Foreword

The Soil and Water Conservation Society (SWCS) is pleased to publish *Advances in Nitrogen Management for Water Quality*. SWCS has a long history of cooperating with other societies in joint activities and symposiums. This book is the result of a collaborative effort between SWCS and the Soil Science Society of America (SSSA). The creation of this work began at the 7th joint SWCS-SSSA annual symposium, which was conducted at the 2006 Soil and Water Conservation Society Annual Meeting in Keystone, Colorado, and at the 2006 Soil Science Society of America Annual Meeting in Indianapolis, Indiana. At each of these meetings workshops, presentations, and posters were presented related to advances in nitrogen management for water quality. Some of the presenters at these two meetings were asked to contribute their knowledge so that the information on this topic could be synthesized in a comprehensive and cohesive work. The ultimate result was this book, which presents new tools, concepts, and other advances in nitrogen management, such as the Nitrogen Index, the Nitrogen Trading Tool, remote sensing, and precision conservation.

Nitrogen is one of the most important nutrients in agriculture; it is used worldwide as a fertilizer, and it played an important role in the Green Revolution. The input of nitrogen to agricultural systems increases production and the viability of world farming operations. However, the use of this nutrient in agricultural systems can also allow it to escape at increased rates to the environment. Average use efficiencies have been reported at about 50% or lower, with some of the more recent reports suggesting that N losses from agricultural systems can average at about 30% of the applied N fertilizer with a 70% recovered in plants and soils. Managing nitrogen effectively thus continues to be a difficult and complicated endeavor. Improving nitrogen management and increasing the use efficiency of this nutrient is essential to reduce leaching to the environment and protect natural resources such as water.

The recent increase of publications on nitrogen attests to the importance of its management. This book reviews some of the newest advances in nitrogen management and explains how these advances can potentially reduce nitrogen losses to the environment. The editors for this book were Drs. Jorge A. Delgado and Ronald F. Follett, who worked with the authors and coauthors of these 15 chapters. An initial editorial committee was formed by Drs. Jorge A. Delgado, Ronald F. Follett, James Schepers, Marvin Shaffer, and Jack Meisinger to organize topics related

to nitrogen management and identify experts in the field who made initial presentations at the SWCS and SSSA annual meetings. Drs. Delgado and Follett then followed up with the authors as needed to update the book, by incorporating new topics such as the Nitrogen Trading Tool/carbon sequestration equivalent tool, and completing the publication.

This book begins with a chapter that explores the "Environmental and Human Impacts of Reactive Nitrogen" (Chapter 1). This chapter presents the basic information on management of the fate and transport of reactive nitrogen to minimize its negative impacts on the environment and human health. Chapter 2, "Water Management: A Key to Reducing Nitrogen Losses," describes how water management for irrigation systems can potentially be implemented to reduce nitrogen losses while optimizing water and nitrogen inputs for economically and environmentally sustainable agriculture. Chapter 3, "Nitrogen and Drainage Management to Reduce Nitrate Losses to Subsurface Drainage," complements the information in Chapter 2 and further explains the management of the water and nitrogen cycles. This chapter examines how the management of drainage can be incorporated into an overall conservation plan to significantly increase nitrogen use efficiencies. Chapter 4, "Integrated Nitrogen Management," describes an approach to reach the desired production levels for most farms. This chapter describes how the efficient use of N is a fundamental agronomic goal, one that needs to consider crop physiological factors, type of fertilizers, fertilizer application methods, and other key factors to ensure global food production occurs an environmentally sustainable manner that maximizes resource use efficiency.

