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In-situ remediation of top soils contaminated with Cu, Zn and Cd in Bolnisi, Georgia - a field experiment

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The valley of the Mashavera River, in Georgia, is an area of more than 300 km^2 in size with very fertile soils. The river water used for irrigation of the arable land is polluted with fines containing sulfidic heavy metals (Cu, Zn and Cd) due to non-ferrous metal mining in the mountainous area of the middle reaches of the Mashavera River. It can be estimated that the annual transfer of heavy metals to arable land by irrigation water is in the range of several g per ha in case of Cd and several kg per ha in case of Cu and Zn. Due to the ongoing heavy metal accumulation in the irrigated soils and the uptake by food crops an acute danger potential for humans and animals exists. Because polluted soils cannot be cleaned, in-situ fixation of the problem elements would be an adequate solution.

In laboratory experiments it was demonstrated that the amendments of iron oxides to topsoil-samples from the study area lead to a noticeable decrease of the heavy metal mobility. This can provide a realistic chance for the conservation of the soil resources of the Mashavera valley.
A field experiment was conducted in 2008 in order to investigate the in situ fixation of plant available heavy metals by amendments of zerovalent Fe in form of metallic iron powder (1 % by weight). Zerovalent Fe has no binding capacity but its oxidation, which occurs rapidly in irrigated soils, forms fresh iron oxides.
The experiment was carried out on two experimental plots with a different degree of heavy metal pollution, which were separated in remediated parcels and control parcels without amendments. Mobile and potential available fractions of Cu, Zn and Cd were measured in March, June and October. Additionally the total contents of Cu, Zn and Cd were determined in March and October.

In remediated parcels with amendments of iron powder the mobile as well as the potential available fraction decreased significantly from March to October in comparison to the control parcels. For both fractions the extent of the immobilisation capacity was different for single elements. The immobilisation decreased in the sequence Zn $>$ Cd $>$ Cu.