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Assessment of Ni and Zn Contamination in Polluted Soil by Kriging Method in Northeast Iran (Mashhad)

Authors: M. Shirani, A. Fotovat, H. Khademi, G. H. Haghnia and A. Lakzian

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Assessment of Ni and Zn Contamination in Polluted Soil by Kriging Method in Northeast Iran (Mashhad)

M. Shirani [1], A. Fotovat[1], H. Khademi[2],G. H. Haghnia[1] and A. Lakzian[1]
1 Department of Soil Science, College of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
2 Department of Soil Science, College of Agriculture, Isfahan University of Technology, Isfahan, Iran

***Key words*:** Heavy metals, Kriging, Soil pollution, Urban and industrial activities

Abstract
Past investigations have shown that accumulation of heavy metals in soils is an environmental problem in many areas. Several factors including industrial and agricultural activities have caused soil contamination at different levels. The purpose of this research was to determine the spatial variability of Zn and Ni in soils under three different land uses: agricultural, industrial and urban, around the city of Mashhad , Northeast of Iran. Topsoil samples (0-10 cm) were collected from 151 sites in an area of 600 km^2. The location of each sampling site and its land use were recorded by GPS. Total metal concentrations were measured by atomic absorption spectroscopy. Soil contamination was mapped using GS+ and Surfer Software and Kriging. The result showed that the concentrations of Zn and Ni were higher in industrial and urban compared to agricultural soils. In some parts of the studied area, the concentrations of Ni and Zn in industrial and urban soil samples were higher than maximum permissible limits. Zn concentration in 4% of soil samples was higher than 150 mg kg^{-1} and in 11% of soil samples was more than 100 mg kg^{-1}. Ni concentration in 23% of soil samples was above the suggested threshold (50 mg kg^{-1}). It seems that Ni and Zn concentrations in soils have been affected by industrial activities and parent materials. Generally, it was concluded that some parts of the studied area were polluted by selected heavy metals; therefore, a monitoring program should be planned for this area.

Introduction
The assessment of heavy metal concentrations in soil is very important to know the level of soil pollution. There are surveys about the current status of selected heavy metals in Central Iran (Amini et al. 2005a,b), but the purpose of this research was to evaluate the total concentration of Ni and Zn by Kriging in North East Iran (Mashhad**).**

Materials and Methods
A total of 151 composite surface soil samples (0-10 cm), including agricultural (52%), urban (34%) and uncultivated (14%) soils were collected from an area about 600 km^2 in some part of Khorasan province (Northeast Iran). In this survey, the average distance between two closest sampling sites was approximately 2 km. Wheat, barley, sunflower and grape have been cropped in agricultural lands. Soil samples were air-dried and sieved to pass through a 2-mm sieve. Total Ni and Zn were extracted from the samples using concentrated HNO_3 and HCl (McGrath and Cunliffe, 1985), and determined with an atomic absorption spectrophotometer. A soil contamination map was produced using Kriging and GS+ and Surfer Software.

Results and Discussion
Table 1 shows summary statistics for total concentrations of Zn and Ni in soil samples. Fig.1 demonstrates the study area, sampling locations and land use in some parts of Khorasan province, Iran and Fig. 2, shows the box plots of the total concentration of Ni and Zn. The maps in Fig 3 display the distribution of Zn and Ni for the entire study area as predicted by ordinary Kriging. The concentration of heavy metals in the south and west of the study area, with industrial and urban activities, was higher than that in the north and east of the area with agricultural and uncultivated activities. Hence, it may be concluded that the type of activities has influenced the concentration of heavy metals in soil in this area. The mean values coincide with the most probable estimators produced by ordinary Kriging.

The result indicated that the concentrations of Zn and Ni in some parts of urban and industrial area were higher than the maximum permissible limits. For Zn, 4% of soil samples were higher than 150 mg kg^{-1} and in 11% of soil samples was more than 100 mg kg^{-1}. Nickel concentration in 23% of soil samples was above the suggested threshold limit (50 mg kg^{-1}). The highest concentration of Ni and Zn occurred in soils of the southern parts. It seems that parent material and industrial activities have already influenced Ni and Zn concentrations. Considering the importance of heavy metal contamination, a monitoring scheme is recommended for this area.

