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Soil bioindicators as a usefull tools for land management and spatial planning processes: a case-study of prioritization of contaminated soil remediation

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When setting up new land management, contaminated site remediation or soil use change are sometimes necessary to ensure soil quality and the restoration of the ecosystem services. The biological characterization of the soil can be used as complementary information to chemical data in order to better define the conditions for operating. Then, in the context of urban areas, elements on the soil biological quality can be taken into consideration to guide the land development. To assess this "biological state of soil health", some biological tools, called bioindicators, could provide comprehensive information to understand and predict the functioning of the soil ecosystem.
In this context, a city of 200 thousand inhabitants has decided to integrate soil bioindicators in their soil diagnostic for their soil urban management. This city had to elaborate a spatial soil management in urban areas which presented soil contamination linked to a complex industrial history associated with bad uses of gardens not always safe for the environment. The project will lead to establish a Natural Urban Park (PNU) in order to develop recreational and leisure activities in a quality environment. In order to complete the knowledge of soil contamination and to assess the transfer of contaminants to the terrestrial ecosystem, a biological characterization of soils located in different areas was carried out using six bioindicators: bioindicators of accumulation which allowed to evaluate the transfers of soil contaminants towards the first 2 steps of a trophic chain (plants and soil fauna, e.g. snails), bioindicators of effects (Omega 3 index was used to assess the effects of soil contamination and to measure their impact on plants), bioindicators of soil functioning (measurement of microbial biomass, nematodes and earthworm community) ; the interest of these last bioindicators is that they also act on the functioning of ecosystems as on the dynamics of organic matter (mineralization) but also on the structuring of the soils. The results from 14 measurement points demonstrated the relatively low average transfers towards the plants and soil fauna although the transfers can be changing a lot in relation to heterogeneity of soil contamination. Results obtained from other bioindicators (nematodes, earthworms and bacterial biomass) showed that the different soils are on average of good biological quality and can benefit from a diversity and abundance of communities of soil organisms. The data obtained in this program underline that these tools can be used to evaluate soil functions (habitat for biodiversity, soil capacity to store contaminants, etc.) and, consequently, the services that the soil can give to humans. Moreover, these biological tools allowed to assess the biological quality of soils and their compatibility with the soil use and the necessity of soil remediation (excavation of hot-spots, surface cover etc ..).Taking into account not only the behavior of soil contaminants but also the environmental factors that influence the biological functioning of the soil, these tools can be useful for land management of large-scale sites and for brownfield conquest.