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Impact of non-ferrous metal mining on soil functions in the Mashavera valley, Georgia

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Trace metal contamination of soils in the vicinity of metal mines and industrial sites is very common in industrial countries. While extensive knowledge concerning the consequences and distribution of metal contamination of soils and their effects on the food chain exists in the western industrial states, such examinations of affected regions in the former Eastern Bloc were either not conducted or not published.

The study area is located in the valley of the Mashavera River in the region of the town Bolnisi, about 80 km south of the capital Tbilisi. It is a rural area with very fertile soils (Kastanozems and Chernozems) of approx. 800 km^2 in size. Cereals, vegetables and fruits are grown for the conurbations of Eastern Georgia under irrigation due to the continental climate. The river water used for irrigation is polluted with eroded mining waste from a Cu and Au mine in the mountainous region of the middle reaches of the Mashavera River since end of the 1970s. Furthermore, wastewater from a floatation plant, erosion material from floatation waste deposits, and acid mine drainage has led to high concentrations of dissolved and suspended sulfidic metals in the river water. It can be estimated that annual transfer of metals by irrigation water is in the range of several g ha^{-1} in case of Cd and several kg ha^{-1} in case of Cu and Zn. Most of the irrigated soils under different land use display a strong enrichment of these metals. The concentrations of total amounts increase with the intensity of irrigation with highest amounts in vegetable gardens. A high proportion of the metals belong to the supply fraction, unspecifically and specifically adsorbed and dissolvable in EDTA. Due to the narrow correlation of this fraction with the mobile and potential-plant available fraction a high long-term risk potential for the food chain exists. Although the soils display a high sorption capacity, the metal concentrations at most of the investigated sites exceed the precaution and trigger values defined in the German Federal Soil Protection and Contaminated Sites Ordinance.

Food crops grown on these soils show Cu and Zn concentrations toxic for plant growth and chlorosis as well as growth inhibitions can already be observed. European food safety thresholds for Cd are partly exceeded, especially in vegetables like *Spinacia olerachea* up to the 2.5 fold. Furthermore soil-microbial enzyme and respiration activity is restrained by the high Cd, Cu and Zn concentrations. Due to this nutrient-cycle might be disturbed.

Hence, actual ecological impact of the metal contamination in the Mashavera valley is alarming and immediate measures (e.g. restriction of land use) are necessary to protect the residents.