

Distribution of Lead and cadmium Levels in the soil of Borkhar District of Isfahan province

A, Gandomkar¹ and M, Hadi²

^{1 and 2} Najafabad Branch, Islamic Azad University, Najafabd, Iran
aagandomkar@yahoo.com



Abstract

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This study aimed to evaluate regional soil Borkhar of the metals lead and cadmium has been made. In this field study fires visits to the regions. The limit of this study located in the East refineries, petrochemical and power plant to 20 km was selected. The 41 soil samples from depths of 0 to 10 cm in area and were randomized. Soil samples were transported to the laboratory and by air was dry and passed through 2-mil thickness sieve. In the laboratory of physical and chemical characteristics and concentrations of total absorption was measured. The results showed that the concentration of Cadmium in soil is higher than the standard limit and the amount of lead in soil in many parts of the range higher than the standard limit. Survey maps show that the lead spatial distribution of the region does not special pattern. [A, Gandomkar and M, Hadi. Distribution of Lead and cadmium Levels in the soil of Borkhar District of Isfahan province. International Journal of Agricultural Science, Research and Technology, 2011; 1(2):55-59].

Keywords: Soil Pollution, Heavy Metals, Borkhar District, Soil Sampling

1. Introduction

Studies of different researchers within the country reveal that: on the one hand, intensification of industrial activities in the country; and on the other hand, disregard of bio-environmental issues and standards by some industrialists, has caused environmental contamination in some regions of our country. During the past decades, thorough industrial progresses, the level of toxic elements in soil has increased. City and industrial sewages, solid residuals from different urban, industrial, and agricultural activities, different chemical fertilizers and pesticides, are some important toxic contaminant resources of soil. (Jafari et al, 2009, p 224). Accumulation of heavy metals in soil, especially in farm lands, is a gradual process, and the density of these elements can reach to such high levels that threaten the nutritional safety of the human being's food (Abbaspour, 2005, p 543). Sewages and industrial waste materials which are discharged from factories, and penetrate the ground in different ways, are other resources of soil contamination (Kardavani, 1997, p 180).

Entrance of heavy metals through human activities, has caused contamination of most of the soils, as contamination level of these soils is either higher than normal, or will be, in near future (Anhfalk, 1996).

Through an investigation, conducted by Hutchinson (2003), about heavy metals dispersion in soils of southern Yorkshire in England, he found that presence of high levels of Lead in the regional soils is due to the old industrial plant, which had been located there, and working for some time.

By studying of the heavy metals level in soil of dry and moist regions, Dasilva et al (2006) found that the level of Zinc(Zn), Cobalt(Co), Cadmium (Cd), Lead (Pb) will be highly increased, in soils with low moist level which are used as farmlands, and it can be due to these region's agriculture type.

Through drawing geochemical maps of soil samples, collected from Skopje region, Jansey et al (2010) found that the level of Lead, Zinc, Cobalt, Zirconium, and Cadmium in this region's soils is higher than acceptable limit, and this is caused by geochemical factors, followed the region's industrial activities.

Through a study, which it's subject was: "the quality of sewages emanated from Mobarake Steel Co, and its effects on the lands which are brought under cultivation of grapevines", Rahmani (2006) found that: the soils which irrigated by industrial sewages, showed higher absorbable density of heavy metals.

Through another study conducted by Mousavi (2009), which the subject was: "zoning of Hamedan region's soils which are contaminated by heavy metals", he found that: from the point of local correlation of heavy metals, all the examined elements possess medium correlation.

A research, conducted by Golchin et al (2006) with the subject: "investigation of Zanjan's lead and zinc factories to find their effects on contamination of garden and agricultural crops by heavy metals", found that the Lead and Cadmium density level in plant samples which have grown near the factory, is alarmingly high and the highest levels of Lead and Cadmium contamination level was observed in grasses used for feeding cattle, and is also harmful to human beings.

In an area of 6800 km, Amini et al (2005) used Indicator Kriging (IK) for 255 surface soil samples (0-20cm) to draw the map of Cadmium and Lead contamination in the soils of Isfahan region. they compared resulted density levels, with the reference value of Switzerland; and observed that in more than 80% of samples, Cadmium level exceed the reference value, while, just in 2% of samples, the Lead level exceed the reference value.

Through a study conducted by Abbaspour et al (2005) with the subject: "study of Cadmium and Lead contamination in some agricultural soils of Iran", they found that in highly contaminated soils, in contrast with Cadmium, the Lead mobility indicator has shown a considerable increase.

Through an investigation with the subject: "geostatistical analyze of Lead, Zink, and Cadmium densities in the soils of Sepahanshahr's suburb, located in the south of Isfahan, Dayani et al (2009) found that high densities of heavy metals specially Zinc and Lead, is the sign of these elements increase in the Sepahanshahr's surrounding lands.

2. Material and Methods

To conduct this investigation, first, the regions located in the east of Isfahan's refinery, power plant, and petro chemistry industries, with 20 km distance, were selected as the investigation territory; and through a field operation, soil samples gathering was done from the depth of 0-10 centimeters of ground; soil samples were collected randomly from 41 points of selected area.

