Improving soil biodiversity, functionality and ecosystem services of trace element-contaminated soils under interacting effects of (phyto)management and climate change

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Soil contamination is a worldwide problem with serious associated environmental impacts and health risks. Trace elements (TE) are amongst the most frequently occurring soil contaminants at polluted sites. TE contamination leads to a decline in soil quality and biodiversity, which in turn reduces the soil's capacity to perform ecosystem functions (e.g. organic matter decomposition, C sequestration, nutrient and water cycling, etc.) and provide essential ecosystem services. Gentle soil Remediation Options (GRO) have been developed to (phyto)manage contaminated soils, with the aim of producing biomass, quenching pollutant linkages to humans, animals and ecosystems, and restoring ecosystem services. GRO include *in situ* stabilisation ("inactivation") and plant-based ("phytoremediation") options. For TE-contaminated sites, GRO aim to decrease the labile ("bioavailable") pool and/or total content of TE in the soil through their uptake and accumulation in harvested plant parts (e.g. phytoextraction), or to progressively promote *in situ* TE inactivation by combining the use of TE-excluding plants and soil amendments (e.g. phytostabilisation). In TE-contaminated agricultural soils, food safety can be improved through the use of *in situ* TE stabilisation combined with phytoexclusion.

GRO are considered to be less invasive and more cost-effective than civil engineering techniques and more sustainable than "dig and dump" strategies. They can provide or restore vital ecosystem services from contaminated soils if appropriate phytomanagement is implemented. Increases in microbial diversity, C sequestration, and soil quality and functionality of contaminated soils have been reported. Phytomanaged contaminated sites can also provide valuable sources of renewable biomass (bioenergy, biofuel, green chemicals and ecomaterials). However, the economic benefits and limits of phytomanagement strategies in terms of their contribution to improved soil biodiversity and delivery of ecosystem services are rarely quantified.

Over the last 10 years phytomanagement has moved from bench-scale studies to full-scale deployment under field conditions. This move necessitated the incorporation of agronomic and ecological knowledge into the remediation process (crop selection, crop rotations/intercropping, planting density, fertilization, irrigation schemes, bioaugmentation with microbial inoculants). However, an additional factor which is likely to influence GRO efficiency and soil ecosystem services is the prospect of rapidly changing climate, including

chronic increased CO_2 levels, frequent extreme phenomena such as droughts and floods, and indirect effects such as migration of exotic species, with consequent effects on ecosystem services. These climate modifications are expected to have serious impacts on plant productivity, phenology and succession, root exudation and turnover, species abundance and distribution in soil biota, soil organic matter (SOM) dynamics, fate and behaviour of pollutants and soil amendments, etc. To date, few studies have evaluated how effective and durable these remediation processes will be under climate change.

The proposed symposium will create a forum for the discussion of current research activities related to: the deployment and optimization of GRO through the use of agronomical and biotechnological approaches, experiences from real case scenarios at a field scale, implications of GRO on soil biodiversity and functionality, the valorization of biomass produced on phytomanaged sites, the effects of climate change on GRO efficiency and ecological processes, and finally, the socio-economic benefits of phytomanaged TE-contaminated sites.