FACULTY OF AGRICULTURE – Department of Agroecology

Trace metal availability under different land uses (forest and agriculture)

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Introduction

In present study soil solution concentration of toxic trace metals (Cd and Pb) and essential trace metals (Mn and Fe) were examined for differences between land uses (forest and agriculture). The study was conducted in the main agricultural region of Croatia (Osijek-Baranja County) (Figure 1).

Aims and objectives

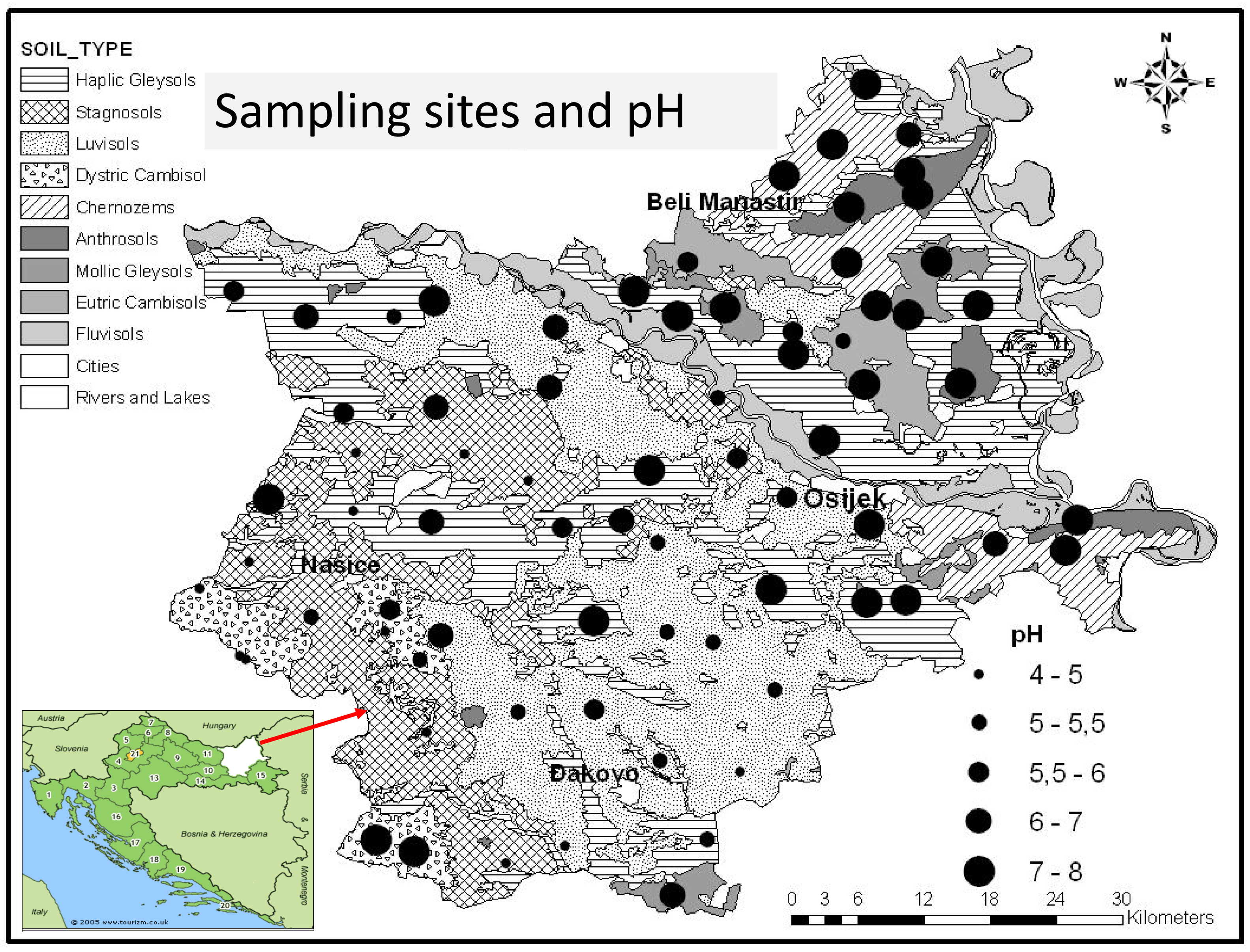
Soil solution concentrations of trace metals are considered as good indicators of mobility and availability. The main objective of this research was to evaluate the diferences in the availability of trace metals between two different land uses.

