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Content

Editors

Director's Desk

Building soil organic carbon (SOC) is an effective way to increase carbon sinks and reduce emissions owing to the associated benefits to agriculture. Agricultural land covers over one third of global land area. Such large proportion of global land area has large potential of sequestering CO_2 from the atmosphere. However, due to land use changes and unsustainable farming methods, it is estimated that humans have released significant amounts of CO_2 into the atmosphere, resulting in a historical SOC depletion of approximate 135 Gt C. The most recent IPCC report emphasized and highlighted C sequestration in forest, grassland, and agricultural soil as a part of climate solution. According to estimates, the worldwide technical potential for sequestering soil organic carbon (SOC) is 1.45-3.44 Gt C (5.3-12.6 Gt CO_2) annually. This amounts to 38–91% of the fossil fuel emissions from the electricity industry worldwide, 67–100% of the fossil fuel emissions from the transportation sector globally, and 9–23% of the global total emissions (53 Gt CO_2) from all sectors in 2017.

SOC represents a global soil stock of approximately 1,500–2,400 Gt C in the top metre of soils. Not only this, SOC also represents approximately three times the stock of carbon (C) in vegetation and double the stock of C in the atmosphere. In this context, introduction of global ambitious goal of "4 per 1000 Initiative: Soils for Food Security and Climate" in advance of COP21 is noteworthy. The global aspirational objective stated by this ambitious programme is to raise SOC stocks by 4 per 1000, or 0.4%, per year in all land uses, including forests. Recently, policymakers are pushing for greater financial assistance in the form of incentives or transferable carbon credits under the Clean Development Mechanism (CDM) to make the goals of soil C sequestration more achievable. The carbon market in India is still in its early stage of developments but it holds great promise for climate action. In this regard, success will depend upon how best one can measure and monitor carbon stocks in agricultural soils and/or emission reduction accurately at a low cost, aggregate farmers so that part of carbon in tradeable amounts are formed and evolve financial mechanism that efficiently connect the demand and supply of carbon offsets.

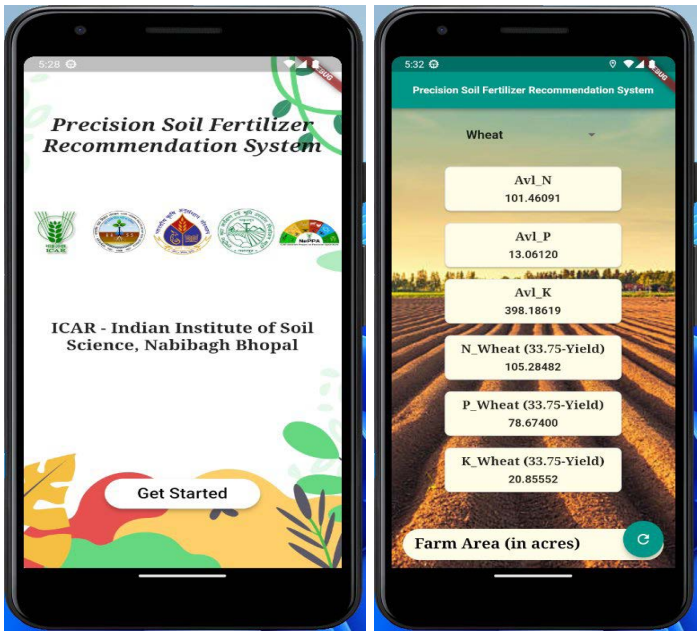
The following sustainable soil managements in crop land such as (i) crop management, (ii) nutrient management (fertilizer application with organic manures/green manures) (iii) reduced tillage intensity and residue retention, (iv) improved water management, (v) improved rice management and (vi) biochar application have been identified at global level to increase and maintain soil C sequestration with GHG mitigation potential. Understanding the potential of natural world and implementing proper land and soil management practices will be a key component in mitigating climate change.

(S.P. Datta)

RESEARCH HIGHLIGHTS

Mobile-based precision soil fertilizer recommendation system (PFRS)

Blanket fertilizer recommendations often don't match the soil and crop requirements and can lead to excessive, imbalanced chemical fertilizer use. This poses a major concern for Indian agriculture as it can deteriorate soil health. Thus, a precise and site-specific nutrient management approach is crucial for sustainable and profitable agriculture. The Institute has developed a mobile-based decision support system that integrates digital soil maps, geospatial tools, and target-based fertilizer recommendations (STCR). This user-friendly and practical system offers an effective solution to the challenges of soil fertility management in Indian agriculture.



