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ORGANIC FARMING BENEFITS FOR AGRICULTURAL SOILS

INTRODUCTION

As the living basis under our feet and a prerequisite for all agricultural activity, soil is one of our most important natural resources. Soils support plant growth, regulate water quality and sustain animal and human life. Its importance can therefore not be overlooked. Soil hosts more than 25% of the global biodiversity[1] but at present, in the EU 60-70% of soils are unhealthy whilst about 70% of farmable agricultural land is degraded[2,3]. Soil is a non-renewable resource and thus its prevention from further degradation and its restoration to a healthy state is essential. The degradation of EU soils has been occurring through erosion, compaction, salinisation, carbon loss, desertification and pollution, such as through the use of synthetic fertilizers and pesticides in agricultural production[2]. Other major pressures on soils in the EU are soil sealing and land take, often at the expense of agricultural land. Degraded soils take decades to recuperate and therefore there is a strong need for clear legislation that protects soils and prevents their further degradation.

Soil health is a cornerstone of organic farming and health is one of the four principles of organic agriculture, the others being ecology, fairness and care.

Despite the importance of healthy soils and it being a finite resource, at present there exists no specific legislation in the EU that protects soils. The Soil Directive proposed by the Commission in 2006 would have set the ball rolling in this regard, but it faced opposition from Member States and was later withdrawn. As a result, soil-related issues are only indirectly addressed through other environmental and agricultural policies. In November 2021, the European Commission launched the EU Soil Strategy for 2030, which aims to address the sustainable use of EU soils and sets a vision and objectives to achieve healthy soils by 2050. One of the key objectives of the Soil Strategy is a Soil Health Law, which the European Commission plans to release in July 2023.

Organic farming maintains healthy soils, delivers high-quality food, fosters biodiversity and reduces greenhouse gas emissions.

Healthy soils are fundamental to produce nutritious and sustainable food and deliver a wide range of ecosystem functions such as water purification and carbon sequestration. Soil health is a cornerstone of organic farming and health is one of the four principles of organic agriculture, the others being ecology, fairness and care. Organic farming has a unique approach to develop soil fertility, and common organic farming practices actively improve soil quality. It is a knowledge-intensive and innovative approach that can contribute to tackle today's challenges of biodiversity loss and the climate crisis, and soils play a crucial role in all these areas. Organic farming is particularly suited to maintaining healthy soil, delivering high-quality food, fostering biodiversity and reducing greenhouse gas emissions.

The benefits of organic for soil health, makes it a leading measure of soil protection and restoration of agricultural soils.

ORGANIC FARMING - AN ASSET FOR SOIL HEALTH

Organic farming has a systemic approach, and its practices aim to build soil fertility while protecting biodiversity, ensuring good water quality and storing carbon in soils, therefore contributing to climate mitigation and adaptation. Instead of being dependent on external inputs, organic farmers are aiming to close nutrient cycles. Common practices in organic systems have allowed organic farmers to improve soil fertility and quality and thus prevent soil degradation. The combination of the various practices and principles can be seen to work in harmony with nature rather than against it. Various studies have proven the benefits of organic farming in terms of sustainability in all its dimensions, including soil health[4].

Maintaining or increasing soil organic matter

Soils cultivated through organic farming methods exhibit significantly higher levels of microbial biomass, microbial activity, and diversity compared to soils from conventional farming[5]. Soils under organic management have been shown to have a 41% increase in microbial biomass carbon and a 51% increase in microbial biomass nitrogen[6]. Organic farming practices are effective in supporting soil health and in the building and/or maintenance of soil organic matter (SOM). The sustainable management of SOM is a crucial component of healthy soils and plays an essential role in sustaining the health and productivity of agricultural and natural ecosystems. SOM helps to create and maintain soil structure by improving soil aggregation, porosity, and water-holding capacity[7]. This helps to promote better root growth, water infiltration, and aeration, which are essential for plant growth. Furthermore, it also increases soil biological activity. Improved SOM provides a habitat for soil microorganisms, such as bacteria and fungi, which play a crucial role in nutrient cycling, soil structure formation, and disease suppression[8]. The improvement of SOM through compost addition has also been argued to decrease the phosphorus and nitrogen runoff[9,10].

Practices in organic farming such as the use of cover crops, reduced tillage, composting, and the incorporation of organic matter into soils can help to increase SOM levels[11,12]. Careful management of crop sequences and providing an enabling environment for soil biota are crucial elements to keeping this vital natural cycle intact, as well as mitigating and adapting to climate change. Therefore, the maintenance and increment of soil organic matter is essential for sustaining soil health and productivity, enhancing agricultural and natural ecosystems, and mitigating climate change.

