Crop Growth Simulation Modelling and Climate Change

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About the Editors

M. Mohanty: A renowned soil scientist, Joined Indian Institute of Soil Science, Bhopal (ICAR) as Soil Physicist in the year 1999 after completing post graduate studies in soil science from IARI, Pusa New Delhi. Worked extensively in the areas of tillage and crop residues management in rice-wheat region in vertisol, climate change, soil quality and published more than 40 research articles in International Journals of high impact factors. He has published three books and many research bulletins and has more than 40 books chapters to the credit. He has published the work in many journal of international repute like Ecological Modelling, Agricultural Ecosystem and Environment, Soil and Tillage research and many more. Recently he was awarded with FAI award for his excellent works on nutrient management in wheat crop of central India.

Dr. Nishant K. Sinha: Agricultural Physicist. Recently, he is working as scientist in the division of Soil Physics, Indian Institute of Soil Science, Bhopal, Madhya Pradesh. He has published 20 research papers in peer reviewed journals and authored 3 books. He also has good expertise in crop root dynamics, crop simulation modelling and water productivity.

Dr. R.S. Chaudhary: Principal Scientist and Head of Division at Indian Institute of Soil Science, Bhopal. He has worked on various research tasks of soil and water conservation, water-shed development, catchment survey and planning, efficient management of water and nutrients, soil surface manipulations, conservation tillage, land configurations, and quantifi-cation of runoff and soil losses, in various soils and cropping systems of India. As enthusiastic researcher and critical reviewer he has a number of research papers in national and international journals, book chapters, review articles, popular articles, and bulletins to his credit. Presently be is involved in the research projects on conservation agriculture, climate change, assessment of soil quality and soil resilience.

Dr. K. M. Hati: Soil Scientist with Specialization in Soil Physics. Presently he is working as Principal Scientist at IISS, Bhopal in the Division of Soil Physics. He has more than 20 years of experience in research and training in the field of Soil Physics, remote sensing and conservation agriculture. During his period of service he has worked on conservation agriculture, carbon sequestration mechanisms, soil quality, water and nutrient dynamics. He also worked on application of remote sensing principles for improving input use efficiency. He published more than 30 peer reviewed research papers in international and 20 papers in national journals of repute. Besides this, he also authored 3 books, 15 book chapters, 10 review articles and 6 papers in national and international conference proceedings.

Dr. Ashok K. Patra: Director of the Indian Institute of Soil Science, Bhopal. He was a recipient of the prestigious INRA Fellowship (2001-2003) of the French Research Ministry to work on molecular soil ecology in N cycling at the CNRS-Claude Bernard Université Lyon, France. He has contributed more than 200 publications, which has been widely cited throughout the world. He was a faculty of Post Graduate School, IARI, New Delhi and actively involved in teaching and guiding of postgraduate students at IARI for 15 years (1999-2014). He is a recipient of several awards/recognitions and fellowships, namely: British Council TCT Award 1996; DBT Overseas Associateship Award 2008; FAI Dhiru Morarji Memorial Award, 2011; Bharat Jyoti Award, 2012; Rajiv Gandhi Excellence Award, 2012; ISSS Dr. G.S. Sekhon Memorial Lecture Award, 2012 of ISSS, New Delhi; Hooker of IARI (2013), New Delhi. Dr. Patra was Editor, Range Management and Agroforestry 1996-1998; Councillor, Indian Society of Soil Science (2005-2006); President (Delhi Chapter), Indian Society of Soil Science (2012-14); Member, Nature's Reader Panel (2009). He served as expert of several important committees and acted as reviewer for more than 25 international journals. Dr Patra is a Fellow of the National Academy of Agricultural Sciences, Indian Society of Soil Science and Range Management Society of India.

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Preface

Profitable crop production to cater to the needs of the growing population with the simultaneous maintenance of quality of the environment in the face of degradation of natural resources under climate change scenario has become a great challenge that agricultural scientists and producers must address in recent days. The anthropogenic enrichment of GHGs in the atmosphere and the cumulative radiative forcing of all GHGs has led to an increase in the global surface temperature of 0.6ºC since 19th Century with the current warming rate of 0.17ºC/ decade (IPCC, 2001), which is higher than the critical rate of 0.1ºC/decade leading to climate change. It has been reported that agriculture contributes to 28% of the global GHG emission. Climate change through its climate variability and climate forcing not only affects crop production but also affects the movement of water and nutrients in soil-plant-atmosphere continuum (SPAC). Crop growth models integrate the effects of soils, weather, management, genetics, and pests on daily growth, and can be used to gain insight into spatial and temporal yield variability. With the help of simulation models, it is possible to simulate various aspects of climate change in crop production. Thus, a crop growth simulation model not only predicts the final state of total biomass or harvestable yield, but also contains quantitative information about major processes involved in the growth and development of a plant and various processes taking place in soil-plant system. These processes govern the utilization of agricultural inputs like water and nutrient and ultimately the crop productivity. It is imperative to understand the various physical processes involved and assess the fluxes of SPAC to manage them efficiently for achieving higher resource use efficiency and sustaining agricultural Productivity at higher level. Crop growth simulation models can help in understanding this complex system and taking critical decisions with respect to improving resource use efficiency under diverse soil and agro climatic situations and management scenarios.

Keeping this in view, the editors have bought out this book on "**Crop Growth Simulation Modelling and Climate Change**". A group of authors have dealt with different aspects of crop modelling viz., Crop

growth simulation models in agricultural crop production, Applications of Crop Growth Simulation Models in Climate Change Assessments, Biophysical impacts and priorities for adaptation of agricultural crops in a changing climate, Climate change projections – India's Perspective, Impact of Rising Atmospheric CO_2 concentration on Plant and Soil processes, Modelling the impact of climate change on soil erosion in stabilization and destabilization of soil organic carbon, Simulating Crop Yield, Soil Processes, Greenhouse Gas Emission and Climate Change Impacts with APSIM, InfoCrop Model, CropSyst model and its application in natural resource management, Climate change and crop production system: assessing the consequences for food security, A biophysical model to analyze climate change impacts on rainfed rice productivity in the mid-hills of Northeast India, AquaCrop Modelling: A Water Driven Simulation Model, Conservation Agriculture: A strategy to cope with Climate Change, Effect of climate change on productivity of wheat and possible mitigation strategies using DSSAT model in foot hill of Western Himalayas, Integrating Remote Sensing Data in Crop Process Models, Climate change impact assessment using DSSAT model, Decision Support System for Managing Soil Fertility and Productivity in Agriculture, De-Nitrification De-Composition Model - An Introduction for SOC Simulations, Crop Simulation Modeling for Climate Risk assessment: Adaptation and Mitigation Measures and Rules of Simulations, Rothamsted Carbon (RothC) Model and its Application in Agriculture etc.

The editors are grateful to Dr A.K. Patra, Director, Indian Institute of Soil Science, Bhopal for his guidance and encouragement in bringing out this publication. The editors are thankful to all the authors who have contributed for this book. Information collected from various sources (published and unpublished) has been duly acknowledged.

It is believed that this book will prove useful for the scientific communities and policy makers, for whom it is intended. Authors look forward to receive suggestions for improvement of the book.

March, 2015 **Editors**

IISS, Bhopal

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