn), and Lead (Pb) in soil samples (DTPA method) and water samples (AAS). In soil and water, the average absorption of heavy metals fell in the following order: Zn>Pb>Cr>Cu>Cd. All of the soil and water samples were well within the WHO, agricultural standards, and standard limit for irrigation pa rameters. The Geoaccumulation Index (Igeo) of soil is uncontaminated, the study area's Contamination Factor (CF) is less contaminated, and the study area's Pollution Load Index (PLI) is unpolluted, according to the results of soil pollution indicators.

Key Words: **Heavy metals, Soil, Water**

1. INTRODUCTION

The definition of soil is a thin stratum of the outer layer of the ground that acts as a typical medium for plant development. Soil is an unconsolidated mineral substance that is affected by both Biological and Natural factors over time such as climate, parent material, geology and organisms. Water, mineral matter, living things, organic matter, and air are the five primary elements of soil. A complicated structure makes up soil. Instead of being constant, the concentration of these compounds in the soil varies with the location. Because of soil is crucial natural resources to human life, soil pollution has grown to be a serious issue. Water is a crucial resources that has an impact on humans life. It's a necessity for all life, including plant, animal life and Human, & it may be obtained naturally from 2 main sources: i.e. fresh water surface (found in lake, river) and ground-water. Well-water & bore-wells both contain groundwater. Everywhere in the world, water is essential for irrigation, home use, and industrial supply. However, population growth, industrialization, and urbanization all contribute to groundwater contamination. Restoring the contaminated groundwater is difficult. Therefore, it is important to preserve the groundwater quality. Due to increased industries tasks, technological advancement, an increasing humans populace, misuse of the environmental resources, run-off from agricultural and domestic waste, a significant amount of pollutants are re - introduced into an aquatic system. Due to there persistent nature, propensity for accumulation in the organism, severity, and inability to degrade, heavy metal are among the contaminants that are considered to become most dangerous.

Elements having metallic characteristics as well as atomic mass more than 20 are considered as Heavy metal. The selected Heavy metals in this study were Cu, Cd, Cr, Pb and Zn. Heavy Metals of various kinds, including Cu, Cd, Bi, Zn, and Mn, among others, are naturally present in trace amounts or at extremely low levels; nonetheless, their higher level is a sign of how contaminated a particular area is. The thorough understanding of various sorts of heavy metals, their forms, and their dependence on soil provides a strong framework for soil's management. Heavy Metals represent a concern to human health in addition to crop plants because of their toxic nature and potent cumulative effects. Using macrophytes and genetically designed bacteria to immobilize contaminants, the Metal contamination % could be reduced. Heavy metal build-up frequently causes ecological dysfunction and damage of the water and soil. Furthermore, Heavy metals pose a concern to both animal and human health because they contaminate food even infiltrate food-chain through contaminated water, Air and Soil. Increased Heavy metal consumption by plants could have an impact on the safety & quality of food in addition to contaminating the environment when heavy metals are accumulated excessively in the cultivated soils.

2. MATERIAL AND METHODOLOGY

2.1 Study Area

The village of Avaragolla is chosen as the study area The distance between Davangere city and Avaragolla village is 12 kilometers. Inside the middle of the Karnataka, among latitudes of 13° 5' & 14° 50' N & the longitude of 75° 30' & 76° 30' E, sits on the Davangere district, which is 602.5 meters above mean sea level. 7.74km^2 is the whole area that Avaragolla occupies. The two main types of soil in this area are black soil and red sandy soil. This location receives 644mm of rain on average per year. The source of water in Avaragolla is Under ground water and Bhati lake water.

2.2 Soil And Water Sampling

During the months of May and June, Water & Soil samples were Collected in the 8 directions of the village of Avaragolla, i.e., E, W, N, S, N-E, N-W, S-E, & S-W. From the earths surface, Soil samples collected at the depth, of 20 cm. Grab sampling is the method used for sampling of soil. For analysis, soil sample samples were placed in clean paper bag and let to air dry for four days. Each sample was ground in an agate-mortar before being put through a sieve with a mesh size of 2 mm stainless steel. The water samples collected are surface water, Borewell water and Domestic Sewage water. The samples were preserved and kept by adding 1% nitric acid (HNO_3) to them. Sample containing bottles and containers had clearly labeled.

2.3 Preparation of soil and Water Sample

2.3.1 Soil digestion by DTPA method

1. In Deionized water, 1.47 grams of $CaCl_2.2H_2O$, 14.92 grams of TEA, and 1.97 grams of DTPA were separately dissolved before being mixed. Concentrated of HCl was used to raise the pH above 7.3, & distilled-water was used to fill the remaining space to make it 1 L.

2. A sample of soil weighing 10 grams was collected in an 100 ml flask, to which 20 ml of the DTPA solutions was poured.

3. Shaking the solution in a shaker at a rate of 70 to 80 oscillations / minute for two hours.

4. Run the samples through filter-paper with a 110mm diameter (Whatman NO 1).

5. Now Collect this filtrate solution in the plastic water bottles, then use an atomic absorption spectrophotometer to measure the Heavy metals (AAS).