The linear sampling method was used to soil sampling at every point, wherein 3 identical samples, on a parallel line, and with the centrality of the main point, and with 25 centimeters distance from each other, were picked up and mixed.

After transferring to Agriculture's soil quality laboratory of Isfahan province, at first, the

samples were dried by air, and were passed through a 2 mm diameter mesh sieve, and then some physical and chemical specifications and also absorbable and total densities of Lead and Cadmium level of every sample were estimated according to the soil international standards.

After finishing the field operation and soil experiments and estimating of every element's density, point data were converted to zone data by using Kriging method, and the distribution map of Lead and Cadmium were drawn.

Moreover, the absorbable Lead level, total Lead level, absorbable Cadmium level, and total Cadmium level related to all of 41 soil samples were estimated; and were statistically analyzed, by using, mediums comparison test, and also according to international standards of acceptable limit of heavy metals in soil.

3. Results and discussion

Borkhar plain has located between 51 degrees and 18 minutes, and 52 degrees and 4 minutes east longitudes; and 32 degrees and 42 minutes till 33 north latitudes.

The plain's maximum height is 2000 m, and minimum height is 1530m; and the plain's medium height is 1550m and the maximum height of the study territory is 2671 m from sea level. The main soil contaminant industries in Borkhar region include: Isfahan refinery, Shahid Montazeri electricity power plant, Isfahan petro chemistry; and small and large industrial towns which most of them are located in the west of Borkhar region, in the steep hillside of Mahmoudabad Mountains.

In order to study the Cadmium and Lead levels of collected soil samples and comparing them with these element's acceptable limit standards in soil, the mediums comparing test (unilateral T test) was used. According to international standards of the soil's acceptable limit of heavy metals, the acceptable limit for Cadmium is 2 milligrams per kilogram of soil, and the higher levels, is the sign of soil contamination. The acceptable limit for Lead is 20 milligrams per kilogram of soil.

Table 1. T- test for Cadmium

Mean	T	Sig	Sd
Difference			
1.085	8.889	0.000	0.781

According to the data shown in table 1, and considering the test results, and as the Sig rate is lower than 0.05, we can claim with 95% confidence level, that the Cadmium rate in the region's soils is higher than standard limit.

