

**Proceedings**  
**of**  
**Golden Jubilee International Salinity Conference-2019 on Resilient**  
**Agriculture in Saline Environments under Changing Climate: Challenges**  
**& Opportunities at Karnal, India during 7-9 February 2019**

The *Golden Jubilee International Salinity Conference (GJISC)-2019 on Resilient Agriculture in Saline Environments under Changing Climate: Challenges and Opportunities* jointly organised by Indian Society of Soil Salinity and Water Quality (ISSSWQ) and ICAR-Central Soil Salinity Research Institute, Karnal in association with Indian Council of Agricultural Research (ICAR), New Delhi was inaugurated at Central Soil Salinity Research Institute, Karnal (India) on 7<sup>th</sup> February 2019. His Highness Engineer Wasafi Hassan El-Sreihin, Secretary General, AARDO was the Chief Guest and Dr. Masa Iwanaga, President, JIRCAS, Japan chaired the Inaugural function. While welcoming the delegates, Dr. P.C. Sharma, Director, ICAR-CSSRI and President, ISSSWQ gave the overview of International Salinity Conference and of the Institute. He informed that the Institute was established on 1<sup>st</sup> March 1969 and we are celebrating the 50<sup>th</sup> year of its establishment and the International Conference is the part of that. He expressed gratitude that very senior dignitaries in the field of Natural Resources Management, especially salinity management were part of this conference. Dr. Ismahane Elouafi, Director General, ICBA, Dubai; Dr Tomio Shichiri, FAO Representative, New Delhi; and Dr. SK Chaudhari, ADG (SWM), ICAR, New Delhi also shared their views on this occasion. Other senior dignitaries- Dr. Gurbachan Singh, Former Chairman, ASRB; Dr. NK Tyagi, Former Member, ASRB; Dr. PS Minhas, Ex-Director ICAR-National Institute of Abiotic Stress Management, Baramati; Dr. JC Dagar, Former ADG (A&AF), ICAR, New Delhi; Dr. J.D. Oster from USSL, California, USA; Dr. Weicheng Wu, East China University of Technology, Nanchang, China; Dr. Ramesh Yadav, Chairman, Haryana Kisan Aayog, Panchkula; Dr. A.K. Patra, Director, ICAR-IISS, Bhopal; Dr. SS Khanna, Former Advisor, Planning Commission; Dr. D Sadamate, Former Advisor, Planning Commission; Dr. D.K. Sharma, Ex-Director, ICAR-CSSRI; Dr. N.P. Singh, Director, ICAR-NIASM, Baramati and Directors of local ICAR Institutes. In total 275 participants from different research institutes and universities of 17 countries participated in the conference. Dr. R.K. Yadav, General Secretary, Indian Society of Soil Salinity and Water Quality presented the vote of thanks to all the dignitaries.

After the Inaugural function, a **Special Session** was organized, which was chaired by Dr. Ismahane Elouafi, Director General, International Centre for Bio-Saline Agriculture (ICBA), Dubai, UAE and co-chaired by Dr. NP Singh, Director, ICAR-National Institute of Abiotic Stress Management (NIASM), Baramati, India. Dr. SK Chaudhari, ADG (S&WM), ICAR and Dr. RK Singh, Program Leader on Crop Diversification & Genetics, ICBA were two key speakers. They delivered talks on (i) Soil health management in India: issues, policies and way forward, and (ii) Crop improvement approaches for salinity and drought tolerances including ICBA's Vision. The main points emerged from discussions in this session are as follows:

- Comprehensive soil health management policy based on ecological approach may be adopted in the country and incentives for balanced fertilization may be taken on priority.
- Assessment of water requirement in agriculture for current and future use vis-a-vis its availability including groundwater may be taken up through modelling supported by sensor/ proximal/remote sensing based technologies.

- National and international networks among different research institutions working in the field of salinity management including ICBA may be established for collaborative research partnership to promote exchange of knowledge and technologies for solving salinity problems in different regions of the World.

