# AGRO-TECH REVOLUTION

## INNOVATIONS IN AGRICULTURE AND ALLIED SECTORS

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Dr. Prem Shanker • Dr. P. Chandramati Shankar
Dr. Vipin Kumar Mishra • Dr. Anjali Verma

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**Dr. Ajit Kumar Srivastava** S/O Late Sri K. K. Srivastava is presently working as SMS- Horticulture at Mahayogi Gorakhnath Krishi Vigyan Kendra, Chaukmafi, Pipiganj, Gorakhpur, Uttar Pradesh, India. He has completed his B.Sc. (Ag. & A.H.) degree from the CSA University of Agriculture & Technology, Kanpur, U.P., and M.Sc. Ag. (Horticulture) from MGCGV, Chitrakoot, Satna, M.P., and Ph.D. degree in Horticulture from CSJM University, Kanpur, U.P. He has qualified ASRB-NET in Vegetable Science. He received more than 12 prestigious awards. His strong scientific background enabled him to author 11 research papers in different journals. He published more than 50 popular articles in reputed Hindi agriculture magazines. He participated in compiling 22 ICAR reports and other books. He attended more than 13 conferences/seminars/symposiums (National/International).

**Dr. Prem Shanker** is presently serving as Scientist (Plant Protection) in the Krishi Vigyan Kendra, Basti (ANDUAT, Kumarganj, Ayodhya). He did his M.Sc., and Ph.D. in Plant Pathology from CSAUAT, Kanpur, U.P. He has qualified ICAR-NET in 2013. Pandit Deen Dayal Upadhyay, Rastriya Krishi Vigyan Protshanhan Puraskar in 2019 and 2021, awarded by ICAR, New Delhi, working during the period. He was awarded of Young Scientist Award -2017 and the best KVK Scientist award in 2022. He has also been awarded Farm and Food in 2016, 2021 & 2022. He has published 6 research papers, 04 Review papers, 03books, 20 book chapters, and 50 popular articles in international and national journals of repute.

**Dr. P. Chandramati Shankar** is currently working as a Professor in the Department of Biotechnology, Yogi Vemana University, Kadapa, YSR District, Andhra Pradesh. She did her Master's in Botany and Ph.D. in Botany from Mumbai University, Maharashtra. She pursued post-doctoral research as a MONBHUSHO Fellow from the Faculty of Textile Science and Technology, Shinshu University, Nagano Ken Japan, for five and a half years. At present working as Professor at Yogi Vemana University, guided 4 Ph.D. students, further 3 more are pursuing. Published many papers in reputed national and International Journals, published a few book chapters, and one Book.

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# Preface

Sustainable food production is essential for addressing global challenges such as climate change, food security, and environmental degradation. With the world population projected to reach 9.7 billion by 2050, ensuring a steady food supply without exhausting natural resources is a critical priority. Traditional agricultural practices contribute to deforestation, soil degradation, excessive water usage, and greenhouse gas emissions, making the transition to sustainable methods imperative.

The importance of sustainable food production lies in its ability to balance productivity with environmental preservation. By adopting eco-friendly farming techniques such as organic farming, crop rotation, agroforestry, and precision agriculture, we can reduce chemical dependency, enhance soil fertility and optimize resource use. Additionally, sustainable practices help mitigate climate change by reducing carbon footprints and conserving biodiversity. Urbanization has led to innovative solutions like vertical farming, hydroponics, and aquaponics, which maximize space efficiency and minimize water consumption. The future scope of sustainable food production is expansive, driven by technological advancements and shifting consumer preferences. Smart farming, powered by artificial intelligence the Internet of Things (IoT), and big data analytics, is revolutionizing agriculture by improving efficiency, monitoring soil health, and predicting crop yields. Lab-grown meat and plant-based protein alternatives are also emerging as sustainable solutions to reduce the environmental impact of traditional livestock farming. Policy reforms and global initiatives, such as the United Nations' Sustainable Development Goals (SDGs), are accelerating the adoption of sustainable agriculture. Governments and organizations worldwide are investing in research, innovation, and farmer education to promote responsible food production practices. In conclusion, sustainable food production is not just a necessity but a transformative shift towards a healthier planet and future generations. By embracing sustainable techniques and emerging technologies, we can ensure a resilient food system that meets the demands of a growing population while safeguarding natural resources.

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# Chapter 6

# Organic Matter Dynamics in Soil

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## 1. Introduction to Soil Organic Matter

Soil Organic Matter (SOM) is a viscoelastic, multi-phase substance found in soils. SOM is heterogeneous in structure and biochemical composition and affects almost all soil processes, such as soil aggregation, water infiltration, soil reaction (pH), ion-exchange reactions, microbiological properties, the fate of pollutants, and the fate of nutrients. Thus, SOM is considered an important factor for soil health and quality. An increase in SOM has been shown to increase plant production and soil health, while a decrease in SOM is associated with degradation of soil, and changes in plants, which can ultimately lead to desertification. Degradation of SOM is primarily due to management activities resulting in SOM loss in agriculture (Jilling, 2019). Disturbance of soils, especially cropping, tends to accelerate the decomposition of the older SOM pool, leading to an overall decrease in SOM.

Agricultural practices will determine the fate of SOM in a given soil. If management is directed towards increasing SOM, the rate of accumulation will depend on a soil's physical, chemical and biological properties, climate, crop and residue management, and contemporary SOM loss rates. All these factors operate on a timescale of a few years to 101-20 years to significantly modify the SOM on the whole. Thus, interpretation of measurement data is greatly complicated cognitive process, and it has been speculated that this lapse of time on the sub-continental timescale of the soil order category is needed before soils significantly 'realize' new rates of SOM change following management interventions. This timescale fits with a speculation that, for a soil to realize such opportunities for new SOM accumulation rates, it needs to first make a transition in its most pre-emptive state.

Information on SOM dynamics at this higher spatial scale has generally come from measurements of Total Organic Carbon (TOC) pools using time-series observations of large areas subjected to different land cover/management. But since soil is a mixture of minerals, living organisms, amorphous material and SOM, which itself consists of minerals, microorganisms and microbially ameliorated SOM, a number of significant abilities are lost, such as estimation of SOM decomposition pathways, allocation of SOM based on size/age, protection mechanisms and change rates.

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