

# ICAR - Winter School

Advances in Next generation Microbial inoculant Technologies to Promote Greenhouse Gas Mitigation, Soil Carbon Sequestration, and Climate Resilient Agricultural Systems



Feb 24-March 16, 2026

Course Directors : Drs S R Mohanty, K Bharati, Asha Sahu, S Bhattacharjya  
ICAR - Indian Institute of Soil Science, Bhopal  
<https://iiss.res.in>

## About ICAR IISS, Bhopal

The Indian Institute of Soil Science (ICAR-IISS) was established on 16th April, 1988 at Bhopal with a mandate of “Enhancing Soil Productivity with Minimum Environmental Degradation”. To accomplish the mandate of the institute, it has given the priority to soil health related issues faced by farmers and other stakeholders.

IISS has emerged as a leader in basic and strategic research on soils in the country. It has achieved significant success in the areas of integrated nutrient management, impact on soil under long-term cropping, technology for preparation of enriched composts, soil test based nutrient prescriptions, generation of district-wise GIS based soil fertility maps, organic farming practices, carbon sequestration in soils, sink capacity of soils for heavy metal pollutants, recycling of wastes, soil microbial diversity and biofertilizers, quality standards for municipal solid waste composts etc. The institute has to take up the emerging challenges of increasing food-grain production and ensuring food and nutritional security from shrinking land resources, characterizing and conserving large soil-biodiversity for appropriate deployment in agriculture, achieving self-reliance in crop fertilization through indigenous mineral and by-product sources, developing efficient technologies for waste recycling, maintaining soil quality and ecological balance, and developing energy efficient agriculture and sequestering carbon by reorienting its research pursuits addressing the emerging issues viz., enhancing nutrient and water use efficiency; sustaining soil and produce quality; soil biodiversity and genomics, climate change and carbon sequestration; minimizing soil pollution etc.



## About ICAR IISS, Bhopal

Climate change poses a serious challenge to Indian agriculture, with rising temperatures, altered rainfall patterns, and increasing greenhouse gas (GHG) emissions threatening soil health, crop productivity, and long-term sustainability. Agricultural soils are both sources and sinks of major GHGs, namely methane ( $\text{CH}_4$ ), nitrous oxide ( $\text{N}_2\text{O}$ ), and carbon dioxide ( $\text{CO}_2$ ). These gases particularly  $\text{CH}_4$  and  $\text{N}_2\text{O}$  with their higher global warming potential than  $\text{CO}_2$  are strongly governed by soil microbial processes regulating carbon and nutrient cycling. Advancing microbial technologies therefore represents one of the most powerful and scientifically grounded pathways to reduce agricultural emissions, enhance soil carbon sequestration, and build climate-resilient agroecosystems. ICAR Indian Institute of Soil Science (IISS), with its long-standing leadership in soil microbiology, GHG dynamics, metagenomics, and microbial inoculant development, provides an ideal platform for this Winter School. The institute houses state-of-the-art analytical facilities including gas chromatographs, walk-in growth chambers, and the Free Air  $\text{CO}_2$  Enrichment (FACE) system enabling advanced training on GHG quantification, microbial characterization, carbon dynamics, and soil biogeochemical processes. The lecture modules of the program cover frontier topics such as methanotroph and PGPR-based inoculant technologies, soil carbon stabilization pathways, conservation agriculture, biochar interventions, AM fungi, genome editing, nutrient-use efficiency, and bioremediation. These are complemented by extensive practicals on GHG flux measurement, soil biological indicators, carbon mineralization, nutrient cycling assays, and field demonstrations under long-term conservation agriculture experiments. Given India's national commitments to low-carbon agriculture, soil carbon enhancement, and net-zero targets, there is an urgent need to build advanced scientific capacity in microbial technologies, soil carbon management, and GHG mitigation. This training program is therefore timely, strategically relevant, and essential for empowering researchers and educators to lead next-generation climate-smart agricultural innovations.