STCR based IPNS modules for crop productivity and soil health in maize-wheat cropping system in Vertisol

In a long-term field experiment, evaluation of 12 IPNS combinations of fertilizers, Farmyard Manure (FYM), Vermicompost (VC), Urban Compost (UC), Gliricidia lopping (Gly), crop residue and Soil Test-Based Fertilizer (STCR) dose revealed that the crop yield, system productivity and soil properties significantly improved with different IPNS modules. The grain yield of crops and system (maize-wheat) productivity was significantly higher with adoption of STCR based IPNS module i.e. 75% NPK based on STCR along with FYM at 5 Mg ha^{-1} as compared to General Recommended Dose of fertilizers (GRD)/ farmers practices and 100% NPK fertilizer based on STCR. However, incorporation of different organic manures alone or with integration maintained the soil properties but was unable to produce the target yields of maize and wheat. A significant increase in Soil Organic Carbon (SOC), SOC stock, and carbon sequestration rate was noticed under high amount of organic manures and STCR based IPNS module (75% NPK + FYM at 5 Mg ha^{-1}). Application of IPNS modules significantly reduced the bulk density in surface soil as compared GRD. The STCR based IPNS module was found to be the best nutrient management technology for sustaining crop productivity in Vertisols.

Agrotain Incorporated Urea effect on N Use Efficiency in rice crop

The experiment was laid out in a randomized complete block design with four replications. Basal application of phosphorus (60 kg ha^{-1}) and potassium (40 kg ha^{-1}) was done at the time of sowing of crop. The rice crop hybrid (Arize-6444 gold) was transplanted in July 2023. Yield of rice was significantly influenced by N application. However, no significant difference in yields were recorded between the different doses of Neem Coated Urea (NCU) and Agrotain Incorporated Urea (AIU). In general, as the application rate increased, the grain yield of rice also increased. Highest grain yield of rice (3.3 t ha^{-1}) was recorded under 100% AIU, which was at par with 100% NCU.

Impact of conservation agricultural practices on soil health and carbon sequestration

Tillage and residue retention significantly affected soil total carbon in 0-10 cm of soil depth. No till system without residue retention enhanced soil total carbon by 6% in comparison to CT, although the difference was insignificant. Retention of residue to the tune of 90% resulted in 47% improvement in soil total carbon in comparison to CT. Similarly, retention of residue of previous crops (90%) resulted in 17% improvement in soil total nitrogen after completion of 8 years of soybean-wheat cropping system.

Farm field survey in the tribal settlement of Balaghat in Madhya Pradesh

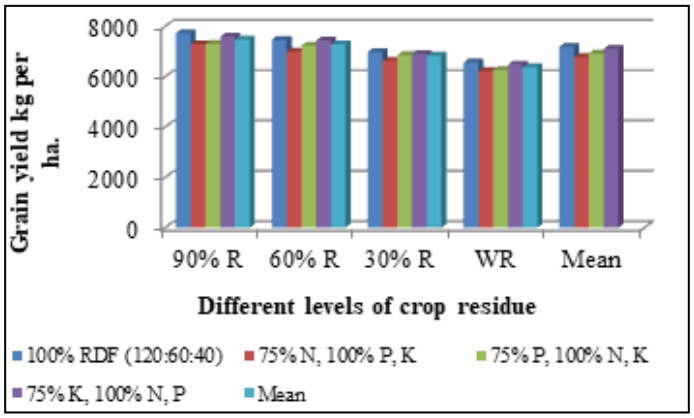
A pilot survey was carried out in 400 tribal households of the project area in Balaghat district showed that major livelihood activity of 92.1% of the tribal population is agriculture and 21% of them adopted chemical fertilizers at a low rate of 10-15 kg ha^{-1}. Only 4% of the farmers were cultivating traditional varieties of the locality. The crop cutting survey carried out in 17 farm fields (random sampling) showed the average rice grain yield of the area as 3.2 t ha^{-1}. Analysis of plant samples from 14 farmer fields of three villages showed the average nitrogen, phosphorus and potassium contents in the grain samples as 1.05%, 0.21% and 0.17%, respectively and that of straw samples as 0.62%, 0.14% and 1.49%, respectively.

