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Division of Environmental Sciences

ICAR - Indian Agricultural Research Institute, New Delhi

Annual Report
2025

Division of Environmental Sciences

ICAR-Indian Agricultural Research Institute
New Delhi 12

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Annual Report 2025

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Supervision and Guidance

Dr. Ch. Srinivasa Rao
Director
Dr. Viswanathan Chinnusamy
Joint Director (Research)

Compilation Committee and Editorial Team

Members

Dr. Sandeep Kumar, Scientist (Sr. Scale), Division of Environmental Sciences

Dr. Sunita Yadav, Scientist (Sr. Scale), Division of Environmental Sciences

Dr. S. Naresh Kumar, Head, Division of Environmental Sciences

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Preface

It is with great pride and satisfaction that I present the Annual Report 2025 of the Division of Environmental Sciences. Over the past three decades, our Division has made exemplary contributions to the field of environmental sciences, addressing some of the most pressing issues of our time. The Division of Environmental Sciences was established on January 10, 1993, with a mission to advance the understanding of environmental processes and to develop sustainable solutions to environmental challenges, especially in agro-ecosystems. Since its inception, the Division has grown significantly, evolving into a hub of research and innovation. Our vision has always been to lead the way in environmental research, focusing on climate change, sustainable development, simulation modelling, environmental pollution, wealth creation from waste, and the preservation of ecosystem services.

Our Division has been at the forefront of climate change research, with a focus on understanding the impacts of climate change and developing effective adaptation and mitigation strategies. We have conducted extensive research on the drivers of climate change, including greenhouse gas emissions and land-use changes. Our team has been actively involved in the development of policies and strategies aimed at reducing greenhouse gas emissions and their impacts on agriculture through green adaptation technologies to promote sustainable development.

In response to the growing challenges posed by climate change to agriculture, our Division has pioneered research in climate-resilient agriculture. We have developed and tested various adaptation strategies to help farmers cope with changing climatic conditions. These include improved nutrient and water management practices, as well as the promotion of improved agronomic and agroforestry systems. Our work in this area, especially under the NICRA Project, has been instrumental in enhancing the resilience of agricultural systems to climate variability.

The Division has made significant advancements in the development of simulation models for crops. These models are used to forecast crop yields, assess the impacts of climate change on agricultural productivity, and develop strategies for optimizing resource use. Our models have been widely adopted by policymakers and practitioners, providing valuable insights for planning and decision-making in the agricultural sector.

A key area of our research has been the quantification of greenhouse gas emissions and the development of emission inventories. Our team has conducted comprehensive assessments of emissions from various sectors, including agriculture, energy, and waste management. Climate change impact, adaptation, and vulnerability assessments on eleven crops, along with greenhouse gas inventories from agricultural soils, nitrogen fertilizer use, and crop residue burning, have been reported by India in the Biennial Update Reports (BUR) and the Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC).

Recognizing the urgent need for sustainable waste solutions, the Division has significantly intensified its efforts in waste management, environmental remediation, and pollution control. Our research addresses critical issues such as the environmental fate of plastics, heavy metal contamination, air and water pollution, and the remediation of degraded lands. We are actively developing strategies for waste-to-wealth transformation, focusing on converting organic and industrial waste into value-added products such as compost, biochar, and biogas.

A key thrust area of our Division is the quantification and valuation of ecosystem services, including carbon sequestration, biodiversity conservation, and climate regulation. Through this work, we aim to promote the conservation and restoration of natural ecosystems as integral components in achieving net-zero targets and ensuring ecological and economic sustainability.

Looking ahead, the Division remains committed to expanding its research on nature-based solutions, integrating renewable energy into agro-systems, and promoting sustainable production and consumption patterns. We envision our work contributing to the broader goals of environmental security, climate neutrality, and resilient rural livelihoods.

Finally, the Division of Environmental Sciences has made remarkable progress in addressing some of the most critical environmental challenges of our time. Our achievements are a testament to the hard work and dedication of our scientists, staff, and partners. As we move forward, we remain committed to advancing our research, fostering innovation, and contributing to a more sustainable and equitable world.

I would like to thank Dr. Ch. Srinivasa Rao, Director, IARI, Dr. Viswanathan Chinnusamy, Joint Director (Research), Dr. Anupama Singh, Joint Director (Education), and Dr. R. N. Padaria, Joint Director (Extension) for their constant support and guidance. I also thank Dr. Mangi Lal Jat, Secretary (DARE) and Director General (ICAR), for his continued support and encouragement towards the inclusive growth of the Division.

I gratefully acknowledge the funding agencies such as ICAR, DST, and other national institutions, as well as the Ministries, namely MoA&FW, MoEF&CC, MoSteel, MoS&T and and FAO.

I express my sincere appreciation to the Annual Report Editorial Team for their dedicated efforts in bringing out this Annual Report. I look forward to many more productive years ahead.

(Soora Naresh Kumar)
Head, Division of Environmental Sciences

"The world has enough for everyone's need, but not enough for everyone's greed."

– Mahatma Gandhi

Content

Division of Environmental Sciences: An Introduction

The Division of Environmental Sciences is a dynamic, interdisciplinary department at the forefront of tackling current and future environmental challenges. Our research extends to crucial areas such as climate change, simulation modeling, greenhouse gases emission quantification, waste management, environmental pollution and ecosystem services where innovative strategies are developed to mitigate the environmental impact. The Division of Environmental Science is actively engaged in cutting-edge research on a wide range of critical environmental issues. The research focuses on climate change, with particular emphasis on simulation modeling to predict future climate scenarios and their potential impacts. Additionally, the division is involved in quantifying greenhouse gas emissions to understand their sources better and mitigate their effects. Waste management practices are being studied to develop more efficient and sustainable solutions. The division also addresses various aspects of environmental pollution, including air, water, and soil contamination, and their impacts on human health and the environment. Furthermore, the division explores ecosystem services, assessing the benefits provided by natural ecosystems and how they can be preserved and enhanced to support biodiversity and human well-being.

Moreover, we delve into the realm of ecosystem services, studying the benefits that ecosystems provide to society and farmers and devising strategies for their sustainable management and conservation. Finally, our division is actively engaged in studying the behavior and remediation of heavy metals in the environment (water, soil and plants), recognizing their significant impact on ecosystems and human health. Through innovative research and national and international collaboration, the Division of Environmental Sciences is committed to advancing knowledge and implementing practical solutions to safeguard our planet for future generations. Division of Environmental Sciences was established in 1993, has a mission for development of sustainable agriculture, climate change adaptation and mitigation strategies, management of environmental pollution, extension and teaching for the benefit of society and farming community.

The vision of this multi-disciplinary division is ‘Enhancing resilience of Indian agriculture to environmental change’. A group of 16 scientists belonging to 7 different disciplines are working in this division with a mission of development and dissemination of efficient and economically viable technologies for climate-resilience, sustainable agriculture and environment protection.

Mandates of the Division

- To conduct basic and strategic research for environment resilient sustainable agriculture with a special emphasis on rainfed and small-scale farmers.
- To impart post-graduate education and training on agriculture-environment inter-relationships.
- To provide advisory and consultancy services on environment assessment and climate change in agriculture.

Thrust research areas

- Climate change, GHGs quantification, Inventory development, Emission factor refinement, adaptation and mitigation strategies
- Climate resilient agriculture
- Development of simulation models for crops, forecasting and vulnerability assessment
- Environmental Pollution (soil, air, and water pollution)
- Waste management, utilization and value addition
- Assessment of microplastics in soil and development of bioplastics
- Quantification of polyaromatic hydrocarbons (PAHs) in air and soil and their toxicity assessment
- Biogas production, enrichment and utilization
- Heavy metals contamination in soil, water, air and plants and their toxicity assessment
- Quantification of ecosystem services and their valuation
- Nutri-physiology and radio-ecological studies
- Development of nano and climate smart fertilizers
- Division also engaged in teaching, extension, capacity building and policy formulation

1. Research Activities

CMIP 6 21 GCMs bias-corrected ensemble scenarios for agricultural seasons in India: •
Kharif seasonal mean maximum and minimum temperatures are projected to increase up to 3 ˚C and 1.4˚C, respectively by the year 2039 compared to the baseline (1980-2014) period, with more warming projected towards the end of the century (4.8-6.6/2.8-4.4 ˚C) under SSP2-4.5, 3-7.0 and 5-8.5.

Rabi seasonal mean maximum and minimum temperatures are projected to increase up to 1.6 ˚C and 1.9˚C by the year 2039 compared to the baseline (1980-2014) period, with more warming projected towards the end of the century (3.3-5.4/4.4-7.1 ˚C) under SSP2-4.5, 3-7.0 and 5-8.5. The variability in minimum temperatures is projected to be higher, particularly in the Rabi season.

Precipitation is projected to change significantly, and the rainfall variability is projected to increase significantly in future climates, particularly during the Rabi season. The Consecutive wet days and rainfall extremes are projected to increase significantly.

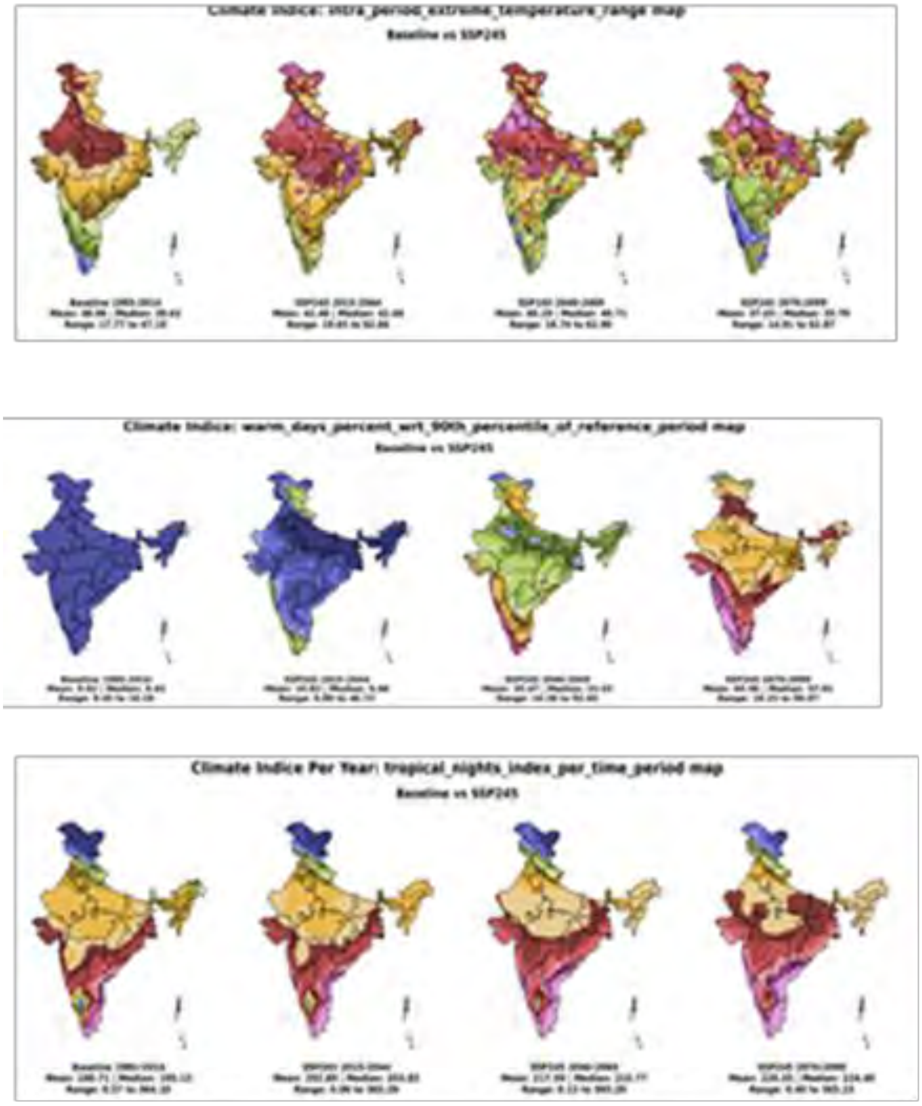


Fig. 1. Climate extremes over India

Climate extremes such as heat waves are projected increase by 5 to 17 times and days above normal by 6.5 times over the Indian region as compared to the baseline period (1985-2014).
During the Kharif season, a significant increase in warm spells, tropical nights, extreme warm days, and warm nights, as well as extreme rainfall events, is projected. The Himalayan Region and North-west India are projected to have significantly higher hot days.
During the Rabi season, warm spells and warm nights are projected to increase by up to 20 times by the year 2100 over the baseline period. Similarly, the number of cold waves, their duration, frost events, and rainfall are projected to increase. The frost events are also projected to increase in northern and parts of central India.
All these mean changes and extremes have significant spatio-temporal variations. In general, warming is projected to be more in central and western India, while the variability is more in the northern parts of India. South and central India may receive more rainfall, while the northern parts are expected to be drier in Kharif, with significant inter-annual variability. During Rabi, the rainfall is projected to increase more in northern and central India, while rainfall over the western ghats and the north-eastern region is projected to decrease marginally

Estimates of methane and nitrous oxide emissions form agricultural soils

The inventory of methane and nitrous oxide emission from agricultural soils was prepared using the IPCC inventory preparation guidelines for the base year 2022 for biennial transparency report to be submitted by India to the United Nations framework convention for climate change. The methane emissions from rice cultivation amounted to 3.497 Gg from 47.4 M ha of total rice cultivated area under different rice water regimes of multiple aeration (MA), single aeration (SA), continuous flooding (CF), deep water (DW), rainfed flood prone (RF-FP), rainfed drought prone (RF-DP) (Table 1). The total direct emissions of nitrous oxide were 243.84 Gg, accounting for 80.7% of the total N2O emissions. The indirect N2O emissions were estimated to be 58.25 Gg accounting for 19.3% of the total N2O emissions from all N input sources to agricultural soils (Fig. 2). The emissions were significantly higher than the emissions in 2005, which is the base year for India's nationally determined contributions.

Table 1. Methane emission from different rice grown under different water regimes

Year	Area M ha	Methane emission MA 000kg	Methane emission SA 000kg	Methane emission CF 000kg	Methane emission DW 000kg	Methane emission RF FP 000kg	Methane emission RF DP 000kg	Total Methane emission 000kg	Total CO_2 eq. Mt
2022	47.4	449	382	1721	175	362	409	3497	97.92

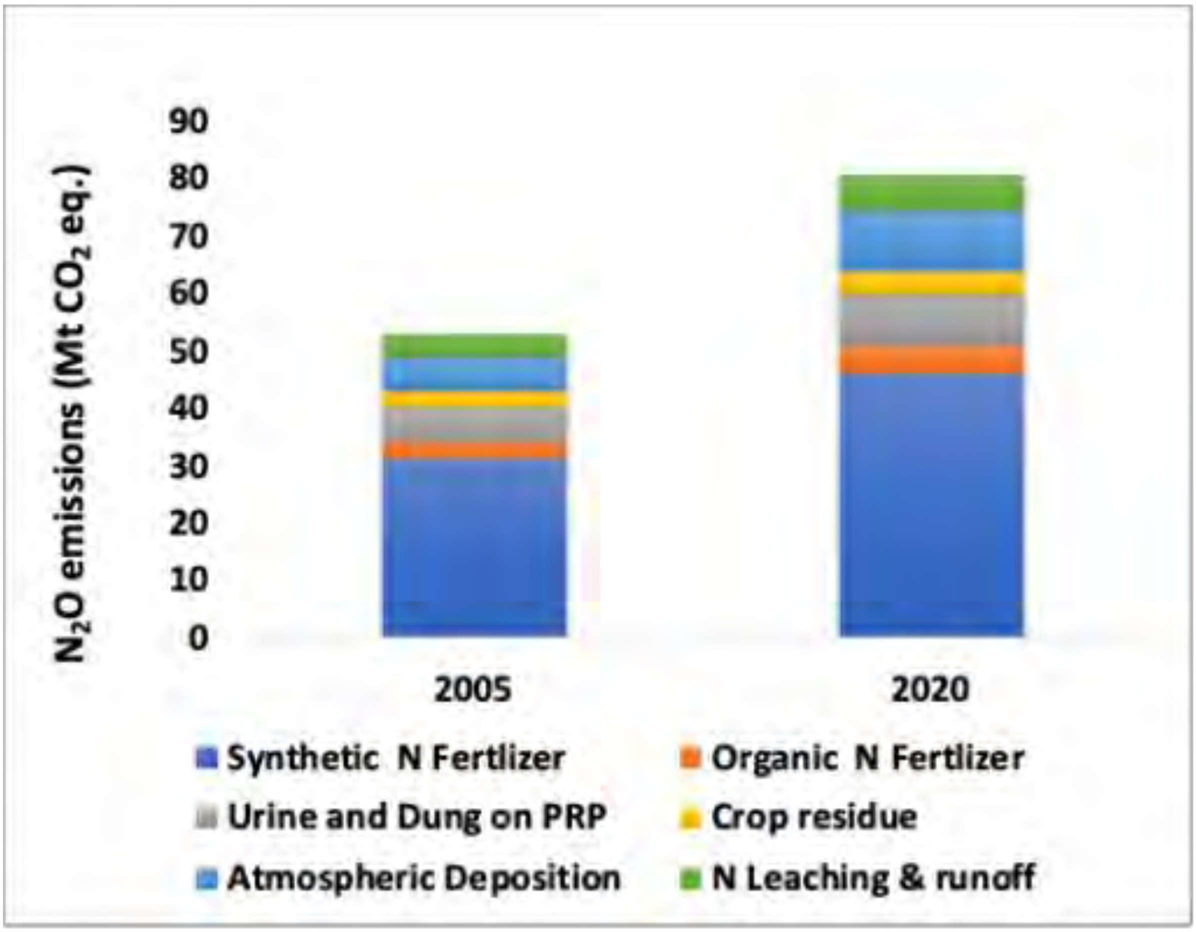


Fig.2. Contribution of different N inputs to Nitrous oxide emissions for 2022 compared to Indias NDC year (2005)

Development of emission factor for N_2O from fertilizer application to cropped soil

Agriculture sector ranks second contributing 14% to total GHG emission of the country. Agricultural soils are the second largest source of GHG emission mainly N_2O. Synthetic fertilizer application contributes app 75% of the total emissions from managed soils. However, there are large uncertainty. Country specific emission factors for N2O is important to reduce the uncertainty in emission inventory of N_2O. Field experiments were conducted for consecutive two years growing cereal, vegetable and oilseed crops under different N application rates to develop country specific N_2O emission factors. The emission factor for N_2O-N ranged from 0.42-0.62% of applied N (table 2). The mean emission factor was estimated as 0.48±0.066% of applied N with an uncertainty of 12.4%.

Table 1: Emission factor for N_2O from fertilizer application to cropped soil

Crop	Total N_2O emission (kg/ha)	Emission factor (%)
Onion (Bhima dark red)	1.425-1.762	0.491-0.502
Potato (Kufri Badshah)	1.966-2.383	0.539-0.611
Tomato (Pusa Rohini)	1.625-1.881	0.480-0.554
Brinjal (Vaibhav)	1.708-0.537	0.498-0.426
Soybean (9712)	0.537-0.674	0.426-0.441
Maize	1.282-1.742	0.390-0.461
Wheat	1.287-1.521	0.399-0.419

Crop Specific emission inventory of NOx emission

Rice and wheat crops cover on an average 35.76% of gross cropped area (GCA) and 41% of total N used in the country. The crop specific NOx emission estimated for the year 2023-24. Total NO-N emission ranged from 4.7 Gg N/yr to 5.02 Gg N/yr from rice soil and from 3.97 Gg N/yr to 4.15 Gg N/yr from wheat soils

Emission inventory of non-CO_2 gases from crop residue burning

The total crop biomass generated in the year 2021 was 801.86 million tons on dry weight basis. Out of the total crop biomass generated 14% (102.65 million tons) was burnt on farm leading to emission of 277.17 million tons of CH4 and 7.19 million tons of N_2O (Fig 3).

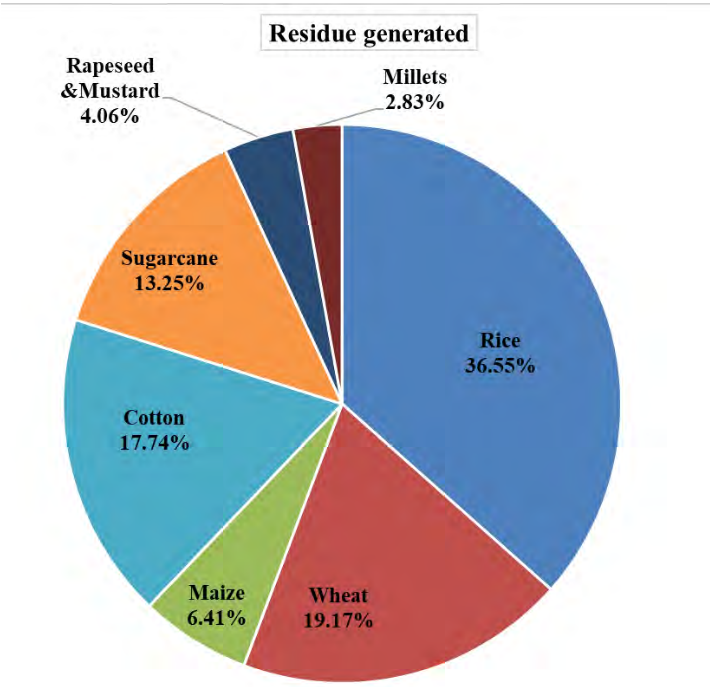


Fig. 3. Contribituion of different crops to total crop biomass generated

Estimation of GHG emission from rice residue burning Punjab and Haryana was also done based on real time monitoring using remote sensing. During the year 2024 rice residue burnt was estimated to be 77% and 60.3% respectively in the districts of Punjab and Haryana. The burning of rice residue led to emission of 27.76 million tons of CO2 eq in Punjab and 8.33 million tons of CO2 eq in Haryana.

