

Muhammad Farooq · Michele Pisante
Editors

Innovations in Sustainable Agriculture

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Muhammad Farooq
Department of Crop Sciences,
College of Agricultural and
Marine Sciences
Sultan Qaboos University
Al-Khoud, Oman

Michele Pisante
Agronomy and Crop Sciences Research
and Education Center
University of Teramo
Teramo, Italy

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Foreword

The term “sustainable agriculture” implies multidimensional approach to managing agroecosystems encompassing (i) environmental, (ii) economic, and (iii) social components of sustainability. This book edited by Prof. Muhammad Farooq and Prof. Michele Pisante is a comprehensive treaty on this timely theme of global significance. In addition, this book also addresses several related and pertinent issues such as resource-use efficiency, water and nutrient management, pest management, genetic resources and biodiversity, and climate change. It is indeed a comprehensive treatise of the subject, based on synthesis of the existing knowledge by authors who are extremely about this important topic.

The “sustainability” issue has been a popular theme ever since publication of the 1987 report by the World Commission on Environment and Development chaired by Gro Harlem Brundtland (former Prime Minister of Norway): *Our Common Future*. This report was also the basis of the Agenda 21 and of the “Rio Declaration on Environment and Development.” The thematic focus has attracted attention of the scientists, policy makers, civic societies, and general public toward an attempt to addressing the emerging global issues. It is in this context that the theme of “Sustainable Agriculture” of the present volume is timely and crucial. It is also pertinent to addressing the Agenda 2030 or the “Sustainable Development Goals” of the UN adopted in 2015.

Major questions related to agricultural sustainability have been raised ever since the dawn of settled agriculture about ten millennia ago when the world population was merely 10–20 million and even more strongly in 1798 by Thomas Malthus who wrote the “Principle of Population: As it Affects The Future Improvement of Society.” Whereas the questions (i.e., resource availability, use efficiency, food and nutritional security, environment quality) have more or less remained the same over millennia, the answers and strategies to address these questions have changed with every generation depending on the population size, lifestyle, and the technical knowledge available at the specific time.

The human population of 7.7 billion in 2019 is destined to reach 9.8 billion by 2050 and 11.2 billion by 2100. Furthermore, the growing affluence of the expanding middle class in emerging economics is increasing demands on the finite and

nonrenewable resources that are also prone to degradation and pollution because of misuse and mismanagement. Therefore, the need to meet the food and other demands of the growing and richer population must be reconciled with the absolute necessity of improving and restoring the environment. These two must go hand in hand.

Therefore, the concept of multidimensional sustainability deliberated in this book (i.e., environmental, economic, and social dimensions) must also encompass the focus on “institutional sustainability.” It is the weak, poor, and unsustainable institutions throughout the developing world that have led to the widespread problems of soil degradation and desertification, water pollution and scarcity, air pollution and gaseous emissions, malnourishment and undernourishment, extinction of biodiversity and weakening of ecosystem services, etc. Strong institutional sustainability is also essential to translating “science into action.” A related but somewhat different issue is that of “political will,” which is also essential to implementation of pertinent programs which protect, restore, and use the finite resources so that demands of the present society are met without jeopardizing those of the future generations.

The Ohio University,
Columbus, OH, USA

Rattan Lal

Preface

Over the millennia, agriculture has evolved over time between the growing demand for food and the progressive decline of natural resources to meet the needs of a society that do not stop, increase rapidly and with new lifestyles, as never first registered. And new challenges are facing the transition from agriculture to production, from migration from rural to urban areas, and from the need to recognize the value and conservation of various aspects such as economic, social, and productive efficiency and soil quality, water quality, greenhouse gas emissions, and biodiversity.

There is no future without agriculture, there cannot be agriculture without innovation, and there can be no innovation without the knowledge that can improve our lives, thanks to the ever-present alliance between plants and people who, through agriculture, use them. This demands pragmatic solutions to manage the agroecosystems rationally and to guarantee, with the current limits of the biosphere, sufficient food for the world population that will exceed 9 billion people by 2050.

Based on these considerations in this book, we have brought together researchers specializing in different disciplines and working in different regions of the world, united by the rigor method of scientific approach to tackle together many of the current and emerging aspects of the sustainability of agricultural production. For an ordered reading and for the accurate thematic analysis, the book is divided into 7 sections and 20 chapters as detailed below.

Part I Introduction

- Chapter “[Sustainable Agriculture and Food Security](#)” describes the basic and evolved concepts of sustainable agriculture and food security.

Part II Ecological Sustainability

- Chapter “[Integrating Conservation into Agriculture](#)” elaborates and integrates conservation with agriculture for sustainable agriculture.
- Chapter “[Microbial Applications for Sustainable Agriculture](#)” describes the new scientific evidence of microbial applications for sustainable agriculture.

- Chapter “[Innovation System Approach for Urban Agriculture: Case Study of Mexico City](#)” discusses the innovation system approach for urban agriculture with focus on Mexico City.

