ARTICLE | MINI REVEW

Innovative Reports

E-magazine by Innovative Scientific Information & Services Network

Macrofauna: Nature's Hidden Engineers Beneath Our Feet

Ayesha Fatima*, Anmol Fatima, Iqra Parveen, Gulzareen Javaid, Iram Munaf

Department of Zoology, Wildlife & Fisheries, University of Agriculture Faisalabad, Pakistan

Published: *Oct., 13, 2025*

Correspondence: ayeshakalaar@gmail.com *Innovative Reports, 2025 02: 41-43 Uoi: 41-43-02-2025IR25-16*
DOI: https://doi.org/10.5281/zenodo.17343297

A hidden army of the worms, ants, beetles, termites, and millipedes lives beneath our soils, quietly keeping them alive. These organisms recycle the nutrients, improve soil structure, and even help to manage the crop pests, making them significant agricultural partners. These unseen soil helpers are under threat from the modern farming, extensive use of the chemical pesticides, and climate change. By turning to practices such as using compost, sowing cover crops, reducing the soil disturbance, and restoring natural habitats, farmers can both protect soil life and improve their harvests. Appreciating the work that they are carried out beneath the soil is vital for the fertility of the soil and reliable food resources.

Keywords: Soil macronutrients, Soil macrofauna, Ecosystem services, Soil fertility, Agricultural sustainability

INTRODUCTION

When we think of the agriculture or the cultivation of food, we generally visualized the seeds, water, and also the sunlight. But did you realize that a whole underground world in the soil is just as important? This subterranean community is full of the miniature organisms like earthworms, beetles, ants, termites, and millipedes that gently work around the clock to preserve the health of our soil and crops growing strong (Sofo et al., 2020). These "ecosystem engineers" modified their surrounding environment in ways that directly supports the plant development. Through activities like burrowing, breaking down organic matter, and the recycling of nutrients, they helps to maintain the soil fertility and structure, enabling crops to grow well without depending heavily on synthetic fertilizers (Kaur et al., 2024).

These miniatures are commonly referred to as the soil macrofauna, and they warrant the distinction as nature's engineers. Earthworms, for instance, burrow into the soil, creating channels that increase the aeration and water infiltration, which enhance the soil porosity, overcome the bulk density, and stimulates the root growth(Akhila & Entoori, 2022). Their casts are rich in nutrients, containing elevated concentrations of nitrogen, calcium, potassium, phosphorus, magnesium, and organic materials compared to the surrounding soil, thereby converting decaying organic substrates into the fertile soil.

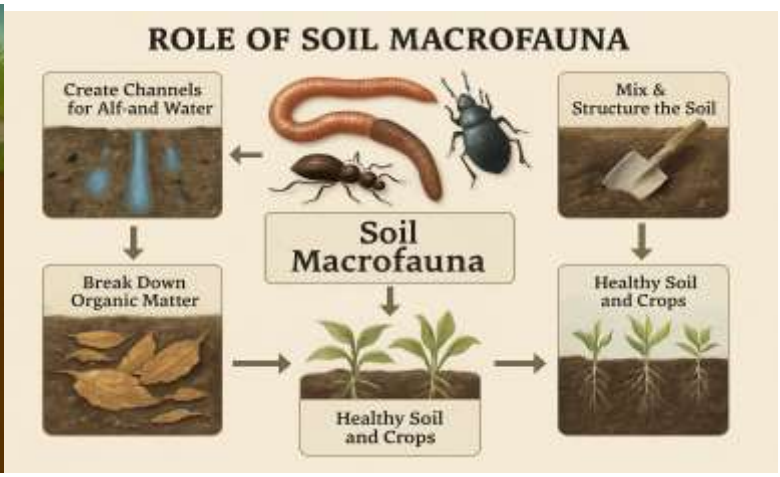
Soil Association expert Alex Burton says:

"Worms are crucial for the soil health; soil that is full of worms is an indicator that it is healthy."

Why is this significant for us? Because healthy soil produces better food. Tiny soil dwellers that recycle the important nutrients like nitrogen and phosphorus, giving plants what they need to grow. By improving the fertility of the soil, they help the crops such as rice, vegetables, and the wheat to thrive without heavy chemical inputs. Farms that care for these hidden workers' lives usually enjoy healthier harvests and also face the fewer pest issues.

How Soil Creatures Help Grow Healthy Crops

Beneath our feet flourishes a bustling community of the soil organisms that contribute significantly to the growth of the healthy crops. Earthworms are commonly referred to as "nature's ploughs," They dig into the soil, allowing the water and air to reach the roots of the plants and their castings serve as organic fertilizer. While termites breakdown the tough materials like wood, beetles and ants help by feeding on dangerous pests and decomposing the organic wastes. Millipedes play their part by shredding the fallen leaves, which speeds up the release of nutrients. These microscopic creatures improve the soil fertility by recycling nutrients like nitrogen and phosphorus, as well as enhancing the soil structure to retain moisture and prevent compaction. In addition, several soil-dwelling species helps to regulate crop pests naturally, reducing dependence on chemical pesticides. These underneath allies work together to keep the soil healthy and productive, which is essential for the robust and long-term cultivation of crops.



