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Analysis of Soil Nutrient and Heavy Metal Concentration in Agricultural Land of Zirani Industrial Area, Savar, Dhaka

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ABSTRACT: Now a days the contamination of soil by heavy metal from industrial sources has become a serious issue. This research was conducted to observe the nutrient status and concentration of heavy metal in soil. In this work, nine soil samples were collected from three different points of the Zirani industrial area, Savar during October/ 2013. The result of pH revealed that all the soil samples were acidic in nature. The maximum value of OC % was recorded 2.13% at point 3. However, it was observed that except N the concentration of available K, P, and S in soil samples were higher than their critical level of soil chemical properties. The highest value of Pb was 0.762ppm which found at point 1 and the lowest value was 0.575ppm in point 2.0.089ppm was the highest value of Cu which was found at point 3 and the lowest value 0.065ppm was found at point 3. The maximum concentration of Zn 3.05ppm was found at point 3 whereas the lowest value was recorded 1.90ppm in point 1.The highest value for the Cd was recorded 0.235ppm which was founded at point 2 and 0.104ppm was lowest value that was founded at point 3. The result also showed that Cu and Pb concentration were relatively higher than their recommended value in soil. The abundance order of heavy metal content in soil samples were Pb>Cu>Zn>Cd which indicated that the concentration of these heavy metals were harmful for the environment and human life.

KEYWORDS: Heavy metals, Environmental Pollution, Soil, Soil nutrient, Contamination.

1 INTRODUCTION

Environmental and health related problems have become a major global concern in the recent years [12]. Environment pollution is a worldwide problem and its potential to influence the health of human populations is great [6]. Pollution reaches its most serious proportions in the densely settled urban-industrial centers of the more developed countries [9]. Soil plays a very important role for environment as it produces food for human beings and animals. But, due to human activities, soil is the receptor of many pollutants including pesticides, fertilizers; particulate matters etc. and getting polluted [3].Main Causes of soil pollution include municipal solid waste, hospital waste, excessive use of pesticides/fertilizers/herbicides, ponding of industrial effluents, disposal of industrial solid waste on open land etc.

Heavy metal contamination in soil is a major concern because of their toxicity and threat to human life and the environment [2]. Heavy metals refer to those metallic elements which have density of above 5 g cm-3. These metals include arsenic, cadmium, chromium, copper, lead, nickel, zinc, molybdenum and vanadium. In Bangladesh, industrial wastes and effluents are being discharged randomly on soils, into canals, rivers, along the road sides or in the vicinity of the industrial areas without any treatment. Lead, cadmium, arsenic, mercury, chromium and nickel are the significant contaminants [7].Lead can be heavily absorbed by particles from sediments and, thus, it is very difficult to be Trans located, while cadmium

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ions can be directly absorbed [13]. Cd, Cr and Pb are of concern because they are toxic to plants and animals even in small concentrations; however Zn is an essential trace metal for plants and animal but can be dangerous at high concentrations [14]. At high concentrations these metals exhibit chronic toxicity or carcinogenicity as well as fatality [10].

Global contamination of the environment has resulted in increasing amounts of heavy metals in both the air and soil. Acid atmospheric pollutants damage assimilatory organs of plants, which results in partial loss of their assimilatory surface, disturbance of their physiological conditions, and decrease of their vitality [8]. Also, their development and growth may be affected at high levels of metal concentration implying reduced cultures and economic loss.

Savar, one of the largest industrial areas near Dhaka in Bangladesh, has more than 100 local and foreign industries. These generate a large amount of effluents everyday which are being directly discharged into the surrounding land, agricultural fields, irrigation channels and surface water that finally enter into the river [11]. So a large number of areas in Saver district are now being threatened by the environmental pollution. The objectives of this research were: i) To observe the nutrient status of sampling soil. Ii) To know heavy metals concentration in the soil of study area.

2 MATERIALS AND METHODS

2.1 STUDY AREA

Nine soil samples were collected from industrial area located at Zirani in savar which location was given in the table and identify the location point on map.

