Available online at
http://agrospheresmagazine.vitalbiotech.org/

ISSN (E): 2582 – 7022

Agrospheres:e- Newsletter, (2025) *6*(7), 101-104

Article ID: 771

Agrospheres e-Newsletter

Organic Amendment Role in the Rejuvenation of Degraded Soils

Abhay Mantri

M. Sc (Soil Science), Bihar Agricultural University, Bhagalpur, sabour

Open Access

*Corresponding Author

Abhay Mantri*

Article History
Received: 09. 07.2025
Revised: 14. 07.2025
Accepted: 19. 07.2025

INTRODUCTION

Soil degradation poses a significant global issue, with more than one-third of the world's arable land showing signs of decreasing productivity and ecosystem performance. In India, almost 29% of the geographical area of about 96.4 million hectares is degraded, affected by different types of land degradation. The major causes for this degradation are deforestation, over-grazing, intensive and unsustainable farming practices, excessive and unbalanced application of chemical pesticides and fertilizers, and mismanaged irrigation leading to salinization or waterlogging.

Degraded soils display a loss of soil structure, compaction, erosion, nutrient loss, reduction in the content of organic matter, and lower microbial diversity and activity. These are the consequences that lead to poor infiltration and retention of water, less availability of nutrients, and a lower ability to sustain healthy plant growth, ultimately posing a threat to food security and rural livelihood.

In the wake of these issues, the utilization of organic amendments that comprise farmyard manure (FYM), compost, green manure, crop residues, vermicompost, biochar, and other plant or animal products has proven to be a sustainable and environmentally friendly method of soil rehabilitation. Organic amendments enrich soil organic carbon, enhance nutrient cycling, microbial activity, and physical properties like porosity and water-holding capacity. They also provide a cushion against pH extremes and minimize the use of synthetic agrochemicals.

Notably, organic amendments are a key factor in recovering degraded soils by constructing soil fertility, promoting beneficial soil biology, and establishing a more sustainable agroecosystem. Their use encompasses not merely the rehabilitation of natural soil processes but also serves the larger objectives of climate-smart and sustainable agriculture, leading to carbon sequestration and enhanced soil-water-plant relationships.

Therefore, the use of organic amendments in land management is a significant measure towards the restoration of degraded lands and long-term agricultural productivity, environmental sustainability, and food system resilience.

2. Organic Amendments Types

Organic amendments are plant or animal-derived natural materials used to enhance physical, chemical, and biological properties of soil by adding them to the soil. Every amendment type has unique advantages based on their composition and mode of application. The most widely used types are:

Farmyard Manure (FYM)

Farmyard manure is an old and commonly practiced amendment made up of animal dung, urine, bedding materials (such as straw or litter), and residual feed. It is usually kept and partially decomposed before it is applied to land. FYM adds soil fertility by contributing a balanced combination of macro- and micronutrients and facilitates soil texture and water-holding capacity. It further increases microbial activity, thus increasing nutrient mineralization and the decomposition of organic matter.

Compost

Compost is the final product of aerobic organic waste decomposition like kitchen wastes, crop residues, leaves, and agro-industrial residues. Humus-rich well-matured compost enhances cation exchange capacity (CEC), improves soil structure, and encourages microbial diversity. Compost is an environmentally friendly method for recycling nutrients, minimizing waste, and rehabilitating degraded soils.

Green Manures

Green manures are fast-growing leguminous plants such as dhaincha (*Sesbania aculeata*), sunn hemp (*Crotalaria juncea*), moong (*Vigna radiata*), and cowpea that are cultivated specially to be plowed back into the land green. Green manures supply biologically fixed nitrogen to the soil, provide organic matter, and enhance soil aeration and tilth. They are particularly beneficial in enhancing fertility in low-quality or degraded soils.

Crop Residues

Crop residues are straw, stalks, husks, stubble, and field residual leaves remaining in the field following harvest. Well-managed crop residues (e.g., by mulching, incorporation, or composting) improve soil organic carbon, reduce moisture loss, and contribute slow-release nutrients. Crop residues are inexpensive, particularly in conservation agriculture systems.

Biochar

Biochar is a long-lasting, carbonated product yielded through pyrolysis (thermal breakdown in low oxygen) of biomass materials like wood chips, crop waste, or manure. Biochar functions as a perennial soil conditioner by enhancing porosity, water holding capacity, and nutrient retention of the soil. Biochar also fosters microbial niches, aids in carbon sequestration, and inhibits nutrient leaching and is thus highly appropriate for impoverished soils with low fertility.

