# Metal Load of Crops Depending on Land Use, Land Management and Soil Characteristics

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## Introduction

**M**etals of different toxicities occur in soils as a result of weathering, industrial processes, fertilization and atmospheric deposition (Kabata-Pendias, 2004). Some of them can be absorbed by the plants due to their mobility. Badly adapted cultivation of the agricultural soils (declining pH-value, unsuitable fertilizers) can enhance the mobility of the metals and increase their concentrations in agricultural products (Tu et al., 2000).

## Material and Methods

**A**im is to test the relations between extractable metal (Cd, Zn, As, Cr, Cu, Pb, Ni, Co, V, Be, Mo, Se, Li, Tl) concentrations in the soil and metal load of the plants (*Lolio-Cynosuretum*) depending on fertilization variations.

**S**oil and plant samples were taken from four arable fields in a mountanious region of Hesse (Germany).

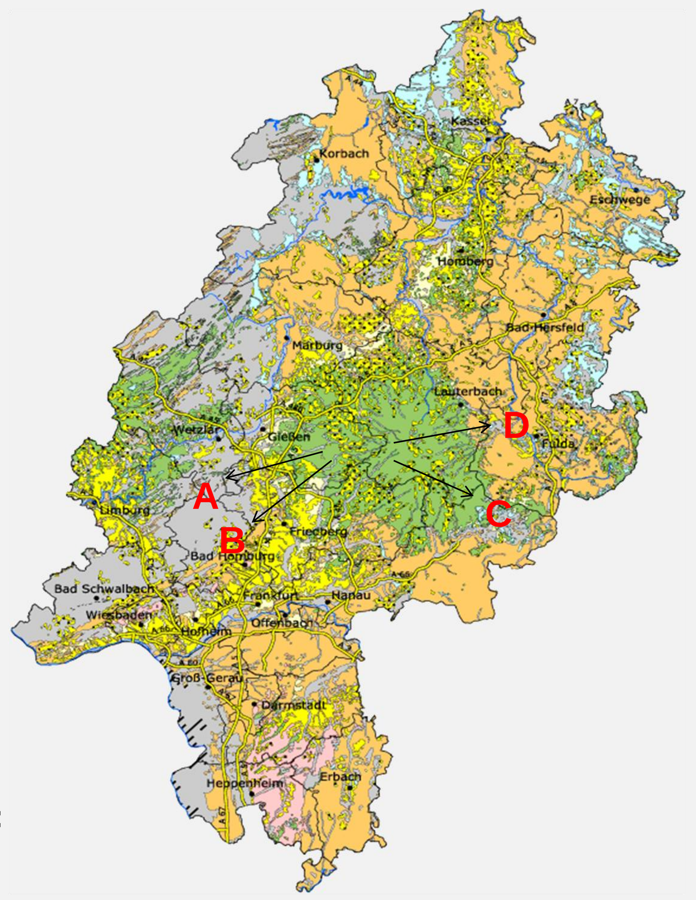

Fig.1: Study sites in Hesse (Germany)

**P**seudo total metal content of soils was determined both with Aqua Regia and Microwave Assisted Extraction (MAE). Here, conventional extraction was compared with MAE (HCl, $HNO_3$).
Furthermore, mobile and potentially available fractions of soils were identified by EDTA and $NH_4NO_3$ extractions.
Metal contents of the plants were also determined with MAE ($HNO_3$, $H_2O_2$).
In addition to the metal contents, chemical and physical properties of the investigated soils were also identified.
Designation of the metals in soil and in plants was done by ICP-OES methodology.

Tab. 1: Fertilization variations of the study sites

| Fertilization Variations | | |
|---|---|---|
| **Criteria** | **Levels** | |
| **1.** N-Fertilization | 1 | 0 kg N ha$^{-1}$ |
| | 2 | 160 kg N ha$^{-1}$ |
| | 3 | 320 kg N ha$^{-1}$ |
| **2.** P-Fertilization | 1 | 0 kg $P_2O_5$ ha$^{-1}$ |
| | 2 | 60kg $P_2O_5$ ha$^{-1}$ |
| | 3 | 120 kg $P_2O_5$ ha$^{-1}$ |
| **3.** K-Fertilization | 1 | 0 kg $K_2O$ ha$^{-1}$ |
| | 2 | 80 kg $K_2O$ ha$^{-1}$ |
| | 3 | 160 kg $K_2O$ ha$^{-1}$ |

