Global Soils Conference 2024

Caring Soils Beyond Food Security:

Climate Change Mitigation & Ecosystem Services

19-22 November 2024

NASC Complex, New Delhi

Recommendations

Organized by

Indian Society of Soil Science, New Delhi

under the aegis of

International Union of Soil Sciences, Italy

in collaboration with

Indian Council of Agricultural Research, New Delhi

National Academy of Agricultural Sciences, New Delhi

About the Conference

World population reaches 9.1 billion by 2050, about 34% higher population than today. According to UN reports, food insecurity is one of the major problems facing the world today. About 95% of food is produced directly or indirectly from soil resource. Therefore, sustainable soil resource management is one of the key socio-economic and environmental issues across the globe. In many parts of the world there is considerable difference between potential and actual yield resulting in food shortage, poverty and malnutrition. It is inevitable that the quantity and quality of the food produce to sustain the present and future generation mostly depends upon the soil fertility. Several researchers and policy makers have made considerable efforts to address soil quality issues for sustainable development. Notwithstanding these efforts, still unprecedented nutrient mining and soil degradation issues creep to upset the sustainability in production system and ecosystem services. In the coming decades, soil science will remain at the focal point of discussion for food production and environmental conservation, but it will be equally essential for devising strategies for issues such as climate change adaptation and mitigation, protection of biodiversity, essential ecosystem services, water quality, poverty alleviation and sustainable development. Thus, it is necessary to maintain and improve soil health to produce more food, fuel and fibre with less land without affecting the soil biodiversity and natural ecosystem services under changing climate scenario across the world.

To adress all these important issues, the Indian Society of Soil Science, New Delhi under the aegis of International Union of Soil Sciences, Italy in collaboration with Indian Council of Agricultural Research, New Delhi and National Academy of Agricultural Sciences, New Delhi organized a '**Global Soils Conference 2024**' during November 19-22, 2024 at Bharat Ratna C. Subramaniam Auditorium, NASC Complex, New Delhi, India. The main objective of the conference was 'Caring soils beyond food security: Climate Change mitigation and Ecosystem Services".

The Conference was inaugurated on 19 November 2024. Shri Shivraj Singh Chouhan ji, Hon'ble Minister of Agriculture and Farmers' Welfare, Government of India was the Chief Guest. He joined the Conference online. Prof. Ramesh Chand, Member, NITI Aayog, Government of India, New Delhi and Dr. Trilochan Mohapatra, Chairperson, Protection of Plant Varieties and Farmers' Rights Authority, Govt. of India; and Former Secretary, DARE and Director General, ICAR, New Delhi were the Guest of Honour. Dr. Edoardo Costantini, President, International Union of Soil Sciences (IUSS) sent his pre-recorded address which had been played during the inaugural session. Dr. S.K. Chaudhari, Chairman, Organizing Committee; and Deputy Director General (NRM), ICAR, New Delhi welcomed the dignitires & delegates and gave a bief introduction about Global Soils Conference 2024. Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR, New Delhi, and President, ISSS presided over the function. Dr. Ranjan Bhattacharyya, Organizing Secretary proposed the vote of thanks.

During the Conference, presentations were made on the following themes/sub-themes.

Theme 1: Soil Health and Ecosystem Services

Sub-theme 1.1: Assessment of Soil Health & Ecosystem Services

Sub-theme 1.2: Soil Biodiversity and Nutrient Cycling

Theme 2: Climate Change and Soil Health

Sub-theme 2.1: Climate Change and Soil Health
Sub-theme 2.2: Impact of Climate Change on Carbon, Water, Nitrogen and Energy Foot Prints
Sub-theme 2.3: Climate Change Adaptation and Mitigation Strategies

Theme 3: Sustainable Soil Management

Sub-theme 3.1: Degraded Soils & Innovative Restoration Practices
Sub-theme 3.2: Soil Management in Challenged Ecosystems
Sub-theme 3.3: Agricultural and Industrial Waste and Waste Water Utilization
Sub-theme 3.4: Soil Pollution and Remediation