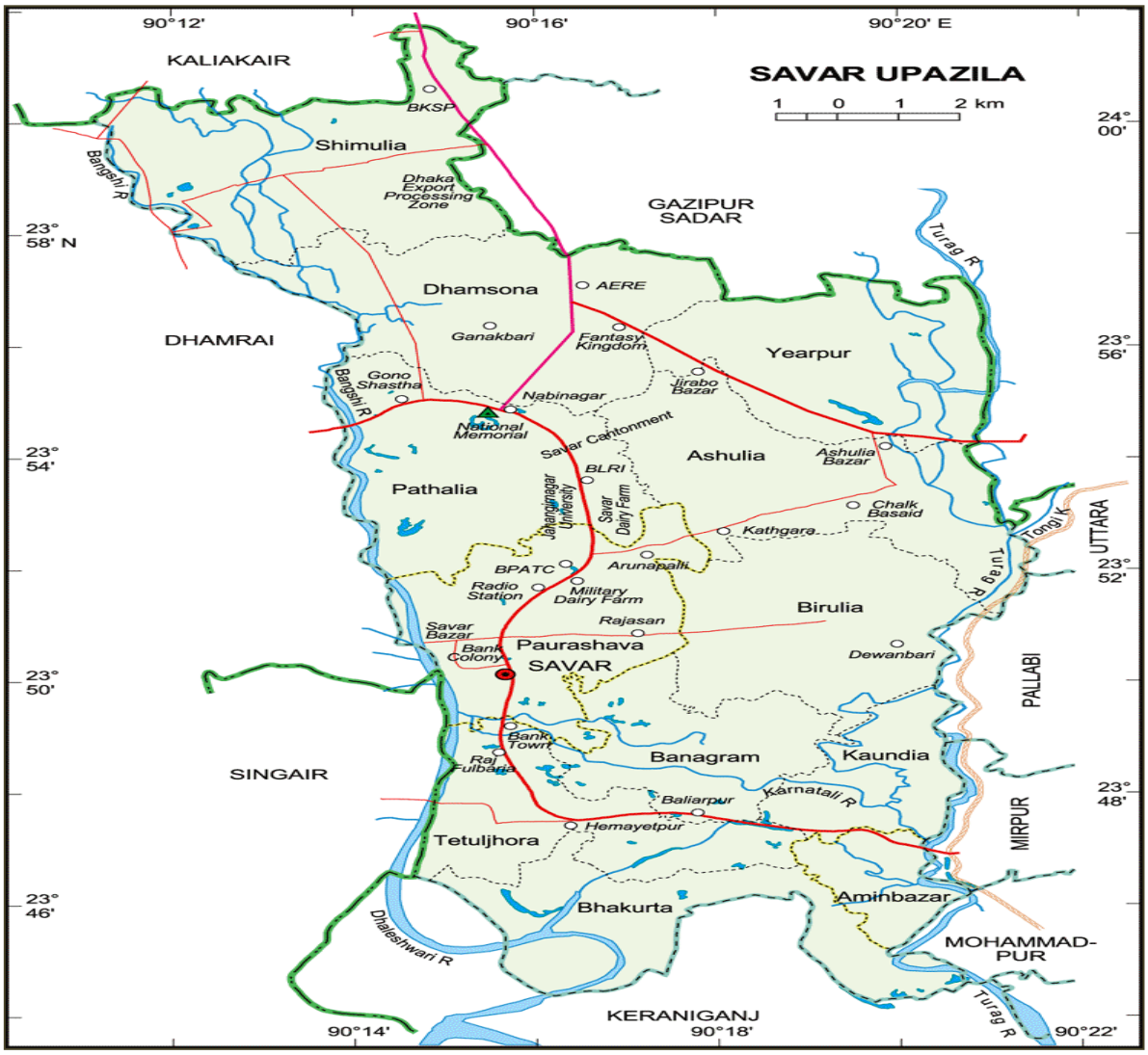

Fig.2.1. Map of Bangladesh showing the study area (Source: Google map, 2013-2014).

2.2 SAMPLES COLLECTION

The soil samples representing 0-15 cm from the surface was collected at a approximate distance of 30, 40 and50 meters from the waste dumping site. The samples were scraped from the top to bottom with the help of an auger. Each samples were kept separately on a brown paper and contents of each brown paper were mixed thoroughly. Then about 1kg of soils was collected from each paper to give a representative sample. Samples were placed in sealed polythene bags and lebeled including date of collection, location and code number of soil sample.

2.3 PREPARATION AND ANALYSIS OF SAMPLES

From the collected samples, the gravels, pebbles, plant roots, leaves, etc. were picked up and removed. The collected soil samples were dried in air for 7 days by spreading on a clean piece of paper, and then the samples were mixed well and ground to pass through a 2 mm mesh stainless steel sieve. The soil samples were kept in a clean polythene bag and then transported to the Central laboratory of Bangladesh Agricultural University (BAU), Mymensingh for the analysis of soil pH, organic carbon, available phosphorus, available sulfur, total nitrogen. These parameters were determined according to the standard methods [1]. To determine the total Cd and Pb content of soil 4 M HNO3 was used as extracting solution. Two grams of soil was digested with 12.5 ml extracting solution at 80^{o}C for 24 hours. Then it was made of 50 ml and filtered. Copper (Cu) and Lead (Pb) content of soil extracts were determined directly by Atomic Absorption Spectrophotometer (AAS) following the procedure of [15]. Zn was determined by soil extraction method using NOV AA-300 Atomic Absorption Spectrophotometer (AAS). It was measured by Atomic Absorption Spectrophotometer on undiluted soil extracts.

2.4 STATISTICAL ANALYSIS OF DATA

All the ends of data collection, data were compiled, tabulated and analyzed. Microsoft Office, Excel 2007 software ware used for data analysis and presentation. Various descriptive statistical measures such as range, percentage, mean, standard deviation (SD), etc were used for categorization and describing the variables. Different tables, graphs, charts, etc. were used for the presentation.

