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Environmental bioavailability of As, Ni and Cr in areas with elevated background concentrations (Wallonia, Belgium)

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Arsenic, chromium and nickel in soils may pose a problem for the ecosystem and/or human health as they can be transferred through the food chain. Large areas can be affected by elevated metal(loid) background concentrations, involving large scale soil management issues. The management of contaminated soils is usually done using quality standards based on total soil content. Although operational, this approach may lead in areas affected by elevated background concentrations to high remediation costs that are not supported by the potential exposure of the people to metal(loid). An alternative approach to manage these contaminated soils relies on the determination of soil metal(loid) environmental bioavailability as it better accounts for the potential risk for human health and for the ecosystem.

This study assesses the environmental bioavailability of As, Cr and Ni in soils from two areas in Wallonia affected by elevated As, Cr and Ni background concentrations: the Liège basin (anthropogenic origin) and the Belgian Lorraine (geogenic origin). For this purpose, a representative collection of soils was sampled from each area (Liège basin: n= 38 and Belgian Lorraine: n=28). Environmental bioavailability was assessed using two complementary approach:(1) by determining the chemical fractionation with the BCR protocol and (2) by estimating the soil plant-availability with *Lolium multiflorum* as plant model (ISO 16198:2015). While total As (6-130 ppm), Cr (15-268 ppm), and Ni (8-140 ppm) contents frequently surpass the standard of the Walloon soil decree, total content is mostly not correlated with the environmental bioavailability. No positive correlation was found between the aqua regia content and BCR extractions or rye-grass content, except for As in Liège's soils. Higher total As, Cr, or Ni contents will thus not necessarily result in higher mobile, potentially mobilizable, and phytoavailable contents. According to the BCR extractions, the mobile and potentially mobilizable fractions of these elements account for less than 30% of their total content. In conclusion, this study provides the required data for a sustainable and rational management of high total As, Cr and Ni soil content at the regional scale.