6. Standard solutions of the each metals are used for the calibration in the AAS for evaluation of the heavy metals Cd, Cr, Cu, Pb, and Zn.

2.3.2 Digestion of Water Sample

1. 100 ml of the collected water sample were accurately measured & transferred, then 2 ml of concentrated HNo_3 and 5 ml of concentrated HCl were also added.

2. After being heated at 95°C until the volume of the solution was decreased to 15ml, it was covered with a watch glass and left to cool.

3. After that Reagent water is used to adjust the final volume to 100ml.

4. It is filtered using filter paper, then the amounts of Cd, Zn, Cu, Pb and Cr and in the water are calculated using AAS.

3. RESULTS AND DISCUSSION

The test's outcomes of Water and Soil samples which were collected in the month of May and June were tabulated below.

Table-1: Concentrations of Heavy metal in Soil Conducted in the Month May

Sl No	Directions	Cd	Cr	Cu	Zn	Pb
1	E	0.10	5.62	4.12	14.54	8.15
2	W	0.01	2.15	2.1	10.2	BDL
3	N	0.05	4.43	2.35	11.8	6.52
4	S	0.02	3.6	2.5	10.65	6.45
5	NE	0.12	6.78	3.85	14.95	7.85
6	NW	BDL	BDL	1.2	8.25	6.1
7	SE	0.15	6.43	3.63	13.2	8.46
8	SW	0.03	4.75	2.2	12.10	5.86

Table-2: Concentrations of Heavy metal in Soil Conducted in the Month June

Sl No	Directions	Cd	Cr	Cu	Zn	Pb
1	E	0.15	6.2	4.35	15.6	9.23
2	W	0.007	1.8	1.8	9.22	5.8
3	N	0.031	3.8	2.14	11.1	5.81
4	S	0.008	3.0	2.34	9.5	5.68
5	NE	0.16	7.1	4.1	15.83	8.62
6	NW	0.006	1.5	1.02	BDL	BDL
7	SE	0.18	7.0	3.4	14.4	9.25
8	SW	BDL	4.0	1.95	11.15	5.15

Table-3: Concentrations of Heavy metal in Water Conducted in the Month May

Sl No	Directions	Cd	Cr	Cu	Zn	Pb
1	E	0.005	0.04	0.25	0.92	0.04
2	W	0.002	BDL	0.075	BDL	0.02
3	N	0.002	0.02	BDL	0.71	BDL
4	S	BDL	0.033	0.15	0.63	0.012
5	NE	0.003	0.045	0.32	0.86	0.035
6	NW	BDL	0.02	0.096	0.51	0.018
7	SE	0.004	0.05	0.28	0.98	0.038
8	SW	BDL	0.028	BDL	0.68	BDL

Table-4: Concentrations of Heavy metal in Water Conducted in the Month June

Sl No	Directions	Cd	Cr	Cu	Zn	Pb
1	E	0.004	0.032	0.22	0.89	0.03
2	W	0.001	0.022	0.06	BDL	0.015
3	N	0.001	0.015	0.01	0.62	0.015
4	S	0.0015	0.026	0.10	0.60	BDL
5	NE	0.002	0.04	0.28	0.80	0.028
6	NW	BDL	0.014	BDL	0.46	0.013
7	SE	0.003	0.042	0.2	0.91	0.03
8	SW	0.002	BDL	0.09	0.56	0.01

Table-5:Result of the Contamination-Factor(CF), Geoaccumulation Index(I_{geo})& Index of Pollution Load(PLI) for the Heavy metal in the Soil samples in Month May

Heavy metals	Average values of HM in Soil (mg/kg)	Reference Values	I_{geo}	CF	PLI
Cd	0.068	0.3	-2.727	0.22	0.180
Cr	4.82	35	-3.45	0.137	
Cu	2.74	25	-3.77	0.109	
Zn	11.96	71	-3.158	0.168	
Pb	7.05	20	-2.089	0.35	

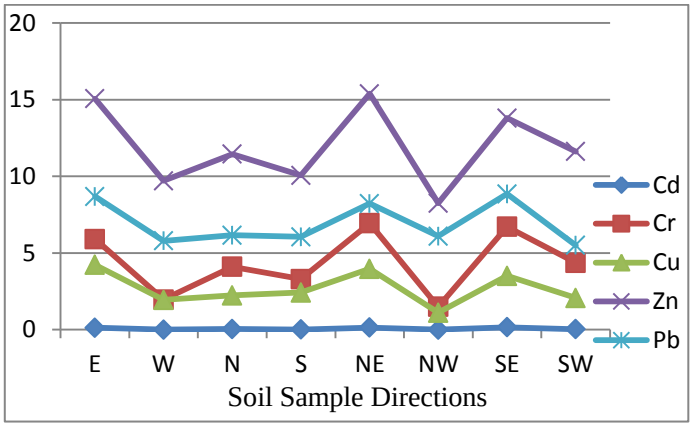

Chart-1: Average values of Heavy metals in Soil.