## Objectives

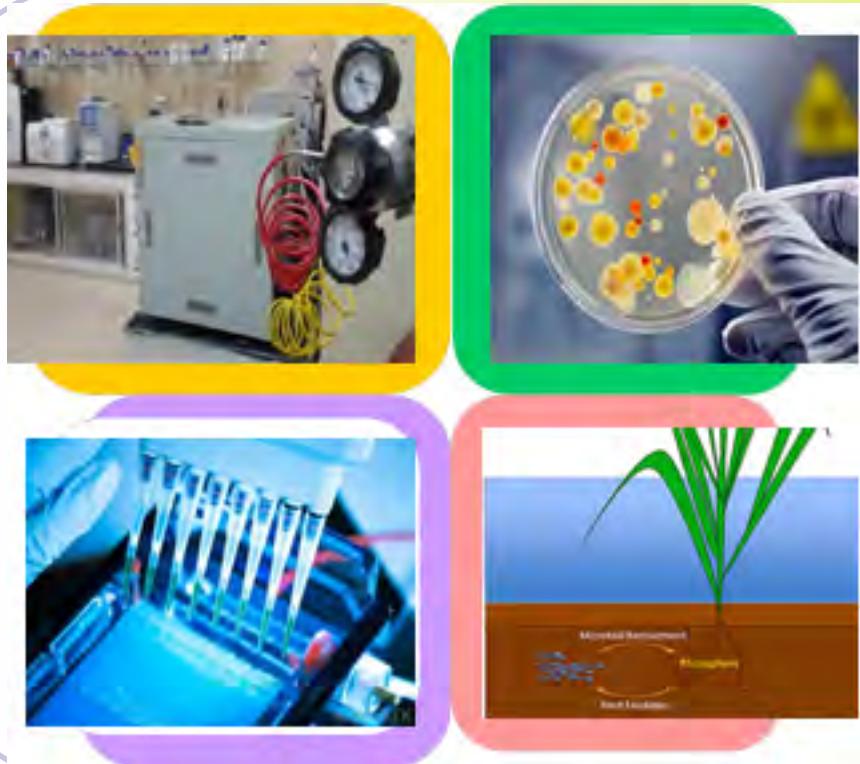
- To develop advanced understanding of microbial inoculant technologies that enhance nutrient-use efficiency, soil health, and climate resilience.
- To strengthen participants' skills in greenhouse gas quantification, microbial functional analysis, and soil carbon assessment using modern analytical tools.
- To build scientific competency in designing and evaluating climate-smart interventions such as conservation

agriculture, AM fungi, PGPR, and biochar-based strategies.

- To enhance capacity for interpreting soil biological indicators, nutrient cycling pathways, and carbon sequestration dynamics under diverse management systems.
- To promote the ability to integrate microbial, biochemical, and agronomic approaches for developing low-emission, sustainable agricultural models.

### Course outline

Promote Greenhouse Gas Mitigation, Soil Carbon Sequestration, and Climate-Resilient Agricultural Systems" is designed to provide participants with a comprehensive, research-driven understanding of microbial processes and technologies that underpin climate-smart agriculture. The 21-day course integrates conceptual lectures, laboratory practical, and field exposure to equip participants with both scientific depth and practical skill. The program begins by establishing foundational knowledge on soil microbial processes governing methane and nitrous oxide fluxes, microbial carbon capture pathways, and the role of biofertilizers in low-emission agriculture. Participants can explore advanced inoculant production techniques, carbon sequestration mechanisms, and conservation agricultural practices that influence soil biodiversity and nutrient dynamics. Hands-on sessions form a major component of the course, covering GHG measurement using static chambers and gas chromatography, soil biological indicators, carbon mineralization assays, and nutrient cycling analysis. Advanced molecular techniques including RT-PCR, genomic characterization, and microbial functional assessment will be introduced using the institute's modern laboratory facilities. The course further expands into frontier areas such as genome editing for nutrient-use efficiency, AM fungi-mediated climate mitigation, biochar applications, phytoremediation, and rapid spectroscopic methods for soil carbon evaluation. Field visits to long-term conservation agriculture experiments, organic farming sites, and progressive farmer fields provide practical insight into real-world applications. By integrating lectures from leading experts with extensive laboratory and field demonstrations, the course provides a holistic understanding of how next-generation microbial technologies, soil carbon strategies, and integrative nutrient management can build resilient, low-emission agricultural systems. It aims to empower participants to apply microbial innovations and



diagnostic tools in research, teaching, and field advisory programs supporting climate-smart agriculture. The course is divided into five modules :

1. Microbial Processes and GHG Cycling :  
Soil microbial regulation of CH<sub>4</sub>, N<sub>2</sub>O, CO<sub>2</sub>  
Methanotrophs, nitrifiers, denitrifiers in climate mitigation
2. Next-Generation Microbial Inoculants  
PGPR, AM fungi, methylotrophs, biofertilizers  
Scalable production, formulation, quality assessment
3. Soil Carbon Sequestration and Nutrient Cycling  
Carbon stabilization pathways, SOC indicators  
Nutrient-use efficiency under climate stress
4. Analytical and Field Techniques  
GHG flux measurement (static chamber, GC)  
Molecular tools: RT-PCR, metagenomics, soil biological indices
5. Climate Smart Management Strategies  
Conservation agriculture, biochar, crop management  
Integrating microbial technologies for resilient agroecosystems

#### **Demonstration/hands-on-experience, visits and audio-visuals**

Hands-on field experience on basic technologies of climate change science. Analysis of GHG using analytical instruments. Soil microbiological and biochemical analysis of GHG cycling processes. Agro waste management approaches to mitigate GHG, Field visits and Multimedia audio-video demonstration of agronomic practices to minimize GHG emission.