This session was followed by **Panel Discussion on Salinity Management under Changing Climate Scenario**. The session was chaired by Dr. Masa Iwanaga, President, JIRCAS, Ohwashi, Tsukuba, Japan and co-chaired by Dr. J.D. Oster, Former Director, US Salinity Laboratory, California and presently Soil & Water Expert at California University. Drs Ismahane Elouafi, Wassfi Hassan EI-Sreihin, Gurbachan Singh, N.K. Tyagi, and N.P. Singh were the panelists. The following points emerged from the discussion are as follows:

- There is need of conversion of appropriate ideas and approaches for salinity and sodicity management into standard practices under climate change scenario. Reclamation of salt-affected soils need to be taken up through all feasible methods including use of new amendments, nano-science based technologies and other modern approaches on priority basis.
- In the scenario of climate change, domestication and development of new salt tolerant crops, multi-enterprise, conservation agriculture and precision farming must be adopted for saline environments.

This was followed by two concurrent **Technical Sessions**. The **Session-I** was on theme “**Drivers and Diagnostic Criteria for Soil Salinity Assessment and Mapping**”. It was chaired and co-chaired by Dr. MS Bajwa, Ex-Dean, PAU, Ludhiana; and Dr. P.S. Minhas, Ex Director, NIASM, respectively. There were 8 speakers in this session which included Weicheng Wu, Raj Setia, Dharmesh Verma, Suresh Kumar, A.K. Mandal, M. Mohanty and A.K. Rai. They talked on variety of subjects including salinity mapping by optical and radar remote sensing and using remote and proximal sensing techniques; geo-informatics in mapping and monitoring reclamation; hyperspectral remote sensing for characterization and mapping; and application of spectroscopy for soil quality assessment. The main points of discussion included:

- Use of hyperspectral remote sensing can help not only in delineation of salt-affected soils but also characterize the presence and concentration of salt type. Hence it will be more useful for mapping.
- L-band radar data is useful for salinity mapping and modelling in deeper soil layer.
- Soil salinity is dynamic in nature and its assessment using RS, GIS and proximal sensing along with ground truth and laboratory analysis should be carried out on regular basis for sustainable management of SAS.
- Soil solution indices can also play important role in determining gypsum requirement of sodic soils, hence pH based calculation of gypsum requirement needs re-visit.
- Coordination between national satellite programmes and users such as national/ state remote sensing agencies is required for real time monitoring and assessment of SAS in the country.

**The Session-II** was on **Stakeholders’ Perspectives and Technology Implementation**. This session was chaired by Dr. Gurbachan Singh and Co-chaired by Dr NP Singh. The Panellist were Dr. Prakash Kumar, Reliance Technology Group, RIL Ltd. Mumbai; Dr. Ramesh Yadav, Chairman, Haryana Kisan Aayog; Dr. Rajbir Singh, Director ICAR-ATARI, Ludhiana; Dr. Kuldeep Gautam, Joint Director (Soil Conservation), Govt of Haryana; Mr. SG

Joshi, GM, Rex Polyextrusion Pvt Ltd, Sangli; Mr Mark Vandergaag, GM, Inter-Drain China Ltd and Mr. VVS Dhillon, Director, Dutch Sub-Surface Technology (DSST), Mohali. Fourteen farmers from Haryana, Punjab, Uttar Pradesh, West Bengal and Gujarat also participated in discussion. Based on the deliberations, the following points emerged are as follows:

- Supply of sufficient amount of quality gypsum at concessional price must be ensured to the farmers through efficient institutional mechanism. Research on identifying remunerative alternative amendment(s) is urgently required.
- Better participation of farmers, preferably through farmers' societies is the need of the day for large scale implementation of sub-surface drainage programs.
- Timely availability of quality and certified seeds of salt tolerant crop varieties in sufficient quantities in the targeted areas must be made available through public, public-private partnerships including NGOs.
- Policies for sustainable use of soil and water resources under crop intensification are needed. Policies of canal water supply allocations need rethinking and incentives are to be ensured to farmers who adopt sustainable practices such as less water requiring crops, agroforestry, efficient irrigation system, etc. which help in prevention of soil salinity problem.
- Crop diversification involving animal and allied sectors (e.g., perennial fruit and agroforestry) along with emphasis on value addition is needed for sustainable income from degraded lands and for strengthening farmers' livelihoods. Better coordination among stakeholders (e.g. farmers, policy makers and developmental agencies) and their capacity building, and aligning them with the existing policies for better outcomes are the urgent needs of the day.