Part III Resources Use Efficiency for Sustainable Agriculture

- Chapter “[Sustainable Soil Management](#)” illustrates the agronomic principles and practices of sustainable soil management.
- Chapter “[Sustainable Water Management](#)” aims to answer five questions on sustainable water management.
- Chapter “[Sustainable Nutrient Management](#)” covers the principles and applications of sustainable nutrient management.
- Chapter “[Alternative Fertilizers and Sustainable Agriculture](#)” analyses the experiences and issues and proposes options for the alternative fertilizers and sustainable agriculture.

Part IV Sustainable Pest Management

- Chapter “[Sustainable Weed Management](#)” describes sustainable weed management between climate change and agronomic and environmental issues.
- Chapter “[Sustainable Management of Insect-Pests](#)” discusses sustainable management of insect pests.
- Chapter “[Sustainable Management of Plant Diseases](#)” analyzes management strategies as an important contribution to the sustainable management of pathogens and diseases.

Part V Genetic Resources and Crop Improvement for Sustainable Agriculture

- Chapter “[Conservation of Biodiversity and Genetic Resources for Sustainable Agriculture](#)” covers the challenges on conservation of biodiversity and genetic resources.
- Chapter “[New Breeding Techniques for Sustainable Agriculture](#)” describes the innovative breeding techniques for sustainable agriculture.

Part VI Agricultural Sustainability in Changing Climate

- Chapter “[Sustainable Agriculture and Climate Change](#)” illustrates the climate change challenges for the sustainability of agriculture.
- Chapter “[Carbon Sequestration for Sustainable Agriculture](#)” describes the experiences on carbon sequestration and sustainable agriculture.
- Chapter “[Use of Biochar in Sustainable Agriculture](#)” covers the use of biochar for sustainable agriculture.
- Chapter “[Managing Drylands for Sustainable Agriculture](#)” highlights strategies for the management of dry lands for sustainable agriculture.
- Chapter “[Crop-Livestock Interaction for Sustainable Agriculture](#)” discusses for crop-livestock interaction for sustainable agriculture.

Part VII Use of IT Tools and Modeling for Sustainable Agriculture

- Chapter “[Information Technology for Sustainable Agriculture](#)” provides an overview of potential applications of information technology tools in sustainable crop production systems.
- Chapter “[Spatializing Crop Models for Sustainable Agriculture](#)” introduces the application and case studies of spatializing crop models for sustainable agriculture.

Our heartfelt thanks is addressed to all the authors who with infinite generosity of their time, proposals, and active participation have contributed to the realization of this book, the result of a harmonious teamwork. A special thanks to the reviewers, for the importance of the contribution offered from the scientific point of view, in the validation of concepts, objectives, interpretation of results, and evidence on the different topics covered and finally, detail not negligible, for having read and reread the different drafts of the manuscript. Of course, if there were still errors, they would be only ours.

We are grateful to Professor Rattan Lal for the clarity of the foreword, full of experience and illuminating wisdom, and for his trust. We also thank Ms Melanie van Overbeek, Assistant Editor, Agronomy, Springer Dordrecht, the Netherlands, for her patience and trust in us during this book project.

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Muscat, Oman
Teramo, Italy

Muhammad Farooq
Michele Pisante

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Contributors

Tanveer Abbas Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Aftab Afzal Department of Botany, Hazara University, Mansehra, Pakistan

Tahseen Afzal Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

J. Álvaro-Fuentes Soil and Water Department, Estación Experimental de Aula Dei (EEAD), Spanish National Research Council (CSIC), Zaragoza, Spain

J. L. Arrúe Soil and Water Department, Estación Experimental de Aula Dei (EEAD), Spanish National Research Council (CSIC), Zaragoza, Spain

Saeed A. Asad Centre for Climate Research and Development, COMSATS University, Islamabad, Pakistan

Muhammad Zahir Aziz Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Paul Kayode Baiyeri Department of Crop Science, University of Nigeria, Nsukka, Nigeria

Sofia Bajocco Research Centre for Agriculture and Environment, Council for Agricultural Research and Economics, Roma, Italy

Ali Ahsan Bajwa School of Agriculture and Food Sciences, The University of Queensland, Gatton, QLD, Australia

The Centre for Crop Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Gatton, QLD, Australia

Prasanta Chitta Bhowmik Stockbridge School of Agriculture, University of Massachusetts, Amherst, MA, USA

Simone Bregaglio Research Centre for Agriculture and Environment, Council for Agricultural Research and Economics, Bologna, Italy

C. Cantero-Martínez Crop and Forest Sciences Department, EEAD-CSIC Associated Unit, Agrotecnio, University of Lleida (UdL), Lleida, Spain

Giovanni Cappelli Research Centre for Agriculture and Environment, Council for Agricultural Research and Economics, Bologna, Italy

Bhagirath Singh Chauhan The Centre for Crop Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Gatton, QLD, Australia

