Change in Trace Metal Fractions in Soils Long-Term after Cessation of the three different Organic Wastes Treatment for seven years

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Objective

➢ The objective of this study was to understand the long-term effect of organic waste treatment on the fate of trace metals in soil originated from the organic wastes.

Materials & Methods

➢ Three organic wastes(Municipal sewage sludge, alcohol fermentation processing sludge, pig manure compost) were used in three different rate for 7 years (1994-2000).
➢ To see the long-term effect, soil examination were conducted in 2000 and 2010, respectively.

Table 1. Selected physicochemical properties and trace metal concentrations of the organic wastes used in this experiment.

	MSS	AFS	PMC
pH (1:5)	6.7	7.1	8.1
EC (dS/m)	42.6	51.8	60.5
Organic matter (g/kg)	559	788	707
Total nitrogen (g/kg)	34.3	75.1	26.0
P_2O_5 (g/kg)	4.61	40.8	60.7
Cations ($cmol_c$/kg)			
Ca	0.38	0.15	0.35
K	0.13	0.15	0.36
Mg	0.02	0.25	0.14
Trace metal (mg/kg)			
Cu	134.4	177.9	576.8
Pb	19.7	15.1	3.7
Zn	792.9	363.2	782.7

MSS = Municipal Sewage Sludge
AFS = Alcohol Fermentation Processing Sludge
PMC = Pig Manure Compost.

Table 2. Chemical extraction scheme for heavy metal fractionation in soils.

Fraction	Extractant	Shaking time	Metal species
F1	H_2O	30 min.	Water soluble
F2	0.5 M KNO_3	16 hr.	Exchangeable
F3	0.5 M NaOH	16 hr.	Organically bound
F4	0.05 M EDTA	6 hr.	Carbonate
F5	4 M HNO_3	16 hr. (at 80℃)	Sulfide & Residual