Silent Threats Beneath the Soil

Even though the soil macrofauna are essential for preserving the integrity of our soils, agricultural methods and changes in the environment and also contributing to the overall decrease in their population. Modern farming practices, such as deep ploughing (tillage) and growing the same crop year after year, damage their homes, destroy burrows, and reduce the variety of food they need to survive (Banerjee et al., 2019). These actions ultimately diminish the diversity in the soil, which impairs the land's ability to recover from harm.

The heavy use of the fertilizers and also the chemical pesticides is another main problem. Pesticides are proposed to eradicate the damaging pests, but they can also affect insects that are beneficial, such as beetles, ants, and earthworms. Extensive use of the fertilizer can change the natural chemistry of the soil, making it unsuitable for many of these types of individuals. When a combination of nutrients and pH in soil is improved, it may modify the food supplies and shelter that macrofauna rely on.

Climate change is making life harder for the soil animals. Changes in the rainfall patterns and temperature can disrupt the natural lifespan of animals living in the soil. While sudden, intense rains can wash away species that live on the surface or flood their channels, long dry spells dry out the soil, making it problematic for them to survive. Overall, these threats merged and put pressure on the soil macrofaunal groups, and without efforts to protect them, our soils and the crops we rely on could suffer in this long run.

Farming with Nature: Protecting Soil Allies

Conserving the soil macro-organisms means looking for their homes, giving them sufficient food, and avoiding the detrimental effects of farming procedures. Little modifications in the farming methods can provide support to these organisms to thrive, keeping the soil healthy and productive. For illustration, cutting back on the deep ploughing keeps the nests and tunnels of ants, beetles, and the earthworms safe, so they can keep doing their work without interruption (Briones, 2014). Similarly, using natural fertilizers such as compost, animal manure, and crop residues enhances the soil with vital nutrients, while cover crops like clover or legumes protect from erosion, preserve moisture content, and provide shelter for soil fauna. These unsung heroes grow in healthier soil that is kept covered all year, making our agricultural operations more environmentally friendly and competitive.

One of the most important steps toward sustainable farming is the significant reduction in chemical inputs. Integrated Pest Management (IPM) promotes pest control by enhancing natural enemies, such as ground beetles, rather than depending solely on pesticides (Barrios, 2007). Habitat restoration through grassy strips, hedgerows, or patches of wild vegetation provides shelter and breeding grounds for soil organisms. Integrating these methods helps to conserve biodiversity while increasing agricultural output.

Educating the Next Generation of Soil Stewards

Although scientists now recognize that soil macrofauna are critical for healthy soils, there is still so much we don’t comprehend about them. Most studies have focused on earthworms, while other important soil inhabitants, such as millipedes, centipedes, and certain beetles, are frequently ignored. Educating the people for more about these unknown macro-organisms could reveal the new ways that support these crops to grow and keep the soil fertile.

We also need to understand that how soil animals are work together with tiny microbes. Although we still don't understand that how they work together, both are essential for the decomposition of dead plants, recycling nutrients, and enhancing the soil structure. Understanding this could provide the benefits to the farmers who use nature’s processes instead of the heavily relying on chemicals.

Changes in the rainfall and temperature brought on by climate change have the potential to modify the habitats and

metabolic processes of the soil organisms. Long-term research is needed to see if they can adjust. Governments, schools, and the agricultural programs can play a key role here by educating the people to value the living world beneath our feet and make sure that these hidden helpers to get the protection they need. Next time you walk through a field or garden remember that even though they may not be visible, they are working every day to put food on your plate.

Working With the Wisdom Beneath Our Feet

Soil macrofauna are the nature's first engineers of fertility, yet industrial farming has forced these active organisms into the silent decline. The consequences? Degraded soils, weaker crops, and a delicate food system. But the solutions exist that, by embracing regenerative practices, reducing tillage, and banning the harmful chemicals, we can partner with these underground allies rather than destroy them. Our agricultural future relies on this simple choice: exploit the land until it is barren, or work with the wisdom beneath our feet.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEGEMENT

I am truly blessed to have the love and support of my family and friends. I want to extend my special thanks to Khadija Batool and Gulzareen Javaid, whose encouragement gave me the strength to complete this work.

REFERENCES

Akhila, A., & Entoori, K. (2022). Role of earthworms in soil fertility and its impact on agriculture: A review. *International journal of fauna and biological studies*, *9*(3), 55-63.

Banerjee, S., Walder, F., Büchi, L., Meyer, M., Held, A. Y., Gattinger, A., Keller, T., Charles, R., & van der Heijden, M. G. (2019). Agricultural intensification reduces microbial network complexity and the abundance of keystone taxa in roots. *The ISME journal*, *13*(7), 1722-1736.

Barrios, E. (2007). Soil biota, ecosystem services and land productivity. *Ecological economics*, *64*(2), 269-285.

Briones, M. J. I. (2014). Soil fauna and soil functions: a jigsaw puzzle. *Frontiers in environmental science*, *2*, 7.

Kaur, A., Aulakh, R., & Rani, N. (2024). Earthworm Diversity and Abundance in Various Cropping Systems under Conventional and Organic Farming. *Environmental Science*, *3*(1), 164.

Sofo, A., Mininni, A. N., & Ricciuti, P. (2020). Soil macrofauna: A key factor for increasing soil fertility and promoting sustainable soil use in fruit orchard agrosystems. *Agronomy*, *10*(4), 456.