Methodology

- Soil samples from different land uses (forest land (21 sample) and arable land (53 sample)) and different soil types were collected from the depth of 0-25 cm from 74 locations in Danube basin of Eastern Croatia (Figure 1).

- Samples were analysed for the following soil parameters: pH, SOM, DOC, total Fe, Mn, Cd and Pb (digestion of soil with ultra pure HNO_3) and water extractable Fe, Mn, Cd and Pb.

Figure 1



Results and discussion

The results indicate significant influence of land use on soil solution concentrations (water extractable conc.) of all examined trace metals except Fe. In water extracts from forest soils, the concentrations were significantly higher compared to extracts from agricultural soils for: Mn ($p < 0.001$), Cd ($p < 0.001$), and Pb ($p < 0.01$) (Table 1). Such behavior of water extractable trace metals is most likely related to soil pH and DOC, since soil properties also showed significant difference among land uses (Table 1.).

Table 1 - Descriptive statistics for water extractable trace metals and main soil properties under different land uses (n = 74)

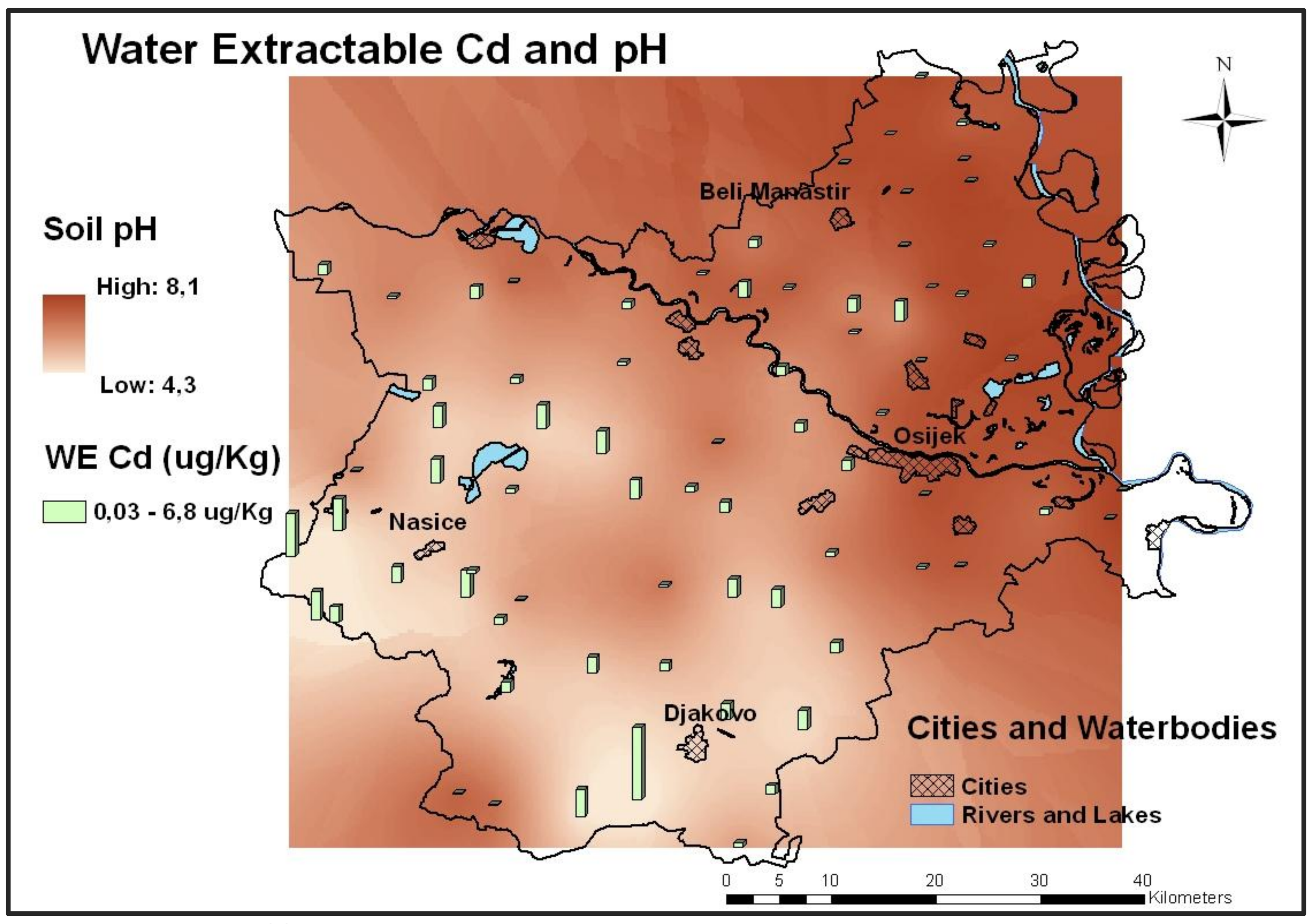
	Land use	n	Mean	StDev	Min	Max
Fe mgkg^{-1}	Agri. field	53	20.13	29.29	0.36	125.3
	Forest	21	20.17	15.37	0.61	69.4
	ALL	74	20.14^{ns}	26.00	0.36	125.3
Mn mgkg^{-1}	Agri. field	53	0.9	2.9	0.004	20.89
	Forest	21	4.3	4.1	0.096	18.15
	ALL	74	1.86***	3.6	0.004	20.89
