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# **Microorganisms for Sustainability**

Volume 7

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Harsha N. Shelat · Rajababu V. Vyas  
Editors

# Microorganisms for Green Revolution

Volume 2 : Microbes for Sustainable Agro-ecosystem

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## Foreword



Agroecosystem is presently disturbed due to human interference in agriculture by impacting on soil, water, microorganism, plant, and animal resources to produce their own requirements. Agroecosystem supports the crops, but due to continuous uncontrolled exploitation of natural resources, imbalance in natural biogeochemical cycles has occurred. This ignorance is now intensified in the era of green revolution, wherein concentration was given only on increasing productivity without worrying for the cost to be paid by agroecosystem. As a result, presently, we are witnessing reduced soil fertility and added ecological factors like climate change which are adversely affecting agricultural production. Promoting the healthy functioning of ecosystem ensures the resilience of agriculture through microorganisms which can set soil cycles properly. [Climate change](#) and related stresses are noticeably affecting basic functions of agroecosystem. The key to sustain the agroecosystem lies in the fact that the linkages between soil, plant, water, and microorganisms in agroecosystem should be strengthened. Microorganisms are in the nexus being able to mitigate the climate impact.

In view of above, the book *Microbes for Sustainable Agroecosystem – Volume II* contributes to sustainable agriculture. It is an attempt to explore knowledge of various national and international researchers and will be of great interest to students, teachers, and scientists working in the area of environmental, soil, and agricultural microbiology. The team of microbiologists from Anand Agricultural University have tried to compile and provide knowledge of experts at a single platform. I am sure that this book will serve as a resource for developing microorganism-based strategies for sustainable agroecosystem.

Anand Agricultural University  
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N.C. Patel,  
Vice-Chancellor

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## Preface

Agroecosystem comprises of air, water, and soil which support the growth of all living things and total food web; however, numerous microorganisms critically involved with all living things are the driving forces of its functioning. It is a need to determine beneficial aspects of plant and microbial interactions in agroecosystem in light of the present challenge like drought, soil fertility loss, climate change, and soil contamination. In order to enhance the food security through sustainable agricultural practices, the role of soil microbes is certainly a priority component for productivity and preservation of soil. Environment and resource conservation for assuring food quality for the quickly growing human population is the major challenge in agriculture during the last few decades. Microbe-based ecological research plays a key role in developing technological approaches to protect the environment and overall agroecosystem for sustainable development as well as for future policies.

This book contains chapters from distinguished experts and dedicated researchers. Efforts have been made to compile the latest information on the present status of microorganism-based mitigation and key strategies for sustainable agroecosystem development and promotion for welfare of mankind. Some chapters deal with bioremediation of pesticides and toxic metals from soil, agro-waste management, and mitigation of effects of climate change on agriculture. The book also provides in-depth insights and scientific linkages as well as evidences to show the importance of microorganisms to mitigate climate change and enable plants to fight with abiotic stresses. We hope that this book *Microbes for Sustainable Agroecosystem – Volume II* will help the researchers in planning their future line of research and the policy makers in taking rational decisions on sustainable agroecosystem for the benefit of farmers as well as other stakeholders and will serve as a treasure of knowledge to students. It must be mentioned here that the scholarly chapters included in this volume do help to enrich the readers' understanding on the issues related to sustainability of agroecosystem with mitigation strategies keeping microbial world of soil

in focus. The views expressed by the authors in their respective papers are based on their vast experience in the agricultural and allied research areas. We thank all the contributors of this volume, and we are grateful for their valuable contributions.

Anand, Gujarat, India

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Yogeshvari K. Jhala  
Harsha N. Shelat  
Rajababu V. Vyas



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## About the Editors

**Deepak G. Panpatte** is a research scholar working for the past 7 years. His research interests include agriculturally beneficial microorganisms, viz., biofertilizers, biopesticides, and biodegraders. He has done pioneering work in the development of fortified biocontrol bacterial consortium with phyto-extracts for the management of phytopathogenic nematodes and fungi. He has received six awards, three for presentation of research outcomes and three for his remarkable role in agriculture sector. His publication profile includes 13 research papers, 1 book and 9 book chapters with Springer publishing house, 1 practical manual, 26 popular articles, and 2 editorial pages.

**Yogeshvari K. Jhala** is an assistant professor having 10 years of teaching and research experience. Her field of interest includes agriculturally beneficial microorganisms, viz., biofertilizers, biopesticides, and biodegraders. She has world over first time reported five unique strains of methanotrophic bacteria. For her outstanding research work of methanotrophic bacteria, she was honored with All India Best Research Award and Young Faculty Award. Her publications include 17 research papers, 1 book and 9 book chapters with Springer publishing house, 2 teaching manuals, 18 popular articles, and 2 editorial pages.

**Harsha N. Shelat** is an associate research scientist and award-winning researcher at Anand Agricultural University, Anand, India. She has 33 years of experience in the field of agriculturally advantageous microbes chiefly biofertilizers, biodegraders, and microbial pesticides. Her contribution in society is the development and dissemination of liquid biofertilizer technology for the benefit of farming community. She has written 3 books and 7 book chapters and has published more than 35 research papers in national as well as international journals.

**Rajababu V. Vyas** MSc (microbiology), PhD, serves as research scientist and head of the Department of Agricultural Microbiology, AAU, Anand. For the past 31 years, he has worked on agriculturally beneficial microorganisms on isolation and characterization, the development of mass production technique, and laboratory and field testing of biofertilizers for crop production. He has also developed native microbial agents for biological control of insect pests and plant parasitic nematodes

for crop protection and PGPR for bioremediation of methane and agro-waste to support organic farming approach. His publications include 112 research papers, 2 review papers, 5 books and manuals, 5 training manuals, and 11 book chapters, 2 in CAB International and Michigan State University Press, USA. He is a recipient of six prestigious awards and instrumental for technology patenting, commercialization, licensing, and services.

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## Introduction



In recent years, we have witnessed fast growth in developing countries with concurrent progress in industrialization and agriculture. These developments have many environmental side effects in the form of pollution. If such type of unrestricted disposal of various wastes to agricultural land is continued, the liveliness of soil and its ability to sustain other ecosystems will be at risk. As climate change and environmental degradation increase, it will challenge sustainable crop production. Climate change has the prospective to intensify abiotic stress on crops while shifting the environmental niches for pathogens and weeds. Consecutively, enhancing food production using current technologies increases fuel requirements, but depleted fuel reserves drive demand for biofuels. Such increase in demand of biofuels creates problem of food vs fuel. Each of these events is closely related to parallel change in environmental quality.

This book entitled *Microbes for Sustainable Agroecosystem – Volume II* focuses on ideas of environmental security by microorganisms in sustainable manner. Microbes can be considered as natural cleaners utilizing garbage of earth. These tiny creatures can utilize almost everything including agrochemicals, heavy metals, and gaseous pollutants. The book focuses on the role of microorganisms in mitigation of environmental stress on crops as well as reduction of greenhouse gases in agriculture. It also contains reviews and original research of reputed scientists to highlight the latest developments in microbiological research, to cope up with the problem of changing climate along with remediation strategies practiced at various

stages for improvement of agroecological health. The book will be a valuable resource for scientists working to develop mitigation strategies for the development of sustainable agroecosystem and also serves as inspiration and ready reckoner for the students who want to pursue studies pertaining to bioremediation of environment making them ready for future challenges.

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