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Soil Pollution in Dravyavati River and its Surrounding Areas of Jaipur City, Due to MSW (Municipal Solid Waste) and Industrial Waste

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***Abstract*: Due to rapid industrialization, urbanization and use of waste water in agriculture in India increasing contamination of soil has become a major concern. The aim of this study was to evaluate the levels of some physical and chemical soil parameters in region of Dravyavati River (Amanishah nala) of Jaipur during post monsoon session (November 2016 – February 2017) and to access the quality of soil for determining its suitability for agricultural and irrigation purposes. Physical-chemical parameters of soil such as pH, EC, available organic-carbon, phosphate, potash and Micronutrients such as Zn, Fe, Cu and Mn were analyzed. Soil samples from Fifteen sites of east- southern part of Dravyavati River (Amanishah nala) were taken during post monsoon session. The analysis of soil samples shows that there is a problem of high alkalinity in soil nature regarding to pH which is somewhat not permissible for irrigation and agricultural purposes.**

However all the value of EC comes in permissible limits. The percentage analysis of organic carbon shows low level in the entire soil samples whereas phosphate and potash availability belongs to medium level. The mean concentration of Micronutrients which is higher than the prescribed limits is in order of Fe > Mn> Cu> Zn (ppm).

Keywords*: Soil Pollution, Dravyavati River, Physical-chemical parameters, alkalinity, Micronutrients.

I. INTRODUCTION

Soil is only part of the agricultural resource picture[1]. Agriculture is also dependent upon inherent water, nutrients and favourable climates to grow productive crop varieties and upon the mechanical to tend and harvest them. Soil water plays a very significant role in soil plant growth relationship. The Chemical, Physical and Bacterial characteristics of soil determine its usefulness especially for irrigation. Out of the sixteen important and essential elements, thirteen elements are provided by the soil. Manures and fertilizers are added to the soil to make up the deficiency of these elements in the soil in order to meet the increasing demand of the crops. Soil contaminated by heavy metals from agricultural and industrial wastes will produce unhealthy food. Heavy metals enter the food chain and are consumed by human beings.

In modern economies, various types of activity, including agriculture, industry and transportation, produce a large amount of wastes and new types of pollutants in present scenario soil pollution has been continuously increasing as a result of industrial activities and contamination of soil constitutes a severe environmental problem all over the world. The Swedish Environmental Protection Agency estimates that there are about 83,000 contaminated areas in Sweden alone, many of them with mixed contaminants, i.e., both organic substances and metals[2,3] (SEPA 2007).

Ivana etal [4] conducted a comprehensive study on Urban Soil Contamination by Potentially Risk Elements in Czech Republic, in Prague and Ostrava. The analyses were carried out on soil samples taken from thirteen parks in two towns of the Czech Republic, in Prague and Ostrava. Significantly higher values of lead (mean 86 mg/kg) and copper (mean 28 mg/kg) were found in Prague. Herawati etal [5] studied the Cadmium, Copper, and Zinc Levels in Rice and Soil of Japan, Indonesia, and China by Soil type. Japanese rice seemed to have somewhat higher Zn levels (23.4 µ g/g). Similar levels were seen in Indonesian rice (23.5 µ g/g), which had higher Zn concentrations.

Myung Chae Jung [6] also analysis the heavy metal concentrations in soils and factors affecting metal uptake by plants in the vicinity of a korean Cu-W mine. During his investigation he found that heavy metal concentrations were measured in soils and plants in and around a copper-tungsten mine in southeast Korea. Atafaret et al [7] investigated the variability of chemical applications on Cd, P band As concentrations of wheat-cultivated soils in Mahidasht, which is one of the active zones of agricultural practices in the Kermanshah province (Iran).The result indicated that Cd, Pb and As concentrations were increased in the cultivated soils due to fertilizer application. Tajik et al [8] also studied soil of the Dasht-e-Naz of Sariregion in the north of Iran.

Some of this manure may wash into nearby streams, and pollute rivers, lakes and soil. The most common kinds of waste can be classified into four types: agricultural, industrial, municipal and nuclear [9] .

Agricultural wastes include a wide range of organic materials (often containing pesticides), animal wastes, and timber by-products. Many of these, such as plant residues and livestock manure, are very beneficial if they are returned to the soil. However, improper handling and disposal may cause pollution. Industrial waste products may be in gas, liquid or solid form. The most important gases are carbon dioxide (CO2), carbon monoxide (CO), nitrogen dioxide (NO2) and sulphur dioxide (SO2). They are produced by combustion in industry and by automobiles, and they pose a hazard to the environment. Food processing plants produce both liquid and solid wastes. Another urban waste is municipal garbage. This is made up of materials discarded by homes and industry. It contains paper, plastic and organic materials. Some of these can be recycled by composting or they may be burnt or disposed of in landfills. Sewage sludge is the product of treatment plants.