To quantify cumulative N_2O emission and development of EF from tomato cultivation under open filed and polyhouse cultivation

The field experiment was conducted to quantify the nitrous oxide (N_2O) emission and calculated the N_2O emission factor under different cultivation practices of tomato, i.e. open field and polyhouse cultivation. The monitoring of nitrous oxide emission in tomato was carried out in fields facilities of Division of Vegetable Science and Division of Environmental Sciences, ICAR-IARI, New Delhi. Five treatments were selected for this study, i.e., T1 (Absolute control), T2 (RDF), T3 (50% Basal + 25% urea (1st split) + 4% urea spray (2nd split)), T4 (50% Basal + 4% urea spray (1st split) + 4% urea spray (2nd split)) & T5 50% Basal + 25% urea (1st split) + 4% Nano Urea spray (2nd split). In open field, highest N2O emission was observed in T2 of about 1.19 kg ha-1 season-1 and the lowest was found to be in T1, i.e. 0.79 kg ha-1 season-1. In the polyhouse the highest N2O emission was observed in T2 of about 1.54 kg ha-1 season-1 and the lowest was found to be in T1 i.e. 0.93 kg ha-1 season-1. The order of N2O emission is found to be in T2>T3. The highest emission factor (EF) of N2O-N from field cultivation was 0.66% in T2 which was lower than polyhouse cultivation, EF 0.71% in T2.

Greenhouse gas intensity mitigation potential of Enhanced efficiency fertilizers

This study evaluated the efficacy of enhanced efficiency fertilizers (EEF), including slow-release fertilizer (Sulphur-coated urea, SCU), and nitrification inhibitors (Neem-coated urea, NCU; Karanj-coated urea, KCU) in reducing GHG intensity and improving soil biological activity in rice systems in the IGP. Field experiments conducted over two years assessed yield parameters, GHG emissions, and indicators of soil microbial biomass, nutrient content, and enzymatic activity. NCU reduced CH4 emissions by 11% and N2O emissions by 16.5% relative to prilled urea (PU), while SCU and KCU also demonstrated notable emission reductions. Sulphur coated urea demonstrated the lowest greenhouse gas intensity (GHGI) (0.128 kg CO2-eq kg-1 grain yield), followed by NCU and KCU. All EEFs significantly improved rice grain yield compared to PU, with SCU and KCU recording the highest mean yields (~5600 and ~5560 kg ha-1, respectively) versus 5010 kg ha-1 under PU.

Additionally, EEFs improved microbial biomass carbon and nitrogen, dehydrogenase activity, and reduced nitrate reductase and urease activity compared to conventional prilled urea (PU), with KCU and SCU showing the greatest improvements and highest net returns. Among the EEFs, SCU consistently achieved the highest yield, lowest GHGI, and overall improvements in soil health, making it a promising alternative for sustainable rice production. Projections indicate that while application of NCU in the IGP region during rice cultivation could reduce the GHGI by 12.2% while adopting SCU may achieve a 25.8% reduction, supporting India's commitment to the Paris Climate Agreement and promoting sustainable agricultural practices in the IGP.

To better reflect soil health, soil quality index (SQI) was calculated to provide a comprehensive assessment of different treatments. To ensure comparability, all the soil parameters (NRA, urease, DHA, MBC, MBN, NO3--N and NH4+-N) were first normalised using a min-max approach. After normalization of individual indicators, SQI was computed using PCA-weighted SQI, where the weights are assigned based on principal component loadings (Table 3). The PCA weighted soil quality index (SQI-PCA) ranged from -0.47 to 0.52, reflecting both positive and negative contributions of soil parameters to PC1. The PCA biplot (PC1 = 43.29%, PC2 = 19.10%) revealed that MBC and DHA had the strongest positive loadings on PC1 (Fig. 4). In contrast, urease and nitrate reductase (NRA) had negative loadings. The PCA grouping also revealed a distinct separation of treatments with PU positioned on the negative side of PC1 whereas, SCU, KCU, and NCU treatments were grouped on the positive side.

Table 3. Principal component analysis-based soil quality index (SQI-PCA) values (mean of replicate plots of each treatment +/- standard deviation).

	SQI-PCA		
Treatment	Year 1	Year 2	Mean
PU	-0.47 ± 0.11 c	-0.44 ± 0.12 c	-0.46 ± 0.02 c
NCU	0.49 ± 0.15 ab	0.42 ± 0.09 ab	0.45 ± 0.05 ab
KCU	0.52 ± 0.08 a	0.51 ± 0.09 a	0.51 ± 0.01 a
SCU	0.41 ± 0.08 b	0.39 ± 0.11 b	0.40 ± 0.01 b

PU = prilled urea; NCU = neem coated urea; KCU = karanj coated urea; SCU = sulphur coated urea

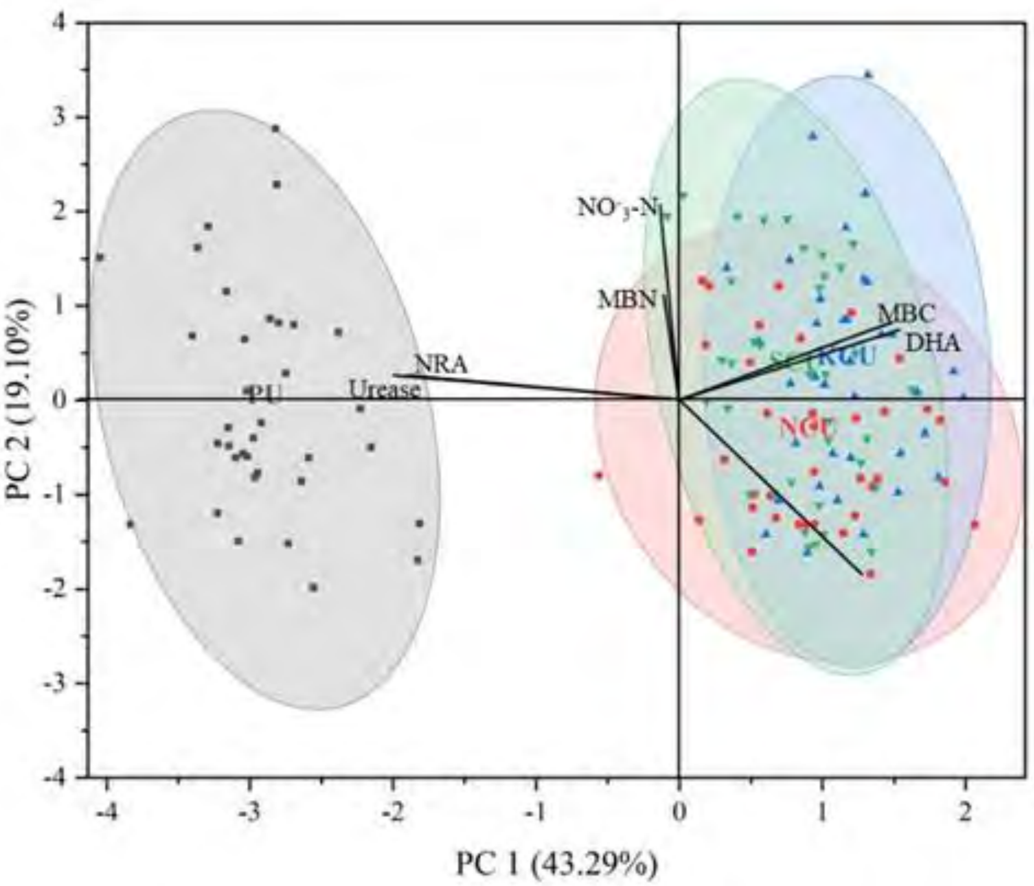


Fig. 4: Principal component analysis (PCA) biplot (PC1: 43.29%, PC2: 19.10%) illustrating the separation of treatments based on normalized soil quality parameters and their associations with soil indicators. Symbols represent individual replicates: ■ = prilled urea (PU), ● = neem coated urea (NCU), ▼ = sulfur coated urea (SCU), ▲ = karanj coated urea (KCU); ellipses denote 95% confidence intervals for each treatment group

GHG mitigation potential of biochar coated urea in rice wheat system

Biochar coated urea (BCU) and Biochar + neem oil coated urea (BNCU) were evaluated under field conditions growing rice (Var. PB1847) and wheat (HD 2967) and were compared with urea and neem coated urea (NCU). The N was applied @ 150 kg N/ha in three equal splits. CH4 emission in rice crop was reduced by 7.4% with BCU and 10.7% with BNCU. The emission of N2O was reduced by ~7.5 & 8.6% in rice and wheat crops with BCU and 12.5-13.3 % with BCU-NCU. The mitigation potential of BCU and BNCU was ~7.7 and 11.8% over NCU in rice-wheat system. The grain yield with BCU (~3% increase) was at par NCU and 5.8-6.3% higher with BNCU compared to NCU (Table 2).

Table 2: GHG mitigation potential of biochar coated urea in rice wheat system

Treatments	Rice			Wheat		R-W system
	CH_4	N_2O	yield	N_2O	yield	GWP
	kg/ha	kg/ha	t/ha	kg/ha	t/ha	Kg CO_2 eq/ha
Control	22.06	0.436	2.32	0.456	2.093	854
Urea	29.48	1.568	4.71	1.485	4.787	1634
NCU	26.02	1.356	5.01	1.296	4.979	1431
BCU	24.10	1.253	5.13	1.185	5.122	1321
BNCU	23.23	1.186	5.31	1.124	5.277	1263
LSD (±)(5%)	1.42	0.062	0.168	0.084	0.15	60




Environmental footprint of tomato: Effect of Fertiliser & Water management

Field experiment was conducted to evaluate the environmental footprint of tomato cultivation under two irrigation practices (Bed and furrow irrigation and drip irrigation) and three N management (no N, farmers practice and recommended dose of fertiliser with micronutrients. Drip irrigation reduced the N2O, NH3 and Leaching losses by ~29.6 %, 55.3% & 98% over bed and furrow irrigation with 25% increase in fruit yield and reduced 70% N footprint and 43% water footprint. Recommended dose of fertiliser with micronutrients reduced the N2O, NH3 and Leaching losses by ~13.6%, 37.3 & 18.9% over farmers practice with similar fruit yield and reduction in N footprint by 30%. The scaling factors for N2O, and NH3 under drip irrigation were 0.70 and 0.45, respectively (table 5).

Table 5: Emission factors and water foot print

Treatments	N_2O-N emission (kg/ha)	NH_3-N emission (kg/ha)	N Leaching (kg/ha)	Fruit Yield (t/ha)	N foot print (kg/ha)	Water foot print (m^3/t fruit)
Irrigation						
Bed and furrow	0.987	6.580	5.554	42.09	13.12	224.66

irrigation						
Drip Irrigation	0.691	2.939	0.135	52.81	3.87	127.11
Nitrogen						
No-N Control	0.346	0.204	0.376	19.59	0.93	394.41
Farmers practice	1.197	9.073	4.039	47.94	14.31	102.51
RDF with micronutrients	1.034	5.686	3.277	48.64	10.00	100.33
LSD (5%)						
N source	0.047	0.261	3.07	4.86	4.86	-
Irrigation	0.025	0.165	1.94	3.08	3.08	-
N*I interaction	0.07	0.369	4.35	5.94	6.88	-

Net ecosystem carbon balance (NECB) under different tillage and residue treatments in rice-wheat system

Among the different tillage and residue treatments in rice wheat system, net ecosystem carbon balance (NECB) was estimated by the following equation

$$\mathbf{NECB = NPP - Rh - H - CH4 + SC + CR + U} \quad (1)$$

where NPP is the net primary production of the crop (wheat, rice and green gram); Rh is the heterotrophic respiration (soil CO2-C flux), measured by closed chamber method; CH4 is soil CH4-C flux measured by chamber technique. H is the harvested straw and grain carbon removed from the field at the harvesting stage; SC is seed carbon; CR is crop biomass carbon incorporation rate (Mg ha^{-1}) and U is carbon added in the form of urea. A positive value of the NECB represents an ecosystem carbon gain after crop harvest on a seasonal scale. The net ecosystem carbon balance (NECB) was the highest in ZT R-W-GG system with GGR+RS retention. The NECB ranged from 1129 kg C ha-1 under conventional rice wheat system with no residue to 3523 kg C ha^{-1} with residue retention in both crops (GGR+RS). The NECB of T6 was 261% higher than conventional treatment. The maximum portion of carbon was lost in the form of harvested biomass (74.6-79.1%), and heterotrophic respiration as CO2 (20.7-25.4 %), whereas percentage of CH4 emission was very low (0.03-0.24%) (Fig. 2). There was significant impact of tillage (p = 0.01) and crop residue retention (p<0.01) on NECB. Crop residue retention in single crop enhanced NECB by 55-99%, while residue retention in both the crops enhanced NECB by 192-212% compared to ZT without crop residue retention (Fig 5).

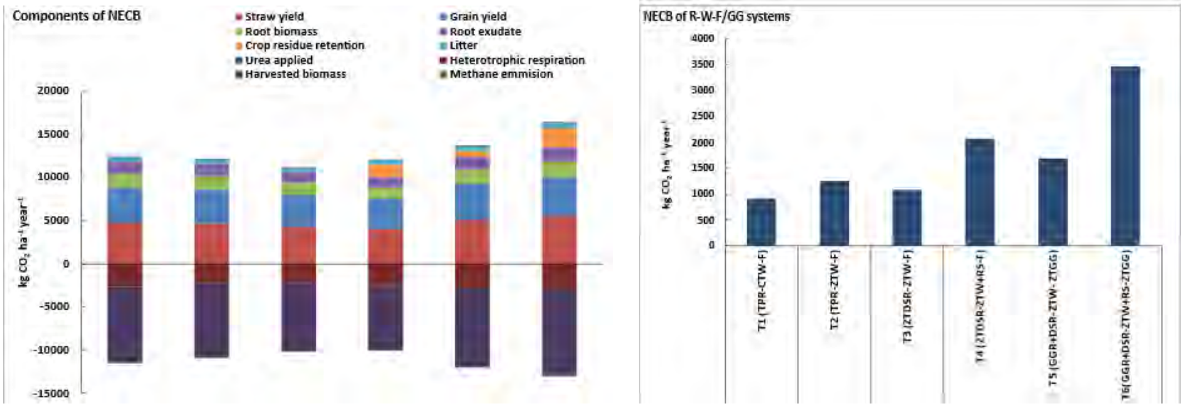


Fig. 5. NECB and its components under R-W-F/GG system. Column with same alphabet are not significantly different

Response of cowpea crop to elevated temperature and carbon dioxide (CO_2) interaction

A study was undertaken to study the interactive effect of elevated CO_2 and temperature on cowpea crop (var. Pusa Sukomal) during the kharif season of year 2024. Crop was grown inside the Temperature Gradient Tunnel (TGT) under three temperature levels (+0, +0.6ºC, +2.4ºC) and two CO2 concentration (ambient and 550 ppm) (Fig 6). There were two cyanobacterial treatments i.e. without cyanobacteria and with cyanobacterial biofilm of Anabaena torulosa-Bradyrhizobium japonicum (An-Rh). In cyanobacterial treatment, rhizobium coated cowpea seeds were treated with cyanobacterial biofilm.

Fig. 6. Cowpea crop grown inside the TGT

Elevated temperature reduced seed yield of cowpea crop. Seed yield reduced by 3.6% and 10.9% with temperature rise by +0.6ºC and +2.4ºC respectively (Fig 7). Application of cyanobacterial biofilm helped in preventing the yield loss. In biofilm applied treatment, there was no yield decline with +0.6ºC temperature rise. In +2.4ºC high temperature treatment, yield reduction reduced by 9.1% with biofilm application. Elevated CO_2 level of 550 ppm enhanced seed yield of cowpea even under higher temperature. Cyanobacterial biofilm application further improved seed yield under elevated CO_2 and temperature interaction.

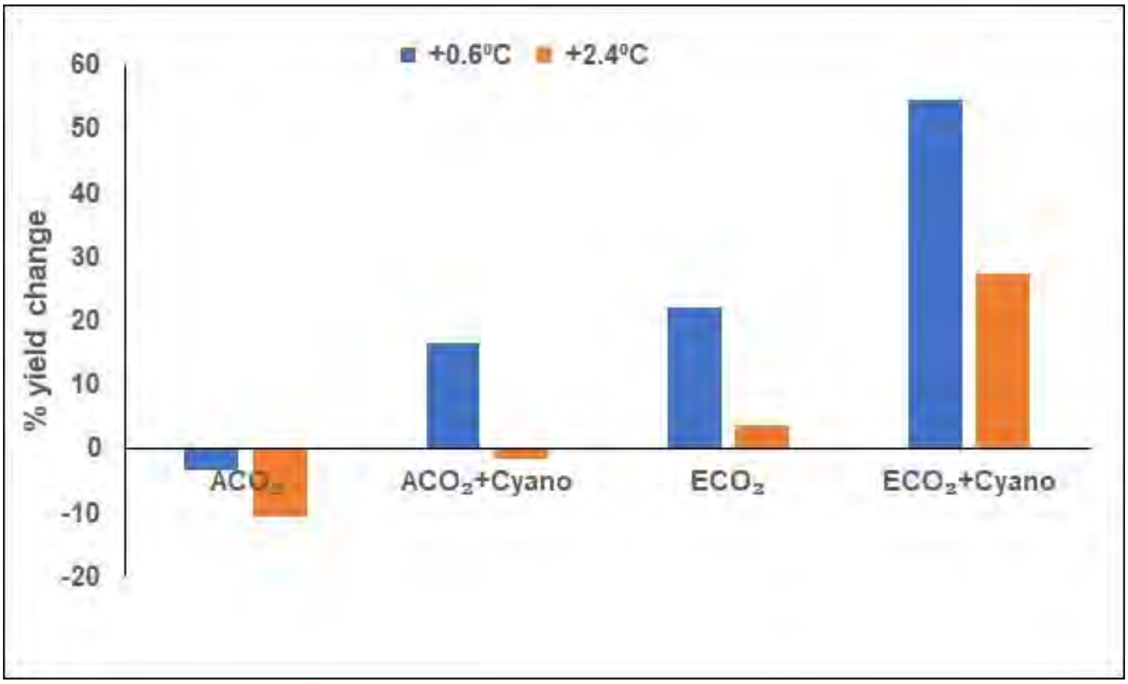


Fig. 7. Change in seed yield in cowpea in different treatments

Interactive effect of elevated carbon dioxide, temperature and salt stress on growth and physiological characteristics of chickpea (*Cicer arietinum* L)

Climate change poses a significant challenge to agriculture globally due to alterations in temperature, precipitation and the frequency of extreme weather events which may lead to a significant reduction in crop yield and quality in following years. Further, an increase in CO2 and temperature also indirectly causes varied abiotic stresses such as drought, salt and nutrient stress. In the past decade, the CO2 level has risen from 350 to 415 ppm, temperatures by ~0.5°C and the area under salinity has increased by 6% of the total cultivable land and may pose another serious concern for sustaining crop productivity and quality. Chickpea, second major pulse crop worldwide, is generally sensitive to salinity, mainly at the reproductive and at the vegetative stage resulting in major yield losses. However, the interactive effect of salt stress under the climate change scenario on crops in general and chickpea in particular are not investigated. An experiment was thus, conducted in temperature gradient tunnels to evaluate the physiological response of a salt tolerant (cv.

Pusa-1103) and a salt susceptible variety (cv. Pusa-256) of chickpea under 100mM and 200mM salt (NaCl) stress, maintained at elevated (~550 ppm, tunnel 1) and ambient CO_2 level (~415 ppm, tunnel 2), at two elevated temperature (+1.5 and +2.5°C over ambient in each tunnel) conditions. Shoot mass was higher under the elevated than the ambient CO_2 condition. Under an elevated CO_2 condition, the temperature and salt stress induced inhibition of growth was mitigated across all chickpea, more so for the salt tolerant (V4 and V3) than the susceptible chickpea varieties (V1 and V2). Mean root mass, in general, was higher under the elevated than the ambient CO_2 condition. An elevated CO_2 condition mitigated partially the negative effect of high temperature and salt stress on the root growth more so for the susceptible than the tolerant chickpea varieties. Plant RSA was increased under elevated than the ambient CO_2 condition but declined significantly with increasing severity of salt and high temperature stress. High CO_2 condition alleviated the negative effect of high temperature and salt stress on the RSA. Root length was significantly induced under an elevated than the ambient CO_2 condition but a general decline in root length was evidenced under salt and high temperature stress irrespective of the CO_2 regime. Elevated CO_2 condition helped in recovery of root growth even under salt and temperature stress. Root volume was also improved significantly under the elevated than the ambient CO_2 condition. Elevated CO_2 condition caused an improvement in root volume across the control and salt-temperature stressed chickpea plants for all the varieties. More finer roots were produced under the elevated than the ambient CO_2 treatment for salt susceptible (V1 and V2) than tolerant (V3, V4) chickpea varieties. Root tip count declined significantly with increasing temperature and salt stress across aCO_2 and eCO_2 condition, but the number was significantly improved under eCO_2. Nodule number was higher under the elevated than the ambient CO_2 condition. Nodule formation was significantly impaired under salt stress irrespective of the temperature stress particularly for salt susceptible varieties (V1 and V2) under the aCO_2. Under an elevated CO_2 condition, the temperature and salt stress induced inhibition of nodulation was improved across all chickpea varieties which may be attributed to higher carbon assimilation in eCO_2 than aCO_2 condition. A similar negative effect of salt and temperature stress on nodule growth was observed across varieties, more so under the aCO_2 than eCO_2. Nodule mass was much more affected under the salt and the temperature stress than the nodule number even under the eCO_2. An impairment of nodulation is likely to impair the symbiotic nitrogen fixation.