Theme 4: Nature Positive Soil Management

Sub-theme 4.1: Tree-based Ecological Restoration
Sub-theme 4.2: Natural and Organic Farming System

Theme 5: Digital Soil Science and Precision Resource Management

Sub-theme 5.1: Soil Survey, Digital Soil Mapping & Land Use Planning
Sub-theme 5.2: Digital Tools and Artificial Intelligence for Sustainable Soil Management and Decision Making

Theme 6: Soil Education and Awareness

Sub-them 6.1: Innovative Soil Science Education

Theme 7: Policy and Governance for Soil Management

Sub-theme 7.1: National and Global Soil Management Policies and Implications
Sub-theme 7.2: Community Engagement and Local Governance in Soil Care
Sub-theme 7.3: Public-Private Partnership for Advancing Sustainable Soil Management

Around 731 delegates attended the Conference. There were 17 lead lectures and 107 plenary lectures delivered in different sessions in the Conference. 397 posters were presented by the delegates. Side events were also organized by the Indian Association of Soil and Water Conservationists, Dehradun; International Rice Research Institute (IRRI) and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) during the Conference.

Major Recommendations

General Recommendations

1. **Soil Health and Sustainable Land Management:** Promoting practices that enhance soil health, such as agroecology, conservation tillage, crop rotation, and organic farming. The goal is to protect soil from erosion, nutrient depletion, and contamination.
2. **Soil Biodiversity:** Emphasizing the role of soil biodiversity in maintaining ecosystem services, encouraging the protection of microbial and other soil organisms essential for soil fertility and resilience.
3. **Soil Carbon Sequestration:** Highlighting the potential of soils to mitigate climate change through carbon sequestration. Encouraging practices that increase carbon storage in soil, such as agroforestry and regenerative agriculture. Deep soil C sequestration, T sensitivity of C decomposition and linking it with soil microbial diversity, soil aggregation, carbon stabilization in micro aggregates inside macro aggregates.

4. **Integrated Soil-Water Management:** Promoting sustainable water management alongside soil conservation to prevent waterlogging, salinization, and drought, which can degrade soil and reduce agricultural productivity.
5. **Balanced Fertilization and Integrated Nutrient Management:** Adoption of integrated nutrient management (INM) and balanced fertilization. The INM is a key part of modern agriculture, helping to address environmental concerns, soil degradation, and rising input costs. It also encourages farmers to plan for the long-term and consider the environmental impact of their practices.
6. **Generating, Monitoring and Harmonizing Data:** Encouraging the development of global soil databases and monitoring systems to track soil quality and changes over time, providing better tools for decision-making. Definition of land degradation in tandem with the International frameworks and also the methodology for assessing land degradation across the country by different Institutions needed to be harmonized. Research on high quality sensor data for mapping of land degradation is required.
7. **Education and Capacity Building:** Strengthening soil science education and building local capacity to manage soils effectively. This includes enhancing knowledge of sustainable practices and soil monitoring techniques.
8. **Soil Awareness and Advocacy:** Raising awareness about the importance of soil for human and environmental health, involving all stakeholders from farmers to policymakers in soil protection efforts.
9. **Policy Support:** Calling for the integration of soil health into national and global policies, including the creation of legal frameworks that support sustainable land use, financial mechanisms for soil conservation, and incentives for farmers to adopt soil-friendly practices.
10. **Collaboration:** Develop a comprehensive national soil management strategy supported by strong institutional coordination and inter-ministerial collaboration.

Specific Recommendations

1. Inclusion of some soil physical and biological properties in soil health card.
2. Linking of abiotic stress maps with location-specific multiple stress alleviate capsules with abiotic stress maps. Prioritize major abiotic stresses responsible for moderate to very high abiotic stress level in major production systems at a particular location.
3. Hybrid modelling which combines mechanistic models and data-driven models with machine learning & AI appears to be promising for assessing the impact of multiple abiotic stresses in different crops.
4. The modified tillage and residue mulch module of InfoCrop may be validated for different crops under varied soil and agroclimatic zones for the present and future climate change scenarios
5. Water management at landscape level, soil management at plot/field level, machine availability at village level, seed availability at family level, unified agro-advisory for each farmer, agro-forestry at panchayat level.