Performance of intercrops in fruit orchards of central India

Performance evaluation of intercrops *viz.,* soybean and cowpea in fruit orchards during rainy season showed that highest soybean yield in lime orchard (134.65 g m^{-2}) and lowest in aonla orchard (26.90 g m^{-2}). Similarly, highest yield of cowpea was recorded in mango orchard (612 g m^{-2}). The yield of mango was highest in mango+chickpea-cowpea system and lowest in mango+mustard-cow pea. Lab experiment was conducted to assess the allelopathic effect of fruit crops (mango, guava, lime and aonla) on germination of cow pea, soybean, chickpea, wheat and mustard. Guava exhibited lowest whereas mango resulted in higher allelopathic effect on germination at various concentrations.

Effect of different residue and nutrient levels on grain yield of maize under conservation agricuture

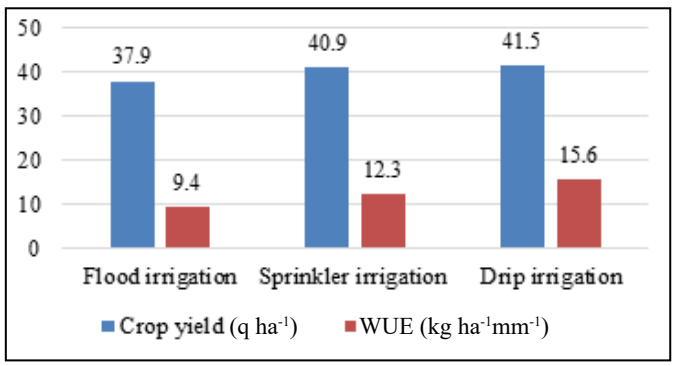
The data pertaining to grain yield of maize crop shows significant differences in grain yield as a result of different levels of crop residue retention. The maximum yield was recorded in 90% residue retention treatment which was significantly superior to other treatments. Under various nutrient application levels, there was non-significant effect of nutrient doses on grain yield. The interaction effect between residue level and nutrient did not show any significant difference on grain yield. The lowest grain yield was observed in No- residue treatment with 75% N and 100% P, K doses.



Grain yied under different residue cover

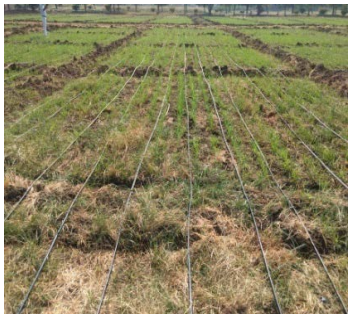
Water, tillage and nutrient interaction in Conservation Agriculture for Vertisols of Central India

A field experiment was conducted on wheat crop (Var. HI 1544) in the rabi season of 2022-2023 under three levels of tillage treatment (CT-Conventional tillage, RT-Reduced tillage and NT- No tillage) and four levels of fertilizer doses (F1: 100 % RDF, F2: 75% DRF, F3: STCR and F4: LCC (leaf colour chart) under three irrigation methods namely FI: (flood irrigation), SI: (sprinkler irrigation- 80% of flood) irrigation and DI: (drip irrigation-60% of flood irrigation) were tested. Under flood irrigation, the crop received irrigation of 402 mm with 61 mm rainfall during the cropping season. The irrigation amounts in sprinkler and drip irrigation plots were 334 mm and 266 mm, respectively measuring about 80% and 60% of the flood irrigation amount. Sprinkler irrigation was given twice a week and drip was run on alternate days. The grain yield of wheat was not significantly different in the three irrigation methods. The water productivity was higher under drip followed by sprinkler and flood irrigation.

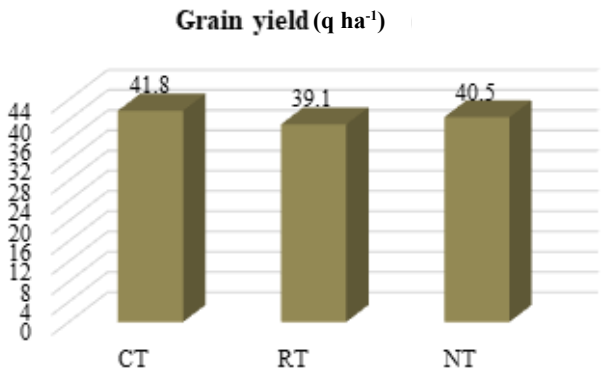


Effect of different irrigation systems on grain yield and WUE of wheat crop

In other words, 13.6 cm of water can be saved under drip irrigation and 6.8 cm under sprinkler irrigation.