Enhanced soil biodiversity

Organic farms host on average 30% more species[13]. The enhanced biodiversity in organic applies not only to above ground biodiversity but also to below ground biodiversity in soils. Soils under organic management have been shown to have an increased diversity of soil-dwelling arthropods[14] and an increased presence of earthworms[15], soil bacteria, fungi and mycorrhiza[16,17,18]. Organic systems have been found to not only increase diversity but also positively improve the activity of soil microbes and microbial communities[19]. In organic farming the restriction of the use of synthetic fertilizer and pesticides prevents the addition of pollutants to the soil, which can have harmful effects on soil biodiversity. Organic fertilizers that are used in organic farming systems are derived from natural sources, such as compost, manure and crop residues and contain a variety of essential nutrients. This influx of nutrients stimulates the growth and activity of soil bacteria, fungi, protozoa, earthworms, and other beneficial organisms, which play crucial roles in nutrient cycling, organic matter decomposition, and overall soil health[20].

Increased carbon sequestration and higher soil organic carbon stocks

The role of soils in combating climate change is significant. An IPCC report states that improved soil management has the capacity to counterbalance 5–20% of worldwide anthropogenic greenhouse gas emissions[21]. Carbon loss or gain in soils is influenced by soil management which impacts biological processes. Depending on factors such as soil type, management practices and climate conditions, soils can either accumulate or release carbon[22].

Soils on organic farms can sequester around 1.6t CO_{2e}/ha/year[23] and on average 450kg more carbon/ha/year compared to land under conventional management[20]. The use of organic fertilizer like composted waste from livestock husbandry, improved crop varieties, crop rotations including legumes, reduced tillage and planting of cover crops contribute to the increased carbon storage. Therefore, organic shows higher soil organic carbon stocks and sequestration rates in comparison to other farming systems[24]. Unlike conventional farming, which relies heavily on the consistent use of synthetic nitrogen fertilizers that have been linked to higher greenhouse gas emissions[25], organic farming takes a different path. Organic farming utilizes organic fertilizers and composts

and also incorporates leguminous crops that not only fix nitrogen but also have a positive impact on the climate.

Improved water retention and conservation

The abundant humus content in organic farming systems endows the soils with valuable water resources, exhibiting a higher water holding capacity during dry periods[26]. Organic farming practices, such as the implementation of cover crops and mulching, play a crucial role in maintaining optimal soil moisture levels and minimizing water runoff, leading to more efficient water usage[27,28]. Moreover, the increased organic matter content in the soil reduces soil density and enhances soil porosity[29]. The presence of organic matter in the soil functions akin to a sponge, enabling it to retain water and release it gradually, thereby improving the soil's capacity to hold water and reducing the risk of drought stress for plants.

Soil porosity, which is the amount of pore space in the soil, has significant implications for good soil drainage, aeration and soil water-holding capacity making it more conducive to plant growth. Additionally, the exclusion of synthetic fertilizers and pesticides in organic systems significantly mitigates the contamination of water systems[30]. Notably, studies have indicated a 28-39% reduction in nitrate leaching in organically farmed systems compared to conventional systems[31]. The positive impact of refraining from the use of synthetic pesticides and fertilizers in organic farming extends beyond soil protection, encompassing the safeguarding of groundwater, water bodies, and the overall ecosystem. This contributes to the sustainability and reusability of water resources.

Prevent and reduce rate of soil erosion

Organic farming practices that improve soil quality like cover cropping, mulching, and reduced tillage play a key role in the prevention of soil erosion[31,32]. By protecting the soil surface, reducing runoff, and improving soil structure, organic farming minimizes the loss of topsoil, which is rich in organic matter and essential nutrients. Retaining topsoil is crucial for maintaining long-term soil productivity and preventing land degradation.

As higher levels of infiltration are present, the reduction in soil erosion and surface water flows becomes more pronounced in the context of organic farming. Specifically, median values depict a decrease of 22% for soil erosion and 26% for soil surface water flows[31]. Also, the increased SOM on organically farmed soils contributes to reducing soil erosion[7].

Organic farming has to be recognized as a sustainable soil management practice and an effective approach for achieving and maintaining health of agricultural soils.

CONCLUSION

Farmland soils must be kept in good state or be restored to be able to fulfil their function of producing healthy food. Healthy soil is an essential and vital natural resource that requires protection in every aspect. The restoration or maintenance of healthy farmland soils is crucial to ensure soil fertility and to allow soils to fulfil their role in producing nutritious food and ensuring future food security. In the context of a Soil Health Law, to trigger effective change on the ground, it is imperative to recognize organic farming, as a sustainable soil management practice and an effective approach for achieving and maintaining health of agricultural soils. Moving towards the target of 25% of the EU's agricultural land under organic farming will make an important contribution in achieving a healthy state of agricultural soils in the EU.

Overall, organic farming practices prioritize soil health through increased organic matter accumulation, increased soil biodiversity, improvement in the retention and conservation of water and the general functioning of the soil. This contributes to improved soil structure, fertility, water-holding capacity, nutrient availability, and erosion control, making organic farming an asset for soil protection on agricultural land. Organic farming is a proven holistic approach which supports building healthy soils and should therefore be considered as a leading measure of soil protection and restoration of agricultural soils in the EU Soil Health Law.

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IMAGE CREDITS

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