6. Mainstreaming water in climate change adaptation and mitigation programme. Internalize climate change scenarios in design and operation of water infrastructures. Integrating future water risks into climate resilience
7. Proper regulatory measures for the discharge of industrial wastes and strict punishment need to be imposed for those discharging industrial effluents into the rivers and soils.
8. Standardize remediation techniques based on the extent of heavy metals contamination in soils specifically with reference to location, soil quality, bio available fractions, and food chain involvement etc., that could provide a long-term effective method for remediation is required.
9. Decentralize soil governance efforts to empower regional authorities and local communities as they can be better positioned to deliver tailored services, particularly in rural area.
10. Development and testing of both alloy-based hardware and remote sensed image-based software for proximal soil moisture sensing systems in different ecosystems for irrigation water management. Validation of digital soil map-based soil testing systems along with a DSS for real time soil moisture monitoring and management. Development and validation of Al enabled integrated soil moisture sensing systems and crop models for water and nutrient management leading to sustainable crop production.
11. Evaluate the performance of perennial rice cultivation and its modelling and development of DSS for its feasibility in different agroecological regions.
12. The management of ravine lands in India with the intricate linkage of ravine formation to geology, the effectiveness of different conservation measures in controlling ravine erosion.
13. Agro-ecological region-based integrated and cost-effective reclamation technologies are to be evolved for salt affected soils considering the resources availability to enhance ecosystem services.
14. Adoption of agro-ecological approaches are to be given priority for promoting nature-based solutions, land-use systems and management of natural resources through policies and programmes.
15. All forms of wastelands or degraded lands needs strategic rehabilitation programme for environmental-cum-productive utilization including harnessing carbon sequestration potential through integrated approach and stakeholders' engagements.
16. National education policy platform should be used to educate next generations about caring soils and other natural resources for posterity to address present and future challenges like environmental issues, land degradation, climate changes, etc.
17. Standardize remediation techniques based on the extent of heavy metals contamination in soils specifically with reference to location, soil quality, bio available fractions, and food chain involvement etc. that could provide a long-term effective method for remediation is required.
18. Long-term conservation management practices in horticultural crops like mango orchard found more carbon and energy efficient than conventional practices. Rehabilitation of

degraded Declan basaltic lands with fruit-based systems proved to contribute C sequestration and provide opportunity for carbon credits.

19. Recycling of waste biomass and low-grade minerals for production of oregano-mineral fertilizer found effective in reducing chemical fertilizer consumption up to 50% particularly in case P and K fertilizers.

20. Nature positive farming found effective in improving fruit yield and quality in marginal and degraded lands. Climate resilient natural farming sustain crop yield as well as restoration of soil health.

21. Establishments of centers of excellence on natural resource management in various agricultural universities and institutes immensely contributed to Human Resources Development of faculties, students and entrepreneurs.

22. In coastal ecosystems, efficient water and nutrient use and multi-enterprise agriculture will improve soil resilience and resource use. Further, carbon farming offers opportunities for carbon sequestration, enhancing soil fertility and supports biodiversity.

23. Utilizing soil testing data through digital platforms to inform precise nutrient application, implementing smart irrigation systems based on real-time soil moisture monitoring, employing drone imagery for field analysis, leveraging farm management software to track soil health trends over time, and incorporating predictive modeling to optimize crop rotations and tillage practices for improved soil health.

24. Emerging soil technologies (nano-remediation, phytoremediation with gene editing, advanced soil sensors, soil mapping with aerial imaging, biochar application, multi-soil layering systems, omics technologies for soil analysis, and advanced soil microbial manipulation) should be adopted for potential for more efficient and sustainable soil remediation and management, particularly in addressing contaminant removal and improving soil health.

25. Promoting new dimensions of soil research is the key for soil health management. The concept of soil security recognizes five dimensions of soil: capability, condition, capital, connectivity, and codification. These dimensions encompass the social, economic, and biophysical sciences, as well as policy and legal frameworks. Soil mapping, digital soil mapping, and soil monitoring systems can help assess soil capability and condition over large areas.