

Rattan Lal · Bruce Augustin *Editors*

Carbon Sequestration in Urban Ecosystems

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Foreword

Urbanization, a principal land use during the twenty-first century, is an anthropogenically driven and a rapid transformation of ecosystems. While more than 50% of the world's population already lives in urban centers, urban encroachment of prime farmlands is caused by a rapid population growth. By 2050, as much as 69% of the world population may live in urban centers. It is estimated that providing accommodation and the supporting infrastructure to one million people requires 40,000 ha of land. Thus, the estimated global population growth rate of 70–80 million people per year needs an additional land area of three million hectares (Mha). Total land area in urban centers in the U.S. is estimated at 24 Mha or 2.62% of the total land area. Such a rapid urbanization has also increased demand for natural resources, with a large ecologic foot print. Further, continued loss of prime farmland may exacerbate food prices, create agricultural shortages across the world, and lead to food price inflation. Urban encroachment has numerous social, economic, political and ecologic implications, including reduction in ability of agroecosystems to produce adequate amount of food and fiber for the ever increasing world population.

Megacities and growing urban centers also use numerous resources including energy, minerals, transport fuel, water and food, and generate a large amount of waste. This drastic ecologic transformation and consumption of natural resources is a principal anthropogenic driver of global change including the global warming. Of the total earth's ice-free land area of 11.3 billion ha, about 3% (338 Mha) is under urban land use. However, these areas are major sources of emission of greenhouse gases. Yet, judicious management and restoration of urban ecosystems can off-set some anthropogenic emissions and also generate essential ecosystem services.

Urban centers consist of build up areas (under buildings, concrete and asphalt) and also green areas (under lawns, shrubs, trees, forests and agriculture or horticultural gardens). While efficient use of energy, water, and minerals in build up areas is extremely important, sustainable management of green areas is essential to restoring the ecosystems C budget. Improved management of green areas can sequester C in the above and below-ground biomass, increase soil organic C pool and improve its depth distribution in favor of translocation of C into the sub-soil layers, reduce emissions of N_2O and CH_4 , and off-set some anthropogenic emissions.

It is argued that the twenty-first century is the Century of the Cities, because of their major impact on global process and significant issues of the twenty-first century. Therefore, a workshop was organized at the campus of The Ohio State University (OSU) entitled, "Carbon Sequestration in Urban Ecosystems" on 14th April 2010. Jointly organized and sponsored by OSU and Scotts Co., the workshop was attended by about 50 participants from around the country. This volume is based on papers presented at the workshop. In addition, some other renowned researchers/authors were invited to contribute additional chapters to address regions or themes not covered by the workshop participants. Principal objectives of the workshop, and of this volume, are to:

- Assess the effects of urbanization on national and global C pools and fluxes,
- Determine credible estimates of C pool and fluxes in turf grass, home lawns, urban agriculture and gardens, urban forests and trees and other land use,
- Evaluate the role of turf grass and lawns on emissions of greenhouse gases (CO_2 , CH_4 , N_2O),
- Study coupled cycling of C with that of H_2O , N, P, etc. in relation to soil quality in lawns and turf grass systems,
- Identify best management practices for diverse land uses within urban green spaces,
- Develop strategies which promote adoption of best management practices to enhance sequestration of C within green areas of urban ecosystems, and
- Identify management systems which reduce emissions of greenhouse gases from urban land systems, and enhance use efficiency of inputs.

These objectives have been summarized into some basic questions which need to be addressed. Some important questions are:

- How much and by what processes does the urbanization influence the global carbon cycle?
- What is the quantitative estimate of diverse green areas (i.e., lawns, turfs, forests, agriculture) in urban centers, and how can the green areas be sustainably managed?
- How does management influence C budget of the "green city areas" within urban ecosystems?

The 19-chapter volume specifically addresses the objectives and question listed above. Specific topics addressed include: (i) adapting urban land use to climate change, (ii) managing urban forests and lawns to sequester carbon, (iii) assessing C pools, and gaseous fluxes in urban ecosystems, and (iv) promoting urban agriculture.

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Columbus, OH

Rattan Lal
Bruce Augustin

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