# Phytomanagement of a Cu-contaminated soil with an agroforestry system enhances soil microbial communities and ecosystem services

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## ABSTRACT

Despite being a promising technology for remediating metal(loid)-contaminated land, the success and effectiveness of phytotechnologies often face important challenges, e.g. selection of suited plant species, budgetary restrictions, an upcoming climate change scenario, or site-specific limitations for deploying best agronomic practices. An ultimate goal of phytomanagement is not only to mitigate the risk associated with excessive exposure to metal(loid)s, but also to restore soil ecological functions and ecosystem services. Agroforestry is a feasible, low-maintenance reclamation option for marginal land with poor soil quality and limited agricultural potential such as metal-contaminated areas. In addition to risk mitigation, the combination of shrub/tree species with grassy crops offers multiple benefits that meet environmental, economic and societal needs, e.g. erosion control, groundwater-table stabilization, biodiversity shelter, visual buffering and provision of renewable biomass. At a former wood preservation site with Cu-contaminated soils, in 2008, a field trial was amended with dolomitic limestone (DL, 0.2% w/w), compost (pine bark chips and poultry manure, OM, 5%), or a combination of both (OMDL), and thereafter phytomanaged with grassy species (*Agrostis capillaris*, *A. delicatula*, *A. gigantea*, *Deschampsia caespitosa*, *Sporobolus indicus* and *Vulpia myuros*). Over the years, the occurrence of shrub and tree colonists (*Populus* sp., *Quercus robur*, *Cytisus scoparius*), along with new grassy species, have turned the field trial into an agroforestry system. At year 9, plant biomass and ionome, plant species richness, and soil physicochemical and microbial properties were assessed. Soil amendments improved soil properties, allowing the growth and development of shrub/trees and grassy species. The combination of amendments with the establishment of a plant cover, in turn, enhanced soil microbial activity and diversity (which may also promote PAH biodegradation) peaking where plant biomass and species richness was the highest, and induced shifts in the composition of soil microbial communities. Our results suggest that compost incorporation and liming and the subsequent development of an agroforestry system is an effective and sustainable phytotechnology option for phytomanaging such Cu-contaminated soils, enhancing the recovery of ecological soil functions and the provision of ecosystem services.

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