Agroecology Highlights
Centro Internacional de Agricultural Tropical (CIAT)

# Harnessing the biological plows of the soil: soil macrofauna communities

The study of macrofauna biodiversity in soils worldwide and their possible use as a biological resource has been neglected during the green revolution years.The management of these communities and the benefits derived from their activities are considered part of an efficient way to improve the sustainability of agroecosystems. Despite the extraordinary array of diverse biological communities in the soil, there is limited knowledge, particularly for tropical areas, of the composition and function of soil macrofauna in natural and non-natural areas and of their responses to disturbances or specific soil conditions.

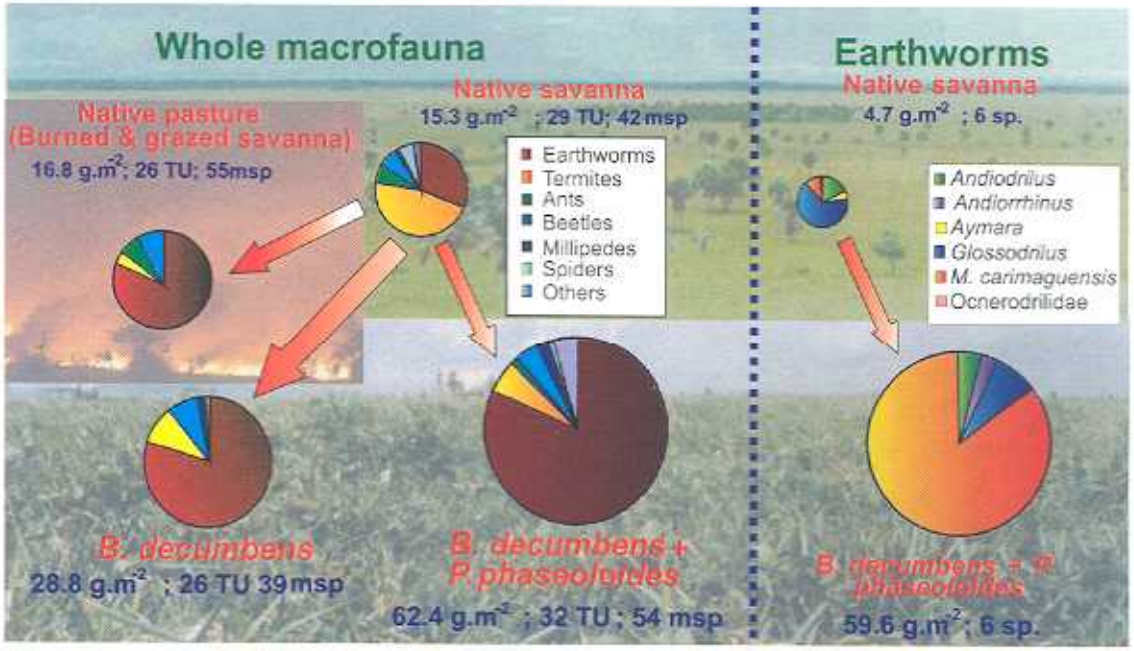
## Agricultural intensification and soil biodiversity

The concept of agricultural intensification includes structural changes in agroecosystems associated with the transition from traditional to a more intensive agriculture. This intensification usually occurs through increased use of the soil resource, specialization of productive species with a resulting reduction in plant diversity and also with the use of inputs such as fertilizers, pesticides and tillage practices.

Soil macrofauna communities in the savannas of Colombia are especially sensitive to factors that determine food resource availability (i.e.,climatic variations and human interventions). The replacement of natural ecosystems by agricultural practices significantly affects soil macrofauna communities and may lead to changes in soil function.

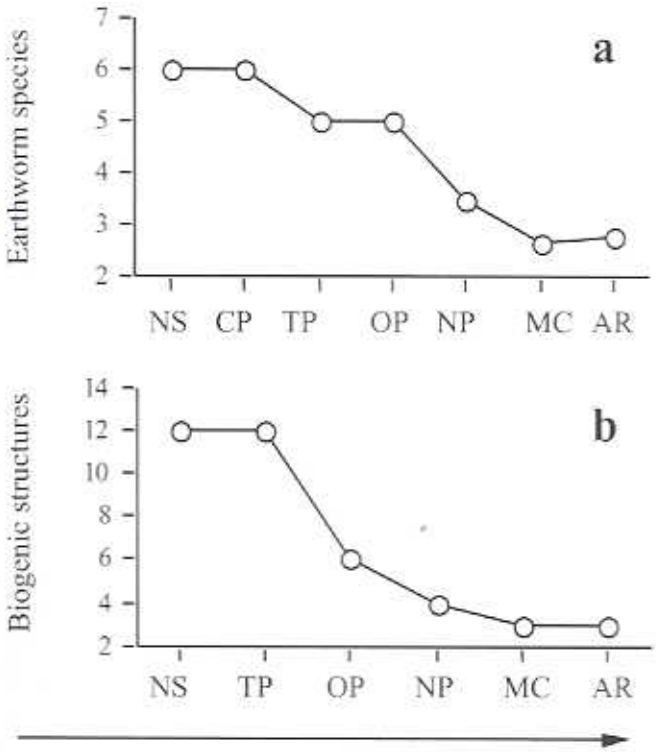
Three types of agroecosystems may be distinguished owing to their effects on soil macrofauna:

- Extensively grazed native pastures: their effects have little significance ; re-colonization after burning the savanna is rapid, i.e., 6 months.
- Introduced grass alone or grass-legume pastures: taxonomic richness of earthworms in savannas is maintained and the pasture is not considered as a green desert, but to the contrary, it increases the activity of native earthworm populations reflected in a more than ten-fold increase in biomass.
- Annual crops: dramatic effect on macroinvertebrate populations; biomass is clearly reduced as are the population density and taxonomic richness. Tillage, fertilization, pesticides and reduction of litter and root production have unfavorable effects when crops substitute the native vegetation.




Soil macrofauna and earthworm biomass in the native savannas and introduced pastures (*Brachiaria decumbens* and *Pueraria phaseoloides*) of the Colombian Llanos. TU = Taxonomic Unit; msp = morphospecies; sp = species.

Different agroecosystems studied in the "Llanos" can be classified across an agricultural intensification gradient that includes:

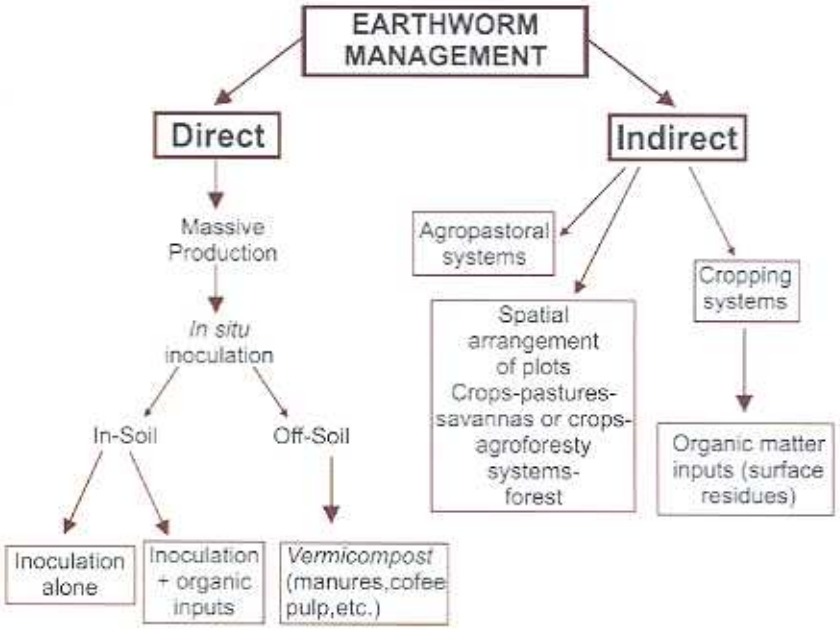



Numbers per meter squared of (a) earthworms and (b) soil organisms that produce structures on the soil surface (biogenic structures) along a gradient of agricultural intensification: NS = native savanna; CP = cashew (*Anacardium occidentale* L.) Plantation; TP = extensive traditional pasture; OP = old introduced pasture; NP = newly introduced pasture; MC = monocropping; AR = annual rotation.

The number of earthworm species or "ecological engineers" as well as their production of biogenic structures on the soil surface decreased progressively from native savanna to monocultures.

## Management guidelines of beneficial soil macrofauna

There are some in-soil and off-soil techniques in earthworm management with potential to be applied in tropical areas:




The management of earthworm biodiversity in agroecosystems should favor a community consisting of species that construct vertical and horizontal galleries to favor root development, that produce biogenic structures on the soil surface and also those that mix plant residues with the mineral soil substrate.

Studies to date suggest the application of various alternatives to conserve and encourage the activities of soil macrofauna communities. Conservation of native savanna areas and gallery forests as well as crop-pasture systems are options to take into account for the sustainability of these large areas.

Certain practices, such as improved pastures, can undoubtedly result in increased populations of soil macrofauna. However, these can be beneficial as in the case of the Colombian savannas or detrimental as in the Amazonian pastures, where the loss of a diverse soil macrofauna and overgrazing are responsible for pasture degradation.

The arrangement of areas that conserve earthworm populations alongside those that tend to reduce populations (i.e. cropped areas) are also examples of indirect management.

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