

Toxic level of some trace elements in the soil sediments of Bhagalpur District, Bihar

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Manuscript received online 16 May 2020, accepted on 30 June 2020

Abstract : Toxic level of six trace elements namely Iron, Lead, Cadmium, Chromium and Arsenic have been determined in the soil sediments of District Bhagalpur, Bihar in order to know the soil quality and to aware the farmers to use only the needful amount of fertilizers to optimize the yield of different crops and to minimise the fertilizer cost and to protect the soil quality and save the environment against the random use of fertilizers.

(Keywords) : Soil sediment, trace elements, toxic level of trace elements)

Introduction

Soil is a very important constituent of lithosphere. Soil may be broadly defined as the weathered layer of the earth crust with living organisms and their products of decay. It is a complex physico-biological system containing water, mineral salts, nutrients and dissolved oxygen.

Earth crust comprises of rocks and the loose material derived from these rocks, the disintegration of which results into the formation of gravel, sand, slit and clay. About 99% by weight of earth crust is constituted by about 12 elements only, whereas the other elements exist in traces¹. The land of north Bhagalpur district gets flooded every year by the water of two Himalayan rivers Ganga and Koshi. Theses rivers travel hundreds of miles from its origin to its destination i.e. Bay of Bengal. They carry several important constituents of soil from one place to other. They get mixed with constituents of the soil and water of the belt. It is expected that this must be changing

the nature of the soil. It is also expected that the water logging for a considerable period of four to five months might be establishing a relation with the constituents of potable water.

The trace element in soil sediments are not in the same form as in the polluting sources. These elements get complexed with inorganic and organic compounds under different conditions. For example, copper gets complexed with humic compounds. De Groot et. al. (1976) have considered these humic compounds as the most active scavengers for copper in soils. Odum and Drifmeyer (1978) have recently reviewed the subject. Several workers²⁻⁶ have studied the agricultural lands polluted by heavy metals. According to Sharma and Yadav⁷, the total and available iron and manganese content in soils is governed by clay content in the soils. The available iron content appears to be associated with not only clay but organic carbon and pH of the soil also. Diwakar⁸ studied some Barahiya Tal soils, Kaber lake soils of Begusarai district along with others and reported the zinc, copper, iron and manganese content in the soils. The metal ions, mostly in the soluble complexed form, move down to the underground water resources by the seepage and are thus responsible for the pollution of the underground water.

Therefore, to have an idea about the pollution level of the soil samples of Bhagalpur district, its assessment for the trace elements seems to be worthwhile. The district Bhagalpur⁹ is located in the eastern part of the state in Ganga

river basin and extends between the 25.07' N - 25.30' N Latitude and 86.37' E - 87.30' E Longitude at the height of 141 feet above sea level falling in the Survey of India toposheet no. 72 K and O. The districts forms a part of the mid-Gangetic alluvium plain covering an area of 2570 square km. It is bounded by the district Munger in the west, Sahebganj and Katihar in the east, Madhepura and Purnea in the north and Banka in the south. Bhagalpur Sadar, Kahalgaon and Naugachhia are the three sub-divisions of the district with a total of sixteen community development blocks namely Pirpainti, Kahalgaon, Sanhaula, Sabour, Nathnagar, Jagdishpur, Sultanganj purushottam (thana road), Sakhund, Bihpur, Naugachhia, Gopalpur, Kharik, Narayanpur, Gauradih, Ismailpur and Rangrachowk. All the block head quarters are chosen as sampling sites.

Six toxic trace elements were selected for the present work according to their toxicity, availability in soil sediment and facility for determination. These six toxic trace elements are Fe, Pb, Cr, Cd, Se and As.

Experimental

Materials and Methods:

Quality of materials used in chemical analysis and the methods and techniques employed as well as the sampling season and the sampling procedure are the most important part of the studies on water quality assessment. Reliability and correct interpretation of data are completely dependent on the field methods and also on the accuracy of the laboratory techniques. Proper sampling is very important in all such cases where chemical variations are to be traced out.

Chemicals used in analysis: All the Chemicals used were of Anal R grade. Double distilled water was used. All the glass wares used in analysis were of Pyrex, Corning and Borrosil.

Sample collection season: Samples were collected

in pre-monsoon (May-June) and post-monsoon (October-November) seasons.