#### **Who can apply**

The Winter School is open for participants from ICAR Institutes/State AUs/CAU/ Agricultural faculty of AMU, BHU, Vishwa Bharti and Nagaland University in the cadre of Assistant Professors or equivalent and above in the discipline of Agriculture/ Soil science/ Agriculture Microbiology/ Microbiology/ Agronomy/ Environmental science/ Forestry/ Horticulture and related discipline are eligible to apply for this course. Participants will be selected on the basis of their ability to benefit from the program. As per the ICAR policy, a few participants from the basic sciences may also be selected. The total number of seats in the Winter School will be 25.

#### **TA/DA, Boarding and Lodging**

The costs of traveling, boarding and lodging etc. of the selected participants will be met out of the ICAR winter school grant by the organizing institute. All participants will be reimbursed to and fro travel fare for the journey to Bhopal by rail or bus through shortest route. The Payment will be made as per the entitlement class of travel, but restricted to the maximum AC-II tier train/bus fare. As regards Daily Allowance (DA), any participants refusing to avail of free board and lodging facilities will not be given any cash payment in lieu thereof. Participants are requested not to bring family members with them, as the institute has limited hostel facilities.

## How to apply

Participants are required to fill out the application form. The printed application form certified by the competent authority of respective organization should be forwarded to the Course Director by post or courier on or before deadline. Final selection will be subject to the receipt of the application form duly recommended by the competent authority. An advance copy of the completed application should also be sent via email to [mohantywisc@gmail.com](mailto:mohantywisc@gmail.com) or [ashaars.iiss@gmail.com](mailto:ashaars.iiss@gmail.com)

## How to reach

**By Air:** The nearest airport is Raja Bhoj Airport, about 10 km from IISS, with regular flights connecting to other major cities. Taxis and buses are available from the airport to IISS. **By Train:** Rani Kamlapati and Bhopal railway station is well connected with major cities through several trains. **By Road:** Bhopal is linked by frequent bus services.

**Venue :** ICAR-Indian Institute of Soil Science, Bhopal

**Weather :** Mildly cold weather is expected during training period. Participants are requested to carry light woollen clothes.

## Important dates

Last date for receipt of application :

29<sup>th</sup> December 2025

Confirmation of participants (by email) :

31<sup>st</sup> December 2025

## For further information please contact

### Course Director

#### Dr. S R Mohanty

Head- Soil Biology Division  
ICAR-Indian Institute of Soil Science (IISS)  
Berasia Road, Nabibagh, Bhopal,  
Madhya Pradesh 462038  
Email : [mohantywisc@gmail.com](mailto:mohantywisc@gmail.com)  
Ph : 0755-2730970 ext 284,  
Fax : 07552733310, Mobile : 08982697699

#### Dr. K Bharati

Principal Scientist, ICAR-IISS, Bhopal  
Email : [bharatik1@gmail.com](mailto:bharatik1@gmail.com)

### Course Co-Director

#### Dr. Asha Sahu

Senior Scientist, ICAR-IISS, Bhopal  
Email- [ashaars.iiss@gmail.com](mailto:ashaars.iiss@gmail.com)

#### Dr. S Bhattacharjya

Senior Scientist, ICAR-IISS, Bhopal  
Email- [bhattacharjya.sandy@gmail.com](mailto:bhattacharjya.sandy@gmail.com)





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## APPLICATION FORM

ICAR Winter School on “Advances in Next Generation Microbial Inoculant Technologies to Promote Greenhouse Gas Mitigation, Soil Carbon Sequestration, and Climate Resilient Agricultural Systems”. **(Feb 24 – Mar 16, 2026)**

1. Full Name of the Applicant:	Photo
2. Designation:	
3. Present Employer and Address	
4. Correspondence Address (with PIN)	
5. Mobile Number:	
6. E-mail ID:	
7. Date of Birth:	
8. Gender:	
9. Previous ICAR Training Course/s Attended (if any)	
10. Academic Qualifications	

Degree	Discipline	Passing Year	OGPA	University
Doctorate				
Master				
Bachelor				

Date:

Place:

Signature of Applicant

### **Recommendation by Forwarding institute/ university**

Date:

Place:

Signature, Designation & Office Seal