Table 1. Summary statistics of Ni and Zn concentrations (mg/kg)

Element	Mean	S.D.	Min	Max	Range	Skewness
Ni	54.7	45.9	21.4	356	334.6	4
Zn	66.8	36.5	12.7	266.3	253.6	2.7

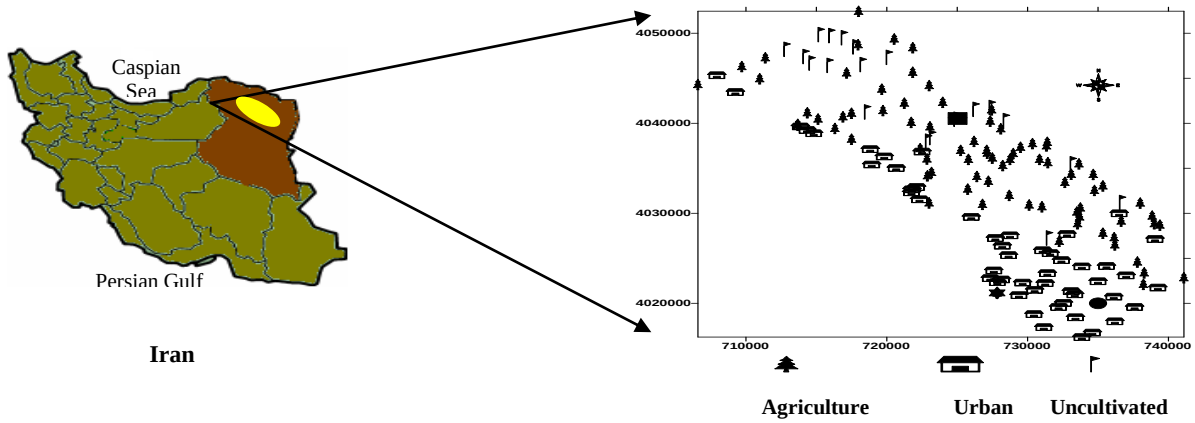

Fig. 1: Study area, sampling locations and land use in Khorasan

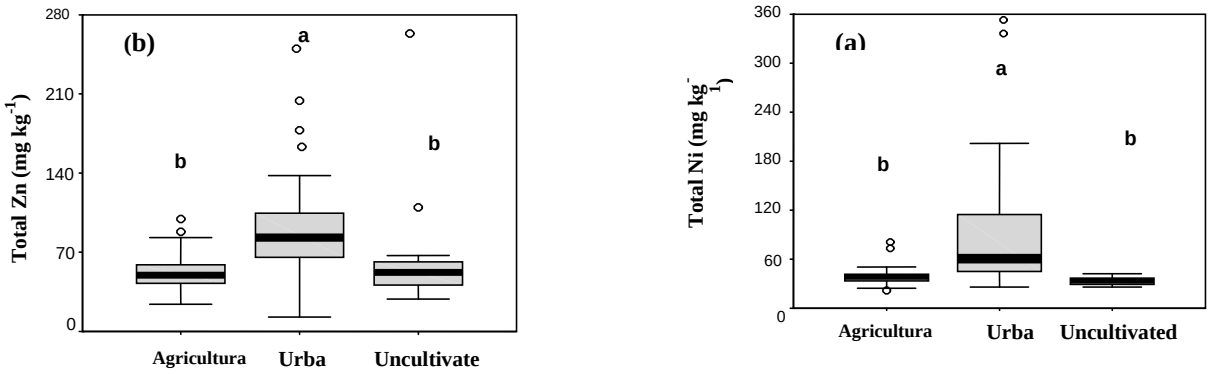

Fig. 2: Box plots of the total concentration of Ni (a) and Zn (b)