Sample collection of soil: Standard method was used to collect soil sample. $20 \times 20 \times 20$ cubic cm parts were dug with sterilized spatula. Uppermost 1.0 cm silt surface was scrapped off and the soil sample was collected in sterilized containers. Samples were taken from different corners of the sampling sites. The containers were brought to the laboratory and all the soil samples from one site were mixed to obtain a composite sample.

Trace elements determination in soil: All the samples were dried in oven and crushed to powder form and were analysed for trace elements by the standard method described in literature. Known weights of soil were digested with conc. HNO_3 in a 800 mL Kjeldah flask until the brown fumes from the reaction of organic matters and the conc. HNO_3 ceased to come out. This was reacted with perchloric acid in the ratio $\text{HNO}_3 : \text{HClO}_4 :: 2:1$. The digestion was continued very carefully for about six hours when a clear transparent solution was obtained and while fumes of HClO_4 started to come out. After complete digestion, the solution was filtered by Whatmann 42 filter paper and diluted to the desired volume by triple distilled water and the samples were subjected to AAS. For Cr conc. H_2SO_4 was used for digestion in place of HClO_4 .

Results and Discussion

The analytical results of the trace elements in the soil sediment have been tabulated in the Table 1 to 3.

(i) **Iron :** the value of iron in the soil sediment of Bhagalpur district ranges between 24169 to 32470 mg kg^{-1} for pre-monsoon and 20424 to 28455 mg kg^{-1} for post-monsoon. Its average values are in between 22147 to 30462 mg kg^{-1} .

(ii) **Lead :** the value of lead in the soil sediment of Bhagalpur district ranges between 32 to 51 mg kg^{-1} for pre-monsoon and 28 to 40 mg kg^{-1} for post-monsoon. Its average values are in between 30 to 45 mg kg^{-1} .

(iii) **Cadmium** : the value of cadmium in the soil sediment of Bhagalpur district ranges between 3.0 to 9.0 mg kg⁻¹ for pre-monsoon and 3.0 to 8.0 mg kg⁻¹ for post-monsoon. Its average values are in between 3.5 to 8.5 mg kg⁻¹.

(iv) **Chromium** : the value of chromium in the soil sediment of Bhagalpur district ranges between 42 to 54 mg kg⁻¹ for pre-monsoon and 34 to 46 mg kg⁻¹ for post-monsoon. Its average values are in between 38 to 50 mg kg⁻¹.

(v) **Selenium** : the value of selenium in the soil sediment of Bhagalpur district ranges between

34 to 45 mg kg⁻¹ for pre-monsoon and 25 to 37 mg kg⁻¹ for post-monsoon. Its average values are in between 29.5 to 40.5 mg kg⁻¹.

(vi) **Arsenic** : the value of arsenic in the soil sediment of Bhagalpur district ranges between 13 to 24 mg kg⁻¹ for pre-monsoon and 12 to 24 mg kg⁻¹ for post-monsoon. Its average values are in between 13 to 24 mg kg⁻¹.

Toxic level: The minimum, maximum and average analytical data for the different elements have been tabulated in Table-5 for pre- and post-monsoon seasons.

Table 1
Trace elements concentration (mg kg⁻¹) in the soil sediment of Bhagalpu District (Bihar)
for pre-monsoon season (May-June, 2012)

Sl. No.	Sampling site	Sample No.	Fe	Pb	Cd	Cr	Se	As
1	Pirpanti	S(pre) ₁	24215	32	6.0	42	44	14
2	Kahalgaoon	S(pre) ₂	31660	46	9.0	54	44	20
3	Sanhaula	S(pre) ₃	24368	37	5.0	48	34	24
4	Sabour	S(pre) ₄	30385	42	6.0	49	38	23
5	Nathnagar	S(pre) ₅	32470	51	8.0	50	40	20
6	Jagdishpur	S(pre) ₆	28122	42	3.0	49	42	19
7	Sultanganj	S(pre) ₇	29320	43	4.0	48	40	20
8	Sahkund	S(pre) ₈	24169	41	5.0	44	44	19
9	Bihpur	S(pre) ₉	25330	40	4.0	42	36	16
10	Naugachhia	S(pre) ₁₀	24250	35	5.0	42	34	16
11	Gopalpur	S(pre) ₁₁	24381	40	4.0	51	37	20
12	. Kharik	S(pre) ₁₂	25898	39	5.0	52	39	23
13	Narayanpur	S(pre) ₁₃	27250	37	6.0	49	38	14
14	Gauradih	S(pre) ₁₄	26463	35	4.0	46	42	13
15	Ismailpur	S(pre) ₁₅	28152	37	5.0	47	45	18
16	Rangrachowk	S(pre) ₁₆	24784	39	6.0	48	41	18

