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REVIEW ARTICLE

Soil Health Management for Sustainable Agriculture and Environment

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ABSTRACT

Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. It connects agricultural and soil science to policy, stakeholder needs, and sustainable supply chain management. Historically, soil assessments focused on crop production, but today soil health also includes the role of soil in water quality, climate change, and human health. However, quantifying soil health is still dominated by chemical indicators, despite growing appreciation of the importance of soil biodiversity, due to limited functional knowledge and a lack of effective methods. In this perspective, the definition and history of soil health are described and compared to other soil concepts. We outline ecosystem services provided by soils, the indicators used to measure soil functionality, and their integration into informative soil health indices. Scientists should embrace soil health as an overarching principle that contributes to sustainability goals, rather than only a property to measure.

Key words: Soil, Climate, Agriculture, Management

INTRODUCTION

Agriculture, in turn, is tied to soil, as soil supplies several major requirements, such as an anchoring medium, as well as water and nutrient supply and storage that are necessary to propagate crops.[1] Therefore, civilization is tied to soil. In the earliest days of agricultural production, human soil knowledge was rudimentary, but before the end of the Neolithic, settlements were being located at sites with rich soils well suited to agriculture, indicating that human knowledge of the soil properties needed for good crop growth was developing.[2]

Climate change and its impact on both soils and civilizations is a major topic of interest today.[3] Studying what has happened in the past during changing climates can help us understand what is likely to happen in the future, and studying the way that past people have either adapted or failed to adapt to changes in climate can provide insight into potentially successful versus unsuccessful strategies to adapt to future climate change.[4] Therefore, understanding our past is an important part of planning for the future.

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METHODOLOGY

We can maintain soil health in many ways. We should focus on sustainable practices to maintain ecological balance.[5]

- We can build a greenhouse for indoor farming, and instead of making its roof slanted, we can make it plane and collect rainwater on the terrace[6]
- We can install a water sprinkler system on the ceiling of the greenhouse.[7]
- Whenever there is a need for irrigation, we can open the valve.[8]

In this way, we can utilize rainwater efficiently without affecting crop production and maintaining the pH of the soil.

- Utilizing all the organic waste to form vermicompost. It can minimize the cost of fertilizers.[4]
- Sprinkling water concentrated with neem leaves on the crops will act as a pest repellent.[6]

RESULTS

- Rainwater harvesting in greenhouses ensured efficient irrigation, reduced dependency on external water sources, and maintained soil moisture levels[9]
- Sprinkler irrigation provided uniform water distribution, minimized water loss, and improved crop establishment[2]
- Application of vermicompost-enriched soil with nutrients, boosted microbial activity, and improved soil structure[10]
- Neem-based pest management lowered chemical usage, preserved soil biodiversity, and offered eco-friendly crop protection[3]
- Collectively, these practices strengthened soil resilience, supported sustainable crop yields, and reduced environmental impacts.[11]

CONCLUSION

Soil health is at the very heart of sustainable agriculture and environmental stewardship. A healthy soil is not merely a medium for plant growth, but a dynamic living ecosystem that regulates water, cycles nutrients, stores carbon, and supports biodiversity. When managed properly, soil becomes the foundation for resilient farming systems, ensuring long-term food security and ecological balance. Conversely, when degraded by excessive tillage, chemical misuse, erosion, or deforestation, soil loses its capacity to sustain crops, exacerbates climate change, and threatens human well-being.

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