3 RESULT AND DISCUSSION

This segment represents the results of analysis of soil quality parameters. The chemical parameters of soil in and around the Zirani municipal area obtained from the analyses are described in the Table 3.1

Table 3.1. Present status of the soil properties in and around the sampling area

Sampling Points	Sampling Stations	pH	OC%	Total Nitrogen %	Available K ppm	Available S ppm	Available P ppm	Zn ppm	Cd ppm	Cu ppm	Pb ppm
P1	S1	5.64	1.22	.09	5.01	13.91	20.76	2.03	.125	.080	.762
	S2	5.71	1.13	.08	4.91	14.08	18.51	2.10	.112	.077	.621
	S3	5.33	1.33	.05	6.31	12.10	19.31	1.90	.130	.075	.747
P2	S4	5.88	1.11	.06	5.08	11.61	14.66	1.99	.201	.079	.589
	S5	5.77	1.22	.04	4.38	12.05	15.67	2.01	.199	.067	.575
	S6	6.12	2.01	.07	4.90	14.11	16.23	2.10	.235	.071	.645
P3	S7	6.22	1.81	.10	3.90	13.01	16.49	3.05	.104	.089	.735
	S8	7.19	2.13	.08	5.53	11.49	15.69	2.99	.183	.067	.713
	S9	6.35	2.03	.07	3.82	12.08	17.97	3.03	.169	.065	.673

PH

All the stations of the sampling points indicate the lower pH value considering the standard value of 7 except station 2 under the point of 3 which indicates the acidic condition of the soil. In the three points from nine stations the highest value of pH is 7.19 in the 2nd station of 3rd point which is slightly basic and the lowest value of pH 5.33 at the 3rd station of 1st point which is slightly acidic. The average value of pH at different points is 6.02. This indicates slightly acidic condition of soil. The

acidic agents of soil may come from the nearby industries which make the soil that condition. The pH value of different points has been presented in the graph.

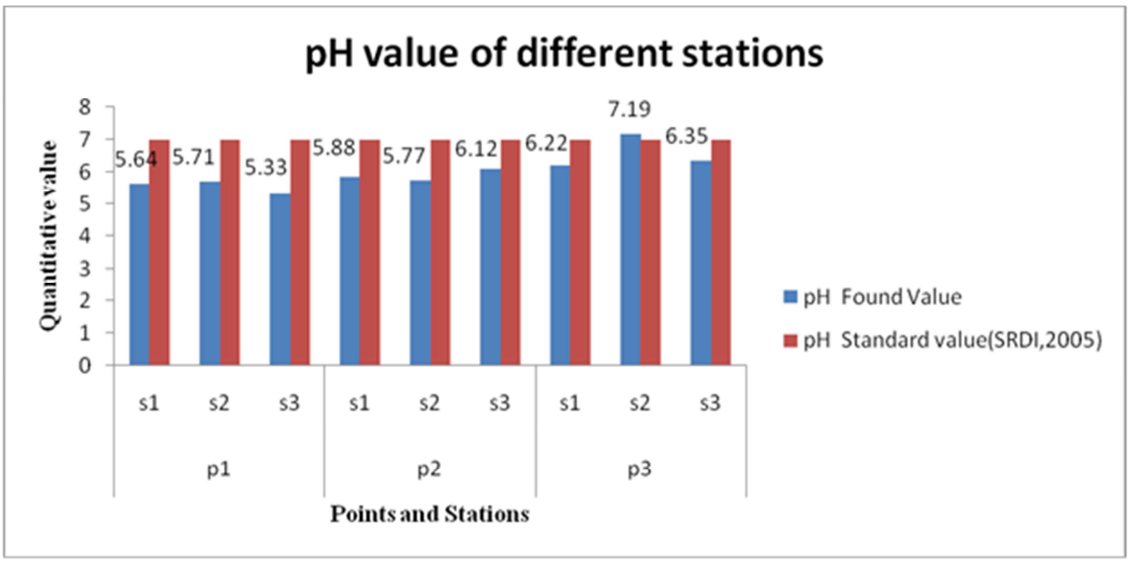

Fig3.1. pH value of different points

OC (ORGANIC CARBON)

The lowest value of organic carbon 1.11% is found station 1 under point 2 and the highest value 2.13% is found in the station 2 under point 3. A standard soil contains 2.89% organic carbon in optimum condition [16]. Higher organic content represents fertile soil condition consequences to higher agricultural production. The point 3 which is almost 50m away from dumping point of industry shows the highest value of organic carbon percentage. The anticipation lies behind is that this point is less polluted.