Effect of Pusa Decomposer-mediated rice residue management on phosphorus fractionation in aggregate size classes under a rice–wheat system

The experiment was laid out in a randomized block design comprising five treatments: full residue burning, full residue retention, full residue incorporation, full residue retention with Pusa Decomposer, and full residue incorporation with Pusa Decomposer, each replicated four times. After the wheat harvest in the third year, soil samples were collected from two depths and analysed for various phosphorus pools and biological indicators. The results showed that the full residue incorporation with Pusa Decomposer treatment significantly increased labile water soluble phosphorus, sorbed phosphorus, easily mineralizable organic phosphorus) moderately labile phosphorus fractions (sodium hydroxide extractable inorganic phosphorus, sodium hydroxide extractable organic phosphorus), as well as total phosphorus, total inorganic phosphorus and enzymatic activities compared to the residue burning treatment, with consistently higher values observed in bulk soils than soil aggregates. Full residue incorporation treatment exhibited the highest levels of hydrochloric acid extractable phosphorus and residual phosphorus which were notably more concentrated in aggregates than in bulk soils. Across all treatments, the topsoil (0-5 cm) consistently contained greater concentrations of phosphorus fractions and biological indicators compared with the 5-15 cm soil layer (Fig 8).

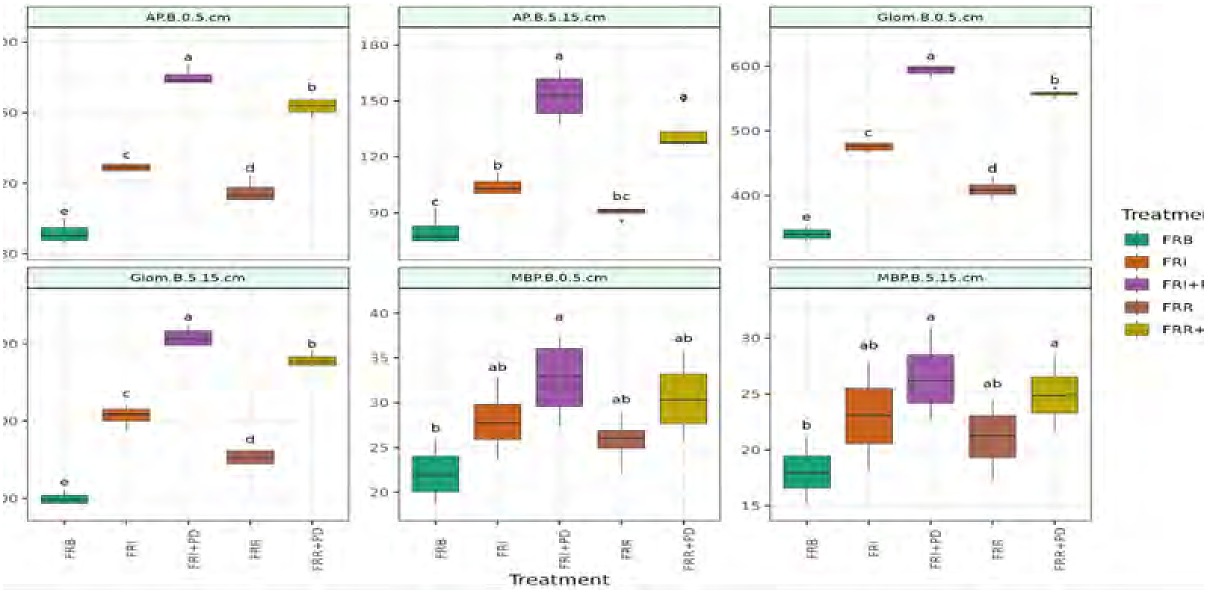


Fig. 8. Influence of decomposer-mediated residue management on alkaline phosphatase activity (µg p-nitrophenol g^{-1} h^{-1}), glomalin content (µg P g^{-1}) and microbial biomass phosphorus (µg P g^{-1}) in bulk soil at two depths after three cropping cycles.

The effect of different agri-management practices on soil organic carbon stability and quality of soil organic matter under present and future climatic conditions

The quality of soil organic matter done by extracting the humic acid fractions and identifying different functional groups from the selected soil samples. The initial soil sampling has been started from the selected sampling sites. Extraction of humic acid and analysis of different functional groups has been started from different agri-management practices. All the humic acids extracted from each land uses showed many bands which are characteristics to the original humic acid substances. More or less all the spectra of humic acids showed similarity with respect to absorption peaks irrespective of the land uses. In this study, the most important bands at 3400 cm^{-1} have been detected which is associated to OH stretch of OH groups, and the bands at 2933 cm $^{-1}$ associated to aliphatic C-H stretching in the humic acids extracted from each land use systems. On the other hand, all the humic acids extracted from each land uses showed many bands which are characteristics to the original humic acid substances. In the region below 1,800 cm^{-1}, some important differences were observed. In land use systems, the FTIR spectra of humic acids extracted from soil aggregates under bamboo, tea, mango and lemon plots showed clear bands compared to other land use systems. Similarly, FTIR spectra of humic acid extracted from soils under rice-rice, wheat-millets, okra-onion and uncultivated land; all the plots showed the characteristics bands of humic acids. In general, the FTIR spectra showed some characteristics and strong absorption bands in the regions from 3700-3400, 1650-1450, 1465-1340, 1200-1020 and 840-532 cm^{-1} wavenumber (Fig 9).

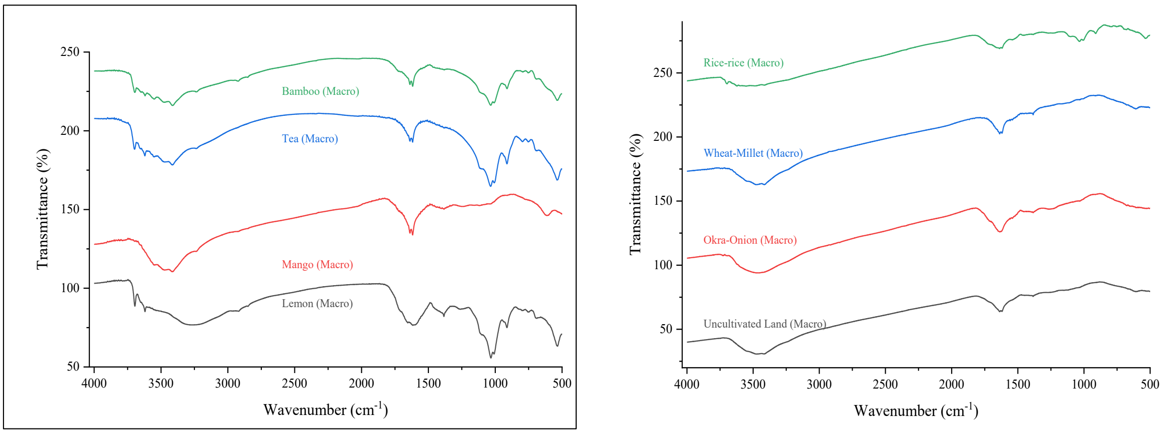


Fig. 9. FTIR Spectra

Effect of gaseous air pollutants (SO_2 and NO_2) on physiological and yield characteristics of Wheat (*Triticum aestivum* L.)

Sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) are major air pollutants that adversely affect crops by generating reactive oxygen species (ROS), which impair photosynthesis and energy metabolism. This leads to reduced crop yields and lower stress tolerance. High SO_2 levels cause visible symptoms such as chlorosis and bleached spots, while NO_2 exposure results in increased leaf drop, stunted growth, and mild necrosis. In developing nations, rising SOx and NOx emissions driven by urbanization, industrial development, and traffic threaten food security. While inter-species variation in pollutant sensitivity is known, this study hypothesizes intra-species variation in wheat. Two bread wheat varieties, HD-2967 and HD-3086, were evaluated under ambient, low, and high concentrations of SO_2 and NO_2. Results showed HD-2967 suffered significant shoot biomass loss under high SO_2 exposure. Leaf necrosis was more pronounced under SOx than NOx. Gas exchange parameters photosynthetic rate, stomatal conductance, and transpiration were measured for both varieties. Yield-related traits were also analyzed to assess pollutant impact. Identifying air pollution-tolerant wheat cultivars is critical to preserving productivity and quality in staple crops, particularly as climate change further challenges agricultural systems.

Redesigning the urban green canopy for an improved air quality

In order to assess the effect of tree canopy on air quality, 18 prominent tree species above 1% Tree population occupying the Delhi's urban green canopy were examined for their pollution removal efficiency, carbon sequestration and heavy metal removal efficiency in relation to their respective foliar characteristics. Leaf area calculation for the tree population was done using i- Tree software (US forest services). The hypothesis that the high enrichment of heavy metals in the particulate matter may be ameliorated by urban green canopy was verified using an additional eleven tree species having their dominance >1% in Delhi, in addition an earlier eight. In general Peepal, Banyan, Kadamb, Jamun and Eucalyptus possessed relatively higher vegetation cum biomass index, a higher air pollution removal efficiency, higher carbon storage & Carbon sequestration in comparison to other experimental tree species.

To assess the various nanotechnological Interventions to reduce nutrients losses to environments

During the year, the study has been conducted to examine the effects of nano-TiO_2 on rice (*Oryza sativa* cv. PB1121) growth and enzymatic activities compared to bulk TiO_2 through a pot culture experiment. Eight Ti doses were applied as soil (0–50 mg Ti kg^{-1}) and foliar (0.05 % and 0.1 %) treatments. The highest grain yield occurred at 25 mg Ti kg^{-1} soil, with a 0.05 % foliar spray being more effective than 0.1 %. Nano-TiO_2 increased antioxidant enzyme activities (CAT, SOD, guaiacol peroxidase, APX) and lipid peroxidation, indicating oxidative stress. The study underscores the dual role of nano-TiO_2 as a growth enhancer and stress agent.

Development of novel nitrogenous fertilizer, approaches for enhanced nitrogen use efficiency

The study has been conducted to synthesis and application of Chitosan/Zeolite Urea Nanocomposite (NC) on wheat (HD-3086) during the Rabi season, focusing on plant growth, nitrogen losses, and soil health. Seven treatments (T1–T7) were applied in a completely randomized design, with Chitosan-Urea NC and Zeolite-Urea NC synthesized and characterized. The highest growth and yield were recorded in T5 (Zeolite-Urea NC) followed by T3 (Chitosan-Urea NC). The maximum microbial biomass carbon (MBC) was found in T3 (298 mg/kg), while the highest microbial biomass nitrogen (MBN) occurred in T3 (17.4 mg/kg). Soil dehydrogenase activity was highest in T5 (58 μg TPF/g soil/h), and urease activity peaked in T6 (52 mg urea/g soil/h). The earthworm toxicity test confirmed eco-safety, with survival rates between 90% and 100%. The study concludes that Chitosan-Urea NC and Zeolite-Urea NC improve nitrogen use efficiency and are eco-friendly alternatives to conventional urea.

To study phosphorus stratification under different agriculture practices

Impact of tillage, residue, and nitrogen management on crop growth and soil health under maize-wheat cropping system studied under field condition. The experiment was conducted in split-split plot design with two level of tillage as main plot of conventional tillage (CT) and no tillage (NT), two level of residue as sub plot of residue (R+) and without residue (R0) and three level of nitrogen as sub-sub plot of 50%, 100% and 150% recommended dose of nitrogen (RDN) for both maize and wheat crop. The distribution of different chemical phosphorus (P) fractions under various agricultural treatments has been determined. The P fractions include carbonate-sorbed P, non-occluded P, Ca-bound P, occluded P, and organically-bound P. under different tretmentes has been quantified. Carbonate-sorbed P shows the highest distribution in Zero-tillage with residue treatment, while Ca-bound P is more prominent in conventional tillage. Non-occluded P has relatively lower distribution across treatments, while occluded P and organically-bound P exhibit intermediate levels. The result indicates that tillage and residue management significantly influence the distribution of P fractions in soil.

Water Quality Index (WQI) of groundwater of southwest Delhi and potential human health risks

This study was conducted to evaluate the Water Quality Index (WQI) and assessed potential human health risks, specifically the Hazard Quotient (HQ) and Total Hazard Index (THI), related to nitrate (NO_3^-) and fluoride (F^-) contamination in groundwater during pre-monsoon and post-monsoon seasons. The WQI analysis indicated that 56% and 34% of groundwater resources were unfit for consumption in pre-monsoon and post-monsoon, respectively. The HQ analysis revealed that in adults, 26% and 36% of samples showed high risk for HQ-NO_3^- and HQ-F^-, while in children, these values were 40% and 54%, respectively. Post-monsoon data indicated NO_3^- posed higher non-carcinogenic risks than F^-, especially in children. The THI ranged from 0.34 to 8.61 (average 1.68) for NO_3^- and F^- in pre-monsoon, and from 0.37 to 2.85 (average 1.86) in post-monsoon. The findings underline the urgent need for environmental management strategies to improve groundwater quality and safeguard public health.

Evaluation of Synthesized Nanozeolite-Based Nitrogen Fertilizers: Slow Release, Toxicity, and Nutrient Use Efficiency in Spinach Beet

This study evaluates the potential of synthesized nanozeolite-based nitrogen fertilizers for improving nutrient use efficiency, minimizing toxicity, and providing slow-release properties in Spinach Beet (Beta vulgaris var. bengalensis). Nanozeolites, due to their high surface area and unique ion-exchange capabilities, offer promising alternatives to conventional nitrogen fertilizers. The research involved synthesizing nanozeolites, characterizing their physicochemical properties through FTIR, XRD, SEM, TEM, TGA, and Zeta potential, toxicity, and slow-release studies, followed by pot experiments using the spinach beet crop to evaluate their effect on plant growth, yield, and nutrient uptake. Results indicated that nanozeolite-based fertilizers significantly enhanced nitrogen use efficiency and exhibited a controlled release pattern, leading to a sustained nutrient supply. Over two years, T4 (100% SNZUF) yielded 8.67% more than T2 (urea), while T5 (100% NZUF) and T6 (75% SNZUF) had slightly higher yields of 0.87% and 1.09%, respectively, compared to T2. Importantly, no adverse toxic effects were observed in Spinach Beet, providing a strong reassurance of the safe application of these nanofertilizers. This study underscores the potential of nanozeolite-based fertilizers to improve sustainable agricultural practices by optimizing nutrient delivery and minimizing environmental impact.

Valorization of Agri-residues for Production of Microbial Lipids and Carotenoids by *Rhodotorula toruloides*

Microbial oils are lipids produced by oleaginous microorganisms, which constitute an alternative to vegetable and fossil-derived oils. They can be produced from organic waste with oleaginous fermentation. *Rhodotorula toruloides* was selected as the target organism, as it demonstrated growth on the pretreated multiple lignocellulosic hydrolysates obtained from sugarcane bagasse, rice straw, and corn cob, highlighting its adaptability and potential for microbial oil production. Pretreatment methods (acid, alkali, and microbial) followed by detoxification were applied to enhance fermentable sugar recovery and minimize inhibitory compounds. Detoxification reduced acetic acid by ~79% (from 2.4 to 0.5 g/L) and hydroxyl methyl furfural (HMF) by ~90% (from 0.8 to 0.08 g/l), thereby improving the fermentation environment. Optimization of fermentation parameters was carried out using Response Surface Methodology (RSM), identifying the carbon-to-nitrogen ratio, inoculum size, and zinc sulphate supplementation as critical factors. Under optimized conditions, Rhodotorula toruloides demonstrated lipid yields above 4 g/L, with fatty acid profiles rich in oleic, linoleic, and palmitic acids. Additionally, carotenoid production with characteristic absorption peaks around 490 nm highlighted the dual bio-product potential of this yeast. Overall, the study demonstrated that valorization of agri residues using Rhodotorula toruloides provides a cost-effective and eco-friendly strategy for microbial oil production, which is in line with the UN Sustainable Development Goals (SDGs 7, 12, and 13).

Mixotrophic cultivation of microalgae using wastewater resources

- Identified and procured established microalgae strains suitable for mixotrophic growth.
- Collected and characterized different wastewater sources for nutrient composition.
- •Conducted preliminary screening of microalgae strains under various wastewater conditions.
- Optimized culture conditions (pH, temperature, light intensity, and CO_2 supplementation) for mixotrophic growth.
- Monitored biomass productivity, lipid accumulation, and nutrient removal efficiency.
- Selected the most suitable microalga based on maximum biomass production and overall growth efficiency (Fig 10).

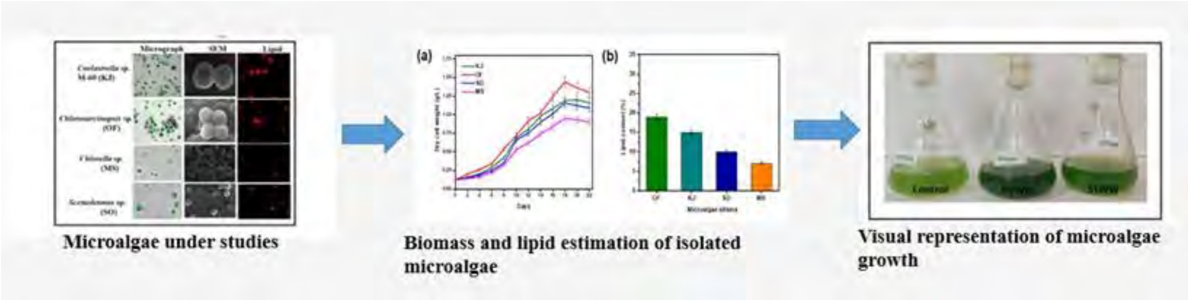


Fig. 10. Biomass and lipid yield of isolated microalgae strains

Step-wise extraction of biopolymers using one-pot multi-phasic fed-batch cultivation

- Designed a multi-phasic fed-batch cultivation strategy to optimize C/N/L ratio.
- Performed shake flask experiments to assess the effect of varying carbon, nitrogen, and lipid supplementation.
- Optimized culture conditions to enhance biopolymer production (e.g., polysaccharides, lipids, and proteins).
- Developed a step-wise extraction protocol for efficient recovery of biopolymers.
- Evaluated biopolymer yield and composition using biochemical and analytical techniques.
- Assessed the feasibility and scalability of the process for industrial applications (Fig 11).

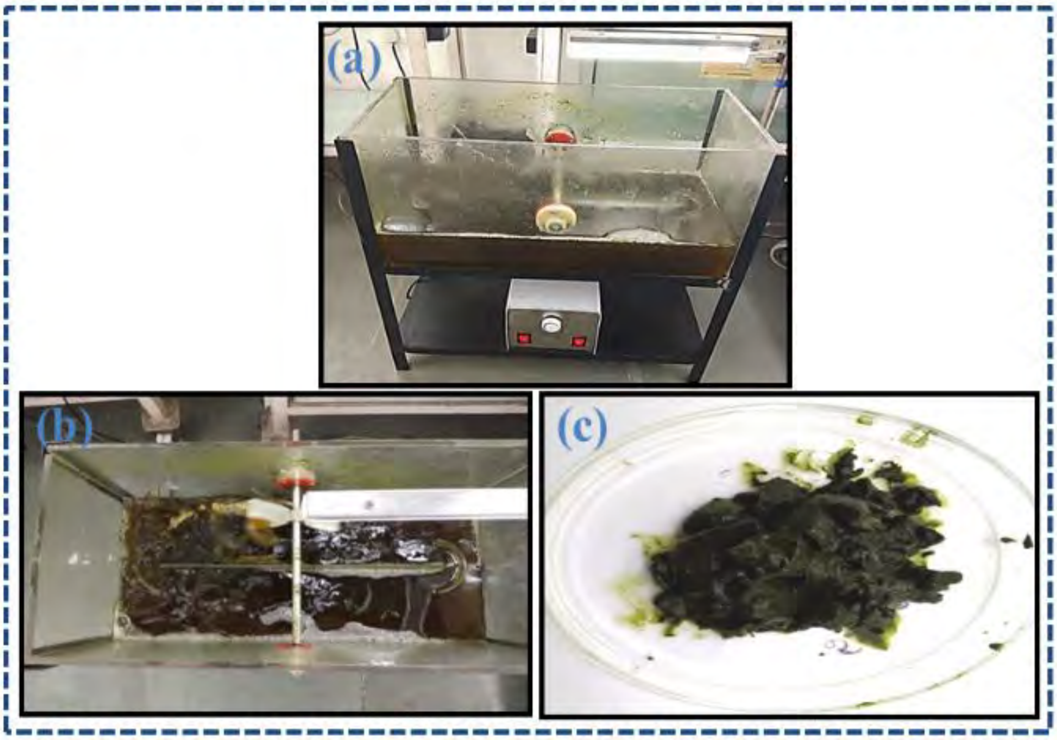


Fig. 11. Biomass and lipid yield of isolated microalgae strains by using Raceway system

Impact of Integrated Application of Biogas Slurry and Organo-mineral Amendments on Soil Microbial Biomass Carbon and Enzymes Activity under Rice-Wheat Cropping System (RWCS)

The mono-cropping system, lacking a balanced nutrient supply and facing diminishing water resources, is contributing to the degradation of soil health. Consequently, agricultural production is becoming unsustainable and leading to environmental degradation. The experiment was executed at the farm of ICAR-IARI in New Delhi under irrigated conditions during 2022-2024 to study the impact of integrated application of biogas slurry and organo-mineral amendments on soil microbial biomass carbon (SMBC) and enzyme activity under rice-wheat cropping system. In this experiment, the doses of urea and biogas slurry were applied for both rice and wheat crop experiment field with 6 different treatments and 4 replications viz., T0-Control (where no urea/biogas slurry applied, BGS), T1-100% N by recommended dose of fertilizer (Urea), T2 – 25% N by BGS + 75% N by recommended dose of fertilizer, T3-50% N by BGS + 50% N by recommended dose of fertilizer, T4-75% N by BGS + 25% N by recommended dose of fertilizer and T5-100% N by BGS. The SMBC has been increased in all the treatments from 2023 to 2024 from 0.98 to 9.0 percent.

