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Healthy Soil for a Hunger-Free Planet

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Abstract

World Food Day (An international day celebrated every year worldwide on October 16 to commemorate the date of the founding of the United Nations Food and Agriculture Organization in 1945) plays an important role in reducing global hunger as it campaigns for the right to food, sustainable food systems, worldwide solidarity by strengthening international cooperation and national efforts, and action on issues like poverty and climate change. Plant nutrition and productivity can be enhanced by fertile and well-managed soil, ensuring sufficient food availability to growing populations of world. The *hidden hunger* problem of nutrient deficiency can be decreased by maintaining a healthy soil. Climate resilience can be achieved by fertile soils, which are rich in organic matter and improve water retention and reduce vulnerability to extreme weather conditions. Sustainable soil practices minimize pollution and degradation, preserving ecosystems while feeding people. 95% of food production is dependent on soil and practices like agroecology, conservation agriculture, and regenerative farming restore soil while producing food.

Introduction

Food security is defined as when all people, at all times, have physical and economic access to enough safe and nutritious food to meet their dietary needs for a healthy and active life. It can be attained by maintaining healthy soil, which is very much fundamental to fighting hunger by supporting healthy crops, enhancing plant nutrition, and improving water retention. The healthy soil enhances agricultural resilience against environmental degradation, decreasing dependence on costly chemical inputs. It is a vital asset in combating hunger. By ensuring consistent food production, healthy soil contributes to stable food prices, reduced poverty, and greater economic well-being for farmers and communities.

Sustainable Development Goals (SDGs)

The *2030 Agenda for Sustainable Development*, adopted by all United Nations (UN) members in 2015, created 17 world Sustainable Development Goals. The aim of these global goals is "peace and prosperity for people and the planet"- while tackling climate change and working to preserve oceans and forests [1]. The SDGs highlight the connections between the environmental, social and economic aspects of sustainable development**.**

Pertinent SDGs intricately connected with soil health include SDG 1 (End Poverty), 2 (Zero Hunger), 3 (Good Health and Wellbeing), 5 (Gender Equality), 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), 9 (Industry Innovation and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 (Life on Land) (Fig. 1). Some of these SDGs rely considerably on plant production and others depend on soil processes [2].

Fig. 1: Sustainable Development Goals by UN

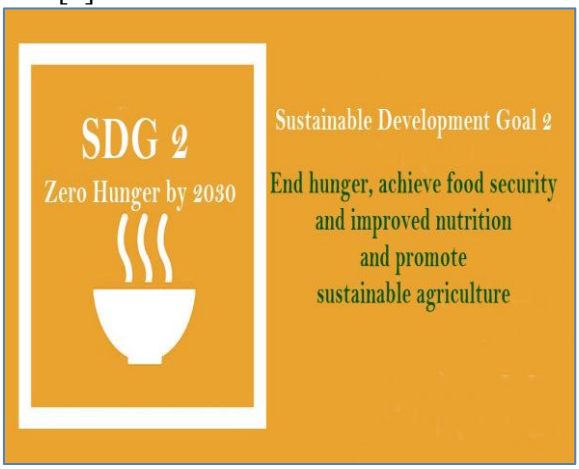

Fig. 2: SDG 2

Goal 2 is about creating a world free of hunger by 2030. The global issue of hunger and food insecurity has shown an alarming increase since 2015, which is increased by a combination of factors including the pandemic, conflict, climate change, and deepening inequalities [3]. It is projected that more than 600 million people worldwide will be facing hunger in 2030, highlighting the immense challenge of achieving the zero-hunger target. Declining food production have contributed to food scarcity and high food prices, leading to heightened hunger cases in the world.

Role of healthy soil in fighting hunger

Healthy soil act as a foundation for food security. It is a reservoir of all essential elements, including macro and micronutrients, that plants absorb. Soil rich in organic matter improves nutrient cycling and facilitates the absorption of nutrients by plants. Degraded soil leads to food insecurity by reducing crop yields and quality, depleting nutrients, increasing susceptibility to drought, and diminishing food availability. This makes farmers more reliant on expensive inputs, and contributes to poverty and displacement. Management of soil

nutrients is a key determinant of the productivity of agricultural lands. Over-exploitation of soil nutrients via harvest without sufficient replacement via fertilizer inputs, lack of cover cropping, compaction from heavy machinery and salinization associated with irrigation are common drivers of soil degradation and decreased agricultural productivity. [5]. Techniques like agroforestry, cover cropping, and conservation tillage, soil carbon sequestration contributes to climate adaptation and food production. Biofortification and soil amendments are two complementary strategies used to address micronutrient deficiencies, or "hidden hunger," in food crops and human populations. Biofortification focuses on increasing the nutrient content of the plant itself (providing a sustainable, food-based approach to deliver nutrients to rural populations that may not have access to fortified processed foods or supplements) and soil amendments directly address nutrient imbalances in the soil.

Policy and investment in soil health involve government programs, farmer incentives, private sector engagement, and international collaboration to improve soil fertility and sustainability. The key initiatives include Pradhan Mantri-KISAN Samman Nidhi (*PM KISAN*), PM Programme for Restoration, Awareness Generation, Nourishment, and Amelioration of Mother Earth (*PM-PRANAM*), soil health card scheme, National Mission for Sustainable Agriculture (*NMSA*), Integrated Watershed Management Programme (*IWMP*). Private Sector Engagement like ESG (Environmental, Social, and Governance) and their role in enhancing soil health, contributing majorly on key soil health indicators like soil organic carbon, N, P, K and microbial diversity and following practices like regenerative agriculture, precision agriculture, improved crop breeding and biotechnology and reduced food waste, addresses food security to a greater extent.

Fig. 3 Shifting from Hungry World to Green earth through increased crop production from healthy soil

Technology and innovation in soil monitoring practices like IoT sensors, drone technology, remote sensing, and AI to provide real-time, high-resolution data on soil moisture, nutrients, pH, and temperature aids in monitoring and increasing soil fertility. Community-based soil restoration projects involve local communities in land and water management to improve soil health and ecosystem resilience. These initiatives often employ techniques like water harvesting structures and reforestation to control erosion and increase groundwater levels, leading to

benefits such as improved crop yields, enhanced food security, and sustainable livelihoods (Fig. 3)

Future strategies

Although fertility remains a crucial issue, soil science research should also explore and improve the use of organic fertilizers. We need to popularize INM and convince farmers that only organic or zero budget strategies will not feed the 1.34 billion population. The responsibility is on the research scientists to make liaison with the policy makers, extension staff, and farmers and demonstrate the benefits of INM holistically to meet the SDGs. [4]

Conclusion

The four main dimensions of food security i.e. *Physical availability of food, Economic and physical access to food, Food utilization and Stability of the other three dimensions over time* are the pillars through which world food problems can be solved, where healthy soil acts as a booster. Improving soil health stands as a global development imperative, especially considering that nearly 600 million people are projected to be chronically undernourished by 2030, and food demand is expected to increase by 70% by 2050. Achieving the Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger), which is intricately connected with soil health, necessitates strong policy, technology, and investment. Research managers must liaise with policy makers, extension staff, and farmers to holistically demonstrate the benefits of approaches like Integrated Nutrient Management (INM) in order to meet this crucial global target. Maintaining cropland area and long-term fertility of soil through optimal management is a key component of the contribution of soil to future food security, through which hunger issue can be resolved to some extent.

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