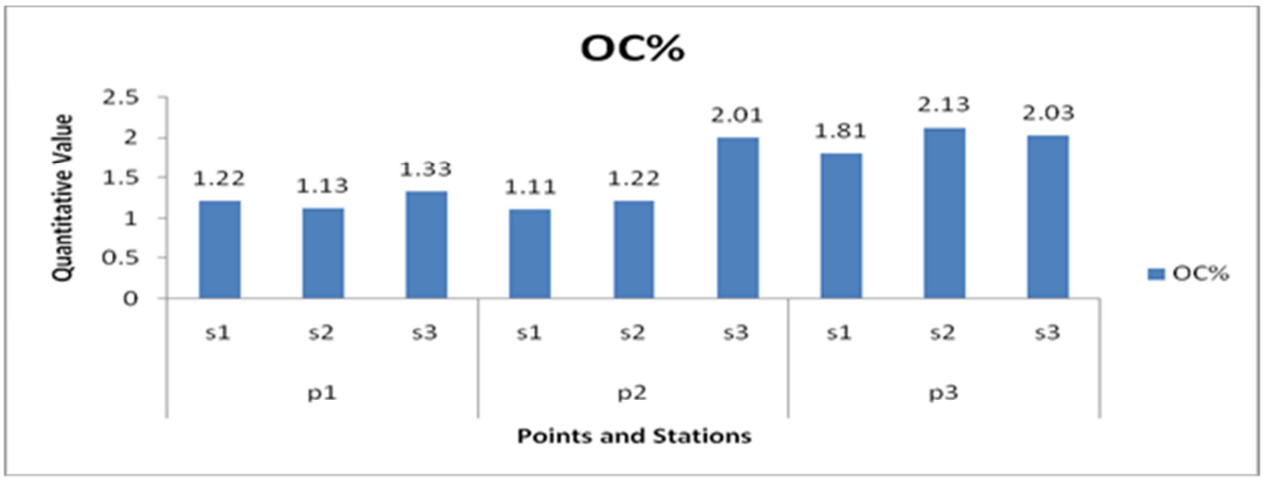

Fig3.2. Available organic carbon of different points

TOTAL NITROGEN (N)

The total nitrogen (N) content in the sampling soils varies from 0.04 to 0.10% which is presented in the following figure. The highest total N content in the surface soils (0.10%) was recorded at the station 1 under point 3 and the lowest value was 0.04% at station 2 in point 2. Analyzed values were lower than the standard value 0.12% [16]. It might be due to continuous release of untreated industrial waste through dumping point. Total nitrogen content in a soil represents the how nutrious the soil is. Higher value indicates higher nitrogen content for crop plants leading to higher crop production.

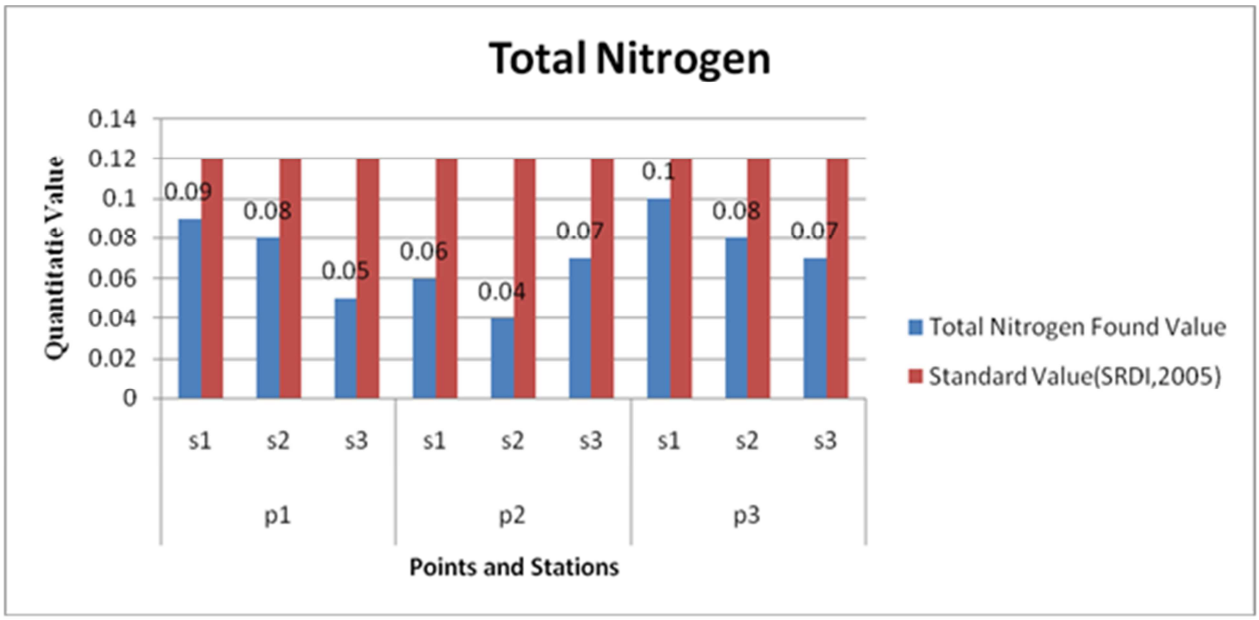

Fig3.3. Total Nitrogen of different points

AVAILABLE POTASSIUM (K)

The following figure shows that the value of available K of collected soil samples from different stations. The highest value 6.31 ppm of available k is found in point 1 at station 3 and the lowest 3.82ppm value is found in point 3 at station 3. It represents the higher value than standard level [16]. The concentration of potassium of all points lies between 3.82-6.31ppm. And the higher concentration which indicated the larger amount for crops production. It is over nutritious soil especially rich in potassium