Muhammad Jehanzeb Masud Cheema Center for Advanced Studies in Agriculture and Food Security, University of Agriculture, Faisalabad, Pakistan
Faculty of Agricultural Engineering and Technology, University of Agriculture, Faisalabad, Pakistan

Sara D'Egidio Agronomy and Crop Sciences Research and Education Center, University of Teramo, Teramo, Italy

Hans Dieleman College of Sciences and Humanities, Autonomous University of Mexico City, Mexico City, Mexico

Muhammad Farooq Department of Crop Sciences, College of Agricultural and Marine Sciences, Sultan Qaboos University, Al-Khoud, Oman

Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan

The UWA Institute of Agriculture, The University of Western Australia, Crawley, WA, Australia

Harriet Ndofor Foleng Department of Animal Science, University of Nigeria, Nsukka, Nigeria

Angelica Galieni Research Centre for Vegetable and Ornamental Crops, Council for Agricultural Research and Economics, Monsampolo del Tronto, Italy

Ankit Garg Department of Civil and Environmental Engineering, Shantou University, Shantou, China

Alessandra Gentile Hunan Agricultural University, Horticulture and Landscape College, Changsha, China

Department of Agriculture, Food and Environment, University of Catania, Catania, Italy

Fabrizio Ginaldi Research Centre for Agriculture and Environment, Council for Agricultural Research and Economics, Bologna, Italy

Muhammad Dildar Gogi Integrated Pest Management Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Nirmali Gogoi Department of Environmental Science, Tezpur University, Tezpur, Assam, India

Maria Lodovica Gullino Center of Competence AGROINNOVA, University of Torino, Grugliasco, Italy

DISAFA, University of Torino, Grugliasco, Italy

Ayse Gul Ince Vocational School of Technical Sciences, Akdeniz University, Antalya, Turkey

Muhammad Wajid Javed Integrated Genomics Cellular Developmental and Biotechnology Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Mehmet Karaca Department of Field Crops, Akdeniz University, Antalya, Turkey

Amir Kassam University of Reading, Reading, UK

Rupam Katak Department of Energy, Tezpur University, Tezpur, Assam, India

Muhammad Azeem Khan Center for Advanced Studies in Agriculture and Food Security, University of Agriculture, Faisalabad, Pakistan

Faculty of Agricultural Engineering and Technology, University of Agriculture, Faisalabad, Pakistan

Muhammad Jamal Khan Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Dookie, VIC, Australia

Ndubuisi Samuel Machebe Department of Animal Science, University of Nigeria, Nsukka, Nigeria

Stefano La Malfa Department of Agriculture, Food and Environment, University of Catania, Catania, Italy

Marcello Mastrorilli Research Centre for Agriculture and Environment, Council for Agricultural Research and Economics, Bari, Italy

Subham C. Mondal Department of Environmental Science, Tezpur University, Tezpur, Assam, India

Faisal Nadeem Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan

Muhammad Naveed Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Ahmad Nawaz Integrated Pest Management Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Cynthia Ebere Nwobodo Department of Agricultural Extension, University of Nigeria, Nsukka, Nigeria

Giancarlo Pagnani Agronomy and Crop Sciences Research and Education Center, University of Teramo, Teramo, Italy

Michele Pisante Agronomy and Crop Sciences Research and Education Center, University of Teramo, Teramo, Italy

D. Plaza-Bonilla Soil and Water Department, Estación Experimental de Aula Dei (EEAD), Spanish National Research Council (CSIC), Zaragoza, Spain

Abdul Rehman Department of Crop Sciences and Biotechnology, Dankook University, Cheonan-si, South Korea

Muhammad Sanaullah Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Banashree Sarma Nature Learning Center- Assam, Assam State Biodiversity Board, Guwahati, Assam, India

Tanvir Shahzad Department of Environmental Sciences and Engineering, Government College University Faisalabad, Faisalabad, Pakistan

Sulman Siddique Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Davide Spadaro Center of Competence AGROINNOVA, University of Torino, Grugliasco, Italy

DISAFA, University of Torino, Grugliasco, Italy

Fabio Stagnari Agronomy and Crop Sciences Research and Education Center, University of Teramo, Teramo, Italy

Muhammad Sufyan Biological Control Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Pakistan

Aman Ullah Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad, Pakistan

D. Villegas Sustainable Field Crops Program, Institute of Agriculture and Food Research and Technology (IRTA), Lleida, Spain

Abdul Wakeel Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Michael Walsh The University of Sydney, Narrabri, NSW, Australia

Liyong Xie College of Agronomy, Shenyang Agricultural University, Shenyang, People's Republic of China

Muhammad Yaseen Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

Hongliang Zhao College of Agronomy, Shenyang Agricultural University,
Shenyang, People's Republic of China

Raffaella Zucaro Research Centre for Policies and Bioeconomy, Council for
Agricultural Research and Economics, Roma, Italy