



Report
on
Monthly Seminar
conducted
by
ICFRE-RFRI
Jorhat (Assam)



INSTITUTE LEVEL

Venue	ICFRE - Rain Forest Research Institute
Theme	Genetic Improvement & Tree Breeding
Presentation Team	Dr. Kingshuk Modak, Scientist-C , Forest Ecology and Climate Change Division of the Institute
Broad structure	<ol style="list-style-type: none">1. Opening session: Welcome and overview2. Introductory remarks by the Director (or senior scientist in the Director's absence) of the institute3. Presentations by the speaker4. Discussion on the presentations5. Closing Remarks by the Director (or senior scientist in the Director's absence) of the institute6. Vote of thanks
Periodicity	Once in a month
Duration	Half day
Expected outcomes of the seminar	Formulation of future strategies/ road map (Attached, Page number 5)
Coordinator	<ol style="list-style-type: none">1. Sh. R K Kalita, Head, Extension Division2. Dr. Druba Jyoti Das, Head, SFM Division3. Ms. Tara Kumari, Nodal Officer (Monthly Seminars)4. Supporting staff of Extension Division
Proceedings	(Attached, Page number 2)

Proceedings of the Monthly Seminar

Date: March 30, 2026 & Time 11:00 AM onwards

Venue: Brahmaputra Hall, ICFRE-RFRI, Jorhat

Theme: Environment Management

ICFRE-Rain Forest Research Institute, Jorhat (Assam) conducted the monthly seminar on 30th March 2026 at Brahmaputra Hall of ICFRE-RFRI, Jorhat campus. The seminar was attended in physical and virtual mode by the scientists, officers, technical, subordinate staffs, researchers and students along with the members of its centers i.e. BRC, Mizoram and LEC, Tripura. The Coordinator of the seminar Ms. Tara Kumari, Scientist, conducted the program. The program was chaired by Dr. Nitin Kulkarni, Director, ICFRE-RFRI.

Dr. Kingshuk Modak, Scientist-C, Forest Ecology and Climate Change Division of ICFRE-Rain Forest Research Institute, Jorhat (Assam) delivered a comprehensive lecture on “*Advancement and prospect of soil carbon research under climate change scenarios*”. The presentation highlighted the critical role of soil as a fundamental natural resource and emphasized its importance in sustaining life, food security and ecosystem stability.

The seminar began with an overview of the significance of soil health in achieving global sustainability goals, particularly the United Nations Sustainable Development Goals (SDGs). It was emphasized that soil, through its biodiversity and nutrient dynamics, supports plant growth and thereby ensures global food security. However, concerns were raised regarding the declining state of soil health in India, including high rates of soil erosion (16.4 t/ha/year), widespread organic carbon deficiency and micronutrient imbalances such as zinc and boron deficiencies. These issues are further aggravated by imbalanced fertilizer use and nutrient mining practices.

The speaker elaborated on key concepts such as soil resilience and resistance. Soil resilience refers to the ability of soil to recover its structure and functionality after disturbances, whereas soil resistance is the capacity to withstand disturbances without significant change. These properties are crucial for maintaining soil productivity under increasing environmental stress.

A major focus of the seminar was on soil organic carbon (SOC), which plays a vital role in nutrient availability, carbon sequestration, soil structure improvement, erosion control and supporting microbial diversity. The presentation traced the evolution of soil carbon research, noting that earlier studies primarily focused on soil fertility and agronomy, while more recent research emphasizes climate change mitigation through carbon sequestration. The increasing number of scientific publications on soil carbon sequestration reflects growing global interest in this field.

The seminar also discussed different pools of soil organic carbon, including active (particulate organic carbon) and passive (mineral-associated organic carbon, MAOC) pools. These pools differ in their stability and turnover rates, influencing the long-term storage of carbon in soils. The concept of soil carbon saturation was introduced as the maximum capacity of soil to store carbon, which depends on soil mineral properties. Understanding this limit is essential for accurately estimating carbon sequestration potential.

Several scientific challenges associated with soil carbon research were highlighted. These include difficulties in measuring SOC accurately due to variations in bulk density, limitations of estimation methods and issues related to permanence and leakage of stored carbon. Additionally, identifying critical SOC thresholds (generally between 1.5% and 2%) is necessary to ensure sustainable soil functioning.

The impact of climate change factors such as elevated CO₂ levels, temperature rise, precipitation variability, atmospheric nitrogen deposition and drought on soil carbon dynamics was discussed in detail. Experimental approaches like Free Air Carbon Dioxide Enrichment (FACE) studies have provided valuable insights into how ecosystems respond to changing atmospheric conditions. However, the speaker noted that such experiments are limited in temporal scale, necessitating the use of predictive models for long-term projections.

The seminar further explored various methods for estimating soil organic carbon. Traditional methods such as dry combustion (high accuracy but costly) and wet oxidation (low cost but less precise) were compared with advanced techniques like Laser-Induced Breakdown Spectroscopy (LIBS), Inelastic Neutron Scattering (INS) and sensor-based remote sensing approaches. Emerging technologies, including UAV-mounted multispectral cameras and eddy

covariance systems, enable rapid and non-destructive assessment of soil carbon at larger spatial scales.

In addition, the application of machine learning models such as Random Forest (RF), Extreme Gradient Boosting (XGB) and Support Vector Regression (SVR) for predicting SOC under different climate scenarios was discussed. Among these, XGBoost demonstrated high accuracy, indicating the potential of artificial intelligence in advancing soil carbon research.

The presentation also included simulation studies from Northeast India, showing how land-use changes and climate variability influence SOC dynamics. Models like RothC were used to project future carbon stocks under different scenarios, highlighting the importance of sustainable land management practices.

In conclusion, the seminar emphasized the urgent need for standardized protocols for SOC measurement and reporting, integration of remote sensing technologies and improved understanding of soil carbon processes under changing climatic conditions. It was suggested that future research should focus on quantifying carbon sequestration potential across different ecosystems, evaluating land-use impacts and developing innovative management strategies.

Overall, the seminar provided a comprehensive overview of current advancements and future directions in soil carbon research, underlining its significance in addressing climate change and ensuring sustainable soil management.

The presentation was followed by an engaging discussion, where participants shared important insights related to the topic. The Director raised key questions regarding the lack of long-term experimental data in India on soil carbon sequestration and soil fertility, and how countries like China have utilized such data effectively. He also sought clarification on the concept, components and classification of land degradation, along with supporting data, and emphasized the need to identify ideal soil conditions for optimal plantation growth. He also suggested focusing research efforts on priority areas in Northeast India and advised to develop research proposal accordingly. Dr Dhruba Jyoti Das, Head, Silviculture and Forest Management Division, raised the need for standardization procedures to correct previously recorded soil carbon data using the Walkley–Black method. Dr. Karma Gyalpo Bhutia, Scientist-C, highlighted the need to understand

why nitrogen deposition is more prominent in temperate forests compared to tropical ecosystems. The discussion also emphasized the development of practical protocols, including soil amendment charts and integrated land management approaches. Participants from both centers actively contributed their views.

The session concluded with a formal vote of thanks delivered by Ms. Tara Kumari, the program coordinator, marking the successful completion of the seminar.

Expected outcomes of the seminar

Formulation of Future Strategies / Road Map:

- ✓ Urgent need for a standard protocol to report on soil organic carbon and integrate remote sensing approaches.
- ✓ Quantifying soil carbon sequestration potential and critical limit in different forest types
- ✓ Understanding soil carbon processes and its flux under climate change scenarios
- ✓ Evaluating the impact of land use and new technical practices on soil C





Tara

(Tara Kumari)
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