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Evaluation of Basrah Soils Pollution with Cadmium

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Abstract.
Eleven Soil samples were selected from Basrah province /southern of Iraq according to source of pollution to investigate their pollution with cadmium. Soil properties of soils were determined and total concentration of cadmium Geo-accumulation index (I-geo) and Environmental Protection Agency (1997) were used assessment soils pollution with cadmium. Results indicated that 81.82% of studied soils were highly polluted with cadmium and there was a positive significant correlation between I-geo index and clay, calcium carbonate, cation exchange capacity and silt and negative significant correlation with sand.
Keywords. Soil Pollution, Cadmium, I-geo, EPA.

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INTRODUCTION

Cadmium is one of the toxic element in the environment, it's effect on of human, animal and plant as shown by many experiments ((Limei *et al*.,2008)

Soils are polluted with Cadmium by many sources directly by mineral and organic fertilization and irrigation water or indirectly by depositing it on the surface layers of the soil by atmospheric air as cadmium particles or by burning of fuel, fat and cigarette factory etc. (Gunill, 2002).

Cadmium is found in all natural soils with low concentrations that exceed 0.1 mg kg^{-1} (APHA, 1998). Industrial development led soils polluted with Cadmium from paint. fertilizers, gas stations, oil refineries, batteries factories and electrical and electronic industries (Hood *et al*.,2004) .

Several countries and scientific institutions had initiated the established maximum and minimum limits for heavy elements concentration for agricultural soil which the World Health Organization (WHO) had relied. WHO (1975) stated the permissible limits for total cadmium concentration in soils ranged from 0.01 to 0.70 mg kg^{-1} soil, whereas in 2000 the same organization changed the limits between 0.1 to 0.4 mg kg^{-1} soil because of its toxicity on human and animal's life. Merian (1991) pointed out that the critical level of total cadmium concentration is soils between 0.01 to 0.30 mg kg^{-1} soil. Padungtod et al. (2004) remembered that critical limits of cadmium concentration differed with the variation of samples (Soil, Sediment and water) Due to multiplicity of Basra Soil pollution with Cadmium from many sources (power plants, ports, hospitals, and fertilization) the study was conducted to evaluate Basra Soils Pollution with Cadmium.

MATERIALS AND METHODS

Soil samples were collected from eleven sites of Basra province most of them agricultural farms at depth of 0-30 cm during the season 20 th Dec.2008 to 6 th Jan.2009. Soil samples were air dried, cursed and passed through a 2mm sieve- Chemical and physical properties of soils were analyzed according to the methods mentioned in Black(1965) and page et al. (1982) (Table 1) .

Table 1: Chemical and physical properties of soil

				CEC Cmole $^{+}$ kg^{-1}	Organic Matter gm kg^{-1}	Soil separators (gm kg^{-1})			
Site name	pH 1:1	EC (1:1) dSm^{1-}	$CaCO_3$ gm kg^{-1}			Sand	Silt	Clay	Texture
Gurna	7.6	16.5	396.0	15.89	3.10	450.61	54.2	495.20	Silty Clay
Midina	7.9	4.5	435.0	17.27	4.50	466.7	67.9	465.4	Silty Clay
Al-Dyer-Al-Shafi	7.6	15.3	340.0	11.10	2.03	460.6	85.7	453.7	Silty Clay
Al-Dyar- Near Paper Factory	7.7	15.4	381.0	18.17	4.80	472.4	74.9	452.9	Silty Clay
Hartha	7.6	18.1	400.0	17.13	3.85	420.02	60.0	520.0	Silty Clay
Garmat Ali-Basrah University	7.5	4.1	410.0	16.18	2.12	385.6	48.4	566.0	Silt Clay Loam
Tanuma	7.5	14.5	321.0	17.03	1.75	388.6	47.8	563.6	Silt Clay Loam
Abu-Khasseb	7.3	6.3	395.5	15.30	4.15	423.6	53.4	523.0	Silty Clay
Al-Syba	7.9	10.5	440.0	14.13	1.77	414.8	46.3	538.9	Silty Clay
Al-Fao	7.6	22.0	345.0	16.30	1.70	440.2	68.8	491.0	Silty Clay
Zubair-Berjisia	8.0	3.0	172.5	5.11	0.95	62.6	898.1	39.3	Sand Loam

Assessment of Soil pollution with cadmium

Geo-accumulation index (I-geo) was used to assessment soils pollution with cadmium according to Muller (1979).

$$\text{I-geo} = \text{Log}_2 \left[\frac{Cn}{1.5\ Bn}\right]$$

Where:

Cn: total concentration of cadmium in soils (mg kg^{-1})

Bn: cadmium concentration in reference sample (0.3 mg Cd kg^{-1})

1.5: correction factor

According to I-geo index, Soils classify to seven class (mg kg^{-1}), (0 – is not polluted), (0 – 1is unpolluted to medium Pollution), (1-2 - medium Pollution), (2-3 medium Pollution to highly Polluted), (3-4 - highly Polluted), (4-5 - highly Polluted to very high pollution), (5-10 very high pollution)

Soil samples were digested by acidic solution (HCl: HNO_3) (hydrochloric acid: nitric acid) according to the method proposed by us States Environmental Protection Agency SW-846, Method 3050 and described in Sparks et al. (1996). Cadmium concentration was determined Atomic Absorption Spectrophotometer (AAS), Phoenix 968.