Now a day the various sites of this Dravyavati river (Amanishah-nala) are used as agriculture land, which is not permissible, because various harmful, hazardous pollutants could be present inside the soil and which may cause serious harmful effects on human health and becomes an upcoming serious threat for the health of people of this city. Therefore it is essential to assess the quality of soil for its safer use. Therefore the present study of the physico-chemical characteristics of soil of Dravyavati river (Amanishah-nala) and its surrounding area has been taken up.

II. MATERIALS AND METHODS

Dravyavati River (Amanishah-nala) is located on 26º55' north latitude and 75º49' east longitude in Jaipur city Rajasthan (India) is becoming fragile and has been concern due to increasing industrialization, urbanization & due to all of this, the soil pollution is increasing day by day in the Dravyavati river and its surrounding areas. All the waste from domestic, municipal and industries are discharge in Dravyavati river (Amanishah-nala) which is the largest element of drainage system of this city and covers the whole city.

Soil samples from 15 different sampling stations were collected using standard methods [1]-[10] and analyzed during post-monsoon session (November 2016 –February 2017). Samples were prepared by collecting soil up to a depth of 9 inches. Quartering technique was used to prepare sample of the required mass and collected in clean good quality polyethylene bags. Samples were named as SSA, SSB SSC and so on upto SSO.

Physical parameters [1], [11]-[13] like pH and EC of the soil samples were estimated in soil, by water suspension (in 1:2) with the help of a pH-Meter and Electrical-Conductivity-Meter by using “Digital Portable Soil-Water Analyzer Kit”.

Available organic-carbon [14] was determined by the wet digestion titration method of Walkley and Black. Phosphate [15] determined by Olsen's method for alkaline and acidic soil, whereas Potash was determined by Flame Photometer (in Kg per hector).

Available micronutrients [16] such as Zn, Fe, Cu and Mn were determined by Atomic Adsorption Spectroscopy (AAS).

III. RESULTS AND DISCUSSION

By the observation of given table following conclusion can be drawn:

A. pH

The pH values of soil varied from 8.5 (SSB and SSH) to 9.5 (SSE and SSJ) within average value of 9.02. It is clear from (table1 & 2) that the all soil samples were showing pH value more than 8 on pH scale. All values of soil pH of Dravyavati river (Amanishah-nala) showing a high alkalinity. These pH values clearly indicate that the soil of Dravyavati river (Amanishah-nala) must not be used as a agricultural land.

B. EC

The EC values range from 0.14 (SSI and SSN) to 0.75 (SSJ) (ds/M). The average of EC was found to be 0.36 ds/m. Most of the values of EC come in normal range. (Table 1 & 2).

C. Percentage of Organic Carbon

On the basis of (Table 1 & 2) it is very much clear that entire soil samples contain low level of organic carbon. The minimum organic carbon percentage was found to be 0.12 (SSB, SSE and SSJ) and the maximum percentage of organic carbon was found to be 0.36 (SSK and SSL). The average value of percentage organic carbon was found to be 0.249 which itself show a very less availability of organic carbon in the soil of Dravyavati river (Amanishah-nala). Thus soil of Dravyavati River (Amanishah-nala) is not good for agricultural practices.

D. Phosphate

Phosphate (available phosphorus) values were ranging from 11 (SSJ) to 86 (SSI) (Kg. /hector), with an average value of 39.2 (Kg./hector). The prescribed value of phosphate according to ISI is 23.0 – 56.0 (Kg. /hector) represent the medium level of phosphate in soil and it is very much clear on the basis of above given data that all the soil sample showing medium availability of phosphate. Above fact about phosphate can also be easily interpreted from Table 1 and 2.

E. Potash

Potash values were ranging from 130 (SSH) to 320 (SSC and SSL) (Kg. /hector) here all the soil samples show medium potash level according to standard criteria. The average value of potash was found to be 211.33 (kg/hector). The values are shown in Table 1 & 2.

F. Concentration Variations of Micronutrients

The Mean concentration of Micronutrients such as Zn, Fe, Cu and Mn is in order Fe>Zn>Mn>Cu.