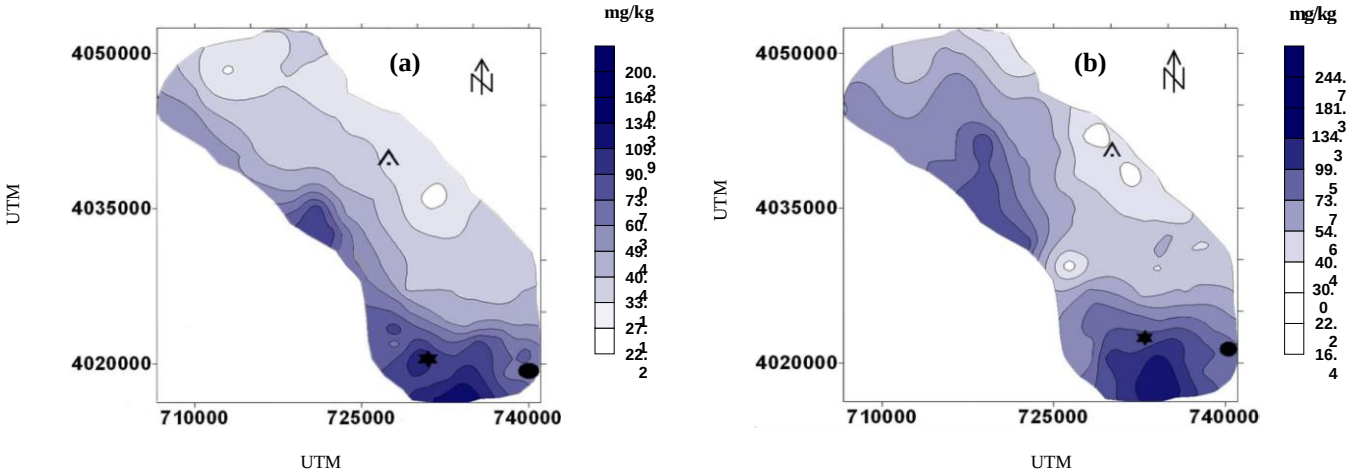

Fig 3. Predicted distribution of Ni (a) and Zn (b)

References

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McGrath S.P., Cunliffe C.I.I. 1985. A simplified method for the extraction of the metals Fe, Zn, Cu, Ni, Pb, Cr, Co and Mn from soils and sewage sludge. Science of Food and Agriculture. 36: 794-798.

Frontiers in Trace Elements

Research and education

Wednesday 15 July 2009

	Room 1	Room 2		Room 4
	Technical Session 6	**Technical Session 9**		**Technical Session 5**
	Arsenic and fluoride, water contamination and remediation processes	**Biogeochemical cycles for trace element in serpentine environments**		**Environmental Sustainability**
	Chairs: Margarita Gutierrez, Josefina Rodríguez, Lena Q. Ma	**Chairs:** Carlos Green , Robert Garrett		**Chairs:** Michel Mench and Giancarlo Renella
9:00-9:20	**Barry Rosen** Biogeochemical cycling of arsenic by a Yellowstone thermoacidophilic eukaryotic alga	**Carlos Green Ruiz** Cu and Pb geosorption by Ca-montmorillonite from aqueous solutions: Effect of salinity		**Amir Fotovat** Assessment of Ni and Zn contamination in polluted soil by kriging method in North East of Iran (Mashhad)
9:20-9:40	**Lucy Mar Camacho** Arsenic and fluoride removal from drinking water by adsorption on natural zeolite	**Robert Garrett** Macro-relationships between regional-scale field pea (Pisum sativum) chemistry and soil-type and eco-classification in western Canada		**Giancarlo Renella** Microbial community composition in trace element contaminated soils subjected to phytostabilization
9:40-10:00	**Hiram Castillo** Study of localization and chemical forms of arsenic in three species of the Parkinsonia plant	**Moritz Bigalke** Isotopic fractionation of copper during soil genesis		**Gary Pierzynski** Influence of compost on microbial function and community structure when applied to heavy metal mine

BACK

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