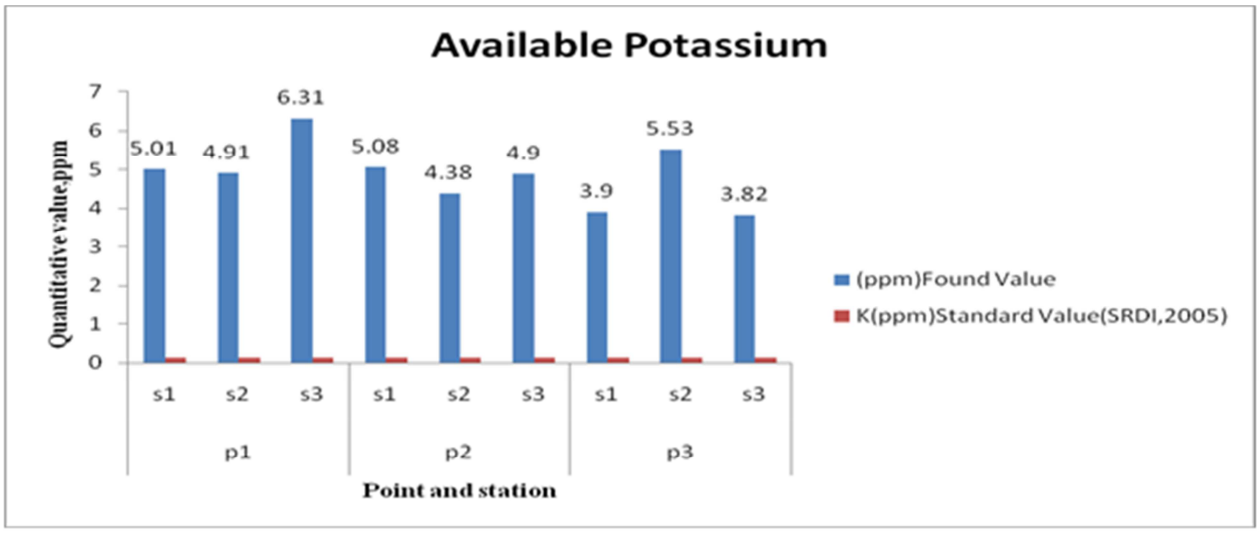

Fig.3.4. Available potassium of different points

AVAILABLE SULPHUR (S)

The conducted research showed that the variation of available Sulpher at different sampling station. The highest value 14.11ppm of available S is found in station 3 under point 2 and the lowest 11.49ppm value is found in point 3 at station 2. The available sulphur concentration was higher than the standard limit of sulpher [16]. Sulphur is used to crops production as macro nutrients of plant but excessive amount of sulpher in soil may cause of detrimental effects of crops production. In this study the lowest limit of the value is much higher than the acceptable limit and the highest value is intolerable for plants.

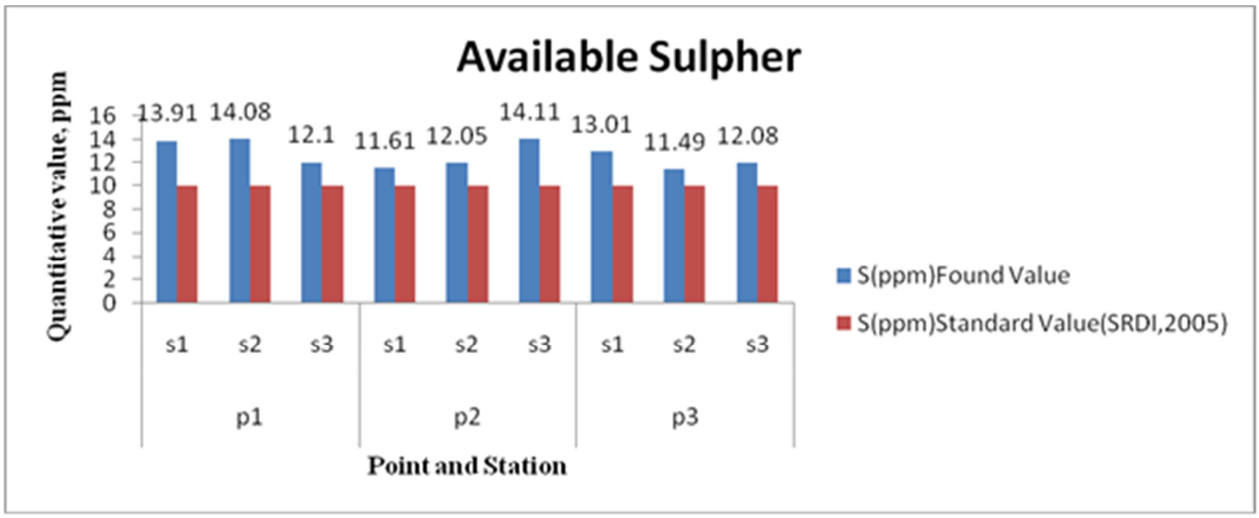

Fig.3.5. Available sulphur of different points

AVAILABLE PHOSPHORUS (P)

The highest value 20.76ppm of available P is found in station 1 under point 1 and the lowest 14.66ppm value is found in station 1 under point 2.The available phosphorus concentration is much higher than the standard limit [16] of phosphorus. Phosphorus is used to crops production as macro nutrients of plant but excessive amount of phosphorus in soil may cause of detrimental effects of crops production. The lowest limit of the value is much higher than the acceptable limit and the highest value is intolerable for plants. It may be due to the excess release of waste from industry.