**N:** $NH_4NO_3$ **P:** Hyper- & Superphosphate **K:** Magnesia-Kainit & $K_2SO_4$

## Results

**T**op soil characteristics:

**A:**Luvisol
Clay content: 33.22%
$C_{org}$: 4.55%
pH($CaCl_2$): 4.72

**B:**Luvisol
Clay content: 29.59%
$C_{org}$ : 3.48%
pH($CaCl_2$): 5.31

**C:**Cambisol
Clay content: 35.18%
$C_{org}$ : 3.36%
pH($CaCl_2$): 5.13

**D:**Cambisol
Clay content: 42.44%
$C_{org}$ : 4.07%
pH($CaCl_2$): 5.44

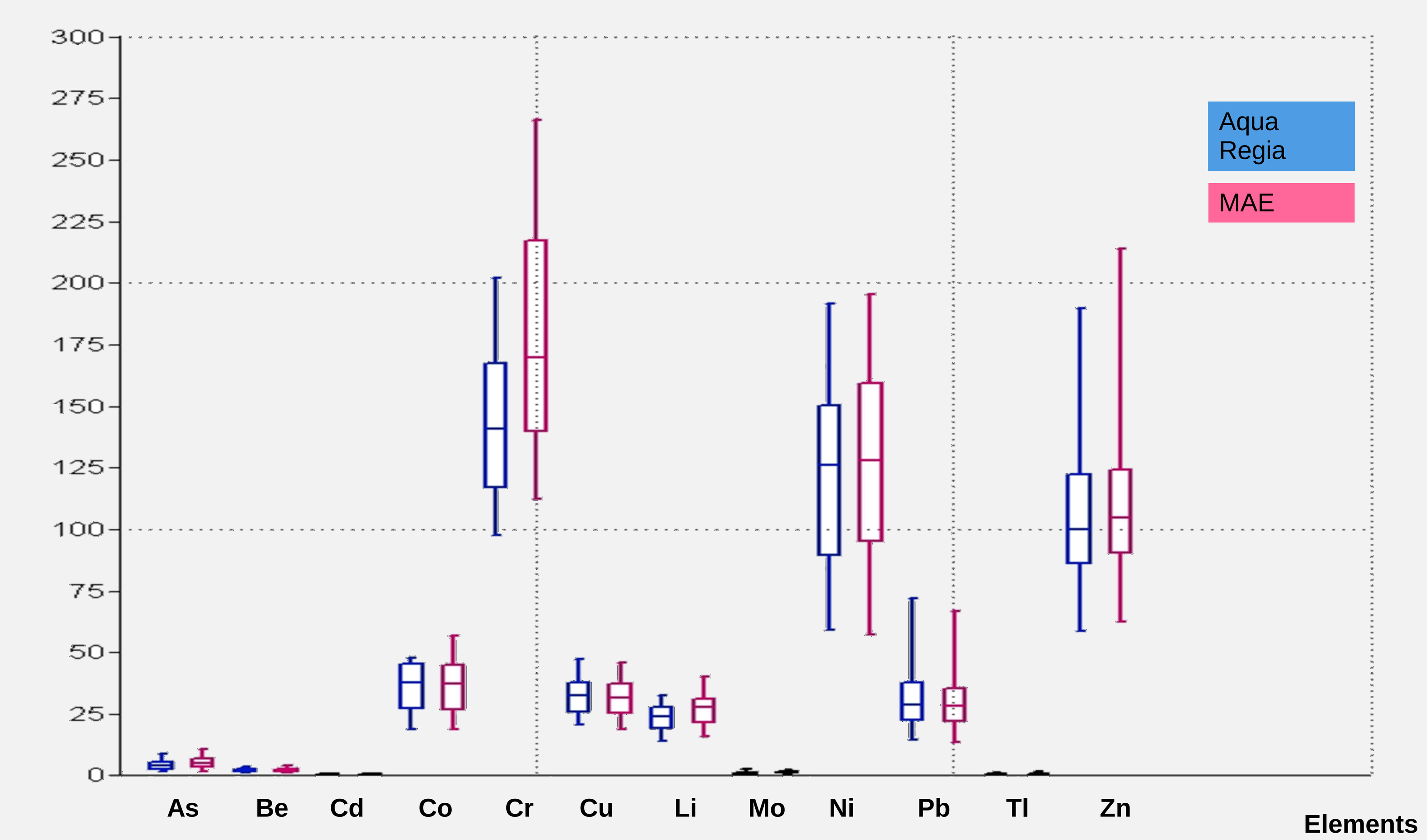

Fig. 2: Concentration of metals of soil samples (Aqua Regia vs. MAE Method) n:68

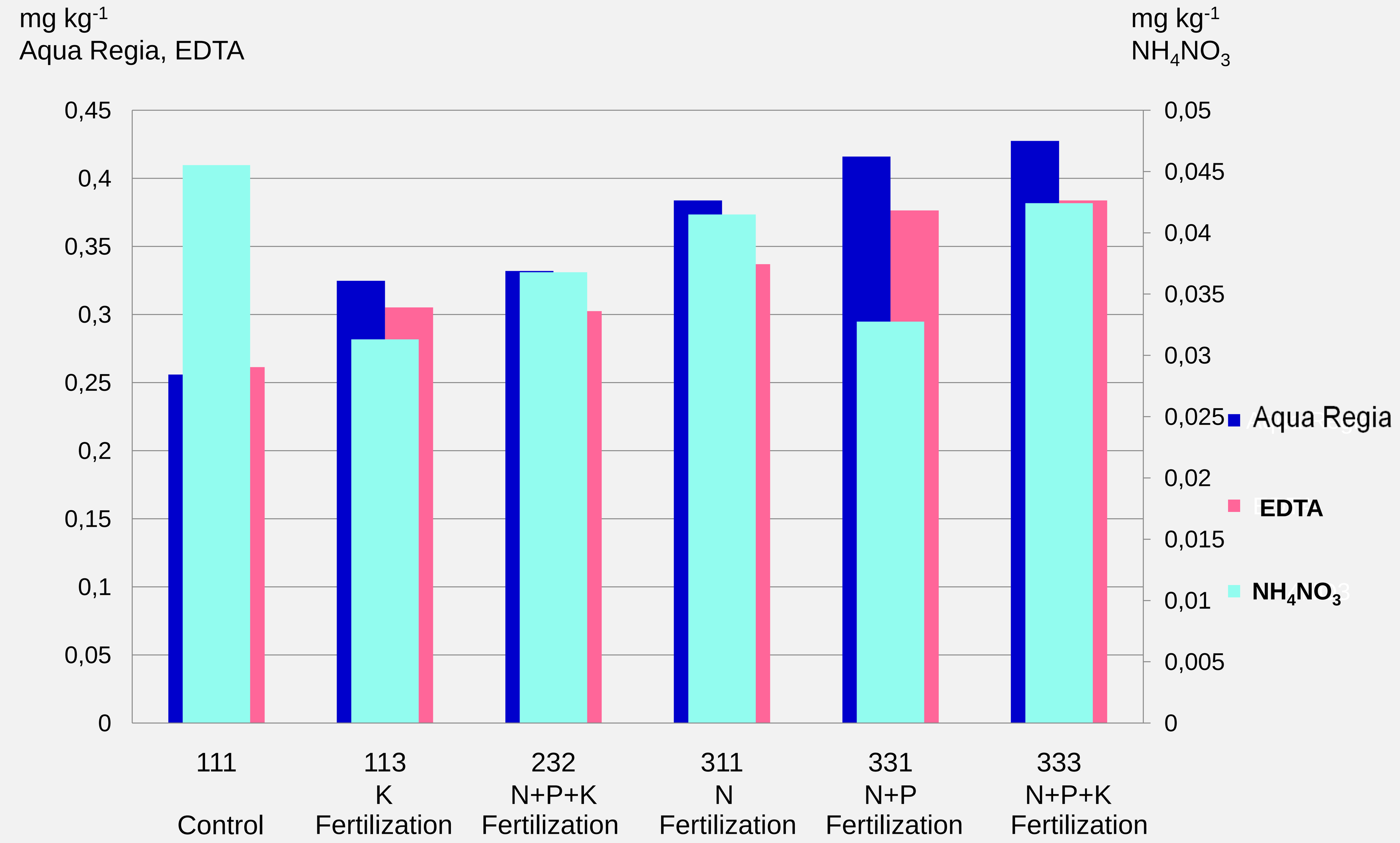

Fig. 3: Cd concentration of soil samples due to different fertilization variations (Aqua Regia, EDTA, $NH_4NO_3$ extractions)