The SMBC of T5 treatment is significantly higher than other treatments viz., T0, T1, T2 and T3 but it is at par with T4 treatment in the both years, respectively. In all the treatments the dehydrogenase activity was increased from 2023 to 2024, such as it increased about 8.48 percent in T5 treatment followed by T2/ T3 (8%), T4 (7.27%), T1 (1.45%) and T0 (1.37%), respectively. The activity of the acid and alkaline phosphatase was observed significantly higher in T5 treatment at reproductive stage of wheat, while minimum activity was recorded in T0 treatment during both the years. The maximum α-Glucosidase activity 404.25 mg/mL (2023) and 415.49 mg/mL (2024) was noticed in T5 treatment with a 100% dose of biogas slurry application and it is significantly higher than T0, T1, T2, T3 and T4 treatment.

The activity of β-Glucosidase was increased in all the treatments from 2023 to 2024 and the maximum activity was recorded in T5 treatment 226.0 µg pNP g^{-1} dry soil h^{-1} (2023) and 232.41 µg pNP g^{-1} dry soil h^{-1} (2024) during both years, while recorded minimum in T0 treatment 169.25 µg pNP g^{-1} dry soil h^{-1} (2023) and 172.39 µg pNP g^{-1} dry soil h^{-1} (2024) during both years, respectively. In case of N Acetyl Glycosaminidase (NaG), the activity was recorded maximum in T4 (4.65%) and T3 (3.27%) treatments in comparison to T5 (3.25%) treatments and it is observed minimum in T0 (0.43%) and T1 (0.67%) treatment, respectively. Hence, this experiment demonstrated that the SMBC and most of the enzyme activities are maximum when higher doses of biogas slurry is applied. The study demonstrates that biogas slurry has a significant positive impact on soil enzymes, which are crucial for maintaining soil health and biological diversity. This research is particularly valuable for mitigating the adverse effects of the rice-wheat cropping system on soil health.

Effect of compressed biogas bio-slurry and its impact on crop growth and yield

CBGS slurry obtained from CBG Plant, Badayu (UP), and analyzed for its key physico-chemical properties (macro- and micronutrients). Results indicated that the bio-slurry had a nearly neutral pH of 6.85 and an electrical conductivity of 1.386 dS/m, with high organic carbon content (19.15%) and a balanced carbon-to-nitrogen ratio (19.23). Major macronutrients measured included total nitrogen (1.75%), phosphorus (0.31%), and potassium (0.34%), while micronutrients such as calcium, magnesium, iron, manganese, boron, copper, zinc, molybdenum, and selenium were also present in notable amounts. Heavy metals like aluminum (350.25 mg/kg), chromium (1.25 mg/kg), nickel (0.40 mg/kg), and vanadium (0.575 mg/kg) were detected at low levels, and cadmium, lead, arsenic, and cobalt were not detected, confirming the bio-slurry's safety for agricultural use as shown in Table 6.

Table 6. Physico-chemical properties of CBG bio-slurry

Macro-nutrients (%)		Micro-nutrients (mg/kg)		Total Heavy metals (mg/kg)	
Total N (%)	1.753 ±0.006	Ca	508.5 ±10.8	Al	350.25±7.42
Total P (%)	0.309 ±0.07	Mg	402.5 ±1.2	Cd	BDL
Total K (%)	0.336 ±0.006	Fe	215.7 ±4.5	Cr	1.25 ±0.24
Physico-chemical properties		Mn	35.475±1.240	Ni	0.40 ±0.05
pH	6.85 ± 0.02	B	12.480 ±1.61	Pb	BDL
EC (dS/m)	1.386±0.012(dS/m)	Cu	0.4 ±0.02	As	BDL
OC (%)	19.155 ±1.18	Zn	3.475± 0.5	V	0.575±0.072
C:N ratio	19.231 ±1.36	Mo	0.225 ±0.03	Co	BDL
Moist cont.	64.446 (%)	Se	0.1 ±0.002		
Bulk Density	0.6-0.7(gm/cm3)				

Compressed Biogas (CBG) bio-slurry is used as an eco-friendly organic amendment to promote the recycling of organic waste, reduce reliance on chemical fertilizers, and improve soil fertility and crop yields. In light of this, the experiment was conducted at the Indian Agricultural Research Institute (IARI) farm in New Delhi during the Rabi season

(November-March) 2025. The purpose was to evaluate the impact of rice-based CBG bio-slurry on soil properties, mustard crop growth, and yield. Soil properties such as pH, organic carbon, and available nutrients (nitrogen, phosphorus, potassium, magnesium) improved significantly with bio-slurry treatments combined with urea, neem cake, gypsum, and rock phosphate, especially in treatments T3, T4, and T8. Soil enzyme activities, such as dehydrogenase and phosphatase, also increased, indicating enhanced microbial activity.

Physiological traits, including plant height, leaf area, NDVI, SPAD value, and photosynthetic rate, were significantly improved under these treatments. The highest seed yield was observed in T3 (21.80 g/m²), followed by T4 and T8, which also exhibited higher harvest index and seed quality characteristics. Correlation analysis showed strong positive relationships between seed yield and soil macronutrients nitrogen (0.771), phosphorus (0.748), potassium (0.664), and copper (0.808) as well as micronutrients like iron (0.619), manganese (0.582), and zinc (0.708). Yield-related attributes, such as dry biomass (0.901), number of siliqua (0.866), and straw yield (0.763), also showed positive correlations with seed yield, underscoring their importance for productivity. Photosynthetic parameters, including net photosynthesis (0.742) and transpiration rate (0.853), were strongly associated with yield, whereas stomatal conductance showed a weak negative correlation (table 7). This study suggests that rice-based CBG bio-slurry, particularly when combined with organic and mineral amendments, improves soil fertility, plant physiological performance, and mustard crop yield. Bio-slurry is a safe and effective nutrient source that supports sustainable farming.

Table 7. Effect of compressed biogas bio-slurry and its impact on mustard growth and yield

Treatments	Seed yield (g/m^2)	Straw yield (g/m^2)	Dry biomass weight (g/m^2)	Harvest index (%)	No siliqua (m^2)	Test weight (g)	Siliqua length (cm)	No seeds/ siliqua
T1	16.344^{bc}	44.767^{ba}	61.111^{ab}	27.10^{bac}	72.22^{bac}	2.938^{bdc}	3.80^{d}	14.44^{abcd}
T2	17.109^{bc}	50.600^{a}	67.708^{a}	25.22^{c}	91.81^{a}	3.300^{a}	3.97^{cd}	12.67^{cd}
T3	21.804^{a}	40.279^{bac}	62.083^{ab}	35.17^{a}	82.50^{ba}	3.243^{bac}	4.03^{abc}	15.33^{a}
T4	19.101^{ab}	40.746^{bac}	59.847^{ac}	32.62^{ba}	74.30^{bac}	3.149^{bdc}	3.93^{cd}	12.55^{cd}
T5	17.112^{bc}	41.291^{bac}	58.403^{ac}	29.39^{bac}	86.11^{ba}	3.272^{ba}	4.01^{abc}	13.78^{bcd}
T6	17.038^{bc}	38.101^{bc}	55.139^{bdc}	30.86^{bac}	72.50^{bac}	3.170^{bdac}	4.12^{ab}	15.11^{ab}
T7	18.181^{bc}	39.944^{bc}	58.125^{ac}	31.35^{bac}	82.36^{ba}	2.842^{dc}	4.16^{ab}	13.11^{bcd}
T8	19.054^{ab}	42.682^{ba}	61.736^{ab}	31.35^{bac}	81.60^{ba}	3.241^{bac}	4.06^{abc}	14.22^{bcd}
T9	15.614^{c}	39.025^{bc}	54.639^{dc}	29.18^{bac}	74.72^{bac}	2.844^{dc}	4.25^{a}	15.00^{abc}
T10	11.711^{d}	31.483^{dc}	43.194^{e}	27.18^{bac}	65.63^{bc}	2.872^{dc}	3.90^{cd}	14.55^{abcd}
T11	15.524^{c}	35.170^{c}	50.695^{edc}	30.72^{bac}	70.00^{bc}	2.786^{d}	3.95^{cd}	13.56^{bcd}
T12	10.990^{d}	35.537^{bc}	46.528^{ed}	23.82^{c}	56.60^{c}	3.310^{a}	3.81^{cd}	12.55^{cd}
T13	6.841^{e}	22.326^{d}	29.167^{f}	19.66^{d}	26.11^{d}	2.313^{e}	2.72^{e}	12.22^{d}
LSD(p=0.05)	3.2453	10.655	9.8175	8.5141	22.548	0.4255	0.2734	2.4998

Treatments details: T1 - 50% RDN(F) + 50%RDN(CBGS) +RDPK(F); T2 - 75% RDN(F) +25% RDN (CBGS) + RDPK(F); T3 - 50% RDN (F) +25% RDN (CBGS) + 25% RDN(NM) +RDPK(F); T4 - 50% RDN(F) +50% RDN(CBGS) +RDP (RP) +RDK; T5 - 50% RDN(F) +50% RDN(CBGS) + Gypsum (S) +RDPK; T6 - 50% RDN(F)+50% RDN(CBGS) ; T7 - 75% RDN(F) +25% RDN(CBGS); T8 - 50% RDN(F) +25% RDN(CBGS) +25%RDN(NM); T9 - 50%RDN(F) + 50%RDN(CBGS) + RDP (RP); T10 -50% RDN(F) + 50% RDN(CBGS) + GYPSUM(S); T11 – 100% RDF (F) NPK – 90:60:40; T12 - 100%RDF(CBGS); T13 – Control

RDN-Recommended dose of nitrogen; RDPK- Recommended dose of phosphorus and potassium; NM-neem cake @ 450kg/ha; RDK-Recommended dose of potassium; RP- Rock Phosphate 545kg/ha; Gypsum@ 188kg/ha; CBGS: 50% @7.5t/ha 25% @3.72t/ha, 100% @15t/ha

A novel cascading *Coelastrella* biorefinery for phycoremediation of wastewater and complete valorization of the biomass to lipids, lutein and fertilizer in circular bio economy

In this study, the green robust microalgae, Coelastrella sp. was used to evaluate the economic feasibility of cascading biorefinery approach to ensure a sustainable and viable production of lipids, lutein and biomass. The biomass was further evaluated for its fertilizers potential and nutrient supply to agricultural crops. The phycoremediation of sewage wastewater by Coelastrella sp. significantly reduced the salinity, ammonical nitrogen (NH4- N), nitrate nitrogen (NO3-N), total dissolved solid (TDS), BOD5 and COD. The removal efficiency of salinity, NH4- N, NO3-N, TDS, BOD5 and COD were 43%, 87%, 82%, 40%, 93% and 87 % respectively. The lutein, lipid and biomass productivity were recorded 1.94 mg/g and 0.42 g/L 0.58 g/L respectively. The biomass was further evaluated for the nutrient potential (fertilizers) and reported 8.4% Nitrogen (N), 1.64% Phosphorus (P) and 0.85% Potassium (K). The economic feasibility analysis of lutein, lipids and fertilizers has reported to generate approx. 142,907.82$/ year by this Coelastrella biorefinery approach. This complete volarization has strengthen the concept of economic viability and environmental feasibility and established the circular bio economy's tenets.

Radiochemical (14C) evidence shows inhibitory effect of microplastic on carboxylation efficiency, carbon-partitioning and root exudation capacity to regulate growth in wheat.

Microplastic contamination in agricultural systems is an emerging environmental concern that may influence plant growth and metabolism. This study investigates the effect of microplastics viz., polyethylene (PE) and polyvinyl chloride (PVC), on the carbon metabolism in terms of the 14CO2 fixation efficiency, shoot: root partitioning of photosynthates and root release of organic acids in bread and durum wheat raised on the nutrient solution culture. Results reveal a significant species- level variation in growth response of wheat to the microplastics. An exposure to PE, then PVC, caused a significantly inhibition in 14C-assimilation, with the bread wheat exhibiting a higher sensitivity to the microplastics than the durum wheat. Durum wheat on the oher hand, demonstrated a greater resilience, maintaining better nutrient uptake and translocation of assimilated carbon than the bread wheat under both experimental microplastic treatments. This may have implications for plant growth, yield, and overall productivity, highlighting the need for further investigation into the long-term effects of microplastic pollution on crop health. Further, heavy metal micro-plastic interaction was studied in wheat. Results reveal that micro-plastics are capable of immobilizing the heavy metals such as Fe and Pb in the soil and thus can reduce their availability for plant uptake. The present research provides valuable insights into the interactions between microplastics and nutrient dynamics, contributing to understanding the environmental risks posed by plastic pollution in agriculture.

Effect of enriched steel slag on crop growth and yield under variable environment

Nutrient -enriched steel slag-based fertilizer/ soil conditioners were produced from nonmetallic LD Slag fine. The products were rich in most of the macro and micro nutrients required for the plants and provides encouraging results which may result in reduced usage of NPK fertilizers. It also helped in increasing the crop yield and quality and disease control of some specific vegetables like cauliflower, capsicum and fruits like pomegranate etc. Thirteen steel slag-based value-added products (SSBVAP's) were given to Industry partners (TSL, JSW steel Ltd, SAIL) for independent performance validation; SSBVAP's yielded 10-15% higher productivity with less (80%) RDF and did not cause any heavy metal phyto and soil toxicity over three crop seasons.

Study on root exudation and phytosiderphore release by graminaceous crops

Root exudates collected from different annual crops like wheat, rice, maize and oat and perennial grass like Panicum maximum and Cenchrus ciliaris and Heteropogon were analyzed for phytosiderophores (PS) and their Fe mobilization efficiency (Fig. 12). Their capacity to mobilize Fe was found in order Perenials>Maize>Wheat>Oat>Rice (Fig. 2). Their diurnal release pattern as well as capacity to chelate other heavy metals (Cd, Pb and Ni) were also studied. maximum release of PS was recorded during morning hours after onset of light. Further, effect of these heavy metals on phytosiderophore release capacity and carbon partioning in different genotypes of wheat was also studied. In general growth inhibition by Cd as compared to Pb was more pronounced in wheat however, Fe/Zn efficient varieties could perform better as evidenced by grain yield and other physiological traits (Fig. 13).

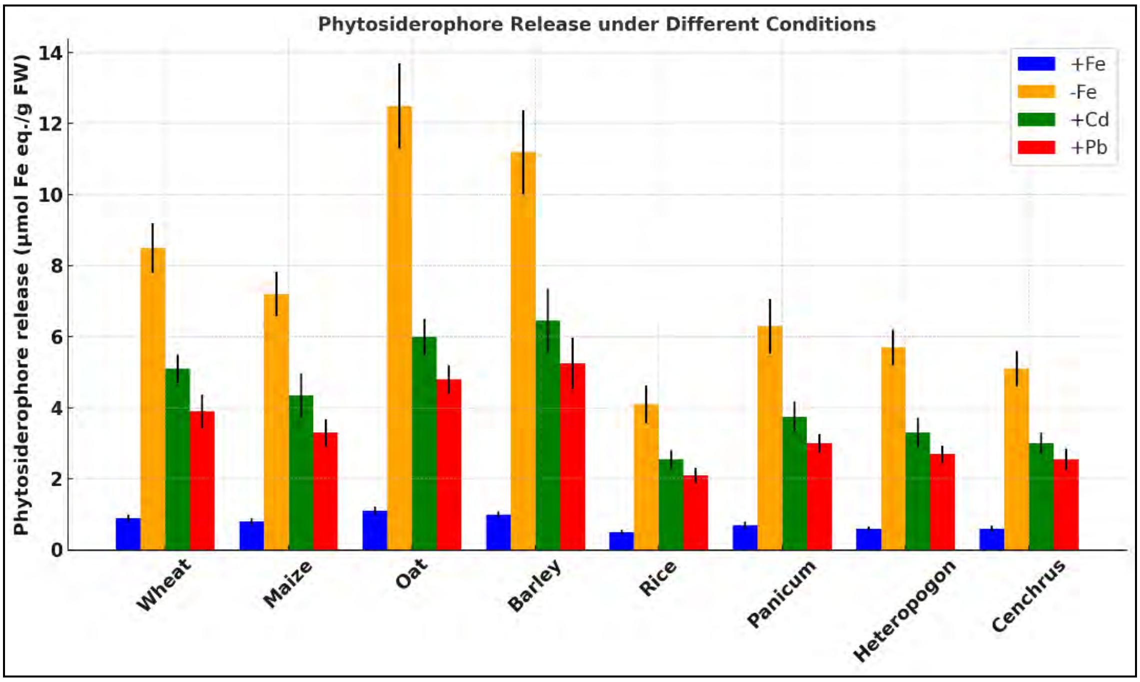


Fig. 12. Phytosiderophore release by different crops under (-)Fe and (+)Fe condition and under heavy metals (Cd and Pb) stress.

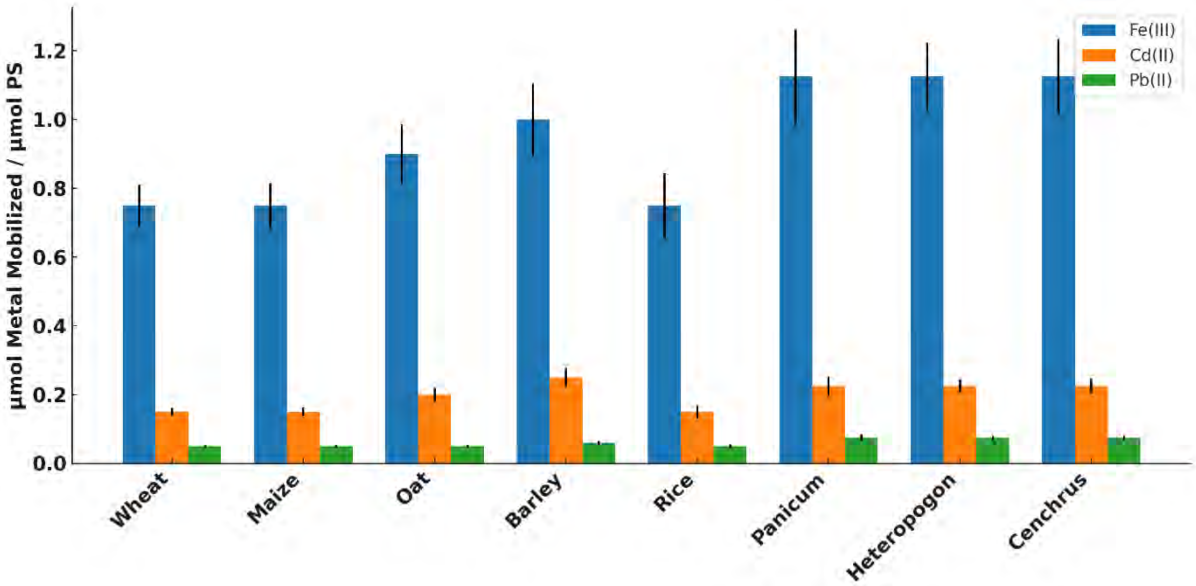


Fig. 13. Metal (Fe, Cd and Pb) mobilization capacity of phytosiderophores produced by different crops.

Development of LD slag based organo-mineral fertilizer cum soil conditioners

The impact of LD slag-based fertilizer products (ranging from 0.5-1.0 t ha-1 for different crops) with and without 80% recommended dose of NPK fertilizers (RDF) was assessed in multiple crops like cereals (wheat, rice, maize) vegetables (brinjal, tomato, amaranthus) and oil seed (mustard) crops, and on the soil physical and biological properties. These amendments led to improvement in physical and chemical properties of slag thereby improving its nutrient profile besides reducing the heavy metal content and optimizing the pH to near neutral. Thirteen SSBVAPs were given to Industry partners (TSL, JSW steel Ltd, SAIL) for independent testing (Table 8).