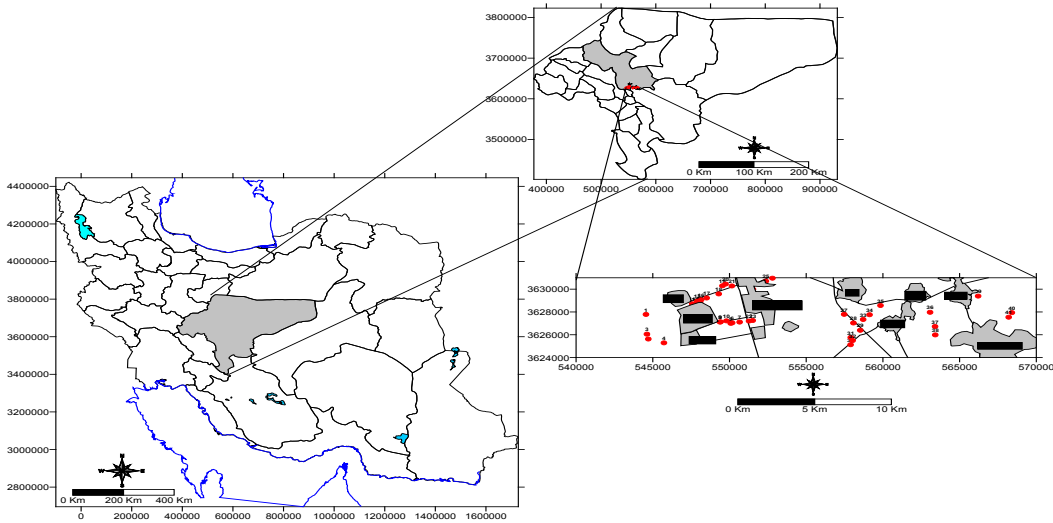


Figure 1. Study area situation map

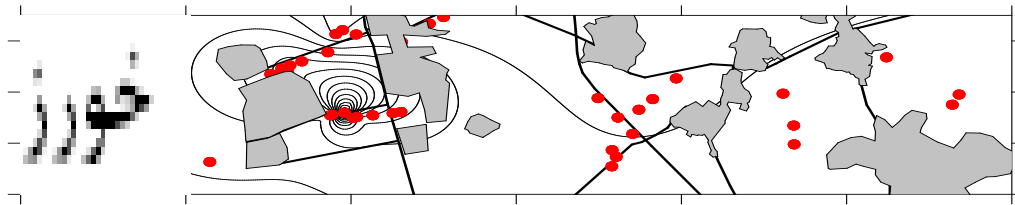


Figure 2. Distribution map of sampling points map

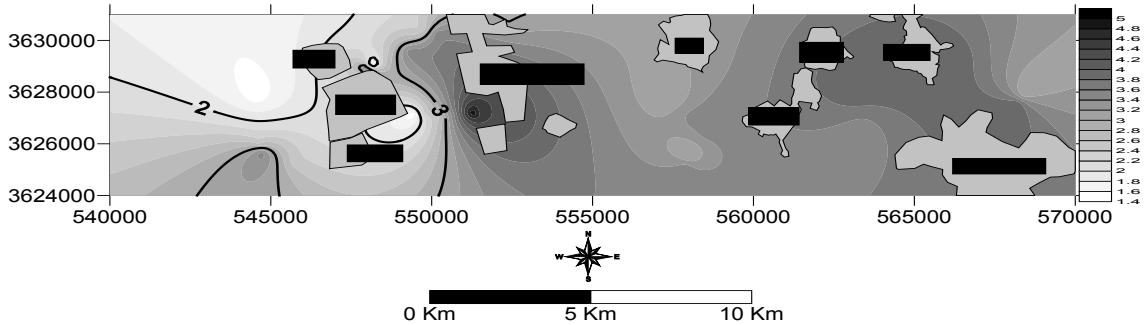


Figure 3. Distribution map of Cadmium in Borkhar

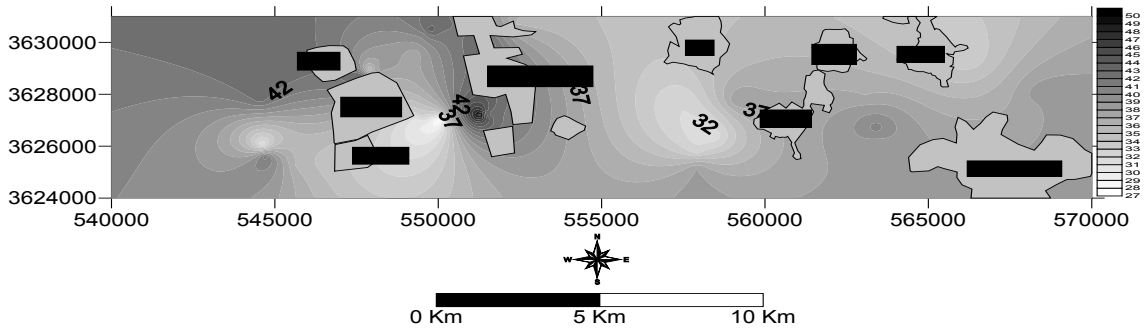


Figure 4. Distribution map of Lead in Borkhar

As you can see in the figure 3, the highest level of Cadmium acclimation is observed in surrounding areas of Mahmoudabad industrial town, and also in the city of Dowlatabad, and the lowest levels of Cadmium were observed in the east parts of power plant and refinery.

Table 2. T- test for Lead

Mean	T	Sig	Sd
Difference			
17.231	24.302	0.000	4.540

And also about Lead, considering the test results, and as the sig rate is lower than 0.05, we can claim with 95% confidence level, that the Lead level in the soils of the region, is higher than standard limit. Studying of the map, shows that local dispersion of Lead in the region, does not follow any particular pattern (figure 4).

In the point type contamination issues, it is expected that: the more distance from contamination resource of point contaminants, lead to lower levels of contaminant's density. Observing such behavior of the total levels of Lead and Cadmium in Borkhar region is in contrast with above issue.

As you can see in figure 3, the Cadmium's density in the east part of petro chemistry industries, power plant and refinery, is very low, and the farther we go from industries, the levels of total Cadmium increase. The maximum level of Cadmium is observed around industrial town of Mahmoudabad, and the last point of sampling, is observed in surrounding area of Dowlatabad.

Considering the Lead acceptable limit standards, in all parts of the region, the soil's Lead level is higher than acceptable limit, but the local dispersion of Lead does not follow any particular pattern; and the maximum Lead level, can be observed on the shoulder of Isfahan-Tehran road, and at the margin of industrial town of Mahmoudabad.

With regard to the results of this test, we can claim that even the least levels of the region's Cadmium level, exceeds the standard limit. While, from the point of local dispersion, in some parts of the region, the Cadmium level is within the acceptable range, but in surrounding areas of industrial town of Mahmoudabad, and also industrial town of Dowlatabad, the Cadmium level of soil, is higher than acceptable limit.

Considering the investigations which were conducted in this study, we cannot surely claim that the existence of giant industries like refinery, power plant, and petro chemistry, is the reason for increasing the levels of heavy metals specially lead and Cadmium, in the soils of Borkhar region.

The results of this study reveal that: two industrial towns of Mahmoudabad and Dowlatabad, have a more significant role, in the increase of the heavy metals density, specially Lead and Cadmium, in the soils of the region.

4. Recommendations

Because the highest levels of cadmium and lead in this area, seen in areas around the two industrial zones, more precise studies of plant waste in this two towns are needed and pollutant industrials are closed or plant wastewaters are treatment .

You should also study the contamination of agricultural products to Lead and Cadmium and if there is a higher than standard limite of these two metals in the agricultural products in this area, production and distribution of these products should be avoided.

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