The grain yield under NT and RT was at par with CT indicating saving of energy, labour and cost involved in tillage operations under NT/RT. The grain yield of wheat was significantly higher under STCR (43.5 q ha^{-1} and LCC (41.3 q ha^{-1}) doses as compared to 75% RDF (36.3 q ha^{-1}).

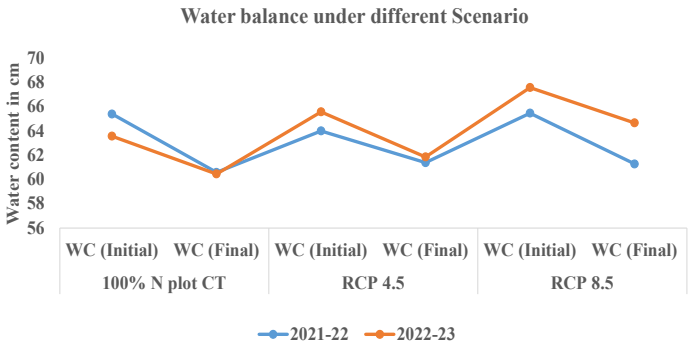


Effect of tillage systems on grain yield of wheat

Impact of tillage and N application on water balance and soil surface temperature using SWAP model

Evaluation of field water balance was carried out for RCP 4.5 and RCP 8.5 climatic scenario to optimize

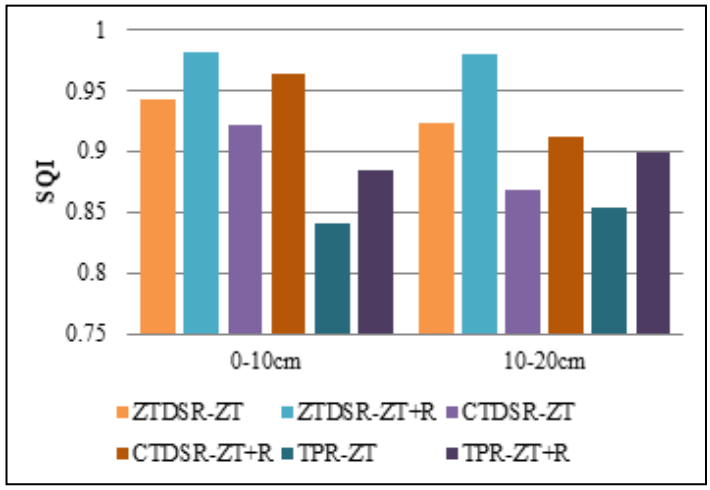
agricultural water management strategies to mitigate climate change under winter maize-wheat cropping system. In this study, the agro-hydrological Soil–Water–Atmosphere–Plant (SWAP) model was used to evaluate the field water balance. Model was first calibrated and validated using the field experimental data including soil water content, soil temperature. The root means square error (RMSE) of 1.09 and 0.32 was observed for soil temperature and water balance, respectively, in the top 10 cm soil layer. This study also indicated that the soil profile moisture in no tillage was comparatively more than the CT.



Water balance under climate change scenario

Effect of tillage and crop establishment techniques on different soil properties under rice-based cropping system in Eastern Indo-Gangetic Plains

Soil samples from two different depths (0-10 cm and 10-20 cm) of two different cropping systems (rice-chickpea and rice-mustard) with six treatments (T1: ZTDSR-ZT, T2: ZTDSR-ZT-R, T3: CTDSR-ZT, T4: CTDSR-ZT+R, T5: TPR-ZT, T6: TPR-ZT+R) from research farm of ICAR-RCER, Patna under consortia research platform on conservation agriculture (CRP on CA) revealed no significant changes in pH and EC due to tillage and crop establishment techniques, whereas organic carbon, available N, P and K (0.78%, 111 mg kg^{-1}, 81.8 mg kg^{-1}, 130 mg kg^{-1}, respectively) were highest under ZTDSR-ZT+R (T2) treatment in both cropping systems at 0-10 cm soil depth. Similarly, microbial biomass carbon (400 µg g^{-1} soil), fluorescein diacetate hydrolysis (62.7 µg g^{-1} soil) and dehydrogenase activity (218 µg TPF g^{-1} hr^{-1}) were highest in T2 treatment. The highest aggregation was recorded in T2 treatment at 0-10 cm depth. Soil quality indices in both the cropping system were highest in T2 treatment as compare to conventional tillage-based practices.