Table 8. Characteristics of steel slag-based value-added products in terms of nutrient content

Product attribute	Range	Product attribute	Range	
pH	6.5-7.5	Fe %	1.02 – 4.41	
OC %	5-8 %	Zn ppm	7.60 -74.0	
N %	0.23-0.85	Mn ppm	386.7-4556	
P %	0.17-5.16	Cu ppm	0.73-22.94	
K %	0.72-14.95	Heavy metals (ppm)		*MAPL
S ppm	4.0-7320.0	Cd	NIL	3.0
Ca %	2.7 - 30.23	Cr	50.5-157.3	150.0
Mg %	0.35 – 7.14	Ni	1.10-20	75.0
Si %	4.04- 31.3	Pb	1.57-45.3	250-500
Co ppm	0.7-7.75			
Mo ppm	5-25			

*MAPL, Maximum Allowable Permissible Limit

2. Intellectual property

Copyrights granted

- Copyright ID: SW-18287/2024, Spinach Simulation Model v1: Lead developer: Dr. S. Naresh Kumar
- Copyright ID: SW-18313/2024, VignaradSim v1: Lead developer: Dr. S. Naresh Kumar

Patent filed

- Namita Das Saha, Priyanka Kumari, Niveta Jain and Bhupinder Singh (2024) Device and method for separation and quantification of microplastics from soil, sludge and farm yard. Patent filed vide application no 202311059521
- Kalidindi Usha and Bhupinder Singh (2024) Laser-induced graphene from single-use plastic Patent filed vide application no 202311030667
- Biosurfactant formulation for degradation of hydrocarbons in soil and method of preparation thereof" by Ashish Khandelwal, Ashwini Yadav, Neera Singh (Patent Number: 202411054900 dated 18-07-2024 CBR Number: 47270)

3. Linkages and collaboration

- Institutes/Industry/University, and details of collaboration (whether it is in project, if so, name of the project, PI etc).
- Agriculture Model Intercomparison and Improvement Project (AgMIP- Global Steering Council Member, led by Columbia University and NASA.
- DST Technology development Programme, Expert Member
- DST Device development Programme, Expert Member
- DST SHRI Programme, Expert Member
- DST INSPIRE Programme, Expert Member
- DAC committee on crop yield forecast (member)
- MoEF&Cc member on Persitant Organic Pollutants
- Bureau of Indian Standards, Expert member.
- MoEFCC Panel on Persitant Organic Pollutants, Expert member.
- MoA&FW committee for crop yield forecast, Expert member.
- Ministry of Steel and Steel Industry: Project (Code 24-774): Development of steel slag-based cost-effective eco-friendly fertilizers for sustainable agriculture and inclusive growth. Tata Steel Limited; JSW Steel Limited; SAIL
- Tata Steel Limited; JSW Steel Limited and SAIL, Ministry of Steel and AMNS Limited (TWO CRP's code 24-774 and 79-184)
- VNIT, Nagpur under the project Use of Biomass ashes to enhance the nutrient supply to the plant and effect on soil health
- IIT, Delhi
- G.B. Pant University of Agriculture & Technology, Pantnagar
- Bhabha Atomic Research Centre, Mumbai
- Collaboration with the NESA (National Environmental Science Academy) New Delhi and working as General Secretary of NESA for organizing environmental awareness and workshop and conferences
- Coromandel International Limited on Evaluation of the Effectiveness of Foliar Applied Nano Urea and Nano DAP Using Dual Labeling 32P and 15N Isotopic Technique in Maize.
- NABL Assessor as per ISO/IEC 17025: 2017 (Air, Water, Soil, Environment and Pollution)

- Centre of Excellence (CoE): A Centre for Technology D4 – Design, Develop, Demonstrate and Deploy in the area of F5 – Food, Feed, Fodder, Fertilizer and Fuel" (Project Code: 24-881)
- AERB and BARC, Mumbai as Radiological safety Officer and In-charge Gamma Irradiation Facility
- Two MOUs signed with the industry
  1. Memorandum of understanding between ICAR-IARI and Coromandel International Limited was signed on 24 march 2025 to undertake CRP on assess the effectiveness of foliar applied nano-urea and nano-DAP. (PI: Dr Manoj Shrivastava; Associates: Dr's Bhupinder Singh and Renu Singh) 2025-2026
  2. Memorandum of understanding between ICAR-IARI and Arcelor Mittal Nippon Steel India Limited, Hyderabad was signed on 2.9.24 to undertake CRP on Characterization of iron ore tailings and assessing its suitability for agricultural application. (PI: Dr Bhupinder Singh; Associates: Dr's Chandan Kumar Gupta and Shiv Prasad) 2024-2025

4. Education

a) MSc and PhD courses

Details of courses offered in MSc and PhD during Semester I and Semester II

Course name	Course code		Credits
Semester I			
Introduction to Environmental Sciences	ES 501	MSc	2 + 1
Environmental Chemistry	ES 502	MSc	2 + 1
Climate Change and Climate Smart Agriculture	ES 503	MSc	2 + 1
Instrumental Methods for Environmental Monitoring	ES 504	MSc	2 + 1
Environmental Pollution	ES 506	MSc	2 + 1
Analysis of Agroecosystem	ES 601	PhD	2 + 1
Environmental Impact Assessment	ES 602	PhD	2 + 1
Waste Management	ES 603	PhD	2 + 1
Crop Geography and Ecology	ES 604	PhD	2 + 1
Agrostology and Agroforestry	ES510	MSc	2 + 1
Master's Seminar	ES 591	MSc	1 + 0
Doctoral Seminar I	ES 691	PhD	1 + 0
Doctoral Seminar II	ES692	PhD	1 + 0
Semester II			
Environmental Engineering	ES 505	MSc	2 + 1
Environmental Microbiology and Ecology	ES 507	MSc	2 + 1
Biofuels and Environmental Protection	ES 508	MSc	2 + 1
Environmental Toxicology	ES 509	MSc	2 + 1
Environmental Geosciences	ES 511	MSc	2 + 0
Biodiversity	ES 605	PhD	2 + 1
Plant Growth Modeling & Simulation of Ecological Processes	ES 606	PhD	2 + 1
Introduction to Environment Law and Policy	ES 607	PhD	2 + 1
Masters Seminar	ES 591	MSc	1 + 0
Doctoral Seminar I	ES 691	PhD	1 + 0
Doctoral Seminar II	ES 692	PhD	1 + 0

b) No. of students admitted: MSc- 17; PhD- 17

c) Fellowships secured by the students (other than IARI Fellowship)

S. No.	Name of the student	Name of the fellowship	Awarding agency
1.	Keerthikumar M	UGC, JRF	UGC
2.	Lokesh Kumar Meena	NFST Fellowship	Ministry of tribal affairs
3.	Rishabh Shrivastava	UGC NET JRF	UGC
4.	Lukeshwari Shyam	UGC NET JRF	UGC
5.	Shemeem Shah P	SRF	UGC

d) Students awarded with degrees during 2024-25

S. No.	M.Sc./ Ph.D.	Name of the student	Name of the Chairman	Thesis title
1.	M.Sc	Mr. Rajdeep Das, Roll no. 21814	Dr. Renu Singh	Preparation and performance analysis of bioplastics synthesized using titanium dioxide nanoparticles with corn cob
2.	M.Sc	Ms. Anjaly. M, Roll No. 21949	Dr. D.K Sharma	Quantification of soil ecosystem service from kole wetland: a coastal agrarian wetland in kerala
3.	M.Sc	Pavan Kalyan, Roll No. 21978	Dr. Manoj Shrivastava	Chitosan / Zeolite Urea Nanocomposite to Improve Nitrogen Use efficiency in Wheat
4.	M.Sc	Asmaul Hossain, Roll No. 21812	Dr. Sandeep Kumar	Study on Reactive Nitrogen Losses from Tomato Cultivation under Open Field and Polyhouse Condition
5.	M.Sc	Ashwini Yadav, Roll No. 60124	Dr. Ashish Khandelwal	Isolation, characterization of biosurfactant and their effect on hydrocarbons' degradation in different soils
6.	M.Sc	Nisha Khatri, Roll No. 21950	Dr. Niveta jain	Greenhouse gases and particulate matter emission due to sugarcane residue burning using

				measurements and remote sensing
7.	M.Sc	Reenu Verma, Roll No. 70024	Dr. Ajay K. Singh	Elevated temperature responsiveness of soybean genotypes
8.	M.Sc	Ashwariya Laxmi, Roll No. 21913	Dr. Niveta jain	Nitrogen and Water footprints of tomato cultivation under different irrigation and nitrogen management practices
9.	M.Sc	Anju Choudhary, Roll No. 21813	Dr. Anita Chuadhary	Effect of Microbial and Non - Microbial Bio-Stimulants for Increasing the Chickpea Resilience to Dry Spell
10.	M.Sc	Arun Meena, Roll No. 21815	Dr. Anita Chuadhary	Impact assessment of plant bio stimulant and phenolic compound for water stress mitigation in wheat crop
11.	M.Sc	Ramakrishna Panda, Roll No. 60131	Dr. Dipak K. Gupta	Mapping of variation in soil organic carbon stock within iari-Jharkhand farm
12.	Ph.D	Ankita Paul, Roll No. 11024	Dr. Arti Bhatia	Effectiveness of modified urea fertilizers in reducing ammonia and nitrous oxide losses and increasing the nitrogen use efficiency in rice
13.	Ph.D	Shravani Sanyal, Roll No. 11491	Dr. Bidisha Chakrabarti	Field and simulation studies on the interactive effect of elevated carbon dioxide and temperature on aestivum and durum wheat
14.	Ph.D	Alesh Kumar, Roll No. 11025	Dr. Manoj Shrivastava	"Phosphorus dynamics under different tillage and residue management practices in maize-wheat cropping system"

15.	Ph.D	Helen Mary Rose, Roll No. 11026	Dr. Niveta Jain	Life Cycle Assessment of Maize and Wheat products

e) Research scholars registered in different universities for Ph.D.

S. No.	Name of the research scholar	Principal Investigator	Thesis title	University at which registered
1.	Himanshu Harit	Arti Bhatia	Effects plant growth promoting microbial culture on soil greenhouse gas emissions in Rice-Mustard cropping systems	Amity University
2.	Ritu Nagdev	Dr. Shakeel A. Khan	Biogas slurry valorization through organo-mineral amendments for sustainable crop production	Amity University, Noida
3.	Bhawana Joshi	Anita Chaudhary	Assessment of structural and functional divergence of soil microbial community under elevated CO_2 and O_3 in wheat crop	Amity
4.	Ruchira Joshi	Niveta Jain	Effect of inhibitor coated urea on soil nitrous oxide and carbon dioxide emissions from wheat and maize crops	Amity University

(f) Awards and recognitions received by the students

Name of student	M.Sc./ Ph.D.	Name of the award	Year	Agency
Ms. Shambhavi Singh (IARIBAR20232005)	Ph.D	1^{st} Prize in Hindi Extempore Competition	2025	Division of Env. Sci.
Ms. Ramya and Riya	Ph.D	Annual Sports Meet SPARDHA 2025. • Discuss throw -Gold • High jump -Gold • Long jump -Bronz • Shot put- Bronze • Team game volleyball and cricket	2025	

5. Internship & mentorship by the scientist

- **Student internship**
  - **Adamya Singh:** “Laboratory Techniques for soil and gas sample analysis “, one-month internship
  - BioCARE Scientist
  - Ramalingaswami Fellow
  - DST Post Doctorate Fellow (TARE)
  - Dr. Anwesha Khanra **(DST No: TAR/2022/000232)** project entitled “A Sustainable Approach of Microalgae Mediated Wastewater Treatment Through One Pot Multiphasic Fed Batch Strategy and Biopolymer Production Towards Metal Corrosion Inhibition”
  - Mentorship of Ms. Priyanka Meena, Scientist, ICAR-NIBSM under the ICAR Professional Attachment Training Program

6. Awards and recognitions received by the scientists

a) ICAR/National awards

S. No.	Name of the scientist	Name of the award	Awarding agency
1.	Dr. S. Naresh Kumar	Lead author for Agriculture, Food, fiber, forest and fisheries chapter, IPCC AR 7 Working Group II	
2.	Dr. S. Naresh Kumar	Lead author for IVA -Agriculture for India's First Biennial Transparent report to National to UNFCCC	
3.	Dr. S. Naresh Kumar	Convenor, Sustainable Agriculture Standards, Bureau of Indian Standards, GoI	
4.	Dr. S. Naresh Kumar	Core Expert Member on Guide to Agricultural Meteorological Practices (ET-GAMP),	
5.	Dr. Arti Bhatia	for completing training programme for technical expert review of national inventory reports of LULUCF sector and country adaptation reports for the enhanced transparency framework under the Paris Agreement.	UNFCCC
6.	Dr. Arti Bhatia	Lead author for chapter 13 on AFOLU for IPCC seventh assessment report (AR7), Working group III,	
7.	Dr. Manoj Shrivastava	Dr. J.S.P. Yadav Memorial Award for Excellence in Soil Science by Indian Society of Soil Science	ISSS
8.	Niveta Jain	UNFCC certifies reviewer for GHG inventories	
9.	Niveta Jain	Member of technical committee for Net zero emission of India, MoEFCC, GoI	

10.	Niveta Jain	Member of Net zero emission of Agriculture Sector, Niti Aayog, GoI	
11.	Dr Ranjan Bhattacharyya	Expert Member of the Intergovernmental Technical Panel on Soils (ITPS) of the FAO	FAO
12.	Bhupinder singh	Member IBSC, Tata Steel Limited Jamshedpur	
13.	Bhupinder singh	Associate Editor and Member Editorial Board	
14.	Bhupinder Singh	Member Core Group on Utilization of steel slag	
15.	Bhupinder Singh	Member Academic Advisory Committee	

b) Fellowship of Professional societies of the relevant Discipline

S. No.	Name of the Scientist	Fellowship/ Associateship	Name of the Academy
1.	Dr. Manoj Shrivastava	NESA Fellowship	National Environmental Science Academy (NESA)
2.	Dr. Shakeel A. Khan	Fellow	NESA, New Delhi
3.	Dr. Shakeel A. Khan	Expert advisor and Adjunct Professor	Centre for Environment and Sustainable Development (CESD) Jamia Hamdard University, New Delhi-110062
4.	Dr. Manoj Shrivastava	NESA Fellowship	National Environmental Science Academy (NESA)

c) Fellowship of Professional societies of the relevant Discipline

S. No.	Name of the Scientist	Fellowship/ Associateship	Name of the Academy
1.	Dr. Shakeel A. Khan	External expert member of Board of Studies	AMU, Aligarh
2.	Dr. Shakeel A. Khan	General Secretary	NESA (National Environmental

			Science Academy) New Delhi
3.	Dr Ranjan Bhattacharyya	Fellowship	Indian Society of Soil Science

d) Best Poster awards

S. No.	**Detail of the poster**	**Presented in**	**Position**
1.	Best oral presentation (first Prize) on paper presentation of the topic entitled "Chlorine free nanocellulose based rice husk edible coating on Kale leaves: Approach towards circular economy" authored by Anamika Thakur, Abhijit Kar, Alka Joshi, Dinesh Kumar, Renu Singh (2025)	in 8th AMIFOST organized by Amity University, Noida from 27-28 March, 2025 (International Conference)	first prize

7. Budget estimates

- **Head-wise budget received and expenditure under EFC 2023-24**
  - Capital (Rs in Lakhs): 9.5 (in lakhs)
  - Revenue (Rs in Lakhs): 52.5 (in lakhs)
- **Total expenditure**
  - Capital (Rs in Lakhs): 9.27 (in lakhs) (97.57%)
  - Revenue (Rs in Lakhs): 53.64 (in lakhs) (102.17%)

a) Budget received from external grant

S. No.	Name of the project	Name of the PI	Duration	Sanctioned budget (lakhs)	Budget received in year 2025 (lakhs)
1.	"National innovation in climate Resilient Agriculture " (NICRA) (12-115)	Dr. S. Naresh Kumar	2021-2026	206 cr. per year	2,63,00,000
2.	"National Mission for sustainable Himalayan ecosystem" (NMSHE) (24-783)	Dr. S. Naresh Kumar	2021-2026	218	37,71,640
3.	Assessments on climate change related agricultural losses, damage, impacts, vulnerability and adaptation for national communications (BTR and FNC) to UNFCCC	Dr. S. Naresh Kumar	2024-27	Rs. 44.99	20,69,943
4.	Development of steel slag-based cost-effective eco-friendly fertilizers for sustainable agriculture and inclusive growth	Bhupinder Singh	2021-2025	866.4 Lakh	61 Lakh
5.	Characterization of iron ore tailings and assessing its suitability for agricultural application	Bhupinder Singh	2024-2026	26.4 Lakh	13.264 Lakh
6.	ACASA project, funded by BISA-CIMMYT	Arti Bhatia	November 2023 to March 2026	80.7	21.27
7.	Greenhouse gas (GHG) emission under different rice crop establishment methods, funded by International Rice	Arti Bhatia	May 2025 to Dec 2027	37.2	22.4

	Research institute (IRRI)				
8.	Greenhouse gas emission inventory from Indian agricultural soils and rice cultivation for BTR 1, BUR4 preparation	Arti Bhatia	April 2024 to June 2027	54.10	12.96
9.	Studies on greenhouse gas emission in rice-wheat and sugarcane wheat cropping system under different agri-management practices – (Contract research)	Arti Bhatia	June 2024 to December 2026	70.94	24.83
10.	Quantifying Rice Greenhouse Gas Emissions (Queri): Impact of Water Management and Sowing Techniques in Telangana and Punjab, India- contract research	Arti Bhatia	October 2024 to March 2026	25.00	7.5
11.	Developing scaling factors of methane and nitrous oxide emission from rice cultivation under different management practices	Arti Bhatia	2025to March 2028	7559600	
12.	Co-benefits of biochar and enhanced rock weathering application to cropped soils	Arti Bhatia	2025 to 2027	6277000/-	
13.	Evaluation of the Effectiveness of Foliar Applied Nano Urea and Nano DAP Using Dual Labeling 32P and 15N Isotopic Technique in Maize (Project Code: 79-199)	Manoj Shrivastava	2025-2026	32.9 Lakhs	32.8 Lakhs
14.	Centre of Excellence (CoE): A Centre for Technology D4 – Design, Develop, Demonstrate and Deploy in the area of F5 – Food, Feed, Fodder, Fertilizer and Fuel" (Project Code: 24-881)	Manoj Shrivastava	2025-2030	60.14 lakhs	1576800
15.	Enrichment of FOM produced from CBG plants and development of package of practices (PoP) for major crops	Manoj Shrivastava	2025-2028	35.11 lakhs	1455000
16.	Evaluation of nanourea on crop productivity and nitrogen use efficiency in diverse Agro-Ecological Zones of India	Manoj Shrivastava	2025-2030	100.88Lakhs	1038900
17.	Emission inventory of agriculture sector: crop residue burning, liming and urea application to soil	Niveta Jain	March 2024-Dec 2027	38.10 L	3.429L

18.	Reducing uncertainty in emission of non-CO2 greenhouse gases from crop residue burning and emission factor for CO2 emission from urea application to soils	Niveta Jain	Dec 2025-March 2028	91.58L	74.374L
19.	A sustainable Approach of Microalgae Mediated wastewater treatment through one Pot mutiphasic fed batch strategy and biopolymer production towards metal corrosion Inhibition	S A Khan	2022-Till date	Rs. 18.30	Rs. 3,35,000

b) Revenue generated

S. No.	Name of the Technology	Brief of commercialization	Revenue generated (Lakhs)
1.	Gamma irradiation of tree species to improve the paper quality and in other crops	Crop and target-based dose optimization and irradiation for Industry, researchers, students; A total of 327 including 84 paid samples of cereals, flowers, fruits, flowers, vegetables legumes, pollen etc were irradiated in 2023-24	0.472

