Food and Agriculture Organization of the United Nations


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Soils and biodiversity

Soils host a quarter of our planet's biodiversity

2015
International Year of Soils

Biological diversity or 'biodiversity' is described as "the variability among living organisms from all sources, whether terrestrial, aquatic or marine". It includes the diversity within species (genetic diversity), between species (organism diversity) and of ecosystems (ecological diversity). Soil is one of nature's most complex ecosystems and one of the most diverse habitats on earth: it contains a myriad of different organisms, which interact and contribute to the global cycles that make all life possible. Nowhere in nature are species so densely packed as in soil communities; however, this biodiversity is little known as it is underground and largely invisible to the human eye.


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SOIL BIODIVERSITY AND AGRICULTURE

Our agricultural systems exert an important influence on soil organisms, including their activities and their biodiversity. Clearing forested land or grassland for cultivation affects the soil environment and drastically reduces the number and species of soil organisms. A reduction in the number of plant species with different rooting systems, in the quantity and quality of plant residues, or in soil organic matter content limits the range of habitats and foods for soil organisms. While the use of external inputs, particularly inorganic fertilizers and pesticides, can overcome some soil constraints to crop production, the overuse or mis-use of agro-chemicals has resulted in environmental degradation, particularly of soil and water resources. The quality and health of soils largely determine agricultural production and sustainability, environmental quality and, as a consequence of both, has bearing on plant, animal and human health. Improving soil biodiversity is vital to ensuring soil health and future food and nutrition security. Agricultural systems and agro-ecological practices that dedicate great care to nurturing soil biodiversity, such as organic farming, zero-tillage, crop rotations and conservation agriculture, can sustainably increase farm productivity without degrading the soil and water resources.


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What do soil microorganisms do?

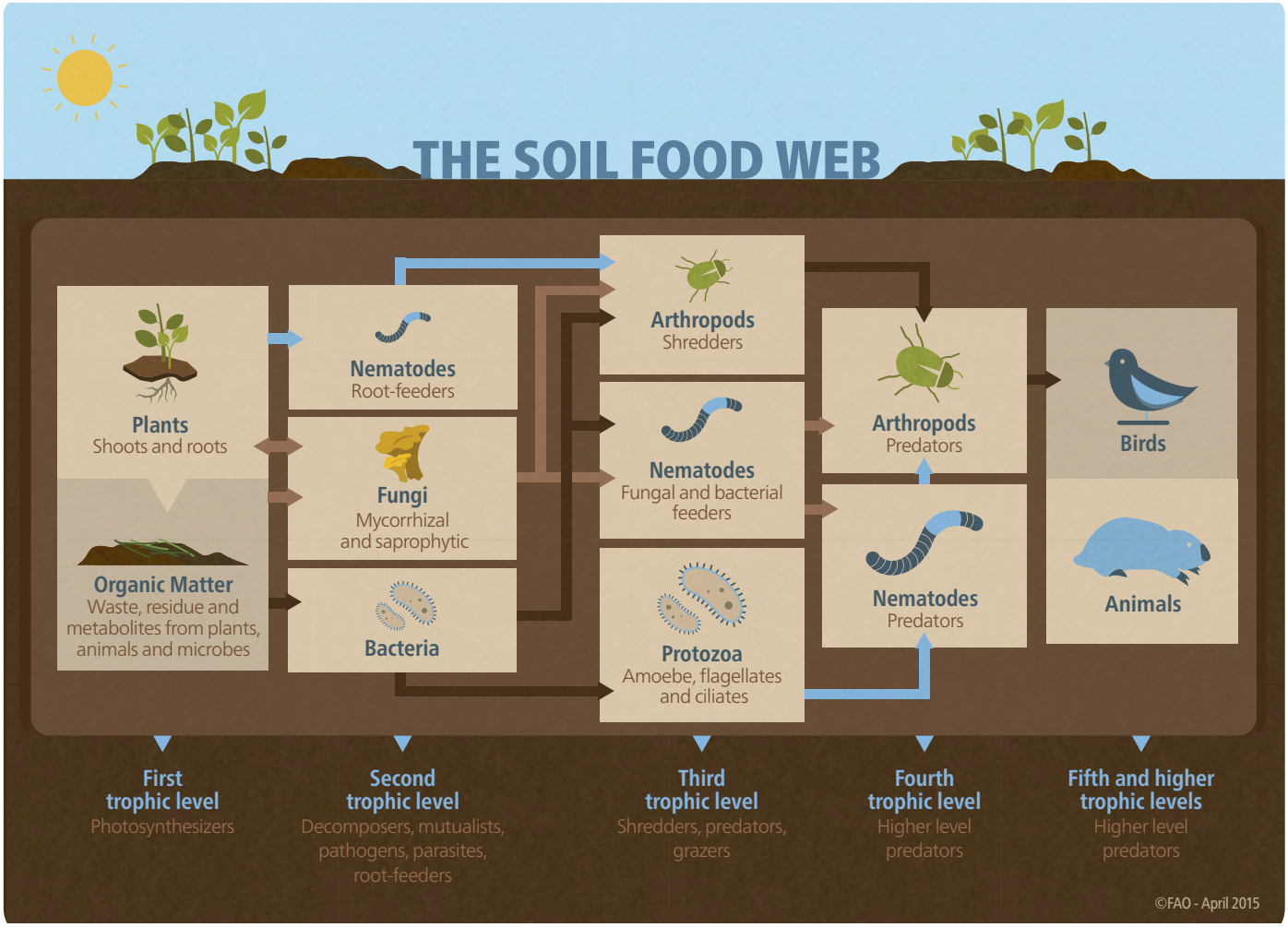
In both natural and agro-ecosystems, soil organisms are responsible for performing vital functions in the soil ecosystem which have direct interactions with the biological, atmospheric and hydrological systems. Soil organisms act as the primary agents of nutrient cycling, regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emissions, modifying soil physical structure and water regimes, enhancing the amount and efficiency of nutrient acquisition by the vegetation through mutualistic relationships, and enhancing plant health. These services are essential to the functioning of natural ecosystems and constitute an important resource for the sustainable management of agricultural systems.