Vermicompost

Vermicompost is generated by the biological breakdown of plant material by earthworms, such as *Eisenia fetida* or *Eudrilus eugeniae*. Vermicompost is a high concentration of plant-accessible nutrients, useful microbes, enzymes, and plant growth hormones (such as auxins and cytokinins). Vermicompost enhances not only nutrient accessibility but also root growth, soil structure, and soil-borne disease resistance.

3. Processes of Soil Revitalization

Soil revitalization is achieved through organic amendments by a series of physical, chemical, and biological processes that operate in a synergistic manner to recover deteriorated soils and improve their productivity.

a. Enhancing Soil Structure and Texture

Organic matter serves as a natural binder that assists in the formation of stable aggregates of soil by binding mineral particles like sand, silt, and clay. These aggregates enhance aeration and porosity of the soil, which favors root respiration and facilitates microbial action. They also prevent compaction of the soil, thereby facilitating root penetration. Better structure also facilitates water entry and retention, hence reducing surface runoff and soil erosion. Consequently, seed germination and seedling establishment are encouraged through the provision of a good rooting environment. These advances are especially important in degraded soils where compaction and surface crusting are prevalent.

b. Improving Soil Organic Carbon (SOC)

Soil Organic Carbon is essential to soil fertility and ecosystem balance. In degraded soils, SOC tends to be depleted as a consequence of erosion, inadequate organic matter management, and excessive use of chemicals. Organic amendments replenish SOC through the addition of carbonaceous biomass that becomes part of the soil matrix. This carbon is a slow-release reservoir of nutrients that promotes long-term soil fertility. It is also a substrate for microbial metabolism, enhancing microbial biomass and enzymatic activity within the soil. Higher SOC also enhances the water retention capacity of the soil and increases its drought resilience. The accumulation of SOC over time helps to mitigate climate change by sequestering atmospheric carbon dioxide.

c. Enhancing Soil Fertility

Organic amendments provide important macronutrients like nitrogen (N), phosphorus (P), and potassium (K), as well as crucial micronutrients like zinc (Zn), iron (Fe), and boron (B) in biologically active forms. They release these nutrients slowly, in accord with plant growth needs and reducing the possibility of leaching. Organic matter also increases the cation exchange capacity (CEC) of the soil, improving nutrient storage and availability. Additionally, organic inputs minimize nutrient loss due to fixation and volatilization. Organic inputs promote nutrient synergism, where the accessibility of one nutrient enhances the uptake of others. These impacts are particularly useful in nutrient-poor or chemically unbalanced soils.

d. Stimulating Soil Biology

Organic matter provides an essential energy source for a broad range of soil organisms. It promotes the development and activity of decomposition- and nutrient-cycling bacteria and fungi, actinomycetes that assist in the degradation of complex organic matter, and helpful macrofauna like earthworms that enhance soil structure by mixing and aeration. Increased biological activity results in more rapid humification and mineralization of organic matter inputs, the steady release of nutrients. It also facilitates natural suppression of soil-borne pathogens by microbial competition and antagonism and disease reduction. Generally, strong biological activity promotes the resilience of the soil to pests and environmental stress and is a prominent factor in regenerative soil health.

e. Buffering Soil pH and Salinity

Organic matter plays a role in the chemical buffering capacity of soils by controlling extremes of pH. It excretes weak organic acids that assist in neutralizing acidic and alkaline reactions in the soil. In sodic or saline soils, organic matter enhances ion exchange and encourages leaching of surplus salts and hence minimizes toxicity and enhances soil structure. This buffering function also increases the availability of pH-dependent nutrients, for example, phosphorus and various micronutrients. These impacts are particularly crucial in degraded soils where high pH or salinity negatively impact crop productivity and growth.

4. Field Evidence and Case Studies

Field research enables evidence from different parts of India, which indicate the potency of organic amendments to rejuvenate deteriorated soils:

In Haryana and Punjab, long-term experiments have shown that repeated use of farmyard manure (FYM) enhanced the yield of wheat and rice by more than 15% over plots where chemical fertilizers alone were applied. The increase was due to improved soil structure, increased nutrient retention, and enhanced microbial activity.