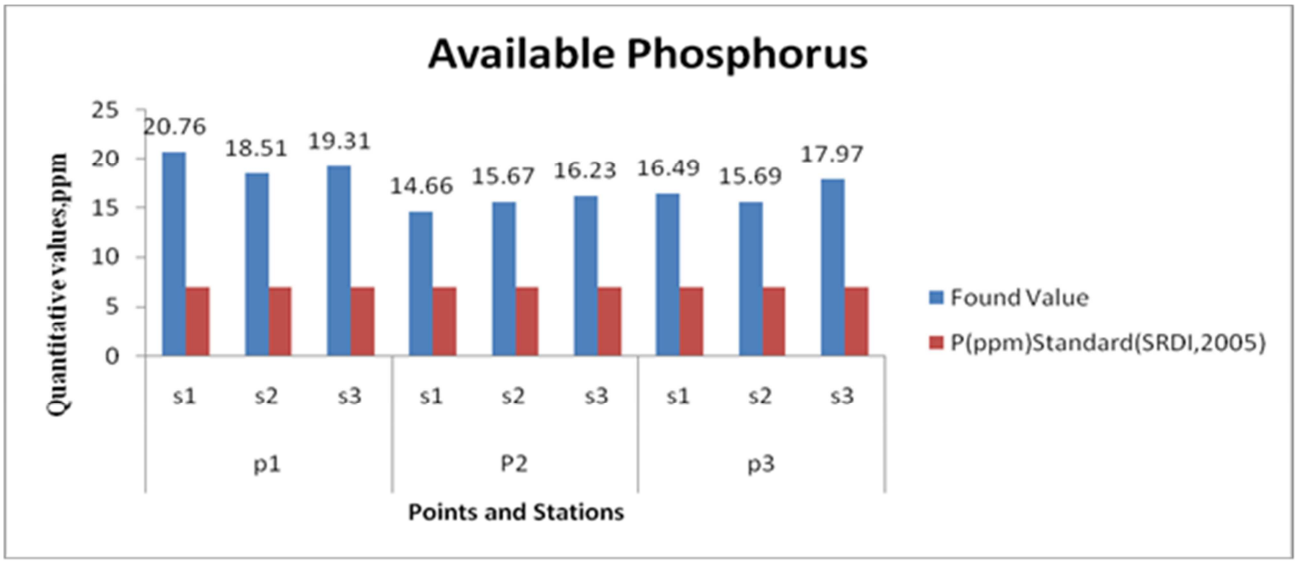

Fig.3.6. Available phosphorus of different points

ZINC (ZN)

The highest value 3.050ppm of available Zn is found in station 1 under point 3 and the lowest 1.909ppm value is found in station 3 under point 1. Zinc plays role in the environment especially in soil as a micronutrient or is used as a trace element. But the concentration of zinc is detrimental for the plants or organisms if it is available in higher amount. The concentration of all stations of P1 and P2 is in the tolerable limit but the three stations of third point exceed the standard limit [16]. There were battery industries in that area so it may be the consequence of that industry.