FUNCTIONS OF SOIL BIOTA

- Maintenance of soil structure
- Regulation of soil hydrological processes
- Gas exchanges and carbon sequestration
- Soil detoxification
- Nutrient cycling
- Decomposition of organic matter
- Suppression of pests, parasites and diseases
- Sources of food and medicines
- Symbiotic and asymbiotic relationships with plants and their roots
- Plant growth control (enhancement and suppression)

THE SOIL FOOD WEB

When diverse soil organisms interact with one another and with the plants and animals in the ecosystem, they form a complex web of ecological activity called the soil food web. The resilience of the food web is inextricably linked to the biodiversity within the soil.



FAO IN ACTION

Increasingly recognised that unsustainable intensification of agriculture, including crop, livestock and forest based systems, is having wide-reaching impacts in all regions of the world on environmental and human health. However, it is only recently with development of the ecosystem approach and strengthened interdisciplinary research that efforts are being made to understand the complex interrelations and to assess, document and communicate the impacts on biodiversity and the range of ecosystem services.

FAO IN ACTION

LIBERATION: Linking farmland Biodiversity to Ecosystem services for effective eco-functional intensification

Ecological intensification is the process of managing service providing organisms that make a quantifiable direct or indirect contribution to agricultural production. LIBERATION is an EU-funded research project of nine universities and FAO that aims to provide the evidence base for ecological intensification and demonstrate the concept in seven representative agricultural landscape types in Europe. The project essentially aims to demonstrate the extent to which ecosystem services can substitute external inputs and still increase or stabilise yields and incomes. Using existing datasets from past and on-going studies, the project will first identify general relationships between semi-natural habitats, such as set-asides, hedgerows or flower strips, on-farm management practices, such as crop rotation or intercropping, and biodiversity in both extensively and intensively managed European landscapes and farming systems.

A novel aspect of LIBERATION is that it considers above- and below-ground ecosystem services simultaneously and analyses synergies and trade-offs between different ecosystem services. By using a modelling approach, the project will ultimately determine which farm management practices and spatial layouts of semi-natural habitats maximize both yields and farm incomes. For more information please see: http://bit.ly/1GoFCQe

KEY FACTS

- Nowhere in nature are species so densely packed as in soil communities.
- Over 1000 species of invertebrates may be found in a single m^2 of forest soils.
- Many of the world's terrestrial insect species are soil dwellers for at least some stage of their life-cycle.
- A single gram of soil may contain millions of individuals and several thousand species of bacteria.
- A typical, healthy soil might contain several species of vertebrate animals, several species of earthworms, 20-30 species of mites, 50-100 species of insects, tens of species of nematodes, hundreds of species of fungi and perhaps thousands of species of bacteria and actinomycetes.
- Soil contains the organism with the largest area. A single colony of the honey fungus, Armillaria ostoyae, covers about 9 km^2.

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Viale delle Terme di Caracalla
00153 Rome, Italy
Tel:(+39) 06 57051
Fax:(+39) 06 570 53152
e-mail: soils-2015@fao.org
web: www.fao.org

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