Chapter 5, "Nitrogen Budgets for Agricultural Policy and Farm Management," can be used as a tool for assessing farms across regional and national jurisdictions and different agroecosystems with a uniform standard. Nutrient management plans should incorporate soil organic matter management and carbon sequestration, and Chapter 6, "Organic Nitrogen Systems in the United States," covers this important point. New technologies such as those discussed in Chapter 7, "Precision Farming for Nitrogen Management," have the potential to increase the effectiveness of nitrogen management practices. The new technologies discussed in this chapter can be used as precision conservation and reduce N losses across space and time. Chapter 8, "Nitrogen Sensors to Fine Tune the Nutrient Management Decision Making Process," can contribute to advanced in-season nitrogen management strategies to improve the synchronization of nitrogen sources and nitrogen sinks in space and time.

Chapter 9, "Using Cover Crops and Cropping Systems for Nitrogen Management," describes a management tool with the goal of optimizing cropping sequences to increase nitrogen use efficiencies, economic returns, and yields, all while improving soil quality and minimizing nitrogen losses. Using cropping systems and cover crops can also serve

as strategies for improving soil quality, increasing soil carbon sequestration and reducing erosion. Chapter 10, "Use of Buffers to Reduce Sediment and Nitrogen Transport to Surface Water Bodies," discusses a management strategy that can be used to remove nitrogen from surface waters, specifically how buffers and riparian buffers can be used to protect streams, lakes, and wetlands by filtering polluted overland and subsurface flow from adjacent agricultural fields. Chapter 11, "Evaluation of Best Management Practices Across Regions of Argentina and Spain," shows that management principles across other regions in other continents are similar to those discussed for North America (US, Canada). This chapter also shows how nitrogen management in other regions of the world is important to reducing worldwide nitrogen losses that could contribute to impacts on our biosphere.

Chapter 12, "Nutrient Credit Trading—a Market-based Approach for Improving Water Quality," looks at an approach that has recently been developed by the USDA Natural Resources Conservation Service (NRCS) in cooperation with USDA Agricultural Research Service (ARS) to implement assessments of nitrogen management. This chapter suggests that water quality trading could lead to a beneficial situation for all involved in the process and discusses the Nitrogen Trading Tool, which was recently developed by the USDA NRCS-ARS cooperation to facilitate this process. In Chapter 13, "Simulation Processes for the Nitrogen Loss and Environmental Assessment Package," algorithms are presented. Chapter 14, "New Tools to Assess Nitrogen Management for Conservation of Our Biosphere," covers how new tools and concepts such as NLEAP-GIS, Nitrogen Index, and Nitrogen Trading Tool can be used for increasing nitrogen use efficiencies and reducing atmospheric, surface and leaching losses of nitrogen. Additionally, this chapter looks at the new concept of using nitrogen trading tools to assess the potential of new best nitrogen practices to reduce emissions of N_2O and the potential to trade these reductions in carbon sequestration equivalents markets. Chapter 15, "A Tiered Approach to Nitrogen Management: A USDA Perspective," describes the concept of using a tiered approach to assess nitrogen management. A Tier One approach can be used, where a simple tool such as a nitrogen index is used to conduct a qualitative/quantitative assessment of nitrogen management, similar to the phosphorus index approach. A Tier Two approach requires a more complex evaluation that can be conducted using a simple model such as NLEAP-GIS 4.2. A Tier Three level tool is a more complex research model that, if needed, could be used to assess the effects of nitrogen management across risky landscape and crop management combinations throughout the US.

The USDA NRCS has developed policy and conservation practice standards for planning and implementing nutrient management. This book presents important information on the subject of nitrogen management. Several management practices and principles presented in

this book can be applied across continents and/or regions and show that nitrogen use efficiencies can be increased while maintaining agricultural production levels. Several available models and tools can assess nitrogen management; this book covers a few of the new tools and concepts that can be used to evaluate nitrogen management practices and ultimately to increase nitrogen use efficiencies. This book covers practical applications of new concepts that can be used to improve conservation practices, such as precision conservation (also known as target conservation) in nitrogen management. Finally, this book covers recent advances that will contribute to improvements in nitrogen management for the conservation of water quality and our biosphere. We hope that readers will find this work an invaluable reference on these topics and are confident that they will find it a thorough and timely volume.

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