Cd mgkg^{-1}	Agri. field	53	0.0006	0.001	0.00003	0.007
	Forest	21	0.0019	0.0008	0.00086	0.004
	ALL	74	0.0009***	0.001	0.00003	0.007
Pb mgkg^{-1}	Agri. field	53	0.008	0.009	0.0004	0.042
	Forest	21	0.015	0.010	0.0010	0.038
	ALL	74	0.010**	0.010	0.0004	0.042
pH	Agri. field	53	6.8	1.003	4.3	8.02
	Forest	21	5.2	0.825	4.4	7.40
	ALL	74	6.3***	1.180	4.3	8.02
SOC %	Agri. field	53	1.5	0.7	0.46	4.4
	Forest	21	2.3	0.8	0.94	5.1
	ALL	74	1.7***	0.8	0.46	5.1
DOC mgl^{-1}	Agri. field	53	16.3	4.8	6.1	33.1
	Forest	21	50.5	12.9	23.8	73.0
	ALL	74	26.0***	17.4	6.1	73.0

n – number of samples, Fe - Iron, Mn – Manganese, Cd – Cadmium, Pb – Lead, SOC – soil organic carbon, DOC – dissolved organic carbon

*, ** and *** indicate significant difference between land uses at $p<0.05$, $p<0.01$ and $p<0.001$ respectively, ns stands for not significant.

Correlation of pH and water extractable Cd (as well as other investigated trace metals) can also be seen from figure 2 where dependence of soil solution Cd and soil pH is also noticeable.

Figure 2



WE – water extractable

Conclusion

Our study confirmed that the soluble concentrations of trace metals are controlled by soil properties, mainly soil pH, SOC and DOC. Therefore, these findings in context of agroforestry indicate that lower need for lime application will result with lower soil pH and consequently greater solubility and mobility of trace metals.