

Preface

There is growing consensus among the scientific community that global warming caused by increased concentration of greenhouse gases in the atmosphere is one of the most serious environmental problems facing the world today. It is estimated that global mean surface temperature could rise over 6°C by 2100. In addition to global warming, increased greenhouse gas concentrations may increase the occurrence of precipitation extremes: greater precipitation is expected in already-wet areas and increased drought in already-dry areas. Furthermore, widespread expansion of industry and agricultural activities may increase atmospheric nitrogen deposition to unprecedented levels, which will modify climate change impacts. Climate change is also expected to increase the severity and frequency of wildfire, floods, and pest and pathogen attacks. These global environmental changes will pose serious consequences for the overall functioning of terrestrial ecosystems, particularly for agriculture and forestry.

Soil is an important component of terrestrial ecosystems that support life on the earth; it serves as a buffer medium for perturbations to biogeochemical processes of importance to global climate change, acts as a source or a sink for greenhouse gases, and thus underpins social, economic and environmental well-being of humans. Many of the ecosystem services provided by soils are reliant on organic matter. It is therefore critical that land is managed to increase soil organic matter, which will assist in halting rising atmospheric [CO₂], improving soil structure, and decreasing soil erosion and land degradation. In view of changing climate, it is vital that soil health is maintained because a healthy soil is able to sustain physical, chemical and biological functions, and recover following perturbations, due to inherent resilience. A healthy soil enhances plant productivity, promotes plant, animal and human health, maintains water and air quality, supports a diverse community of soil organisms, and resists stresses of human impact and climatic perturbations, so resists environmental degradation. A healthy soil is a complex dynamic living resource that is resilient as a result of its capacity for self-organisation. “Soil health” is thus a broad term, encompassing physical, chemical and biological characteristics, which may be assessed through quantitative measures and also qualitatively expressed indicators. The terms “soil health” and “soil quality” are both used in the literature to describe the capacity of a soil to contribute to ecosystem

functions, meet human needs and bear stresses. In this book, we use these two terms synonymously.

Several books on the topic of soil health or soil quality have been published over the last two decades, mainly with a focus on assessing soil health/quality indicators or soil functions in relation to managing soil health in terrestrial ecosystems under existing climatic regimes. The principal objectives of this book are to: (i) present a comprehensive overview of responses of key soil properties or processes to potential impacts of climate change; (ii) highlight the importance, for major conventional and emerging land use systems, of maintaining soil health to mitigate and adapt to climate change impacts; and (iii) describe soil-related feedback processes with implications for plant productivity and climate change. A better understanding of the influences of global environmental changes and land management on soil health is important for ensuring sustainable agro-ecosystems, developing adaptive strategies and sustaining the capacity of soil to meet demands for food, fibre, fodder, timber, and fuel for present and future generations.

Part I provides an overview of the concept of soil health, highlighting the role of soil carbon sequestration for improving soil health and mitigating and adapting to potential impacts of climate change. This section also provides a review of current knowledge about physical, chemical and biological indicators of soil health within the context of climate change and their significance for monitoring impacts of land management and climate change on soil health. Part II focuses on important soil attributes and processes including soil structure, soil pH, soil organic matter, nitrogen cycling, soil respiration and soil biota, and their responses and/or their role in sustaining the environmental functions of soil ecosystems under future climate change scenarios. Part III considers a range of conventional land use systems such as cropping, pastoral, forestry and rangeland, as well as rehabilitated mine-sites, with focus on managing soil health and the processes in these systems that can help to mitigate and adapt to climate change impacts. In Part IV, special attention is given to describing emerging management systems such as organic farming, biochar and bioenergy, and the impact of these systems on soil health and climate sustainability.

With contributions from internationally renowned experts, this book will be a great knowledge resource on the topical area of “soil health and climate change”. We believe the book will interest students and researchers in soil, plant and environmental sciences, as well as policy makers and industry stakeholders involved in natural resource management, agricultural development and climate change mitigation through land use management. The compiled information is expected to generate stimulating discussions among scientists and will assist in formulating research aiming to tackle knowledge gaps identified by the contributors.

We thank the authors for their contribution to this volume and appreciate their diligence in responding to reviewers’ comments, thereby ensuring high standards. All chapters have been peer-reviewed as per the standards of international scientific journals, and we are thankful to reviewers for providing critical assessment and suggestions that helped in improving the chapters. Last but not least, we also

express our thanks to the series editor, Prof. Ajit Varma, and the publisher for providing us the opportunity to edit this book.

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