

MANAGING BELOW-GROUND BIODIVERSITY: INTRODUCTORY PAPER

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Soil organisms contribute a wide range of essential services to the sustainable function of all ecosystems, such as regulating nutrient cycles and the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emission; modifying soil physical structure and water regimes; enhancing the amount and efficiency of nutrient acquisition by the vegetation through mycorrhizal fungi and nitrogen fixing bacteria; and influencing plant health through the interaction of pathogens and pests with their natural predators and parasites. These services are not only essential to the functioning of natural ecosystems but constitute an important resource for the sustainable management of agricultural ecosystems.

The soil community which performs these functions is extremely diverse, often with more than 1000 species of invertebrates in 1m² of soil. The diversity of the microbial component may be even greater than that of the invertebrates yet is only just beginning to be realised by studies using molecular methods. Few data are available from tropical regions, where it is suspected that the highest levels of diversity may be found. Consequently, although the biological diversity of the community of organisms below-ground is probably higher in most cases than that above-ground, it has generally been ignored in surveys of ecosystem biodiversity. Nonetheless rapid assessment methods have been proposed and tested and considerable progress made towards the development of indicators. The most useful approaches in this respect are those based on a selective focus on 'Key Functional Groups'.

The processes of land conversion and agricultural intensification are a significant cause of soil biodiversity loss with risks of impact on ecosystem services. Enhancement of BGBD may be accomplished by *direct* manipulation (e.g. re-inoculation with desirable indigenous organisms such as N₂-fixing bacteria or agents for biological control of plant disease) and/or *indirectly* through manipulation of the cropping system (e.g. by choice of plants, the cropping pattern in time and space, or management of organic inputs). Agricultural practices which provide good soil protection and maintain high levels of soil organic matter favour higher biodiversity. Examples include agroforestry systems, inter-cropping, rotational farming, conservation tillage, green cover-cropping and integrated arable-livestock systems. Actions that directly target the joint conservation of both above- and below-ground components of biological diversity will have environmental benefits at ecosystem, landscape and global scales. It remains a matter to be critically evaluated whether the maintenance of higher diversity entails trade-offs between agricultural production and other ecosystem services.