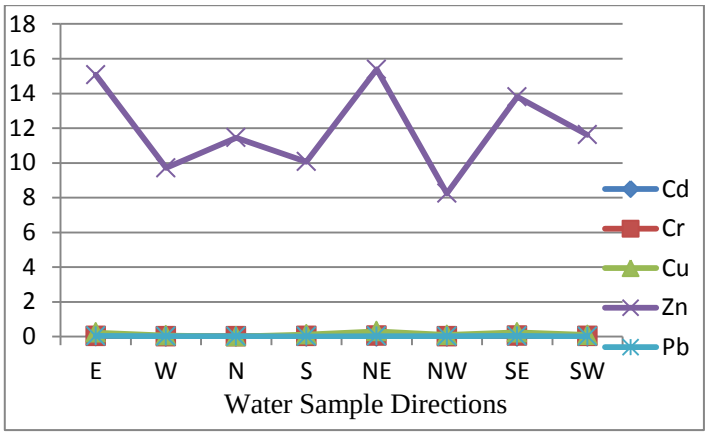

Chart-2: Average values of Heavy metals in Water

Table-6:Result of the Contamination-Factor(CF), Geoaccumulation Index(I_{geo})& Index of Pollution Load(PLI) for the Heavy metal in the Soil samples in Month June

Heavy metals	Average values of HM in Soil (mg/kg)	Reference Values	I_{geo}	CF	PLI
Cd	0.077	0.3	-2.547	0.25	0.181
Cr	4.3	35	-3.608	0.122	
Cu	2.63	25	-3.836	0.105	
Zn	12.4	71	-3.107	0.174	
Pb	7.07	20	-2.089	0.353	

The mean concentration of Cadmium in Soil is 0.068mg/kg in the month of May and 0.077mg/kg in the month of June was found to be less when compared to the standard limits. The Cadmium content is more in the direction of East, NE and SE because of the prolonged use of domestic wastewater and also the frequent application of fertilizer.

The mean concentration of Cadmium in Water is 0.0031mg/l, in month May and 0.0021mg/l in month June both were compared with WHO and BIS standards and found within the limits. The mean concentration of Cadmium in Water is less in the month of June due to Water diluted by the rain.

The mean concentration of Chromium in Soil is 4.82mg/kg in the month of May and 4.3mg/kg in the month of June & Since those values were discovered to be below the limitations, crops as well as other microorganisms are unaffected. The average concentrations of Chromium in the Water is 0.033mg/l in month May and 0.026mg/l in month June. Cr concentration in water is less in the month of June due to Water Dilution.

The mean concentration of Copper in Soil is 2.74mg/kg in the month of May and 2.63mg/kg in the month of June was found to be less when compared to the standard limit set by WHO and International Agricultural Standards for Soil Analysis (Awasthi 2000). Cu are a result of neighboring traffic and agricultural activity. The mean concentration of Copper in Water is 0.187mg/l in month May and 0.0137mg/l in month June both were compared with WHO and BIS standards and are found within the limits. Because of surface runoff & atmospheric deposition, copper heavy metal may have been introduced to the area.

The average zinc concentration in soil was found to be lower than the standard limit i.e. 11.96 mg/kg in May and 12.4 mg/kg in June. Zn is present in soil naturally since it exists as in atmosphere in free state, but anthropogenic tasks like burning fossil fuel, using liquid manures, fertilizers, & use of pesticide in agriculture cause Zn to get dissolved in the soil. The average zinc concentration in water was 0.187 mg/l in May and 0.0137 mg/l in June. The facts that pH of the water sample was somewhat alkaline and that zinc's solubility is function of the decreasing the pH may be the reason for the low amount of zinc in drinking-water.

The mean concentration of Lead in Soil is 7.05mg/kg in the month of May and 7.07mg/kg in the month of June. Lead is present because of vehicle activity & vehicle emissions. The mean concentration of Lead in Water is 0.026mg/l in the month of May and 0.019mg/l in the month of June both were compared with WHO and BIS standards and are found within the limits.

The Result of Contamination Factor for Heavy metals i.e. ,Chromium, Cadmium, Lead , Copper, and Zinc has revealed that, within the study area the soil sample fell with class <1 i.e. Low Contamination in the study area.

The Result of Geoaccumulation Index for Heavy metals i.e. ,Chromium, Cadmium, Lead , Copper, and Zinc of soil sample are less than o suggesting that soil in the study area is Uncontaminated by these elements.

Result of Present study shows that a soil's Index of Pollution Load is inferior to 1 that represent that the study area is not polluted.

4. CONCLUSIONS

In the present study all the Heavy metals Concentrations of soil and Water samples analyzed in the month of May and June were well within in the standard limits. The Heavy metals in Soil in the Direction E,NE,SE is more in the month of June than in May due to Leaching from the Solid waste Dumping Site. The Heavy metals in Water are more in Domestic Sewage than in Ground and Surface water. The heavy metals in water collected in the month of June is less than in the month of May due to runoff, dilution, and rainfall activities. The Heavy metals in Ground and Surface water are well within the Safe limits which can be used for Irrigation and also for Drinking Purposes as it is not affected to Humans. Instead of using chemical fertilizers, organic manures need to be used to increase soil fertility.

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