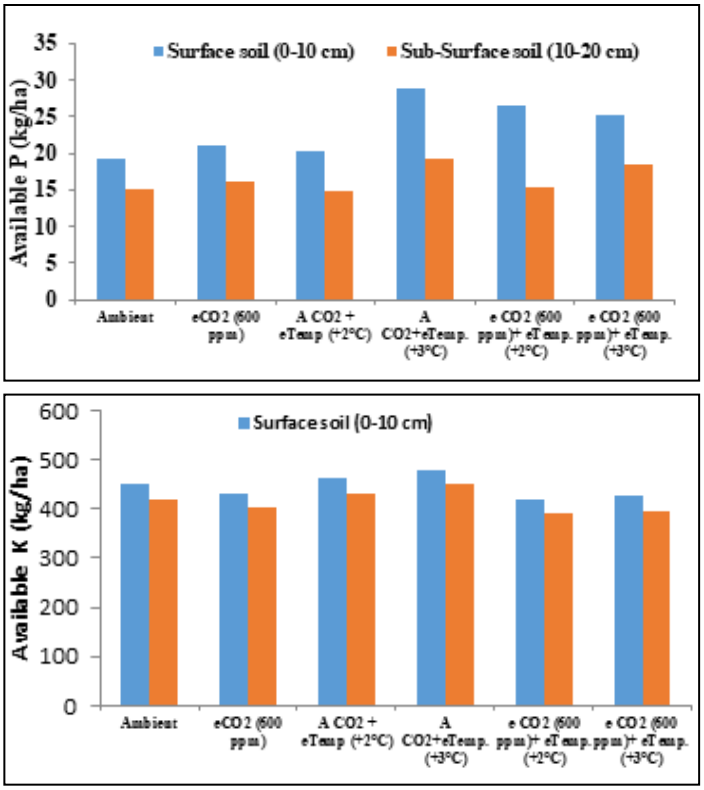
Effect of different tillage and crop establishment techniques on SQI. (ZT- Zero Till, DSR- Direct seeded Rice, TPR- Transplanted Rice, R-Residue)

Spatio-temporal trend analysis of long-term ESA CCI surface soil moisture content across different agro-ecological regions of India

The spatio-temporal trends in near-surface soil moisture across different agro-ecological regions of India was compared using the European Space Agency Climate Change Initiative (ESA CCI) surface soil moisture data spanning from 1979 to 2021 (43 years). The non-parametric Mann-Kendall trend test was applied to detect the presence of monotonic trend, and Sen's slope estimator to compute the magnitude of trend at 5% level of significance on grid basis at monthly and seasonal time scale. Interestingly, majority of India (94.09%) did not show significant temporal trend ($p < 0.05$) in soil water content. Only 2.75% indicated a declining trend, and 3.16% showed an increasing trend with a slope of 0.0002 m^3 m^{-3}/year. The maximum percentage of area having decreasing trend were found in the August month (11.28%), belonging to northern and central India having alluvial, red and black soils. The maximum percentage of area showing increasing trend were found in the month of December (12.39%), mostly in the northern and central India and in eastern and western coastal regions.

Effect of climate change on soil available phosphorus and potassium content under FACE experiment.

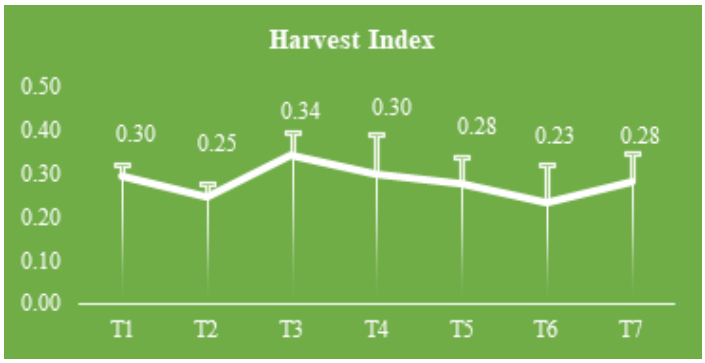
The impact of elevated CO_2 and temperature on soil-available phosphorus (P) and potassium (K) was studied in the FACE experiment. The available P content in soil ranged from 19.1 to 28.8 kg per hectare across all treatments in surface soil. The treatment with the highest level of available P content in soil was ACO_2 and eTemp. (+3 ℃) with a value of 28.8 kg per hectare. However, no significant differences of available P were observed among the treatments in surface and subsurface soil of the treatments. Similarly, the study found that the impact of elevated CO_2 and temperature on the available K content in both surface and subsurface soil was insignificant.