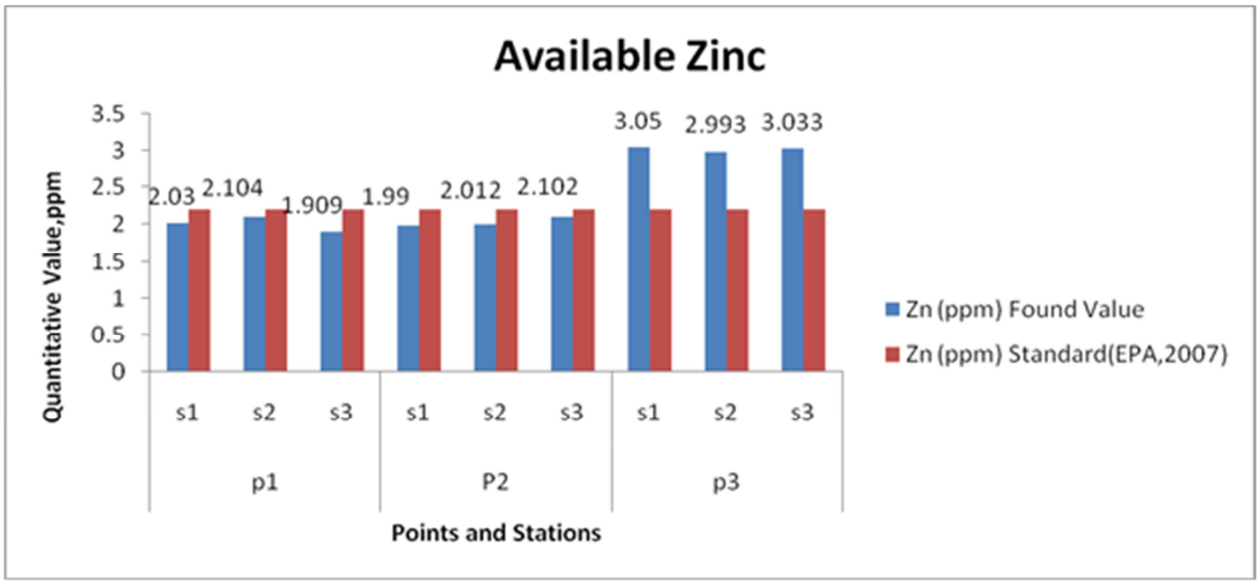

Fig.3.7. Concentration of zinc at different points

CADMIUM (CD)

From the figure (3.8) the analyzed value of Cd of different sampling points that the highest value .235ppm of available Cd was found in point 2 at station 3 and the lowest .104ppm value was found in point 3 at station 1. The point 2 of station 3 has relatively higher Cd concentration than the other stations. The continuous deposition and accumulation of industrial wastes and effluents might be responsible for this high concentration of Cd.

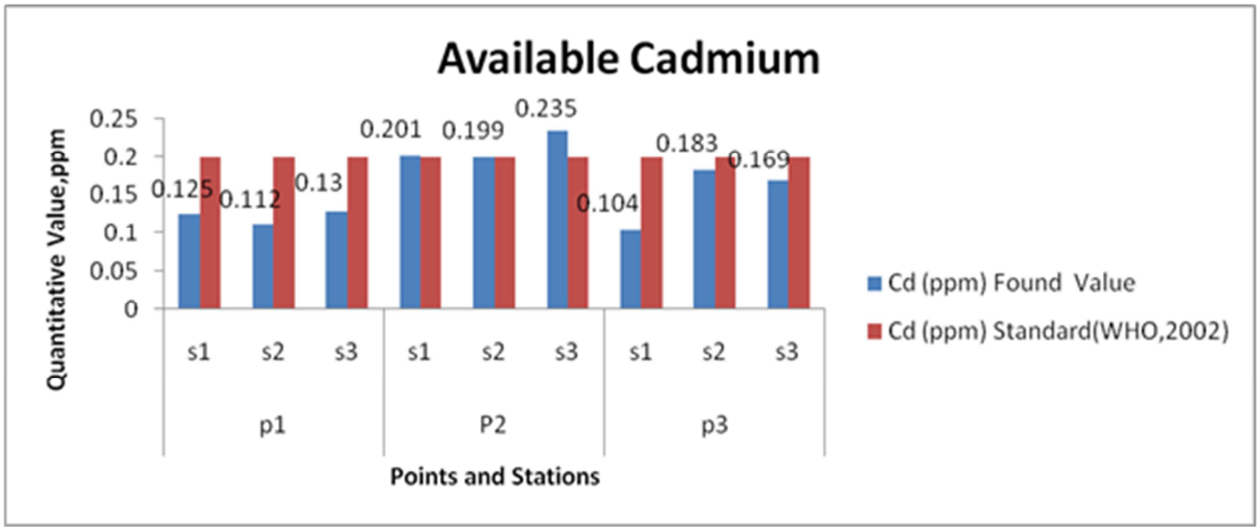

Fig.3.8. Concentration of Cadmium at different points

COPPER (CU)

Analyzed result of the study showed that concentration of Cu at different sampling stations The highest value .089ppm of available Cu was found in point 3 of station 1 and the lowest .065ppm value was found in point 3 of station 3. All the stations contain the value higher than the standard value [17]. It may be the consequences of release of waste from battery industries.

