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From agriculture to forests: restoring fertility and biodiversity of exploited soils

Innangi Michele[1], Antonietta Fioretto[2], Georg Guggenberger[3], Olga De Castro[4], Daniele De Luca[4], Emanuela Di Iorio[4], and **Tiziana Danise**[2]

[1]Department of Bioscience and Territory, University of Molise, Pesche, Isernia, Italy
[2]Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università degli Studi della Campania "Luigi Vanvitelli" Via Vivaldi 43, 81100 Caserta, Italy
[3]Institut für Bodenkunde, Leibniz Universität Hannover, Herrenhäuser Str. 2, 30419 Hannover, Germany
[4]University of Naples Federico II, Depatment of Biology, Via Foria 223 – Botanical Garden, 80139 Naples, Italy

The issue of exploited soils that become unproductive after extended agriculture use is constantly growing and it is considered of great interest on a global level. Soil degradation induces loss of important ecosystem services and biodiversity, which is aggravated by the on-going climate change. Here, we investigated the chances of reforestation of an exploited soil as a possible nature based solution to this problem. We aimed at identifying a type of forest management capable of requalifying these soils. For that, we investigated a site in Central Italy characterized by a mixed-species plantation represented by tree different associations consisting of particular ancillary species, namely *Alnus cordata, Elaeagnus umbellata* (both N-fixing species), and *Corylus avellana*, in association with valuable species, such as *Populus alba* and *Juglans regia* planted on a former agricultural land. The criteria for the improvement of soil quality was an increase in organic matter and biodiversity. We evaluated how the relationship between soil chemical and biological parameters varied among different intercropping systems and in a conventional agricultural field. We tested topsoil (0-10 cm) total organic carbon, total nitrogen, lignin and cellulose, as well as biological parameters such as fluorescein diacetate hydrolase (FDAH) enzyme activity, and fungal biodiversity by using a DNA metabarcoding approach. The comparison with the agricultural field revealed that revegetation led to an increase in both carbon and nitrogen as well as FDAH activity and fungal diversity. In this context, ancillary species could play a key role in restoring degraded soils quality, whereas N-fixing species *Alnus cordata* increased both soil fertility and biodiversity compared to the agricultural field and to other tree associations.