Genesis and Management of Sodic (Alkali) Soils

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Dr. S.K. Gupta (Ph.D., FNAE, FAAS, FISAE and FISSRS), (b. 1949) obtained Ph.D. in Civil Engineering and superannuated from the position of Project Coordinator, AICRP on Management of Salt Affected Soils and Use of Saline Water at Central Soil Salinity Research Institute, Karnal. He has been associated in developing irrigation water management technologies, surface and subsurface drainage and eco-friendly strategies for disposal and reuse of saline/waste waters. He has been an international consultant to UNDP through WAPCOS and Ethiopia. He has guided 14 M. Tech. and 4 Ph.D. students. He has contributed 140 papers in referred International and National journals, besides writing 13 books. He is recipient of the prestigious Rafi Ahmad Kidwai Award of the Indian Council of Agricultural Research (ICAR) and is the Chief Editor of the Journal of Water Management.

Dr. I.C. Gupta (b. 1941), was awarded Ph.D. on a subject thesis of environmental soil science by CAZRI/University of Jodhpur in 1968. He worked at Central Soil Salinity Research Institute from 1970 to 1986 (Principal Scientist). Dr. I.C. Gupta served Central Arid Zone Research Institute from 1986 to 2001 where he worked as Head of Regional Research Station, Bikaner and Head, Division of Natural Resources and Environment. A Fellow of Indian Water Works Association, United Writers Association of India & Indian Society of Salinity Research Scientists, Dr. Gupta was elected Vice-Chairman of Arid Zone Research Association of India. He has been working as Secretary of Indian Society of Salinity Research Scientists & Chief Editor Current Agriculture since 1977. Dr. Gupta had been conferred several awards notable being Glaxo Scientific Honours Club, Dr. Rajendra Prasad Puraskar, First Prize, Outstanding Book Award by ISAE, Dr. Gorakh Prasad Puraskar First Prize, S.P. Unvala Memorial Prize by IWWA and Life Achievement Award by IARS. He was nominated as member of the 'Environment Conservation Council of Rajasthan' and of 'Special Committee on Environment Impacts' of INCID, Ministry of Water Resources, Govt. of India. He has about 250 publications including 30 books and two inventions (Jaltripti and Jalshuddhi).

Dr. Gupta was appointed Ph.D. examiner by ten universities. He was also nominated for one of the most INTRIGUING PEOPLE of 2003 by American Biographical Institute, North Carolina, USA, after close scrutiny of biographical archives of over one million individuals.

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PREFACE

Salinity is an age old problem with catastrophic consequences. Civilizations in southern Mesopotamia and Tigris–Euphrates valley were wiped out as a result of widespread problems of water logging and soil salinity. Magnitude of damages being reported in the Aral Sea Basin is the living example of how things go wrong in the absence of proper land and water management practices in irrigated agriculture. Other basins in Australia, China, India, Pakistan and the United States are also grappling with salt related land and water degradation, making these problems global issues that extend to more than 100 countries. As per an assessment of the FAO - Land and Plant Nutrition Management Service, more than 6% of the world's land and 20% of the irrigated lands are afflicted with water logging and/or soil salinity, the latter often characterized as saline and sodic. In India also, current state of the land and water resources has been worrying all the stakeholders considering precarious nature of the food security achieved so far and in view of the recently enacted 'Food Security Bill". To ensure food for all, India needs to produce significantly more food grains to meet the requirements envisaged in the bill. Since twin problems of water logging and soil salinity have emerged as the major abiotic stresses, it has worried the Ministry of Water Resources, Ministry of Agriculture and other organizations connected with natural resources management. It is assessed that if the 'Business As Usual' approach continues, area under water logging and soil salinity by 2050 may treble to 20.0 million ha from the current level of 6.73 million ha, 3.77 million ha sodic and remaining being saline in nature. Amongst the two, soil sodicity has always been considered complex because basic principles of the problem were not understood until recently. It is why, reclamation and management of sodic soils has been considered difficult.

Soil and water salinity including sodic land and water adversely affect farm, regional and national interests that spirals into food security, land and water quality and environmental implications resulting in serious economic and social problems. Considering the looming food security crisis of the 2050, no let-up can be allowed in our efforts to understand the behavior of salt affected lands, salt tolerance mechanisms in crops, develop new technologies and apply the existing ones for prevention, living with salts and/or sustainable land reclamation programs. It calls for an inter-disciplinary approach drawing knowledge and experiences of the experts from soil science, agronomy, engineering, hydrology, other water sciences, plant sciences, environmental sciences, modeling and computer sciences.

CSSRI in its initial years of inception came out with the sodic land reclamation technology in the form of an integrated package and extended the same to the stakeholders. The state governments besides adopting the technical solutions supported the endeavor by framing enabling policies as a result of which significant headway could be made in addressing the sodic problem scene in the country. Current estimate suggests that nearly 2 million ha of sodic lands have been reclaimed by 2015 in various states led by Uttar Pradesh, Punjab and Haryana. In spite of this impressive record, the pace of reclamation so far is much below the expectations as CSSRI estimates show that salt affected areas are likely to increase in future. Therefore, concerted efforts to prevent further degradation and reclamation of already degraded sodic lands need to be strengthened including publications of literature for various stakeholders involved in land reclamation.

To prepare this publication, the authors made a comprehensive review of the current status of sodic land reclamation scene in India and around the globe and extracted relevant information across disciplines. While latest information/ technologies are included, references to old information are highlighted since these provide a treasure of scientifically generated information having lot of application potential. Since the book specifically addresses the sodic soils, technologies are segregated to include that specifically deal with this issue although important issues related to soil salinity in general are included. The technologies included are discussed in a self explanatory manner so that field officers and workers can learn about the practical aspects of these technologies. We have also included many issues that are in the course curricula of various universities related to salt stress management. All the chapters have been categorized to deal with a specific issue. Since formation of sodic soils is also governed by the use of sodic water, a special chapter is included that deals with the management of sodic water to get optimum productivity without impacting the soil health. Since the publication gives the readers a holistic picture of reclamation and management of sodic soils, it should cater to the needs of those interested in soil/water sodicity-plant-environment interactions.

The authors believe that this publication should prove to be a valuable reference for all professionals that are associated with soil salinity management research, professional training institutes, technical agricultural centers, irrigation research centers, agricultural extension service and other agencies. Knowledge gained through this publication should help various stakeholders in taking effective and integrated remedial actions as per local needs to eradicate the menace of soil sodicity. Although, most aspects of sodic land management are included, we do not claim that every issue on the subject has been covered in this publication. We would welcome any feedback and suggestions/comments from the readers so that the same can be incorporated in future editions of this publication.

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