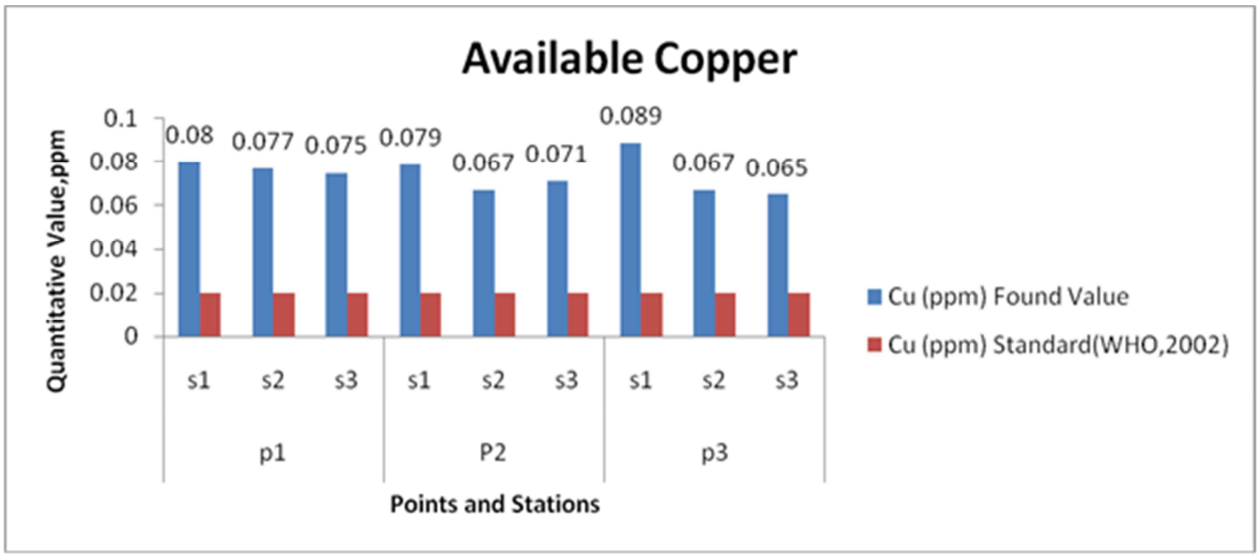

Fig.3.9. Concentration of copper of different points

LEAD (PB)

The highest value .762ppm of available Pb is found in station 1 under point 1 and the lowest .575ppm value is found in station 2 under point 2, but the standard value of lead for soil is 0.2ppm [17] and all the values of lead in all sampling point are greater than the standard value. There were a number of battery industries here so the concentration of Pb may be present here for this reason.

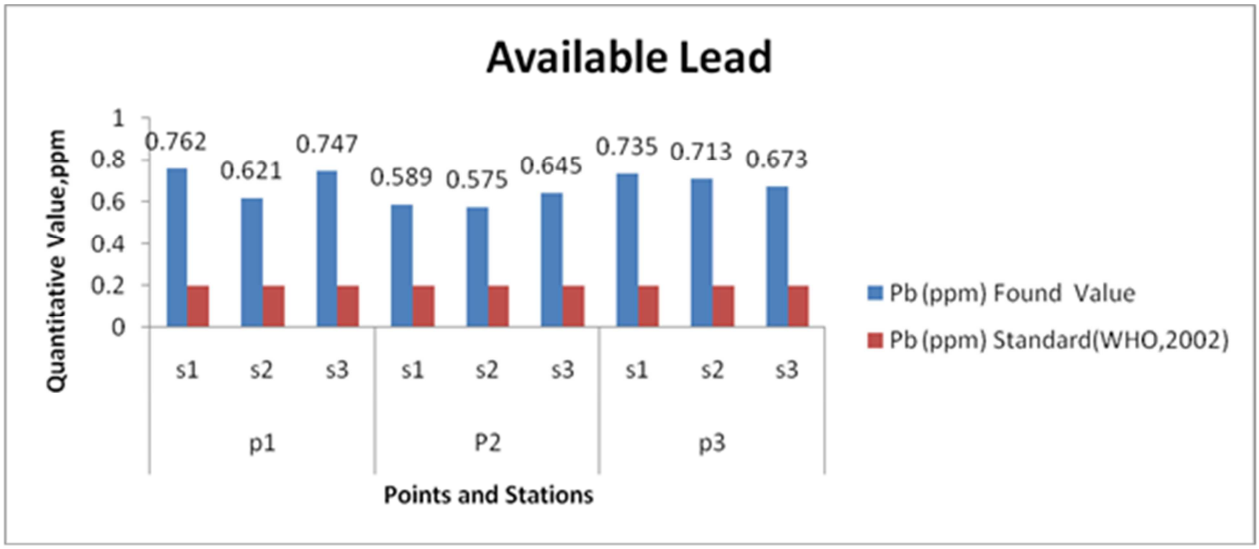

Fig.3.10. Concentration of lead of different points

4 CONCLUSION

The contamination of soil by heavy metals from industrial sources had become a serious environmental issue. Bangladesh is a developing country and there are many industries like garment, battery, plastics, glass, leather factory and tannery etc situated here. Zirani of Savar is an important industrial area of the country which provides wide range of potentiality for economic development. The analyzed result revealed the soil surrounding the dumping site was slightly acidic which is not harmful for agricultural production. The highest value of OC was recorded 2.14% at point 3 and the lowest value was 1.92% which was found point 2 that is greater than the reference value. Except total N concentration, the amount of available P, K, and S were greater than their recommended level. In addition the result showed that the concentration of Cu and Pb were much higher than their recommended level and the maximum value of Cu was 0.089 ppm and 0.762 ppm was the maximum

concentration of Pb. and the concentration of Zn and Cd were within tolerable limit. Zn at point 3 showed higher concentration which was 3.050ppm. The maximum value of Cd was 0.089ppm that was found at station 1 under point 3. From present research it has been stated that the soil quality was not satisfactory during study period. So ETP should be establish and properly maintain to reduce heavy metals concentration in soil.

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