RESULTS AND DISCUSSION

Cadmium concentration in studied soils was ranged between 0.85 mg kg^{-1} (site 11 / Zubair ,Bargisia station) 3.32 mg kg^{-1} (site / Al-Deyar-near paper plant) With the mean value of 2.508 mg kg^{-1} (table 2) .According to 1-geo classification, Soils were medium to highly polluted with cadmium (table 2). Highly polluted soils accounted 81-82 % of studied soils. This percentage is very high and indicates the risks that threaten agricultural land and environment pollution especially in soils with high concentration of cadmium, which was evident in site / Al-Deyar near paper plant, I-geo reached in this site to 2.884 mg $kg^{-1,}$ while the lowest value of I-geo was in sight 11 /Zubair - Bargisia station (0.981) and site 8/ Abul-khaseeb (1.876).

The high value of I-geo in site 4/ Al-Deyar(2.884) because of multiplicity of source of soil pollution , it is close from paper plant and discharged pollutants to air and then transferred to the soil ,or its polluted from irrigation water and phosphate fertilizers. Site 31 Al-Deyar-Al-Shafi had a high value of I-geo because it's near the street and vehicles and cars added exhaust to the atmosphere and nearby fields with pollutants such as lead and cadmium, or from irrigation water because the field irrigated from Shah Al-Arab river.

Table 2. The I-geo geo-chemistry index was evaluated for the study sites based on the total concentration of cadmium

Location	Site of study soil	Value of I- geo	Total cadmium mg kg^{-1}	Soils classify
1	**Gurna**	2.738	3.0	**medium to highly Polluted**
2	**Midina**	2.785	3.10	**medium to highly Polluted**
3	**Al-Dyer-Al-Shafi**	2.870	3.29	**medium to highly Polluted**
4	**Al-Dyar- Near Paper Factory**	2.884	3.32	**medium to highly Polluted**
5	**Hartha**	2.830	3.20	**medium to highly Polluted**
6	**Garmat Ali-Basrah University**	2.683	2.89	**medium to highly Polluted**
7	**Tanuma**	2.602	2.73	**medium to highly Polluted**
8	**Abu-Khasseb**	1.876	1.65	**medium Pollution**
9	**Al-Syba**	2.687	2.90	**medium to highly Polluted**
10	**Al-Fao**	2.718	2.96	**medium to highly Polluted**
11	**Zubair-Berjisia**	0.918	0.85	**unpolluted to medium Pollution**

There results agreed with the results of Al-Sabah (2007) Who found that the values of I-geo for the Sediments of ten sites of Shatt A-Arab and its tributaries, ranged between 2.150 to 4.00. Which were highly polluted with cadmium.

Results of statistical and analysis of simple correlation coefficient (r) between Soil properties and I-geo values (table3) showed a high positive signification correlation with

Table 3. The factor simple correlation coefficient (r) between soil properties and the I-geo index of total cadmium

Form of cadmium	Soil properties							
	pH	E.C	CaCO3	O .M	CEC	Clay	Silt	Sand
total cadmium	-0.290	0.555	0.772**	0.518	0.760**	0.887**	0.812**	-0.873**

Mineral carbonate (r= 0.772 **), cation exchange capacity (r=0.760**) clay (r=0.887**), and silt (r=0.812**) and a high negative significant correlation with sand (r= -0.873**).

These results indicate that fine textured soils have ability to retain and adsorbed cadmium by their surfaces and organic matter. These results agreed with the results of Faghote and Olanipekum (2010), Al-Haidarey and Hassan (2010).

Many international organization, environmental and health agencies initiated to set critical limits for cadmium concentration in soils. The World Health Organization (WHO, 1975) reported that the allowable concentration of cadmium in soils with the range 0.01 to 0.70 mg kg^{-1}, while the concentration (limits) was changed at the same organization at year 2000 to 0.01 to 0.40mg kg^{-1} Based on Hesse limits, our studied soils classified as polluted with cadmium.

Environmental Protection Agency (EPA) (1989) suggested the critical limit of cadmium concentration in soils planted with rice 10 gm kg^{-1} and vegetables 3mg $kg^{-1.}$ World countries had set standard and limits for heavy metal concentration in the environment (soil, water and air) which differed with the different nature of soils and environment. The critical level of cadmium in United States of America soils is 0.40 mg kg^{-1}, according is this concentration our studied soils classified as highly polluted with cadmium.