8. PUBLICATIONS

- During 2025, total number of publications: 32

a) Research and review publications

S. No.	Publication	IF	NAAS Score
1	Mahesh, R., Murtaza Hasan, D.K. Singh, R.N. Sahoo, Soora Naresh Kumar, Md Yeasin (2025). Effect of LED spectra (red: blue ratios) on morphological and physio-biochemical performance of pak choi (Brassica rapa var. chinensis (L.) Hanelt) grown under controlled environment multi-tier hydroponic production system. Plant Physiology and Biochemistry. https://doi.org/10.1016/j.plaphy.2025.110054	5.7	11.7
2	Swarnashree Barman a , Ranjan Bhattacharyya a,* , Charan Singh b , A.C. Rathore b , Vibha Singhal b , M. Muruganandan b , Anshuman Patel a , Anshuman Das a , S.L. Jat c , P. Jha d , Avijit Ghosh e , D.R. Biswas a , Nayan Ahmed a , Shrila Das a , T.K. Das a , Soora Naresh Kumar (2025). Soil organic carbon stabilization inside microaggregates within macroaggregates is the major mechanism of carbon sequestration under a long-term agroforestry system in the foothills of the Indian Himalayas. Soil and Tillage Research. 253, 106649. https://doi.org/10.1016/j.still.2025.106649,	6.8	11.8
3	*Singh, Bhupinder, Pandey, V., Kumari, S., Usha, K., Gupta , C.K., and Khan , A. (2025). Effect of Linz-Donawitz (LD) steel slag on soil properties and yield of cereal, vegetable and oilseed crops. Journal of Eco-Friendly Agriculture, 20(1), 52–58. https://doi.org/10.48165/jefa.2024.20.1.9; NAAS ID: J193, NAAS Journal Rating: 5.36.		5.36
4	Bhattacharyya, P., Bhatia, A., Jain, N., Chatterjee, D., Mohanty, S., Prabhakar, M., Jambhulkar, N.N., Ananthakrishnan, S., Nayak, S.K., Nayak, A.K. and Pathak, H., 2025. Modified emission and scaling factors for methane and nitrous oxide in rice system of India: A country specific disaggregate approach. Journal of Environmental Management, 377, p.124595.	8.4	14.4
5	Paul, A., Bhatia, A., Drewer, J., Tomer, R., Kumar, V., Sharma, S., Saha, N.D., Chakrabarti, B., Shivay, Y.S., Rees, R.M. and Sutton, M.A., 2025. Sulphur-coated urea reduces greenhouse gas intensity and enhances soil quality in rice cultivation. Journal of Agriculture and Food Research, p.102376.	6.2	12.2
6	Chakrabarti, B., Bhatia, A., Deo, A., Jain, N., Kumari, V., Ramarao, C.A. and Aggarwal, P., 2025. Climatic stresses and adaptation options for South Asian wheat: A systematic literature review. Frontiers in Agronomy, 7, p.1670235.	3.7	9.7
7	Kumar, S., Bhatia, A., Drewer, J., Rees, R.M., Sharma, S., Kumar, V., Tomer, R., Rahman, M.M. and Sutton, M.A., 2025. Mitigating ammonium and nitrate leaching in rice-wheat crop rotation: efficacy of neem coated urea and compost co-application. Frontiers in Environmental Science, 13, p.1656231.	4.1	10.1

8	Yadav, A., Singh, N., Bhatia, A., Varghese, E., Banerjee, K. and Khandelwal, A., 2025. Effect of biosurfactant on degradation of polyaromatic hydrocarbons in different agricultural soils under different environments. Current Science (00113891), 129(1).	1.1	7.1
9	Sharma, R., Yadav, A., Lata, C., Verma, A., Singh, D., Singh, L., Joshi, R., Samota, M. K., Kumar, S., Kumar, K., Ram, A., Kumar, N. & Arunachalam, A. (2025). Role of biotechnology for shelf-life extension and quality improvement of perishable fruits and vegetables: a comprehensive review. Food Science and Biotechnology 34(9): 1-20.	3.1	9.10
10	Meena, S., Manjaiah, K. M., Sharma, V. K., Purakayastha, T. J., Das, S., Bana, R. S., ... & Salem, A. (2025). Exploring soil organic carbon fractions, stocks, and carbon management index across land uses in subtropical ecosystems of Tripura, India. Frontiers in Sustainable Food Systems, 9, 1604101.	3.1	9.10
11	Meena, S., Manjaiah, K. M., Sharma V. K., Bana R. S., Yadav, S., Meena A. R., and Saini R. (2025). Effects of land use systems on soil physical, chemical and biological properties in north-eastern region of India. Indian Journal of Agricultural Sciences 95 (11).	0.4	6.4
12	P. Bhattacharyya, A. Bhatia, N. Jain, D. Chatterjee, S. Mohanty, M. Prabhakar, Pratibha M, N.N. Jambhulkar , S. A. Krishnan, S.K. Nayak, A.K. Nayak, H. Pathak, 2025, Modified emission and scaling factors for methane and nitrous oxide in rice system of India: A country specific disaggregate approach, Journal of Environmental Management 377 , 124595	8.70	14.70
13	Gulshan Kumar Sharma, Anwesha Khanra, Fayaz Ahmad Malla, Shakeel A Khan*, Sanjeev Mishra, Amit Kumar, Aradhana Singh, Krishna Kumar Yadav, Roomesh Kumar Jena, Randhir K Bhartii, Suhaib A Bandh, Priti Pandita, Lal Chand Malav, Kaustubha Mohanty (2025). Zero-waste perspective for circular bioeconomy of phycoremediation and life cycle assessment: Essentialities, development and challenges. Biomass and Bioenergy. Volume 202, pages 108103. https://doi.org/10.1016/j.biombioe.2025.108203	5.80	11.80
14	Vaibhav Singh, Anupam Jyoti, Prince Jain, Juhi Saxena, Anwesha Khanra, Shrasti Vasistha, Papita Das, Lukeshwari Shyam, Shakeel Ahmad Khan, Swapnil M Parikh, Monika Prakash Rai.(2025). A Critical Review of Cyanoblooms and Cyanotoxins: Risk Assessment on Human Health and Agriculture along with Mitigation Strategies Using Machine Learning Perspectives. ACS Chemical Health & Safety. Vol 32. Pages 341-360.	3.40	9.40
15	K Kudimetha, Ganesh, R Machanuru, L Shyam, R Srivastava, S. A. Khan* (2025). Enhancing Maize Productivity and Nitrogen Uptake through Integrated Application of Biogas Slurry and Chemical Fertilizers. Asian Journal of Soil Science and Plant Nutrition 11 (3), 96-108		5.06

16	Sunil Kumar*, Manjeet Singh Nain, V. Sangeetha, Satyapriya, Sukanta Das, P. Anbukkani and Shakeel A. Khan (2025). Measuring Sustainability of Zero Budget Natural Farming Practices. Journal of Community Mobilization and Sustainable Development Volume 20(2), April-June 2025, 613-618 DOI: 10.5958/2231-6736.2025.00141.4		5.02
17	Mandal, N., Maity, P.P., Das, T.K., Bandyopadhyay, K.K., Adak, S., Sarkar, A., Bhattacharyya, R., Sen, S., Pillai, S.N., and Chakrabarti, B. (2025). Long-term conservation agriculture influences ecosystem service in maize- wheat cropping system in the North-Western Indo- Gangetic Plain. Journal of Agriculture and Food Research 19, 101720.	6.2	12.2
18	Singhal, V.K., Ghosh, A., Singh, A.K., Singh, Y., Biswas, S.S., Ojha, D. and Bhattacharyya, R. (2025). How grasses stabilize soil organic carbon in aggregates of semi-arid ecologically restored land: Evidence from 13C natural abundance. Catena, 249, 108627.	5.7	11.7
19	Barman, S., Bhattacharyya, R*., Singh, C., Rathore, A.C., Singhal, V., Biswas, D.R., Ahmed, N., Das, S., Kumar, S., Jat, S.L., Das, T.K., Kumar, S.N., Ghosh, A., Ullah, F., Elansary, H.O., Nazim, M., Fickak, A.A., Rashwan, M.A. and Moussa, I.M. (2025). Long-term agroforestry enhances soil organic carbon pools and deep soil carbon sequestration in the Indian Himalayas. Frontiers in Environmental Science 13: 1568564.doi: 10.3389/fenvs.2025.1568564.	3.7	9.7
20	Dinesh, G.K., Venkatramanan, V., Jayaraman, S., Bolan, N., Rao, C.S., Meena, R.S., Prasad, J.V.N.S., Ramasamy, V., Bhatt, R., Dubey, R. and Sinduja, M., Raveena, R., Richard Harper, Karthika, S., Pete Smith, Shiv Prasad, Sabarivasan, R., Dalal, R.C., Rattan Lal, Pathak H., Gokul, S., A. Velmurugan (2025). Carbon farming: Ecosystem services and its potential in achieving UN sustainable development goals. Advances in agronomy. 196, 201-379.	-	7.73
21	Singh, R.J., Kumar, G., Sharma, N.K., Deshwal, J.S., Mishra, M., Roy, P., Bhattacharyya, R., and Madhu, M. (2025). Conservation tillage-based Arundo donax agro-geotextiles enhance productivity and profitability of sloping croplands in the Indian Himalayas by reducing soil erosion and improving soil organic carbon. Journal of Environmental Management 377, 124728.	8.4	14.4
22	Roy, J., Biswas, D.R., Basak, B.B., Bhattacharyya, R., Das, S., Biswas, S., Dass, A., Rupesh, T., Singh, A.K. and Ghosh, A.K. (2025). Long-term impact of silviculture systems on phosphorus transformation and adsorption behaviour in semi-arid restored lands. Agriculture, Ecosystems and Environment 381, 109449.	6.4	12.4
23	Mehmood Azhar, Anita Chaudhary*, Swati Gabaa, Latief Bashira, Anil Kumar pinaka, Anju Kamra, Soora Naresh Kumar, Praveen Kumar Singh, Neeraj Panwar.2025. Biopreservation of Cherry Tomato CPCT 263 with Cell Free Supernatant of Lactobacillus fermentum O1.1. Journal of Food protection (accepted)	2.1	8.1

24	Rajdeep Das, Renu Singh*, Pooja LR, Sibananda Darjee, Ananta Vashisth, Arun Kumar T.V., Anamika Thakur, Manoj Kumar, Manoj Shrivastava. (2025). Corn Cob-Derived Bioplastics Infused with Titanium Dioxide Nanoparticles: Synthesis and Functional Assessment. Waste and Biomass Valorization. DOI: 10.1007/s12649-025-02907-y.	3.4	9.4
25	Arvind Dhaloiya, Swadhina Koley, Manjar Alam, Soora Naresh Kumar (2025). Analyzing soil loss dynamics in the Indian Himalayan Region using geospatial approach	10.4	4.40
26	Jain Niveta, Verma Himanshi, Deo Aniket, Bora Kaushik, Vishwakarma Prashant Narayan, Bhatia Arti, Chakrabarti Bidisha, Visha Kumari V., Rama Rao C. A., Aggarwal PK (2025) Effect of climate change adaptation options on maize yield across different agro-climatic zones in South Asia. A meta-analysis. Agronomy for Sustainable Development 45:78 https://doi.org/10.1007/s13593-025-01075-6	12.7	6.7
27	N.Jain, H. Verma, A. Deo*, K. Bora, A. Bhatia, B. Chakraborti, V. Venugopal, C.A. Rama Rao, P.K. Aggarwal, (2025). Effect of climate change adaptation options on maize yield across different agro-climatic zones in South Asia: A meta-analysis, Agronomy for Sustainable Development, Published online, Dec 2025	13.3	7.3
28	Mukherjee Sweety, Padaria, R. N., Burman, R. R., Nikam Vinayak R., Velayudhan Praveen Koovalamkadu, Mahra Girijesh Singh, Aditya Kaustav, Chakrabarti Bidisha, Saini Sushmita, Shravani Kotha, Ghosh Bhaskar, (2025) Development and Standardisation of a Digital Competency Index for Extension Professionals of India: A Principal Component Analysis Approach. Agricultural Research. https://doi.org/10.1007/s40003-025-00865-4	7.1	1.1
29	Apoorva, M.S., Bhatia, A., Chakrabarti, B., Vinod Kumar, Ritu Tomar (2025) Effect of liquid nano urea and coated urea on gaseous N losses and agronomic efficiency under elevated CO2 and temperature interaction. Environ Sci Pollut Res. https://doi.org/10.1007/s11356-025-36986-0	5.0	
30	B. Gopalakrishnan · E. Bhavani · V. Visha Kumari · N. Jain* · N. C. Paul · A. Deo · R. B. Ojha · C. A. Ramarao · P. K. Aggarwal, Climate Hazard Linked Adaptation Options for Soybean in South Asian Region – A Meta-Analysis, Journal of Soil Science and Plant Nutrition https://doi.org/10.1007/s42729-025-02853-7, accepted	9.4	3.4
31	N.Jain, H. Verma, A. Deo*, K. Bora, A. Bhatia, B. Chakraborti, V. Venugopal, C.A. Rama Rao, P.K. Aggarwal, Effect of climate change adaptation options on maize yield across different agro-climatic zones in South Asia: A meta-analysis, 2025, Agronomy for Sustainable Development, 45:78.	12.4	6.4
32	Yadav, S., Mandira B, Manjaiah KM, Sandeep K, Siyaram M, Rajendra KY, Deep MM, Seema, Preeti S. (2026). Impact of different land-use systems on soil aggregate–associated organic carbon and nitrogen in Northeast India. Plant Science Today 13(1), 1-9.	0.8	6.8

b) List of Research Papers Published in Conference, Symposia and Other Papers.

1. Best poster award "Enhancing Nitrogen Use Efficiency and Reducing Greenhouse Gas Emissions with Nano Zeolite-based Nitrogen Fertilizers "Pooja Ramalingappa, Renu Singh, Manoj Shrivastava, Shiva Dhar and Harshwardhan Choudhary under the theme "Nano Agri-Inputs" at the Global Conference on NANO Connect 2024, organized by the Centre for Agricultural Nanotechnology, Tamil Nadu Agricultural University (TNAU), Coimbatore, September 5th to 6th, 2024.
2. Pooja, L. R., Shrivastava, M., Dhar, S., Choudhary, H., Darjee, S., & Singh, R. (2024, January 17-20). Role of zeolite-based nitrogen nanofertilizers in reducing greenhouse gas emission and increasing nitrogen use efficiency. Young Scientist Conference, India International Science Festival (IISF)\, Faridabad, Haryana.2023. (Best Oral presentation)
3. Pooja, L. R., Singh, R. &Shrivastava, M., (2024, September 26) "Nanozeolite-Based Nitrogen Fertilizers: A Sustainable Approach for Enhancing Soil Health, Reducing GHG Emissions, and Improving Nutrient Use Efficiency". National Seminar on "Alternative Fertilizers for Environment Smart Agriculture" (Oral presentation), SSAC, IARI, New Delhi.
4. Poster presentation "Evaluating the Impact of Synthesized Nanozeolite-Based Nitrogen Fertilizers on Soil Health and Sustainability" Pooja LR*, Renu Singh*, Manoj Shrivastava, Shiva Dhar and Harshwardhan Choudhary. Global Soils Conference 2024.
5. Anita Chaudhary.2025. Value addition of agricultural waste through microbial fermentation. In Training manual, Bindvi Arora, Shruti Sethi, and Dinesh Kumar. 'Recent advances in food processing technologies for agri-hort produce (TB-ICN 352/2025)' ICAR winter school 16 January to February 05, 2025.
6. Anita Chaudhary. 2025.Soil Microbiomes and Climate Change. In Training manual, Biswas, S., Debashis, M., Purakayastha, T. J., Ahmed, N. and Singh, P. (2025). Soil Health- Measure, Monitor and Manage for Ensuring Food Security and Climate Change Mitigation. Organized under SERB DST- sponsored project "Assessing the role of quality and stability of soil organic carbon (SOC) in maintaining soil health and crop productivity under different agro- ecological regions of India" 17-22 March, 2025 at Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi, pp 98-102. TB-ICN: 365/2025.

c) List of books / chapter in books

1) Renu Singh, Manoj Shrivastava, Sapna Langyan, Suniti Yadav, and Sibananda Darjee (2025). Biodiesel Production of Sesame Oil: An Overview.In Sesame: Sustainable Production and Applications (pp. 231-242). Singapore: Springer Nature Singapore.
2) Kumar, S, Anusha, BS and Bhatia, A, 2024. Soil, Water, and Crop Management Practices to Mitigate Greenhouse Gases Emission. Climate Change and Soil-Water-Plant Nexus: Agriculture and Environment, pp.189-222. Futuristic Trends in Renewable & Sustainable Energy Edition: Volume 3, Book 3, 2025, IIP Series ISBN: 978-93-6252-917-6
3) Kumar, S., Anusha, B. S. and Bhatia, A. (2024). Soil, Water, and Crop Management Practices to Mitigate Greenhouse Gases Emission. Climate Change and Soil-Water-Plant Nexus: Agriculture and Environment edited by Md. Mizanur Rahman, Jatish Chandra Biswas and Ram Swaroop Meena, Springer Nature Singapore Pte Ltd, pp.189-222.
4) Chakrabarti Bidisha (2025) Modelling approach for measuring carbon sequestration and budgeting in Indian soil. In: Biswas S et al. (Ed.) Managing carbon to improve soil health and combat climate change under SERB-DST sponsored project. 18-23 March, 2024. Training Manual pp. 64-67.
5) Jain N., Rose HM, Kumar A, Mathiyarasi KV, Bhatia A, Chakrabarti, B. and Kumar S.,Organic Farming and Greenhouse Gas Emission , in Agricultural Greenhouse Gas Emissions: Problems and Solutions, 2025, Eds N. Bordoloi, K. Bauddh and K. K. Baruah, Springer Nature Singapore Pte Ltd.ISBN 978-981-97-7553-8 https://doi.org/10.1007/978-981-97-7554-5, pp33-5
6) Prasad, S., Gupta, V. C., Singh, M., & Sevda, S. (2025). Biomass Feedstocks: Diversity, Availability, and Logistics. The Principles of Green Energy & Technology: Basic Concepts to Applications, 85.CRC Press
7) Shiv Prasad, Vikas Chandra Gupta, Rajan Bhatt, M. S. Dhanya, Krishan K. Verma, Mauro Wagner Oliveira (2025). Alternate Use of Sugarcane Products and By-Products for Bioethanol Production to Improve Air Quality. Publisher: Apple Academic Press (CRC Press, Taylor & Francis Group), pp. 21. DOI: 10.1201/9781003619222-18
8) Monika Kundu, Shiv Prasad, Ananta Vashisth, Krishnan Prameela (Eds.). (2025). Nanotechnology-Based Detection and Remediation for the Environment, Food, and Agriculture. Cambridge Scholars Publishing, Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK. ISBN-13: 978-1-03-645544-6, ISBN-10: 1-03-645544-0. pp. 613

9) Anamika Thakur, Arun Kumar T. V. and Renu Singh (2025). Implementation of food safety and quality systems. Recent Advances in Food Processing Technologies for Agri-Horti Produce. Published by Division of Food Science & Postharvest Technology (FS & PHT), ICAR - IARI, New Delhi-110012 (TB-ICN: 352/2025). Pg: 139-141

d) List of popular articles

1) Direct seeded rice: Perspective in Indian in Indian Agriculture. Manoj Shrivastava, Renu Singh, Dharmesh Verma, YS Shivay. Rice India. 9-12, May, 2024
2) Renu Singh, Manoj Shrivastava, Sapna Langyan, Suniti Yadav, and Sibananda Darjee (2025). Biodiesel Production of Sesame Oil: An Overview. In Sesame: Sustainable Production and Applications (pp. 231-242). Singapore: Springer Nature Singapore.
3) BS Anusha, A Bhatia*, S Kumar, (2025). Evolving farming practices in India: Adapting to Modern Demands, Biotica Research Today 7 (3), 78-80
4) Bhupinder Singh (2025) Irradiation of foods as a means to improve product quality and enhance shelf life, In Lecture notes: ICAR sponsored 21-days winter school during January 16 to February 05, 2025 on 'Recent advances in food processing technologies for agri-horti produce'. organized by the Division of Food and Post-Harvest Technology, IARI, New Delhi, pp:1-13
5) Bhupinder Singh (2025) Phytoremediation of heavy metals in soil for sustaining productivity and quality: Challenges and opportunities, In lecture Notes of the Training program on abiotic stress management in agriculture for enhancing the farmers income with special reference to millets / fodder crop cultivation in arid and semi-arid regions of India" organized by ICAR-IIMR and MANAGE, Hyderabad from 6-10 Jan 2025. pp 1-15.

