Lead and Cadmium Spatial Pattern and Risk Assessment around Coal Mine in Hyrcanian Forest, North Iran

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Abstract : In this study, the effect of coal mining activities on lead and cadmium concentrations and distribution in soil was investigated in Hyrcanian forest, North Iran. 16 plots (20×20 m^2) were established by systematic-randomly (60×60 m^2) in an area of 4 ha (200×200 m^2-mine entrance placed at center). An area adjacent to the mine was not affected by the mining activity; considered as the controlled area. In order to investigate soil lead and cadmium concentration, one sample was taken from the 0-10 cm in each plot. To study the spatial pattern of soil properties and lead and cadmium concentrations in the mining area, an area of 80×80m^2 (the mine as the center) was considered and 80 soil samples were systematic-randomly taken (10 m intervals). Geostatistical analysis was performed via Kriging method and GS$^+$ software (version 5.1). In order to estimate the impact of coal mining activities on soil quality, pollution index was measured. Lead and cadmium concentrations were significantly higher in mine area (Pb: 10.97**$\pm$**0.30, Cd: 184.47**$\pm$**6.26 mg.kg^{-1}) in comparison to control area (Pb: 9.42**$\pm$**0.17, Cd: 131.71**$\pm$**15.77 mg.kg^{-1}). The mean values of the PI index indicate that Pb (1.16) and Cd (1.77) presented slightly polluted. Results of the NIPI index showed that Pb (1.44) and Cd (2.52) presented slight pollution and moderate pollution respectively. Results of variography and kriging method showed that it is possible to prepare interpolation maps of lead and cadmium around the mining areas in Hyrcanian forest. According to results of pollution and risk assessments, forest soil was contaminated by heavy metals (lead and cadmium); therefore, using reclamation and remediation techniques in these areas is necessary.

Keywords : traditional coal mining, heavy metals, pollution indicators, geostatistics, Caspian forest

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