Therefore, the concentration of cadmium in Iraqi soils must be set within environmental standard and criteria according to nature of soils and plant.

REFERENCES

[1] Al-Haidarey, M. J. S. and F. M. Hassan (2010). The geo-accumulation Index of some heavy metals in Al-Hawizeh marsh, Iraq. *J. of Chem.* 7(1): 57-62.

[2] AL- Sabah, B. J. J. (2007). Studying the Physic - chemical Behavior of Mineral Elements Contaminating the Shatt al - Arab Water and Sediments. *PhD thesis, College of Agriculture, University of Basra.*

[3] APHA: American Public Health Association (1998). Standard methods for examination of water and wastewater. *20th ed. New York,* PP 1193

[4] Baker, A. J. M. (1981). Accumulators and excluders-strategies in the response of plants to heavy metals. *J. Plant Nutr.* 3: 643-654.

[5] EPA (1989). Recent development in situ treatment of metal contaminated soils. Office of solid waste and Emergency Response, *US Environmental protection Agency, Washington, DC.*

[6] Hood, P. S.; R. Naidu and A. Speciation (2004). Bioavailability and toxicity relationships of contaminants in the terrestrial environment, in: proceedings of international contaminated site remediation conference. *Adelaide. South Australia.*

[7] Fagbote. E. O. and E. O. Olanipekun (2010). Evaluation of the status of heavy metal pollution of soil and plant (*Chromolaena odorata*) of agape bitumen deposit Area. *Nigeria. American-Eurasian Journal of Scientific Research.* 5(4): 241-248.

[8] Gunill. J. (2002). Cadmium in arable crops. The influence of soil factors and liming. Doctoral thesis. Swedish Univ. of Agri. Sci.

[9] Lindsay. W. L. and W. A. Norvell (1978). Development of a DTAP soil test for zinc. lead. iron. manganese and copper. *Soil.Sci. Soc. Am. J.* 42: 421.

[10] Limei, Zhai.; Liao Xiaoyony; Chen Tongbin; Yan Xiulan (2008). Regional assessment of cadmium pollution in agricultural land and the potential health risk related to intensive mining active ties:a case study in Chenzhoncity, China. *J. of Environmental Sci.* 20: 696-703.

[11] Merian. E. (1991). Metals and their compound in the environment occurrence. analysis and biological relevance. VCH Wenham. PP 704. Muller. G. (1979). Schwermetalle in den Sediment des Rheas-Veranderungen Seit. Umschav. 79: 133-149. (in Audry. S.; J. Schafer; G. Blanc and J. M. Jouanneaua (2004b). Fifty-Year Sedimentary record of heavy metal pollution (Cd. Zn. Cu. Pb) in the Lot River reservoirs (France). *Environ. Pollut.* 132: 413-426.

[12] Muller, G. (1979). Schwermetalle in den Sediment des Rheas-Veranderungen Seit. Umschav, 79: 133-149. (in Audry, S.; J. Schafer; G. Blanc and J. M. Jouanneaua (2004b). Fifty-Year Sedimentary record of heavy metal pollution (Cd, Zn, Cu, Pb) in the Lot River reservoirs (France). *Environ. Pollut.* 132: 413-426.

[13] Padungtod. C.; W. Swaddiwudhipong; M. Nishijo; W. Ruangyuttikarn and T. Inud (2004). Health risk management for cadmium contamination in Thailand. Environmental Geochemistry and Health. 27: 501-511.

[14] Page. A. L.; R. H. Miller and D. R. Kenney (1982). Methods of soil analysis. Part 2 chemical and biological properties. *Amer. Soc. Agron. Inc. Pnnblisher. Madison. Wisconsin.*

[15] Sparks. D. L.; A. I. Page; D. A. Helmke; R. H. Loeppert; P. N. Soltanpour; M.A. Tabatabai; C. T. Johnston and M. E. Sumuer (1996). Method of soil analysis Part. 3. Chemical methods. *Inc. Madison Wisconsin. U.S.A.*

[16] WHO (1975). Environmental hazards of heavy metals: summary evaluation of lead. cadmium and mercury "Environmental" *Health Criteria 20. Geneva.*

[17] Satyabrata das sharma, lakshman nayak, chitta ranjan panda, mitali priyadarsini pati, subhalata samantaray (2016) a review on benthic study along odisha coast, east coast of india: a neglected research. *Journal of Critical Reviews,* 3 (4), 27-32.

[18] Prasad, D.S., Kabir, Z., Dash, A.L., Das, B.C. Prevalence and risk factors for metabolic syndrome in Asian Indians: A community study from urban Eastern India (2012) *Journal of Cardiovascular Disease Research,* 3 (3), pp. 204-211.