In Bundelkhand, which has drought-prone and degraded rainfed agricultural lands, the joint application of green manure and compost considerably enhanced the health of the soil. The amendments increased the moisture retention capacity, fertility recovery, and resulted in better yield of cereals as well as pulses under rainfed situations.

In Jharkhand and Chhattisgarh, where soils are usually acidic and poor in organic carbon, the use of biochar increased soil pH, minimized aluminum toxicity, and improved microbial biomass and activity. All these improved root growth and nutrient absorption, particularly in vegetable and pulse crops.

These case studies underscore the regional versatility of various organic

ISSN (E): 2582 – 7022

amendments and their capacity to re-establish productivity in varying agro-ecological environments.

5. Best Practices for Use

To optimize the advantages of organic amendments and make soil rejuvenation effective, the following best practices must be followed:

Right Material Choice: Always employ well-decomposed compost or farmyard manure because raw or immature materials can bring plant pathogens, weed seeds, or phytotoxic substances into the soil.

Timing: Use organic amendments in land preparation or prior to the start of the monsoon season to time nutrient release with crop need and utilize natural rainfall for moisture uptake.

Soil Incorporation: Organic material needs to be plugged 10–15 cm deep within the soil to allow microbially mediated decomposition, enhance nutrient mineralization, and limit nitrogen loss by volatilization.

Inorganic Inputs Integration: For nutrient balancing and maximum yields, organic manures need to be combined with chemical fertilizers according to an Integrated Nutrient Management (INM) strategy. This provides both timely availability of nutrients as well as sustained soil health.

6. Challenges and Limitations

There are despite their many advantages challenges to the use of organic amendments in soil management. A key limitation is bulkiness and high transportation cost of organic materials like farmyard manure or compost, particularly when there is a need to transport them over long distances. Furthermore, the nutrient composition of organic materials may be extremely variable in terms of source material (feedstock) and processing or composting methods. Such variability complicates exact nutrient management.

A further issue is the risk of weed seed introduction, plant disease, or even heavy metal contamination if organic waste is not decomposed, sterilized, or derived from contaminated inputs. In addition, compositing or organic amendment preparation demands sufficient space, labor, and time, which can be unaffordable for small or poor farmers. These issues need to be overcome by better processing technologies, quality, and institutional assistance for increased adoption of organic farming.

7. CONCLUSION

Organic amendments offer a sustainable, environmentally friendly, and efficient solution to the global problem of soil degradation. By enhancing soil structure, promoting nutrient retention, stimulating microbial diversity, and augmenting soil organic carbon, these amendments rejuvenate degraded soils and build sustainable crop production and soil fertility in the long term. To achieve maximum and sustained benefits, application of organic amendments must be combined with other best management practices like crop rotation, integrated nutrient management, and conservation tillage. Their universal adoption can also be promoted by farmer awareness campaigns, support through government policies, economic incentives, and strong extension services.

Finally, rejuvenating soils with organic inputs is more than a reactive action it is a proactive investment in robust, regenerative agriculture that protects food security, environmental stewardship, and the livelihood of farm families.

REFERENCES

Carlson, J., Saxena, J., Basta, N., Hundal, L., Busalacchi, D., & Dick, R. P. (2015). Application of organic amendments to restore degraded soil: effects on soil microbial properties. *Environmental Monitoring and Assessment*, *187*(3), 109.

Hueso-González, P., Muñoz-Rojas, M., & Martínez-Murillo, J. F. (2018). The role of organic amendments in drylands restoration. *Current Opinion in Environmental Science & Health*, *5*, 1-6.

Larney, F. J., & Angers, D. A. (2012). The role of organic amendments in soil reclamation: A review. *Canadian Journal of Soil Science*, *92*(1), 19-38.

Omokaro, G. O., Osarhiemen, I. O., Idama, V., Airueghian, E. O., West, S. T., Igbigbi, F. E., ... & Omoshie, V. O. (2024). The role of organic amendments and their impact on soil restoration: A review. *Asian J. Environ. Ecol*, *23*, 41-52.

Saviozzi, A., Bufalino, P., Levi-Minzi, R., & Riffaldi, R. (2002). Biochemical activities in a degraded soil restored by two amendments: a laboratory study. *Biology and Fertility of Soils*, *35*(2), 96-101.