1) *Zn-ion concentration (in ppm):* The Zn-ion concentration varied from 1.65 (SSO) to 15.63 (SSE) with an average value of 8.59. The desirable value of zinc ion is 0.6 ppm or more and according to that all fifteen samples shows normal or higher concentration of Zn in soil samples of Dravyavati river (Amanishah-nala). Results are shown in Table1 and 2.
2) *Fe-ion concentration (in ppm):* The Fe-ion concentration varied from 6.2 (SSA) to 45.12 (SSH) with an average value of 18.66 however the desirable value of iron in soil is 4.5 ppm or more according to ISI. On the basis of that it is clear that obtained Fe-ion concentration is relatively much above than the normal prescribed value. Soil samples showing high content of iron in the soil which is not good for vegetation because excess availability of iron in soil may cause iron toxicity. Values are shown in Table 1 and 2.
3) *Cu-ion concentration (in ppm):* The cu-ion concentration varied from 1.14 (SSF) to 7.12 (SSA) with an average value of 2.195. The prescribed value of copper ion in soil is 0.2 ppm or more but data obtained from our investigation reveal that most of the soil samples showing relatively high copper content in the soil again this may cause copper toxicity. Results are shown in Table 1 and 2.
4) *Mn-ion concentration (in ppm):* The Mn-ion concentration ranges from 1.35 (SSJ) to 16.48 (SSD) with an average value of 9.15. The desirable value of Mn-ion in soil is 2 ppm or more and on the basis of that we can conclude that the availability of Manganese-ion is also above than the prescribed value except SSJ which is showing less amount of manganese. Results are shown in Table 1 and 2.

IV. CONCLUSION

Soil pH is the main important factor controlling the solubility and availability of many macro and micro-nutrients in the soil as soil solution. The sorption of trace metals becomes good in soil having low pH value & it could be reduced as the soil pH increasing. In our investigation various data of pH reveal relatively high pH value (above 8.0) and on the basis of that we can conclude that availability of various micro nutrients such Zn, Fe, Cu and Mn may be less to the plant or crops growing in soil of Dravyavati river (Amanishah-nala) even they present in sufficient amount.

Percentage of organic carbon in soil of Dravyavati river (Amanishah-nala) is also found to be low in all the soil samples again it is not a good sign for any type of agricultural practice because low percentage of organic carbon also reduces the availability of various micronutrients.

Most of the soil samples belong to medium category of phosphate and potash level. Regarding micronutrients Fe and Mn shows high concentration than the prescribed value, copper content also show slightly high concentration whereas zinc indicates normal permissible range.

Table 1. Obtained values of various parameters of soil of dravyavati river (amanishah-nala) (during post-monsoon session nov. 2016 – feb. 2017)

Sample Code	pH	EC	Organic Carbon percentage	Phosphate (Kg/Hc)	Potash (Kg/Hc)	Micronutrient concentration			
						Zn	Fe	Cu	Mn
SSA	9.2	0.21	0.35	36	360	4.6	6.2	7.1	9.4
SSB	8.5	0.54	0.12	32	150	8.5	14.5	1.3	10.3
SSC	9.1	0.25	0.5	30	320	12.3	12.5	1.3	4.0
SSD	8.7	0.24	0.13	25	300	10.3	24.4	2.5	16.5
SSE	9.5	0.35	0.12	56	150	15.6	2.6	1.5	20.1
SSF	8.9	0.65	0.25	35	140	12.6	12.2	1.1	12.3
SSG	9	0.45	0.35	46	150	12.4	36.0	2.6	12.5
SSH	8.5	0.25	0.19	36	130	5.8	45.1	3.0	5.2
SSI	9.1	0.14	0.25	85	180	8.9	12.4	2.5	7.5
SSJ	9.5	0.75	0.12	11	200	9.8	12.1	1.8	1.4
SSK	9.4	0.42	0.36	36	180	5.5	14.6	1.3	6.1
SSL	8.8	0.15	0.36	25	320	4.5	8.5	1.3	13.2
SSM	9.1	0.24	0.25	64	210	12.1	34.9	3.2	4.5
SSN	9.3	0.14	0.14	35	200	4.5	9.5	1.2	5.4
SSO	8.7	0.62	0.25	36	180	1.7	34.5	1.3	8.9

Table 2. Recommended ranges of physico-chemical parameters of soil (except micronutrients)

Parameters	Value	Conclusion
pH	7-8.5	Normal
		Close Proximity of alkalinity
		Fragile of alkalinity
	> 8.5	Problem of alkalinity

EC (In ds/M)	0-1	Normal
	> 1	Problem of alkalinity
Org. Carbon (%)	0-0.50	Low Nutrient Level
	0.5-0.75	Medium Nutrient Level
	>0.75	High Nutrient Level
Phosphate (In Kg. /Hector)	0-23	Low Nutrient Level
	23-56	Medium Nutrient Level
	>56	High Nutrient Level
Potash (In Kg. /Hector)	0-142	Low Nutrient Level
	142-337	Medium Nutrient Level
	>337	High Nutrient Level

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