R. Nieder
D.K. Benbi

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R. Nieder
Institut für Geoökologie
Technische Universität Braunschweig
Braunschweig
Germany

D.K. Benbi
Department of Soils
Punjab Agricultural University
Ludhiana
India

ISBN 978-1-4020-8432-4 e-ISBN 978-1-4020-8433-1

Library of Congress Control Number: 2008927744

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Printed on acid-free paper

9 8 7 6 5 4 3 2 1

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Preface

One of the biggest reality before us today is the global climate change resulting from the emission of greenhouse gases (GHGs). There has been an unprecedented increase in the concentration of carbon and nitrogen containing GHGs in the atmosphere, resulting primarily due to intervention in terrestrial carbon (C) and nitrogen (N) cycles by human beings. Two anthropogenic activities viz. food production and energy production are mainly responsible for perturbation of C and N cycles. If drastic remedial measures are not taken, the concentration of GHGs is projected to increase further. According to Kyoto Protocol, industrial countries are to reduce their emissions of GHGs by an average of 5% below their 1990 emissions by the first commitment period, 2008–2012. Therefore, there is an increased focus to look for options for mitigating the emission of GHGs. Terrestrial C sequestration through biotic processes is being viewed as a plausible option of reducing the rates of CO_2 emissions while abiotic processes of carbon storage and alternatives to fossil fuel take effect.

The importance of the C and N transfer from soils to the atmosphere lies not only in global warming, but also on soil quality and the potential of soils to perform ecosystems functions some of which are related to the three major international conventions on Biodiversity, Desertification, and Climate Change. Soil organic matter (SOM) being the main reservoir of C of the continental biosphere, can either be a source of CO_2 during mineralization or a sink if C sequestration is favored. During the last two centuries, soils have lost a considerable amount of C due to land use changes and expansion of agriculture. These losses from soils are clearly of concern in relation to future productivity and environment. To ensure sustainable management of land, it is imperative that organic matter in the soil is maintained and sustained at satisfactory levels through improved management practices.

As pool changes of C and N are often very slow, and the full impact of a change in land management practice may take decades to become apparent, long-term perspectives are required. The cycling of C and N is intimately linked and the two cannot be studied effectively separately. This necessitates a thorough understanding of the interdependent and dynamic pools and processes of C and N in the terrestrial ecosystem. Models could help in formulating or assessing land use strategies, generating scenarios for optimizing SOM conditions and minimizing emissions and upscaling research findings at different levels of spatial and temporal aggregation.

Development and use of models require a comprehensive knowledge about several interdisciplinary processes.

Most of the currently available books on C and N cycling either deal with a single element of an ecosystem, or are limited to one or a few selected aspects. This book fills the gap by presenting a comprehensive, interdisciplinary description of C and N fluxes between the atmosphere and terrestrial biosphere, issues related to C and N management in different ecosystems and their implications for the environment and global climate change, and the approaches to mitigate emission of GHGs. This unique volume presents comprehensive literature drawn from books, journals, reports, symposia proceeding and internet sources to document interrelationships between different aspects of C and N cycling in terrestrial ecosystems. Following an introductory chapter, Chapter 1 presents distribution of C and N in the various terrestrial pools, with special emphasis on storage in plants and soils. Chapter 2 presents the basics of C and N cycling processes and a generalized overview of fluxes in terrestrial ecosystems so as to develop an understanding of the complex interrelationships among different processes and the emission pathways, which are discussed in subsequent chapters. Soils, particularly soil organic matter, play an important role in the bidirectional flow of C and N in terrestrial ecosystems. Therefore, knowledge about the composition and characteristics of soil organic matter, and its role in influencing soil functions is essential to exploit synergies between management practices, GHG mitigation and sustainable productivity. While Chapter 3 presents physical, chemical and morphological characterization of soil organic matter, Chapter 4 enunciates the influence of SOM on soil quality and its ability to perform ecosystem functions. To complement the information provided in Chapter 1 on C and N forms, Chapter 5 presents the transformations of organic and inorganic forms of carbon and nitrogen in soils and their role in influencing C and N fluxes between soils and atmosphere. The impact of anthropogenic activities, particularly land use and land use changes and agricultural management on C and N dynamics is presented in Chapter 6. Chapter 7 discusses leaching of reactive C and N forms from soils and contamination of groundwater. Chapter 8 provides a detailed description of bidirectional biosphere-atmosphere interactions with current estimates of GHG emissions, their sources, governing variables and the mitigation options. Finally, Chapter 9 presents modeling approaches adopted to simulate various components of C and N cycling processes. The use of models to upscale measurements and generate scenarios on a regional and global scale vis-à-vis management options are discussed.

We are thankful to the German Research Foundation (Deutsche Forschungsgemeinschaft) for funding the stay of D.K. Benbi at Braunschweig Technical University. We appreciate our families: Alexandra, Raphaela and Petra (R. Nieder), and Adwitheya and Meenu (D.K. Benbi) for their patience and understanding during the preparation of this book. We are grateful to Hans P. Dauck for help in the preparation of illustrations.

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