**Day-two** started with two concurrent sessions (Sessions-III and IV). The **Session III- Saline Agro-Ecosystem Impact and Management of Soil and Crops** was chaired by Dr. PS Minhas and co-chaired by Dr. AK Patra. There were nine presentations and following researchable issues emerged are as follows:

- To explore the scope of organic amendments such as by-product of sugar mills as alternate to gypsum, low input sustainable agriculture (LISA), and also bioremediation and phytoremediation as priority areas of research.
- Enhancing soil health and agricultural productivity through advanced approaches.
- Guidelines for sub-surface drainage and cost analysis for reclamation of waterlogged saline soils.
- Application of "Cut-drain" technology followed in Japan may be thought for benefit of farmers.
- To find out feasibility of applicability of modified Roth-C model for salt- affected soils

**The Session-IV on Saline Agro-Ecosystem Impact and Management of Water and Environment** was chaired by Dr. NK Tyagi and co-chaired by Professor Weichung Wu and Dr. DK Sharma. There were eight papers and the following issues were flagged as follows:

- There is need of developing understanding on potential impacts of water supply and demand under climate change at project/groundwater basin/river basin level and its implications on the hydrological system, soil and groundwater salinity with associated crop yields.

- In view of the growing risk of secondary salinization of streams and aquifers, it is important that economic evaluation of salinity-imposed assets is needed. Salinity accounting at farm, watershed/irrigation project/ groundwater basin should be initiated forthwith.
- Most of the agro-hydro-salinity models do not include economics as part of their structure. There is need to add economic concepts in water resource management models through hydro-economic modelling.
- Coastal areas face grave risk due to sea level rise under climate change as well as due to intensified anthropogenic activities leading to loss of their bio-diversity. Database on increase in stream /estuary salinity due to sea level rise and climate change in coastal region needs strengthening.
- In coastal areas, safe groundwater abstraction levels, location and depth of well, location of recharge facility etc, and management practices need to be established using saltwater intrusion management models.
- Develop agro-techniques for high value cash crops in reclaimed sodic soils with emphasis on developing sub-soil sodicity management modules.
- Identification and evaluation of alternate reclamation amendments is needed along with developing regional and national guidelines for their application in agriculture.
- Transient state models need to be developed and standardized to estimate real-time root zone salinity and leaching requirements within cropping season.

These sessions were followed by the **Session-V (Advances in Crop Improvement for Salinity Tolerance)**, which was split into two concurrent sub sessions. The First sub-session was chaired by Prof Rameshwar S. Kanwar, Iowa State University and co-chaired by Dr. Yash Dang, Univ. of Queensland, Australia and Dr. Jaya Kumar Bose, University of Adelaide, Australia while the second sub-session was chaired by Dr. Ashwani Pareek, JNU, New Delhi and co-chaired by Dr. Girisha K. Ganjagunte, Texas Agrilife Research, USA. In total, there were 11 papers on different aspects of crop improvement under salinity stresses. The following issues were flagged in these sessions:

- There is need to use genetic manipulations to improve nutrient use efficiency of the crop genotypes under salt stress environments.
- Physiological traits like relative electron transport rate (rETR), Fv/Fm, O<sub>2</sub> evolution during photosynthesis and charge balance between PS-I & PS-II should be given due consideration for breeding salt tolerant genotypes.
- Wild progenitors and halophytes are good source the new genes for salt tolerance, which can be mined through next generation sequencing/ map based cloning and validation with conventional breeding approaches for utilization in the crop improvement.
- Reverse genetic concept is the best option to identify and enhance the salt tolerance in crops. Development and identification of Micro RNA for salt tolerance in wheat with development of SSR markers for these salt responsive miRNAs can be used to enhance the salinity tolerance in crop plants.
- Identification of salt responsive genes in unexploited halophytes to be used for enhanced salt tolerance in major crop plant. Utilization of salt responsive genes, developing markers and their utilizations in introgression of QTL/genes in crops.

During the **Session-VI (Alternate Land Use Systems for Saline Environment)** chaired by Dr. JC Dagar and co-chaired by Professor Sharda Gupta, there were in total 5 presentations. The following researchable points emerged from this session are as follows:

- Domestication of valuable halophytes such as *Salicornia (Salicornia europaea/bigelovii)*, *Chenopodium (Chenopodium album)*, *Moringa (Moringa oleifera)* and many others with developing standard agro-techniques for their productive cultivation on salt-affected soils.
- Promotion of high value tree species and their clones, with understanding of water salinity in root-zone and tree-crop–microbes interaction for increasing farmers' income in saline and waterlogged environments.
- Working out the size of tree-belts for efficient control of seepage along canals and waterlogging in farmers' fields
- Energy budgeting and evaluation of environmental benefits of different agroforestry systems and promotion of peri-urban agroforestry for climate change mitigation.
- Quantification of greenhouse gases and other organic volatile chemical compounds released from forests and agroforestry systems and to assess their role under climate change.
- Assessing role of VAM in carbon sequestration in biosaline agroforestry systems and understanding mechanism of carbon protection in the soils.
- Bio-remediation of sodic soils through silvi-pastoral system and microbial intervention.
- Developing climate smart agroforestry models for carbon sequestration and ecological restoration of salt-affected soils.
- Value addition of agroforestry tree products growing in salt-affected soils along with market linkages.
- Promotion of shrimp farming in inland saline water along with agroforestry systems. There is need to develop market linkage, establishment of processing industry and developing commercial products from shrimp.
- Identification of root stock and trial of varieties of potential salt-tolerant fruit trees
- Promotion of solar-based farming systems as an alternative practice in degraded saline environment.

**The Session-VII (Climate Resilient Approaches for Sustainable Productivity)** was chaired by Dr. SS Khanna and Co-chaired by Dr. CL Acharya. Four lead speakers presented their papers on various aspects related to conservation agriculture and climate change. The following points were flagged:

- Conservation agriculture (CA) based farming could face the challenges posed by climate change especially extreme weather events like heavy downpour induced waterlogging in the region, and this is also the solution for crop residue burning, and for improved crop and land productivity by enhancing energy and water use efficiency
- For water limited ecologies, diversified cereal-legume system is an approach which would work well. CA based management has small footprints and diversification with CA provides better options for sustainable intensification
- Single technology may not be of help, so a multi-tier approach is better with diversification with legumes.

- Mechanization is an integral part of conservation agriculture. Happy seeder has brought in CA revolution in Punjab and Haryana states.
- A step further, marrying CA with smart irrigation/fertigation using subsurface drip provides better management, efficiency and increased yields.

**The Session-VIII (Integrated Approaches for Livelihood Security under Salinity and Climate Threats)** was chaired by Dr. JS Samra and co-chaired by Dr. SK Gupta. The points emerged from 8 presentations are as follows:

- Climate-cropping system interactive models may be useful tools to indicate the effect of climate change on farmers' livelihood security and to develop climate resilient agro-interventions to prepare farmers to mitigate the challenges of climate change.
- Resilient agro-technologies for salt-affected black soils under rainfed environments may be adopted with alternative livelihood and agri-business models to ensure livelihood security for farmers in the Purna river valley in Maharashtra and similar other river valleys.
- Inland saline aquaculture may be a viable option for doubling farmers' income from waterlogged saline soils in the country where no drainage outlet is available and environmental clearance guidelines are met.

*There were daily Poster Sessions, in which posters of different specified themes (specific to different seasons) were displayed. In total, 243 posters were included. The Best poster for each session (2) was awarded.*

**The Closing (Plenary) Session** was chaired by Prof. Ramesh Chand, Hon'ble Member, NITI Aayog. The recommendations of different technical sessions were presented and some publications were released on this occasion. In his welcome address, Dr. PC Sharma, Director, ICAR-CSSRI briefed about the success of the conference and about different technologies developed by the institute. Prof. Ramesh Chand congratulated ICAR-CSSRI and ISSSWQ for organizing the Golden Jubilee International Salinity Conference- 2019 and complimented the institute for its illustrious journey of 50 years for developing technologies/techniques for productive use of salt-affected areas and turning these into productive resource. He also warned that there are huge challenges ahead, especially at a time when natural resources are shrinking at a rapid rate and food demands are growing and diversifying and the climate is abruptly changing. He exhorted the salinity fraternity for ensuring productive use of marginally salt-affected soils for premium crops and suggested that major emphasis should be on potential fruit and agroforestry species. He pointed out that due to scarcity of good quality of water, agricultural sector will suffer the most and only option will remain to use available marginal quality water resources. Stubble burning of rice is major issue which needs to be managed by developing technology to decompose biomass in the field itself. He said that integrated farming systems would be the key to enhance farmers' incomes while ensuring soil health and maintaining environmental sustainability. He emphasized that partnerships between research institutions and krishi vigyan kendras need to be further strengthened for quick and effective dissemination of improved technologies to the farmers' fields. Dr. R. K. Yadav, General Secretary, ISSSWQ, gave the brief account of the technical sessions and proposed the vote of thanks to all before the formal closure of the GJISC- 2019 Conference.