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Soil risk assessment of heavy metal contamination in an urban area: Belgrade, Serbia

Procena rizika zemljista zagadjenog teskim metalima, urbanog podrucja: Beograd, Srbija

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The present study is focused on the investigation of urban soil pollution in the area of thermal plant New Belgrade with more than 200000 residents.

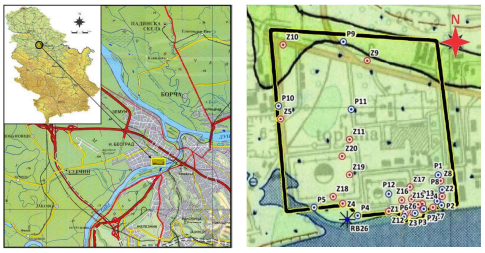

Fig. 1 Map of the study area; locallity of sampling sites

A total of 45 soil samples were collected in May, 2015, and ten heavy metals, including Fe, Mn, Co, Cd, Cr, Cu, Pb, Ni, Zn and V were analyzed for their concentrations, potential ecological risks, and human health risks.

Analysis of metals was carried out using the atomic emission spectrometer with an inductively coupled plasma iCAP-6500 Duo, after triacid total digestion (HCl, HNO_3 and HF, Devic et al., 2014).

The aim was to investigate the spatial distribution of heavy elements in order to identify the sources of pollutants, to evaluate the soil contamination degree and to improve their monitoring in analyzed area and to assess the human health risk for the sensitive population.

The results demonstrate a general enrichment of Zn(141mg/kg), Pb(70 mg/kg) and Cd (2.79 mg/kg) in the topsoils, so direct risk for humans could be expected. The highest metal concentrations Cr (121mg/kg), Ni (94.9mg/kg) and especially V (299 mg/kg) were found at soil depth of 2-15m. Using target values given by the Netherlands Ministry of Housing, Spatial Planing and Environment, it may be conluded that Belgrade soil can, for the most part, be regarded as polluted (Table 1; Fig.2).

Chemometric methods were successively applied to evaluate the spatial variations in soil quality and source identifications at soil sites in urban area indicating that the different methods are effective and harmonious with each other. The results from chemometric methods (Principal Component Analysis and Cluster Analysis) suggested that most of the variations could be explained by a set of natural and anthropogenic pollutions. Accidental spilage from reservoirs and vehicular transport were the primary sources of heavy metals.

Moderaty to very high ecological risk (Table 1).

	MERMQ	PER	CSI
Max	0.765	156	2.83
Min	0.161	60	1.97
Mean	0.481	122.6	1.18
SD	0.23	25.1	0.39

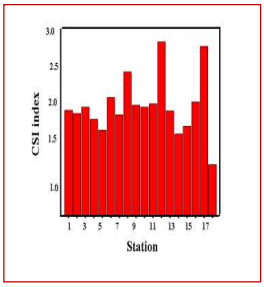

Fig.2 The results of CSI index demonstrated that pollution of heavy metals in soils at several sites is very intense.

These results can be used for effective management of urban soils.