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Intensive agriculture leaves lasting legacy on soil health

The long-lasting and negative effects of intensive farming on soils persist even where complex animal communities have been reintroduced to the soil in attempt to restore the natural balance, according to a recent study. The findings highlight the possible effects of historical land use on soils' ability to deliver ecosystem services.

Converting natural land, such as grassland, to intensively managed agriculture land affects the soil. For example, the soil's structure is disturbed, soil organic matter is lost and bacteria increase at the expense of fungal communities. These impacts damage the fertility of soils and ecosystem services provided by soils, for example, interfering with soils' ability to regulate water, hold nutrients and retain or break down pesticides.

In addition, soil biodiversity is reduced. Since soil biodiversity is fundamental to how well soils function and deliver ecosystem services, agricultural intensification can seriously damage the quality of soils. Previous studies suggest the impact of intensive land use on soil ecosystem services can last for hundreds of years, even after intensive farming has ended.

As part of the EU SOILSERVICE[1] project, this study investigated whether the historical effects of intensive land use could be reduced by re-establishing soil animal communities, typically found in natural grasslands, in intensively farmed soils.

In the laboratory, a series of pots were filled with soil taken either from an intensively managed wheat field or from adjacent grassland. The soils were sieved and treated so that only soil microbes survived. Different communities of soil organisms, including nematodes, earthworms and enchytraeids (potworms), were then introduced to the soil samples. To determine how well the different soil samples could consequently provide ecosystem services, the researchers measured the retention of nitrogen, carbon and the herbicide metribuzin in the soils, and the performance of wheat planted in the pots.

The results suggest that the history of land use affected the soil processes and the level of ecosystem services provided by the soils. For example, disturbed soil from the wheat field retained more carbon and nitrogen, but less metribuzin than the grassland soils. This is because sieving of soils accelerated decomposition of soil organic matter (SOM) and hence release of carbon and nitrogen bound to clumps of soil particles in the grassland soil. In addition, wheat soils supported better growth of wheat seedlings, which were able to take up more nitrogen compared with wheat growing in the grassland soils. The reason for this is probably related to soil phosphorus content: wheat growing in the grassland soil were limited by availability of phosphorus The presence of introduced earthworms was also shown to improve plant growth in both types of soils, whereas potworm presence was, unexpectedly, shown to reduce plant growth.

Furthermore, the effects of the introduced soil animal community on SOM were different for the two soil types. The presence of earthworms and potworms slowed the loss of SOM in the grassland soils, but increased SOM loss in the wheat soils. The reason for this probably relates to availability of carbon in soils: in soils with high carbon availability, earthworms can stabilise SOM, but in soils with low carbon availability and input, earthworms further increase losses of carbon from the soil as they have to consume old, stabilised SOM.

1. SOILSERVICE is supported by the European Commission under the Seventh Framework Programme. See: www.lu.se/soil-ecology-group/research/soilservice

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