Table 2
Trace elements concentration (mg kg⁻¹) in the soil sediment of Bhagalpu District (Bihar)
for post-monsoon season (Oct.-Nov., 2012)

Sl. No.	Sampling site	Sample No.	Fe	Pb	Cd	Cr	Se	As
1	Pirpainti	S(post) ₁	20424	28	5.0	38	34	13
2	Kahalgaon	S(post) ₂	27751	39	8.0	46	35	20
3	Sanhaula	S(post) ₃	22341	30	6.0	40	32	24
4	Sabour	S(post) ₄	26370	38	5.0	41	31	19
5	Nathnagar	S(post) ₅	28455	40	7.0	44	32	21
6	Jagdishpur	S(post) ₆	22279	32	4.0	42	34	18
7	Sultanganj	S(post) ₇	25375	38	3.0	42	30	17
8	Sahkund	S(post) ₈	26125	34	7.0	40	32	18
9	Bihpur	S(post) ₉	21395	31	3.0	37	26	14
10	Naugachhia	S(post) ₁₀	20424	29	5.0	34	25	15
11	Gopalpur	S(post) ₁₁	20455	36	6.0	44	34	18
12	. Kharik	S(post) ₁₂	22729	34	5.0	42	33	20
13	Narayanpur	S(post) ₁₃	23470	30	6.0	39	29	12
14	Gauradih	S(post) ₁₄	22429	31	4.0	38	37	12
15	Ismailpur	S(post) ₁₅	23207	29	6.0	37	36	17
16	Rangrachowk	S(post) ₁₆	22173	33	5.0	40	33	16

Table 3
Average of trace elements concentration (mg kg⁻¹) in the soil sediment of Bhagalpur District
(Bihar) for pre- and post-monsoon season 2012

Sl. No.	Sampling site	Sample No.	Fe	Pb	Cd	Cr	Se	As
1	Pirpainti	S ₁	22320	30.0	5.5	40.0	39.0	13.5
2	Kahalgaon	S ₂	29706	42.5	8.5	50.0	39.5	20.0
3	Sanhaula	S ₃	23354	33.5	5.5	44.0	33.0	24.0
4	Sabour	S ₄	28378	40.0	5.5	45.0	34.5	21.0
5	Nathnagar	S ₅	30462	45.5	7.5	47.0	36.0	20.5
6	Jagdishpur	S ₆	26700	37.0	3.5	45.5	38.0	18.5
7	Sultanganj	S ₇	27348	40.5	3.5	45.0	35.0	18.5

8	Sahkund	S ₈	22147	37.5	6.0	42.0	38.0	18.5
9	Bihpur	S ₉	23362	35.5	3.5	39.5	31.0	15.0
10	Naugachhia	S ₁₀	22337	32.0	5.0	38.0	29.5	15.5
11	Gopalpur	S ₁₁	22418	38.0	5.0	47.5	35.5	19.0
12	. Kharik	S ₁₂	24314	36.5	5.0	47.0	36.0	21.5
13	Narayanpur	S ₁₃	25360	35.5	6.0	44.0	33.5	13.0
14	Gauradih	S ₁₄	24446	33.0	4.0	41.5	39.5	12.5
15	Ismailpur	S ₁₅	25680	33.0	5.5	42.0	40.5	17.5
16	Rangrachowk	S ₁₆	23478	36.0	5.5	44.0	37.0	17.0

Table 4
Toxic level of some trace element concentration (mg kg⁻¹) in the Soil Sediments
of Bhagalpur District, Bihar for the year 2012

Elements	Pre-monsoon		Post-monsoon		Average	
	min	max	min	max	min	max
Fe	24169	32470	20424	28455	22147	30462
Pb	32.0	51.0	28.0	40.0	30.0	45.5
Cd	3.0	9.0	3.0	8.0	3.5	8.5
Cr	42.0	54.0	34.0	46.0	38.0	50.0
Se	34.0	45.0	25.0	37.0	29.5	40.5
As	13.0	24.0	12.0	24.0	12.5	24.0

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