Results

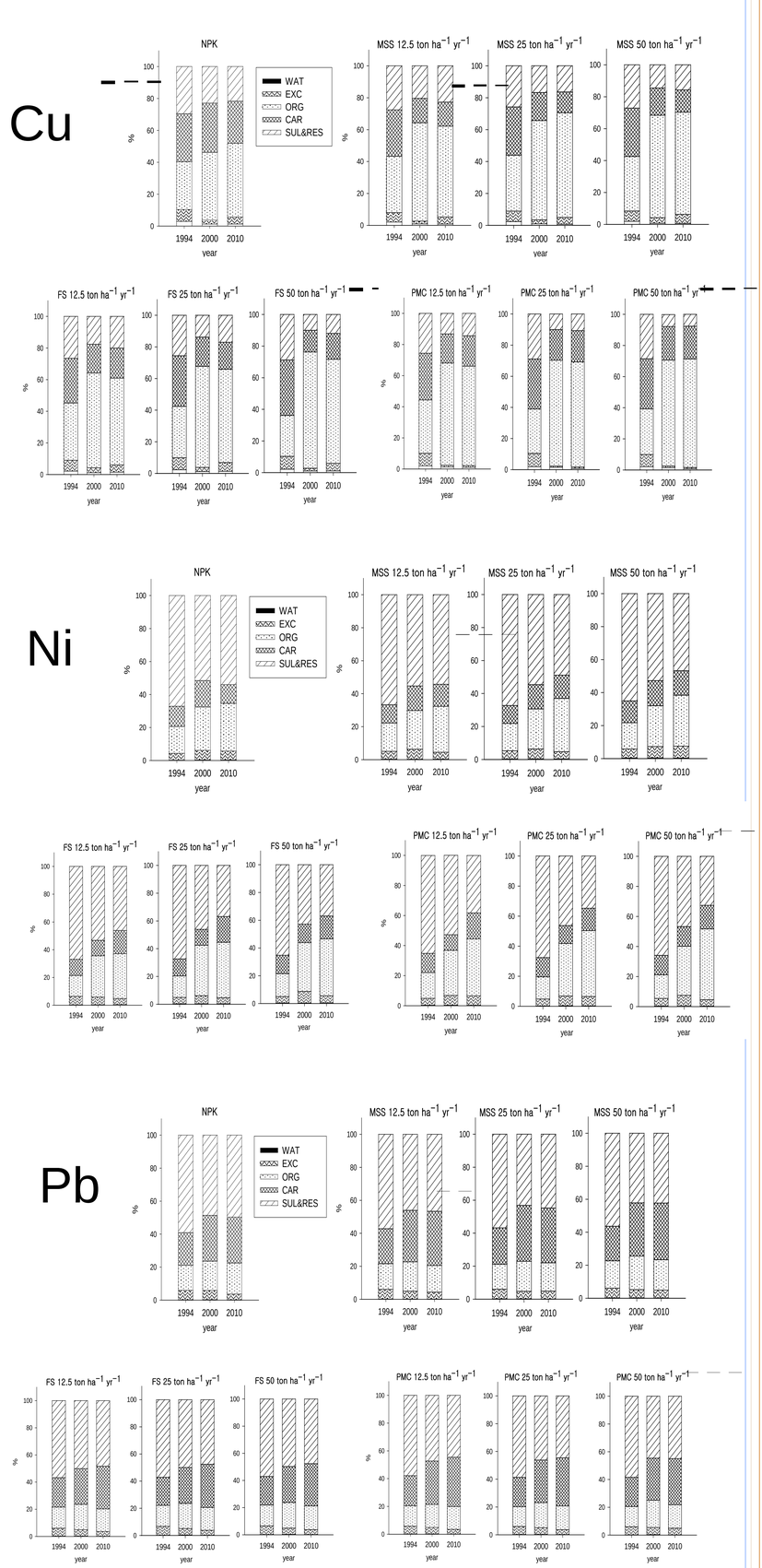

Fig. 1. Fractions of Cu, Ni and Pb in the soils received long-term three different organic wastes applications. The values were determined in 1994, 2000 and 2010.

Zn

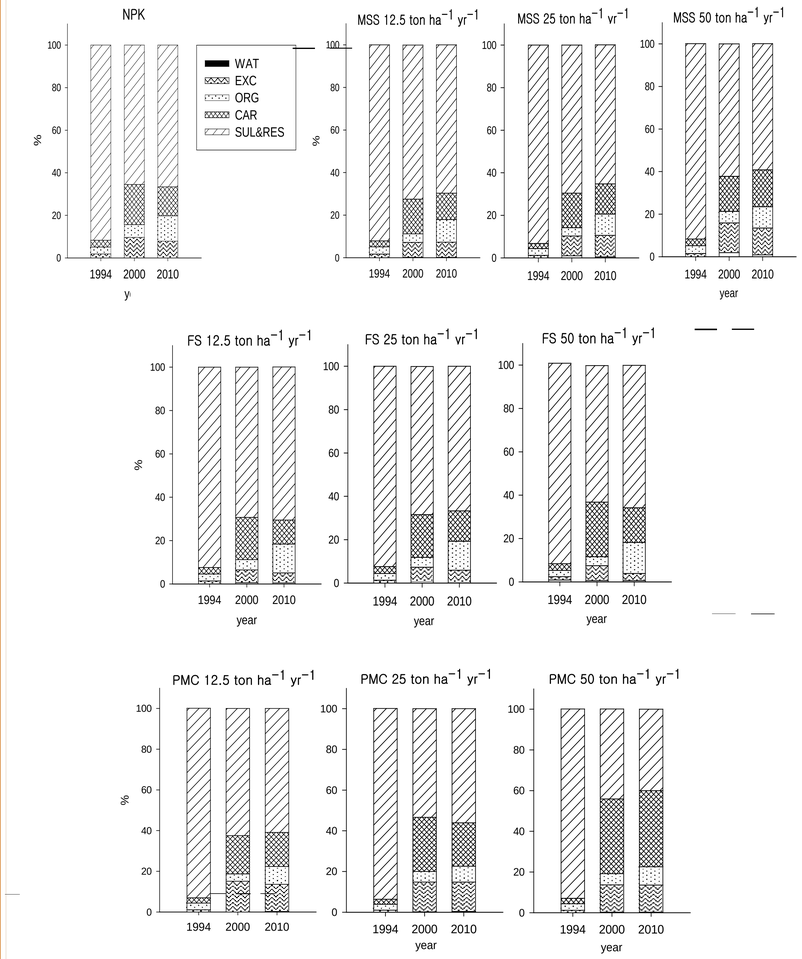

Fig. 2. Fraction of Zn in the soils received long-term three different organic wastes applications. The values were determined in 1994, 2000 and 2010.

Conclusions

➢ Speciation of trace metals in soil through sequential extraction showed that organically bound form of Cu was the dominant species in all treatment and exchangeable form of Cu was increased in the plots treated with municipal sewage sludge and alcohol fermentation processing sludge.
➢ Organically bound form of Ni increased from 25~30% to 32~45% in 2010 in all treatment while Pb showed increase in Carbonate extractable amount in all treatment.
➢ Zn existed mainly as Sulfide and residuals, showing increases in Organically bound form of Zn in all treatment after 10 years.

References

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➢ Smith, S.R. 1996. Agricultural Recycling of Sewage Sludge and the Environment. CAB International. Wallingford, UK. Pp.382.

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