9. Trainings/workshop/seminar organized

S. No.	Name of programme	Training/ workshop/ seminar	Duration	Number of trainee (s)		
				Male	Female	Total
1	A farmers' training programme on “Agricultural residue management for income generation” cum seed distribution day on at Village Tana, Distirct Shamli, U.P. for the Scheduled Caste farmers under the ongoing SCSP scheme	Training	08.11.2025	147	53	200
2	Training on Greenhouse Gas Emission from Cropped Soil	Training	23rd Jan., 2025			10
3	Brainstorming workshop on carbon credits for small-holder farms: Approaches and framework for implementation	Workshop	28th April, 2025	20	6	26

10. Participation by scientists in scientific meetings, etc.

S. No.	Detail	Detail/description of each item
	In India	
1	Seminars	▪ Bhupinder Singh (2025) Invited Keynote speaker "Challenges and opportunities in waste management" at National Conference "Urban waste management and sustainable solutions" under the aegis of Spreading awareness of emerging challenges of air pollution and climate change on human health in urban ecosystem conducted by Environmental pollution laboratory, University of Delhi sponsored by DST, Govt. of India from 3-4 March 2025. ▪ Bhawana Joshi, Anita Chaudhary, Swati Tripathi Arti Bhatia Namita Das Saha, Achhelal Yadav, Govindaraj Kamalam Dinesh, Ajit Varma. 2025. Impact assessment of elevated carbon dioxide and elevated ozone on the soil microbial communities' structure and functional diversity in wheat agroecosystem. 7th international conference on "bioenergy, environment & sustainable technologies - BEST2025" 29-31 January, 2025 Department of Biotechnology Arunai Engineering College, TN, India ▪ Suchitra Kunduru, Anita Chaudhary, Anju Kamra, Ram Swaroop Bana, Soora Naresh Kumarand Vishwanath Rohidas Yalamalle. Impact of plant and microbe derived biostimulants' formulation on chickpea (cicer arietinum) under water stress. 7th International Conference On "Bioenergy, Environment & Sustainable Technologies - BEST2025" 29-31 January, 2025 Department of Biotechnology Arunai Engineering College, Tiruvannamalai, TN ▪ Sai Kiran, Anita Chaudhary, Shiv Prasad, P. Anil, Sudhesh Kumar, Usha Meena.2025. Nanobioremediation of Arsenic from water with green synthesized ZnO Nanoparticles. International Conference on "Global Perspectives of Medicinal plants: Traditional system of medicine to Nanomedicine" (ICGPMP-2025) Department of Botany, Ramjas College DU, Delhi ▪ Anita Chaudhary 2025. Agri-inputs for sustainable agriculture and

		Climate Change (AISAC-2025) ▪ Workshop on, 'Gender suitability and scalability of the crop-specific technological interventions and adaptation options for climatic risk', at Division of Environment Science, ICAR-IARI, New Delhi (20th January, 2025). ▪ Knowledge Session on Opportunities and Challenges of Biochar and Enhanced Rock Weathering-based Carbon Dioxide Removal (10th December, 2025)
2	Scientific meetings	▪ Brainstorming session on carbon credits for small holder farms ▪ Brainstorming session on nano and microplastics in agriculture and food system ▪ Knowledge session on biochar and enhanced rock weathering-based CO_2 removal ▪ MoEFCC, Niti Aayog
3	Workshops	▪ MoEFCC ▪ AICRP on Energy (online)
4	Symposia	NIL
5	Any other	▪ Sustainability, Waste Valorisation, Agriculture, Health, Awareness (SWAHA), DST, Centre of Excellence (CoE) at Visvesvarya NIT, Nagpur. project meeting ▪ Recent advances in food processing technologies for agri-hort produce' ICAR winter school 16 January to February 05, 2025. ▪ Soil Health- Measure, Monitor and Manage for Ensuring Food Security and Climate Change Mitigation. Organized under SERB DST- sponsored project 17-22 March, 2025 at Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi
	Abroad	
1	Seminars	
2	Scientific meetings	▪ Online Webinar on biochar chemistry and applications for sustainable solutions, organised by School of Biological Sciences, The University of Aberdeen, June 02, 2025 ▪ IPCC lead authors meeting virtual

3	Workshops	▪ Lead author for chapter 13 on AFOLU for IPCC seventh assessment report (AR7), Working group III, first lead authors meeting held in Paris, France, 1st to 5th December 2025 ▪ ACASA Spatial Crop Modelling Workshop, Kathmandu, Nepal, 12-14th May, 2025 ▪ APO, Tsukuba Japan UNFCCC ▪ Attended the 20th Working Session of the ITPS at FAO, Rome, Italy for three days (3-7 March 2023).
4	Symposia	▪ Presentation at Carbon and Nitrogen Accounting in Paddy Rice Systems: Data Analytics, Modelling and Reporting" held at The International Rice Research Institute (IRRI) at Los Baños, Laguna, Philippines Los Banos, Philippines held from 1 to 5th September 2025

11. Foreign deputation by scientists

1. Dr. Soora Naresh Kumar, Head, Div. of Environmental Science, ICAR-IARI, in the afternoon of 14.02.2025 to attend in the Scientific Committee meeting of the Indo German Science and Technology Centre at Bonn, Germany during 19/02/2025 - 20/02/2025(excluding journey time) on Ex-India leave from 17/02/2025 - 21/02/2025 (with 5 days E.L from 17/02/2025 to 21/02/2025)
2. Dr. Niveta Jain, Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi for paper presentation (oral) entitled "Climate change adaptation and mitigation activities in agriculture in India" in the "Capacity Development Workshop on Carbon Credit Methodology for Biochar and other Carbon Dioxide Removal" at Bangkok, Thailand during 26/02/2025 to 27/02/2025
3. Dr. Ranjan Bhattacharyya, Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi to attend in the twenty-second working session of the Intergovernmental Technical Panel on Soils at Rome, Italy during 04.03.2025 to 06.03.2025
4. Dr. Niveta Jain, Pr. Sci, Div. of Environmental Science, ICAR-IARI, in the afternoon of 21.03.2025 to attend meeting of International Panel on Climate Change (IPCC) for development of "Methodology Report on Inventories for Short-Lived Climate Forcers" at Bilbao, Spain during 24/03/2025 -26/03/2025(excluding journey time)
5. Dr. Bidisha Chakrabarti, Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi to attend BISA - ACASA spatial crop Modelling workshop at Kathmandu, Nepal during 12.05.2025 to 14.05.2025 (excluding journey time)
6. Dr. Arti Bhatia, Principal Scientist, Division of Environmental Science, to attend workshop on "Carbon and Nitrogen accounting in Paddy Rice System: Data Analltics, Modelling and Reporting" under IRRI-IARI collaborative research project titled,"greenhouse gas emission under different rice crop establishment methods Intemational Rice Research Institute (IRRl), at Los Banos, Laguna, Philippines during 0l /09/2025 to 05109/2025
7. Dr. Soora Naresh Kumar, Head, Division of Environmental Sciences, to attend workshop on project titled "Carbon and Nitrogen accounting in Paddy Rice System: Data Analytics, Modelling and Reporting" at international Rice Research Institute (IRRl), Headquaters, Los Banos, Lagma, Philippines during 0l/09/2025 lo 05109/2025

8. Dr. Niveta Jain. Principal Scientist, Division of Environment Science, ICAR-IARI, to attend two paper presentations (oral) entitled (i) Nitrous oxide emission from Agriculture sector and migration strategies and (ii) Meta - analysis of nitrous oxide emission from agriculture soils in the ad hoc workshop titled, " Capacity Developmenl Workshop on Meta - Analysis of Soil Nitrous Oxide Emissions in Asian Agriculture" at Asian productivity organization, Japan in collaboration with NARO, Tsukuba, Japan during 25/1l/2025 to 28/11/2025
9. Dr. Arti Bhatia. Principal Scientist, Division of Environment Science, ICAR-IARI, to attend meeting as Lead Author in the Intergovemmental Panel on Climate Change (IPCC) AR7 working group III report hosted by IPCC Secretariat at Paris, France during 0l/12/2025 to 05/12/2025
10. Dr. Soora Naresh Kumar, Head & Principal Scientist, Division of Environment Science, ICAR-IARI, to Participate in the Joint WGI-WGII-WGII first Lead Author Meeting of the Intergovernmental Panel on Climate Change (IPCC) at Paris, France during 01/12/2025 to 051/12/2025

12. Extension activities

1. Team Leader, Viksit Krishi Sanmalp Abhiyan (29 May – 12 June 2025) Bithan, Budhera, Amirwas, Luharu, Bhiwani Distt, 01/06/2025.
2. Team Leader, Viksit Krishi Sanmalp Abhiyan (29 May – 12 June 2025) Majra Dabas, Tatesar, Chandpur, Kanjhwala, South West Delhi Distt, 06/06/2025.
3. Viksit Krishi Sanmalp Abhiyan (29 May – 12 June 2025) Bithan, Budhera, Amirwas, Luharu, Bhiwani Distt, 09/06/2025.
4. Viksit Krishi Sanmalp Abhiyan (29 May – 12 June 2025) Hastinapur, Meerut Distt, 09/06/2025.
5. A one-day farmers' training on 'Improved Rabi Crop Production & Input distribution programme' 11-10-2025 at Village Nagla Vijwana, Tappal, Aligarh, U.P., for farmers under the ongoing SCSP plan of the Institute. (500 Farmers)
6. A farmers' training programme on "Improved package of practices for higher productivity of field crops" cum seed distribution day on 16.10.2025 (World Food Day) at ICAR-IARI RS, Karnal for the Scheduled Caste farmers under the ongoing SCSP scheme. (500 Farmers)
7. A farmers' training programme on "Agricultural residue management for income generation" cum seed distribution day on 08.11.2025 at Village Tana, Distirct Shamli, U.P. for the Scheduled Caste farmers under the ongoing SCSP scheme. (200 Farmers)
8. Under Viksit Bharat along with KVKs team, 3 Clusters of Villages in Gurgaon and Hapur were visited. Dissemination about the ICAR technologies and how carbon credits can be earned though different technologies were discussed

13. List of staff members

Scientific Staff	Technical Staff
Dr. S Naresh Kumar, Head	Dr. N.K. Singh, T-7/8
Dr. Bhupinder Singh, PS	Sh. R.C. Harit, T-7/8
Dr. Anita Chaudhary, PS	Dr. Vinod Kumar, T-4
Dr. Shiv Prasad, PS	Mrs. Neeraj Panwar, T-3
Dr. Dinesh Kumar Sharma, Professor	Mrs. Bhawana Joshi, T-4
Dr. Arti Bhatia, PS	Sh. Ankit Kumar, T-1
Dr. Niveta Jain, PS	
Dr. Ranjan Bhattacharya, PS	
Dr. Manoj Shrivastava, PS	
Dr. S.A. Khan, PS	
Dr. Bidisha Chakrabarti, PS	
Dr. Renu Singh, PS	
Dr. Chandan Kumar Gupta, Sr. Scientist	
Dr. Sandeep Kumar, Scientist (Sr. Scale)	
Dr. Sunita Yadav, Scientist (Sr. Scale)	
Administrative staff	**Multi-tasking Staff**
Mr. Munesh Chand Meena, AAO	Mr. Sunil Kumar, MTS
Mrs. Vandana Rawat, Assistant	Mr. Sonu Kumar, MTS
Mrs. Durgesh Sharma, Assistant	
Mr. Gaurav Chaudhary, Assistant	
Mrs. Ankita Kumari, PA	
Mr. Dinesh Kumar, LDC	

14. Divisional committees (Jan-Dec., 2025)

1. Divisional Budget and Research committee

1. Dr. S. Naresh Kumar Head & Pr. Scientist -Chairman.
2. Dr. D. K. Sharma, Pr Scientist -Member
3. Dr. (Mrs.). Arti Bhatia, Pr. Scientist -Member
4. Dr. Bidisha Chakrabarty, Pr. Scientist -Member
5. Dr. Sunita Yadav, Scientist - Member Secretary

2. BOS committee

1. Dr. D. K. Sharma, Pr Scientist -Chairman.
2. Dr. S. Naresh Kumar Head & Pr. Scientist -Member
3. Dr. Shakeel Khan, Pr Scientist -Member
4. Dr. Renu Singh, Pr Scientist -Member
5. Mr. Anik Chandel -Member
6. Dr Sandeep Kumar, Scientist - Member Secretary

3. Purchase Advisory & Physical Verification Committee

1. Dr. Manoj Shrivastava, Principal Scientist — Chairman
2. Dr. (Mrs.) Bidisha Chakrabarti, Principal Scientist — Member
3. Dr. Sandeep Kumar, Scientist (Sr. Scale) — Member
4. Dr. Sunita Yadav, Scientist (Sr. Scale) — Member
5. Shri Munesh Chand Meena, AAO — Member Secretary

4. Divisional Database Committee

1. Dr. Sandeep Kumar, Scientist (Sr. Scale) — Chairman
2. Dr. Sunita Yadav, Scientist (Sr. Scale) — Member
3. Mrs. Bhawana Joshi, STA — Member
4. Shri Ankit Kumar, Technician — Member Secretary

5. Technology Information, Assessment & Forecasting Committee

1. Dr. Soora Naresh Kumar, Head & Principal Scientist — Chairman

2. Dr. Anita Chaudhary, Principal Scientist — Member

3. Dr. (Mrs.) Arti Bhatia, Principal Scientist — Member

4. Dr. Manoj Kumar Shrivastava, Principal Scientist — Member

5. Dr. Shakeel Ahmad Khan, Principal Scientist — Member

6. Dr. Ranjan Bhattacharya, Principal Scientist — Member

7. Dr. Renu Singh, Principal Scientist — Member Secretary

6. Labour & Farm In-charge

1. Sh. Ramesh Harit, ACTO

2. Dr Vinod Kumar, STA

7. Price Fixation Committee

1. Dr. Bhupinder Singh, Principal Scientist — Chairman
2. Dr. (Mrs.) Arti Bhatia, Principal Scientist — Member
3. Dr. Manoj Kumar Shrivastava, Principal Scientist — Member
4. Dr. Sandeep Kumar, Scientist (Sr. Scale) — Member Secretary
5. Shri Munesh Chand Meena, AAO — Member

8. Facilities Committee

1. Dr. Soora Naresh Kumar, Head & Principal Scientist — Chairman
2. Dr. Manoj Shrivastava, Principal Scientist — Member
3. Dr. (Mrs.) Bidisha Chakrabarti, Principal Scientist — Member
4. Dr. Chandan Kumar Gupta, Senior Scientist — Member
5. Dr. Sandeep Kumar, Scientist (Sr. Scale) — Member
6. Dr. Sunita Yadav, Scientist (Sr. Scale) — Member Secretary
7. Shri Ramesh Chand Harit, ACTO — Member
8. Shri Vinod Kumar, Technical Officer — Member

9. Foreign Deputation Proposal committee

1. Dr. D. K. Sharma, Pr Scientist	-Chairman.
2. Dr. Shakeel A. Khan, Pr. Scientist	-Member
3. Dr. Sunita Yadav, Scientist (SS)	-Member Secretary

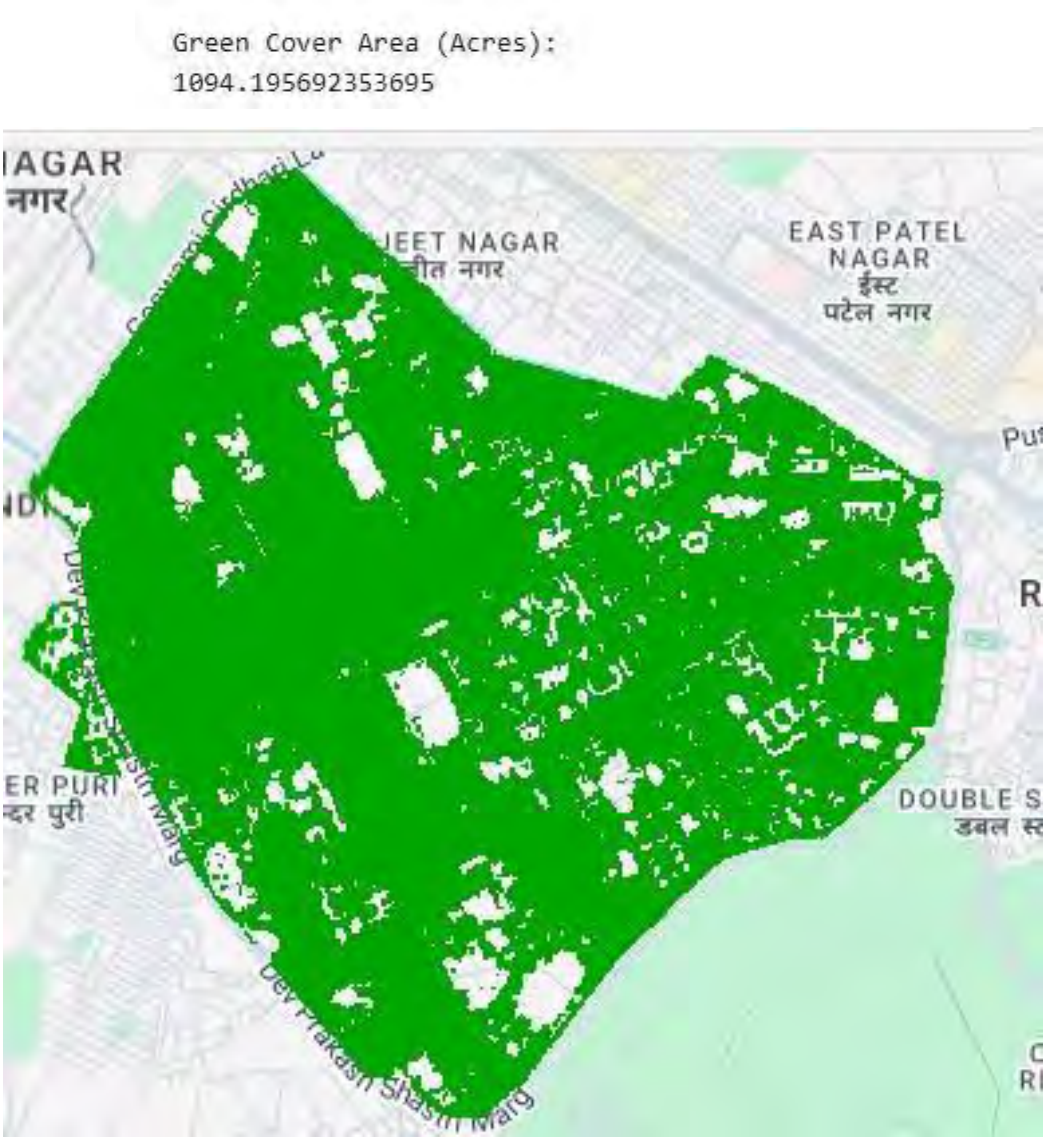
National Institutional Ranking Framework

(Divisional Contribution in NIRF SDGs category)

SDG-NIRF 2026 - Green Cover

FY	Total campus area	Green area	No. of mature plants (older than 10 years)	No. of saplings planted within campus by Div.
Unit	**Acre**	**Acre**	**Number**	**Number**
2024-25	1244.87	1094.19	-	80
2023-24	1244.87	1059.91	-	27
2022-23	1244.87	1066.52	-	10

IARI Campus Green Area Map (2024-25)



SDG-NIRF 2026 - Waste Management

	A.	B.	C.	D.	E.	F.	G.
Category	Total (wet + dry) solid waste generated, (plant waste not included)	Total horticulture waste generated (plant waste)	Total dry waste generated (plant waste not included)	Total wet waste generated (plant waste not included)	Total dry waste recycled	Total biodegradable (food) waste processed (excluding plant/tree waste)	Total electronic waste generated
Unit	Tons	Tons	Tons	Tons	Tons	Tons	kg
2024-25	0.65	0.91	0.19	0.46	0.20	0	75.2
2023-24	0.56	0.87	0.17	0.39	0.10	0	64
2022-23	0.54	0.85	0.16	0.38	0.09	0	60.5

SDG-NIRF 2026 - Water Management

	A.	B.	C.	D.	E.	F.
Category	Total horsepower of all pumps installed	Total rooftop area connected to rainwater harvesting (NRL building)	Percentage of wastewater treated & reused	Total no of taps in the campus (Div.)	No of taps installed with low-flow fixtures (Div.)	Total rooftop area
Unit	HP	Sq. ft.	%	Number	Number	Sq. ft.
2024-25	0	15758	0	87	39	15758
2023-24	0	15758	0	81	25	15758
2022-23	0	15758	0	80	21	15758

SDG-NIRF 2026 - Sustainable Communities and Partnership

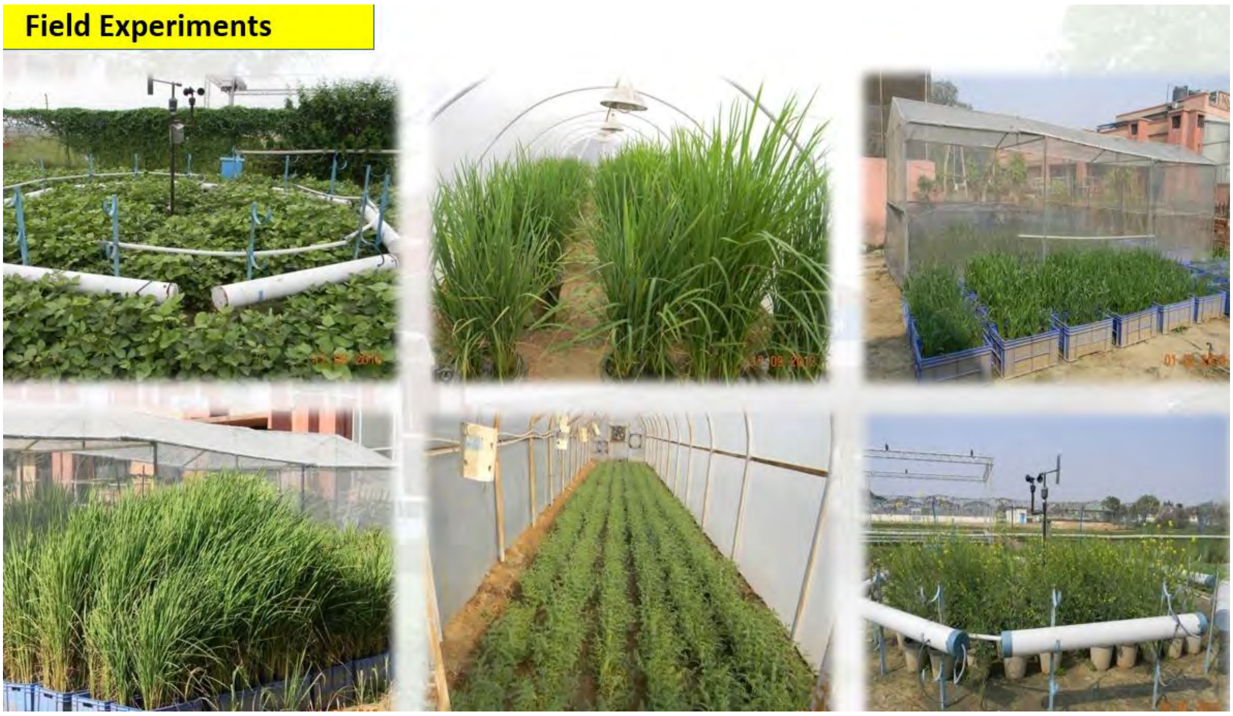
	A.	B.	C.	D.	E.
Category	Number of active sustainability initiatives involving external communities (not events/ seminars, e.g. regular waste reduction, planting, awareness drives) (Div.)	Number of students exposed to real-world sustainability action during the year (planting trees), inside and outside campus (Div.)	Number of students exposed to real-world sustainability action during the year (other than planting trees), inside and outside campus (Div.)	Number of students exposed to real-world sustainability action during year (Outside campus, including all activities) (Div.)	Number of events/ seminars organized within and outside the campus to share sustainable practices (Div.)
Unit	Number	Number	Number	Number	Number
2024-25	2	110	45	50	3
2023-24	1	70	40	42	1
2022-23	1	60	40	37	1

