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Soil fertility and Biodiversity in Organic Farming

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Introduction

Soil fertility and biodiversity management through organic farming are gaining support to overcome the problems faced by chemical fertilizers like soil pollution, nutrient leaching, and dependent on costly external inputs. The context is no exception to a country like India, which has had a glorious agricultural background since the Vedic era. In the Vedic era, the cultivation procedure was solely based on local resources, which were completely free from the application of synthetic compounds. The uses of animal manure, oil cakes, green manures, *etc*. were emphasized in the Vedic Era to maintain soil fertility. With the advent of green revolution technologies dependent on external inputs, the environment became polluted, natural resources depleted, human health deteriorated and agriculture itself experienced the challenge of sustainability.

Organic farming thus could be an option to reverse the trend of dwindling soil fertility that conventional farming systems are facing. Organic management is a combination of local and traditional knowledge with scientific agriculture technologies. Nutrient availability in organic farming principally depends on the microbial activity on the organic matter instead of readily soluble forms of nutrients. Compost, green manure, crop residues, and bio-solids are important sources of nutrients for organic management practices. FYM is one of the commonly used organic inputs, but the development of several compost production technologies boosts the nutrient-bearing mineral and other additives. These nutrients rich manures can meet the demand of crops by enhancing the activity of micro and macro flora and making nutrients available to plants. The concept in organic farming is to enhance the ecosystem's functioning and make them less dependent on external inputs by reducing nutrient losses. From the environmental perspective also, organic practices were claimed to have improved soil ecosystem quality and long-term farm-level sustainability.

Environmental benefits of organic Agriculture

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Organic agriculture is based on practices that not only protect environmental health but also strive to improve it. Organic farming strives to preserve and protect natural habitats with the understanding that a diverse biological landscape helps to feed both people and the planet.

Water. In many agriculture areas, the pollution of groundwater courses with synthetic fertilizers and pesticides is a major problem. As the use of these is prohibited in organic agriculture, they are replaced by organic fertilizers and through the use of greater biodiversity enhancing soil structure and water infiltration. Well-managed organic systems with better nutrient retentive abilities, greatly reduce the risk of groundwater pollution.

Air and climate change. Organic agriculture reduces non-renewable energy use by decreasing agrochemical needs. Organic agriculture contributes to mitigating the greenhouse effect and global warming through its ability to sequester carbon in the soil. The more organic carbon is retained in the soil, the more the mitigation potential of agriculture against climate change is higher.

Biodiversity. Biodiversity in soil refers to a variety of taxonomic groups including bacteria, fungi, protozoa, nematodes, earthworms, and arthropods present in the soil. The maintenance of natural areas within and around organic fields and the absence of chemical inputs create suitable habitats for wildlife. The frequent use of underutilized species reduces erosion of agro-biodiversity, creating a healthier gene pool the basis for future adaptation.

Ecological services. The impact of organic agriculture on natural resources favors interactions within the agro-ecosystem that are vital for both agricultural production and nature conservation. Ecological services derived include soil forming and conditioning, soil stabilization, waste recycling, carbon sequestration, nutrients cycling, predation, pollination, and habitats.

Impact of Organic Farming on Soil Health

Soil building practices such as crop rotations, inter-cropping, symbiotic associations, cover crops, organic fertilizers, and minimum tillage are central to organic practices. These encourage soil fauna and flora, improving soil formation, structure and creating more stable systems. In turn, nutrient and energy cycling is increased and the retentive abilities of the soil for nutrients and water are enhanced, compensating for the non-use of mineral fertilizers.

Soil physical properties: Organic management can improve the structure, bulk density, water-holding capacity, organic matter content, and porosity in soil. Crop rotation is an

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important component under organic farming that directly and indirectly influences the physical structure of the soil. Mulching of soil surface with organic materials renders the soil soft, pulverized, and humid that ultimately creating a congenial environment for beneficial microbes to maintain bulk density and porosity in the soil. The presence of this organic matter in soil increases its water holding capacity and aggregate stability.

Soil chemical properties: Organic farming has the potential to maintain soil fertility and increase organic carbon pools in soil. Application of different organic inputs like FYM, vermicompost, green manuring, *etc*. ensures both the sustainability of soil organic carbon and supply of primary, secondary, and micronutrients to the plants. The application of FYM improves the total nitrogen and organic matter in the soil, which is an important substrate of cationic exchange, and the warehouse of most of the available nitrogen, phosphorus, and sulphur which is the main energy source for microorganisms. Organic acids and humus fraction of decomposing matter are more efficient in releasing phosphorus and reducing its fixation in soil.

Soil biological properties: Soil biological properties are very important while assessing soil quality because soil quality is strongly influenced by the flora and fauna present in the soil. Soil micro-organisms are the living part of soil organic matter present in the soil. The microbial biomass and microbial activities in soil are crucial to sustaining the productivity of the soil. The soil having high organic matter content ensures greater microbial activity and greater soil N supply. Soil organic matter can sink the atmospheric CO2 and thereby increasing the carbon content in the soil, which further enhances the microbial biomass and respiration. Organically managed soil enriched with several beneficial microorganisms like arbuscular mycorrhizal fungi for ensuring improved crop nutrition and decreasing soilborne diseases. Arbuscular mycorrhizal fungi make a symbiotic association with the plant's root system enhancing plant nutrient uptake and water absorption. As organic farming increases microbial activity, leads to increased competition, parasitism, and predation in the rhizosphere, it collectively reduces the chances of plant disease infestation.

Conclusions

To achieve sustainable crop and livestock production, the primary requirement is the maintenance of soil fertility and soil health. Organic production systems have improved soil physicochemical properties over modern chemical farming systems. The organic production system also encourages soil microbes in their ecological niche as helps to facilitate the process of mobilization of nutrients. Organic farming systems being highly complex and integrated biological systems could be the potential technology option to maintain good soil health. The impact of organic practices on different aspects of crop production, soil health, and the environment envisage the potentiality of organic farming in maintaining soil health for the future generation.