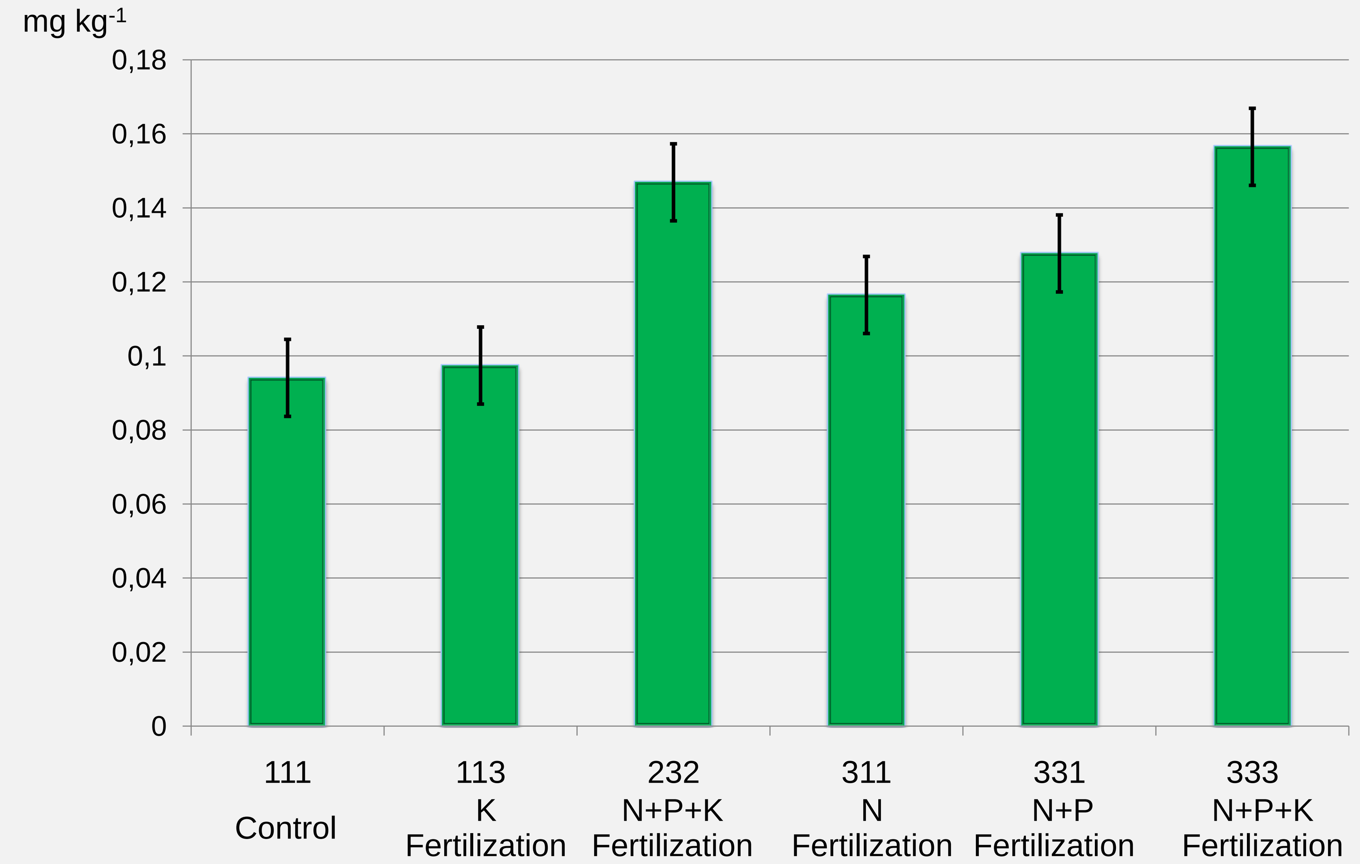

Fig. 4: Cd concentration of plant (*Lolio-Cynosuretum*) samples due to different fertilization variations

## Conclusion

**T**he results confirm that in terms of total metal content of soils, Aqua Regia and MAE show nearly the same results (fig. 2). The metal content of the soil is dependend on fertilization (N, P, K ). According to the fertilization variants, total metal content of the soils are increased in soil samples which have high amounts of N, P, K fertilization (fig. 3). Results on the Cd content of the plant samples (fig. 4) also revealed that transition of metals from soil to plants depends on the fertilizer since plant and soil samples treated with the same fertilizer showed similar results.

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