SDG-NIRF 2026 - Health and Well-Being

	A.	B.	C.	D.	E.
Category	Total area designated as pedestrian / vehicle-restricted zones (other than building area)	Total area designated for sports facilities	Total area of the campus	Number of people taking part in Yoga, and meditation programs at least twice a year (Div.)	Number of people taking part in Yoga, and Meditation programs, once per week (Div.)
Unit	Acres	Acres	Acres	Number	Number
2024-25	0.20	-	1244.87	55	22
2023-24	0.20	-	1244.87	52	16
2022-23	0.20	-	1244.87	47	12

15. Lab and Field Facilities

Divisional field facilities:

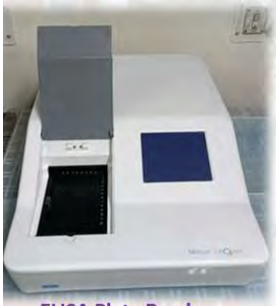


Divisional Lab facilities:

Environmental Modeling Lab

ICP-AES, Gas Chromatography, HPLC and Spectrophotometer

Microbiology Lab



ELISA Plate Reader

PCR

Autoclave

Laminar Air Flow Cabinet

Compound Microscope

Fluorescence Analysis Cabinet (UV & Visible)

Orbital Shaker

Spectrophotometer

Air Pollution Measurement instruments

Respirable Dust Sampler (RDS) & PM2.5 sampler

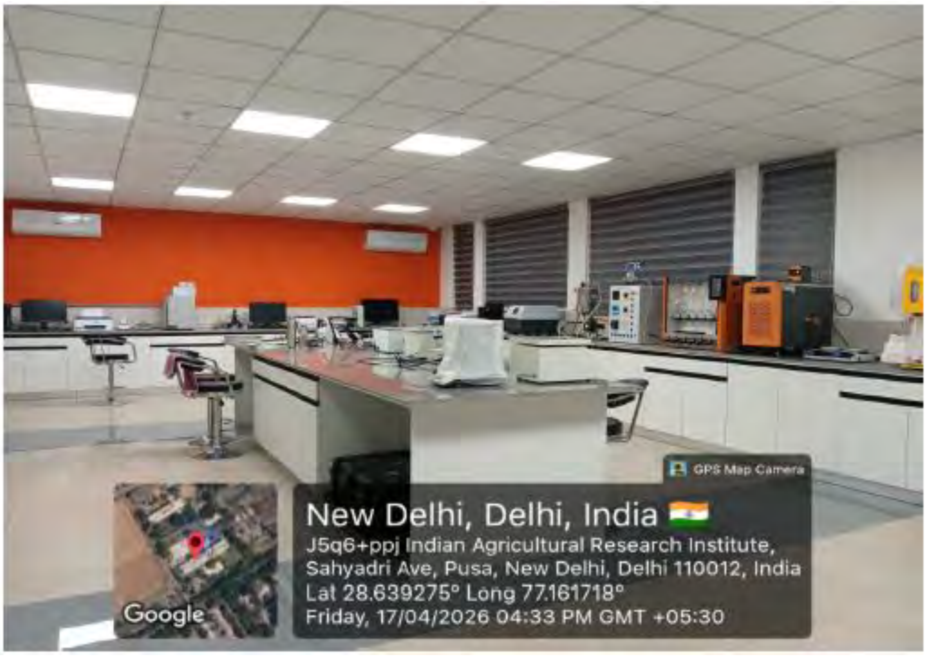
CARIGAR Lab facilities

List of instruments and facilities in CARIGAR Lab, 2nd Floor, Division of Env. Sci.

Instrument/ Facility	Fixed/Portable	Parameters can be analysed
CHNS Analyzer	Fixed	**Total C, N, H and S** in soil and plant samples
Portable FTIR Gas Analyzer	Portable	**50 parameters of air (listed below*)** and **7 parameters from soil: CO_2, CH_4, N_2O, NH_3, CO, C_2H_2 and H_2O**
Air Quality Monitoring Systems	Portable	10 parameters: **CO, CO_2, CH_4, SO_2, VOC, NO_2, NH_3, PM2.5, O_3, NMHC**
6-Channel Particulate Matter Analyser	Portable	6 different fractions of PM: **0.3, 0.5, 1, 2.5, 5 and 10 µm**
Eddy Flux Tower	Fixed in field	Carbon flux, evapotranspiration, energy balance, and gas exchange
Canopy Analyzer with Image Processing System	Portable	Leaf area index (LAI), canopy cover, and light interception.
Micro-irrigation Systems	Fixed in field	Water discharge rate, irrigation efficiency, and uniformity fertigation.
Soil Testing Meter (Pusa STFR)	Fixed	14 parameters: **pH, EC, Organic Carbon, N, P, K, S, Zn, Fe, Cu, Mn, B and gypsum/lime requirements**
Water Quality Testing Meter	Portable	11 parameters of water: **pH, ORP, Conductivity, DO, Salinity, Turbidity, GPS, Seawater Specific Gravity, TDS, Water Depth, Water Temp**
Fourier Transform Infrared (FTIR)	Fixed	Functional groups and molecular composition of samples
Microwave Digestion System	Fixed	Soil and plant sample digestion for elemental analysis
Anaerobic Bio-digester	Fixed	Biogas production and methane content monitoring
Nitrogen Analyzer	Fixed	Nitrogen or protein content in samples
Fat Analyzer	Fixed	**Crude fat** content in food and feed samples
Analytical Balance	Fixed	Accurate mass measurement of samples
Moisture Meter	Fixed	Moisture content in samples
Refrigerated Circulating Bath	Fixed	Temperature-controlled reaction or sample conditions
Semi-automatic Fiber Analyzer	Fixed	**Crude fiber** analysis

Soil ORP Meter	Fixed	pH and **ORP**
Micro Centrifuge	Fixed	Separation of cellular components or particulates by density
DD Water Unit	Fixed	Double distilled water
pH and EC meter	Fixed	pH and EC of soil and water samples
Ice Flaking Machine	Fixed	Production of ice flakes
Nano-particle Size Analyzer with Zeta Potential	Fixed	**Particle size distribution and zeta potential**
Refrigerated Incubator Shaker	Fixed	Microbial growth, incubation conditions, and culture kinetics.
UV-Vis Spectrophotometer with Scanning Facilities	Fixed	Absorbance, concentration, and optical properties of compounds.
Raman Spectrometer	Fixed	**Molecular structure**, chemical composition, and vibrational modes.
Hydride Generator for AAS	Fixed, attached to AAS	Trace elements like **As, Se, Sb, and Hg.**
Water Purification and Recycling System	Fixed, near to NRL auditorium gate	For neutralization and purification of lab water

*Water vapor, Carbon dioxide, Carbon monoxide, Nitrous oxide, Methane, Formaldehyde, Ethylene oxide, Benzene, Toluene, Ethyl benzene, m-Xylene, o-Xylene, p-Xylene, Methyl bromide, 1,2-Dichloroethane, Chloropicrin, Styrene, Phosphine, Sulfuryl fluoride, Hydrogen cyanide, Carbon disulfide, Acetone, Dichloromethane, Ethane, Propane, Butane, Hexane, Octane, Isopentane, Ethylene, Propene, Cyclohexane, alpha-Pinene, beta-Pinene, Delta-3-Carene, Limonene, Formic acid, Acetic acid, Methyl acetate, Ethyl acetate, 2-Butoxyethyl acetate, Dimethoxymethane, Acetaldehyde, Methyl ethyl ketone, Methanol, Ethanol, Isopropanol, Ethylene dibromide, Ammonia, Hydrogen chloride



Miscellaneous Activities

New year 2025 celebration

World Environment Day 2025 celebration

Plantation drive on the occasion of World Environment Day

Quiz and painting Competition organized by Environmental Sciences division on the occasion of World Environmental Day

Brainstorming workshop on Carbon credits for small-holder farms

Knowledge Session on Opportunities & Challenges of Biochar & Enhanced Rock Weathering-based Carbon Dioxide Removal held on10th Dec, 2025

Orientation programme of newly admitted students

Freshers' celebration

Farewell celebration

Divisional facilities visit by delegates

Climate Change Facility Visit by Bill Gates

Climate Change Research Facilities Visited by Union Agriculture Minister by Mr. Arjun Munda

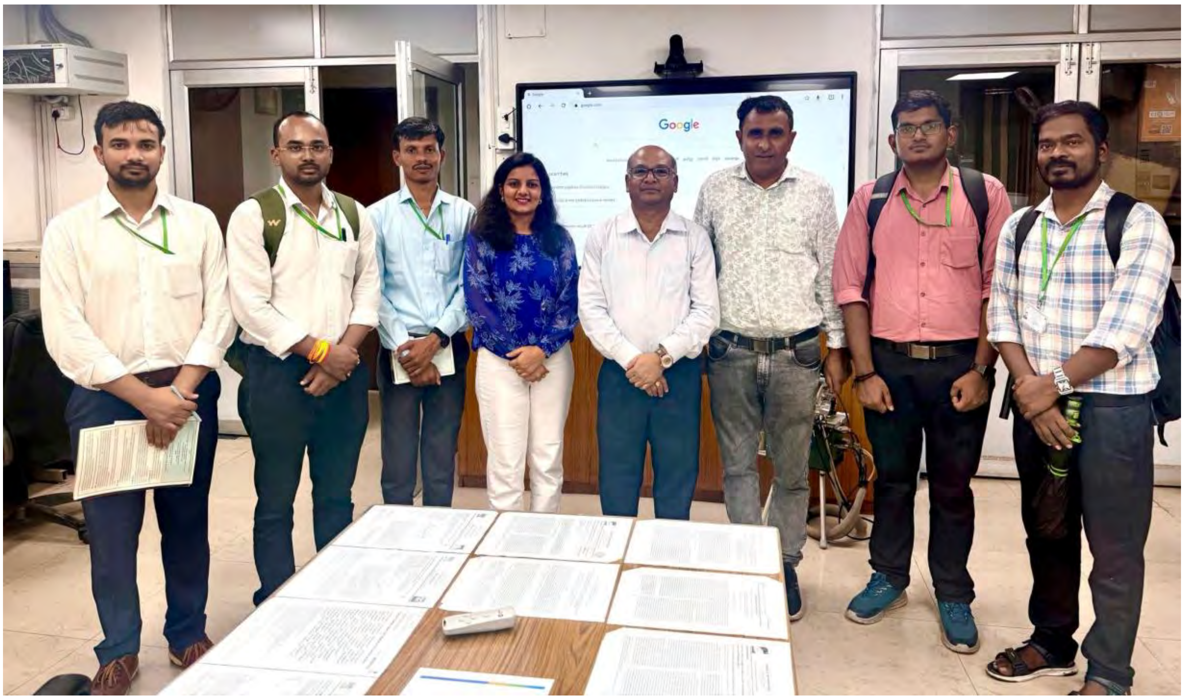
Professor Rattan Lal, visited the climate change research facilities

Divisional facilities visit by Students and Trainees

Visit of College of Agriculture, Pasighat, Central Agricultural University (Imphal), Arunachal Pradesh.

College of Horticulture & Forestry Central Agricultural University (Imphal) Pasighat Arunachal Pradesh

Visit to Divisional facilities of Newly recruited scientists of IARI



Felicitation program of Dr H. Pathak (Outgoing DG ICAR & designated DG ICRISAT)

&

Welcome to our New Director Dr. Ch. Srinivasa Rao

Students-led Swachh Bharat Abhiyan

Insightful lecture on

"Emerging Environmental Challenges and Agriculture: Scope and Approaches for Developing Solutions"

by Dr. Parth Sarathi Roy, Former Director of IIRS-ISRO

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IARI NEWS

EDUCATION

Lecture under NMSHE-Taskforce

The Division of Environmental Sciences and IQAC, ICAR-IARI, under the aegis of NMSHE-Taskforce (Agriculture), organized an invited lecture on "Emerging Environmental Challenges and Agriculture: Scope and Approaches for Developing Solutions" by Dr. Parth Sarathi Roy, Former Director of IIRS-ISRO, on April 08, 2025. He emphasized the urgent need for sustainable strategies to safeguard our climate, biodiversity and food security.

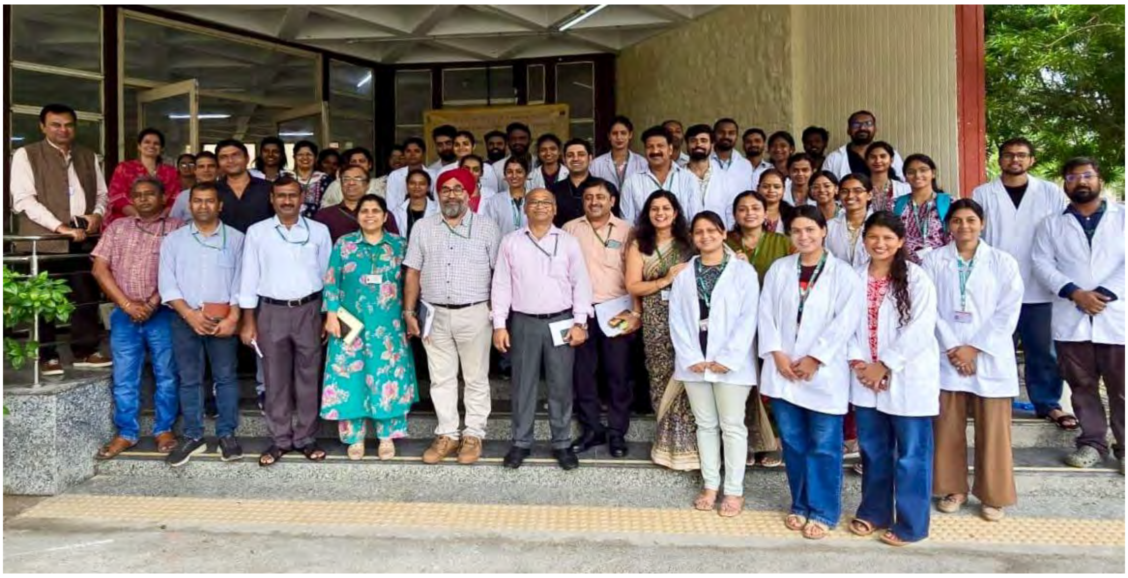
Felicitation of Dr. Parth Sarathi Roy, Former Director, IIRS-ISRO by Joint Director (Research)

PUSA Krishi Mela-2025

Interaction with farmers

Seed and sprayers distribution to farmers

QRT Visit



Interaction meeting of Heads for Net Zero Farms establishment at IARI, New Delhi

Awards/Recognition/Appreciation

Dr. S. A. Khan, Chief Guest and keynote speaker on the world water 2026 day at Khwaja Moinuddin Chishti University, Lucknow

Annual Hindi Award Received by Dr. D K Sharma, Dr. Manoj Shrivastava and Dr. Renu Singh

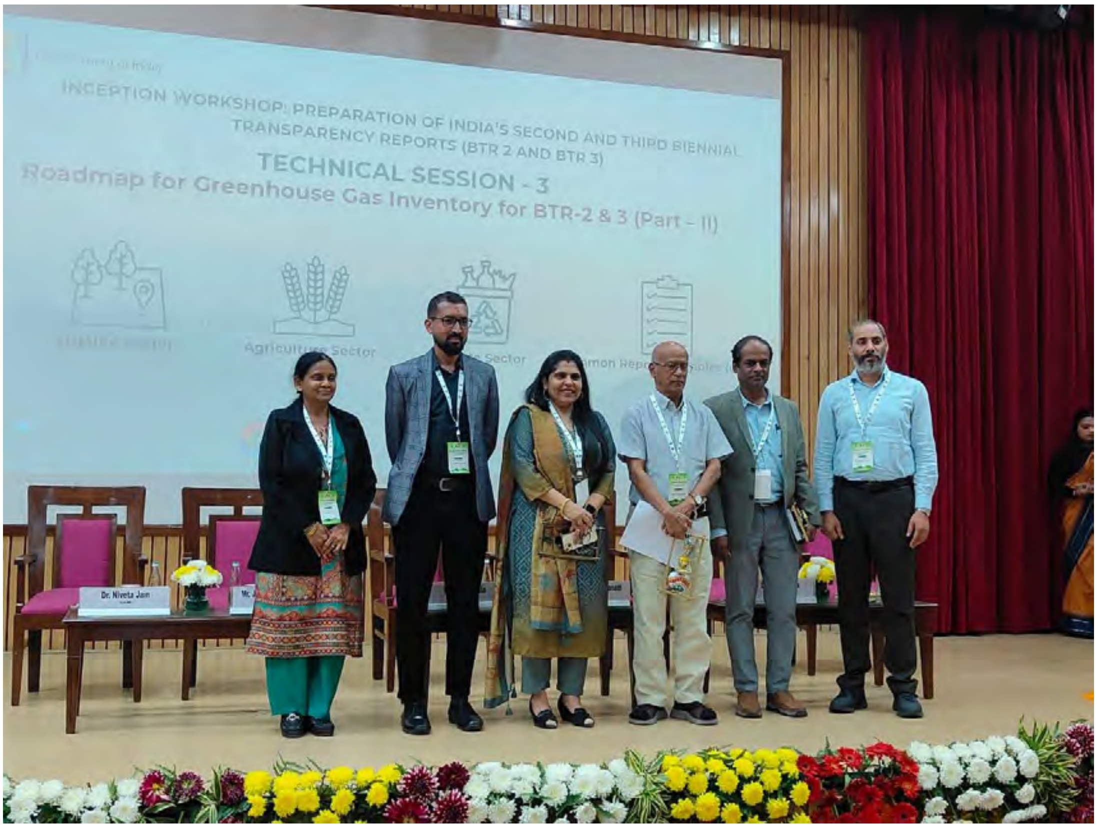
Dr. Manoj Shrivastava received ISSS-Dr. J.S.P. Yadav Memorial Award for Excellence in soil Science

Dr. Ranjan Bhattacharyya, Fellow of ISSS

Dr. Manoj Shrivastava received NESA Fellow Award

Received award of Eminent Women Scientist in Natural Resource Management on International women day organized by IISC Bhopal

Deputation visits by Dr. S. Naresh Kumar at Paris, France to attend 7th AR first lead author meeting



Dr. Arti Bhatia attended the technical session-3 on roadmap for greenhouse gas inventory for BTR-2 & 3 (part-II)

Invited lecture on the occasion of World Environment Day 2025

Pusa Samachar 2025

Radio/TV program

विकसित कृषि संकल्प अभियान (VKSA-2025)

Divisional students' sports activities


RUNNER UP
CHAMPION


AGRICO
RAICHUR


Divisional students' cultural activities

Dr. Ch. Srinivasa Rao, Director, ICAR-IARI, visited Field Experiments of Environmental Sciences Division on 28th August, 2025


TPR-CTW
(RI)

MoU with ICICI Foundation of Setup of CARIGAR lab

In a significant step towards empowering farmers and strengthening capacity building in climate-resilient agriculture, the Indian Council of Agricultural Research–Indian Agricultural Research Institute (ICAR-IARI), New Delhi, signed a Memorandum of Understanding (MoU) with the ICICI Foundation for Inclusive Growth under its Corporate Social Responsibility (CSR) initiative on January 13, 2026.

The MoU aims to establish a **Climate Resilient Green Agriculture (CARIGAR) Laboratory**, envisioned as a dedicated hub for hands-on training, awareness generation, and skill development of farmers, students, and scientists. The initiative is expected to play a vital role in promoting sustainable agricultural practices, climate-smart technologies, environmentally responsible farming systems and developing the post-harvest products. The CARIGAR Laboratory will focus on training farmers in climate-resilient practices, enhancing students' experiential learning, and providing advanced research exposure to scientists. It will also serve as a platform for awareness programmes, demonstrations, and interactive sessions linking scientific research with field-level application.

Glimpses of Scientific meetings


DR. HIMANSHU PATHAK
IMMEDIATE PAST PRESIDENT
DR. R.S. PARODA
FORMER PRESIDENT

Division of Environmental Sciences

ICAR-Indian Agricultural Research Institute

New Delhi 12