Impact of elevated temperature and carbon dioxide on (a) available P (b) available K in soil under FACE experiment.

Deciphering thermophiles from hot springs of Central India for rapid decomposition of crop residues

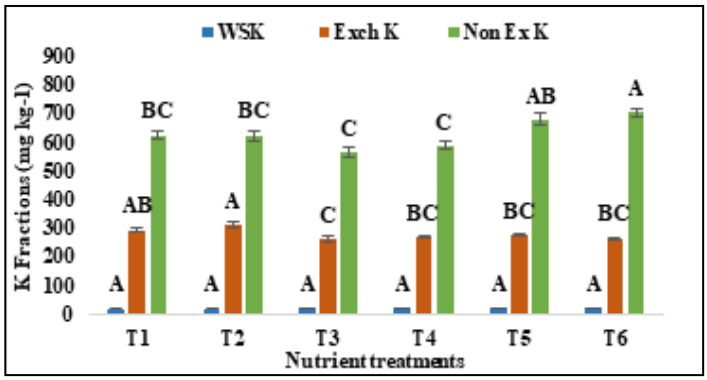
The treatment consists of (control) (T1); residue burning (T2); residue incorporation with Thermophilic consortia (T3); residue incorporation with EKCEL decomposer (T4); residue incorporation with Pusa decomposer (T5); residue incorporation with waste decomposer (T6); residue incorporation without any consortia (T7). Harvest index of paddy crop are given below.



Harvest index of Paddy crop

Effect of various organic nutrient management practices on soil potassium (K) fractions in Vertisols of central India

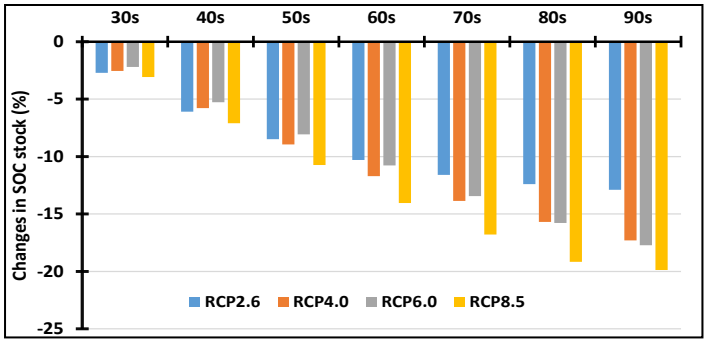
Nutrient management had no significant impact on water soluble K (WSK) while it had significant impact on Exch K fractions. 50% organic + 50% inorganic sources maintained the highest Exch K followed by 100% Organic sources. In case of Non-Ex K, state recommendations maintained the highest value followed by 100% Inorganic whereas 50% organic + 50% inorganic sources exhibited the lowest value. The increase in yield of crops in the organic treatments may also indicate that the demand of K in these treatments by crops are high which in turn may trigger the transfer of K to more soluble and available pool from non-exchangeable pools.

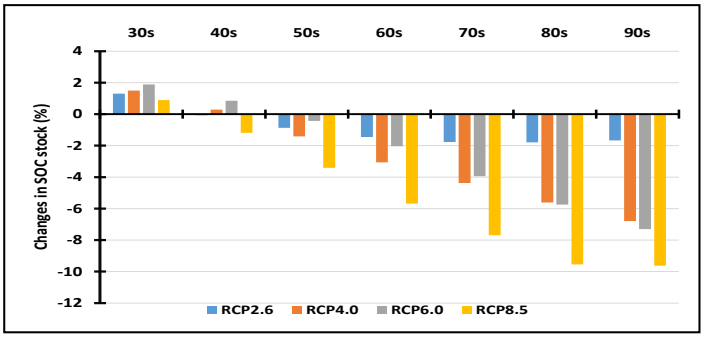


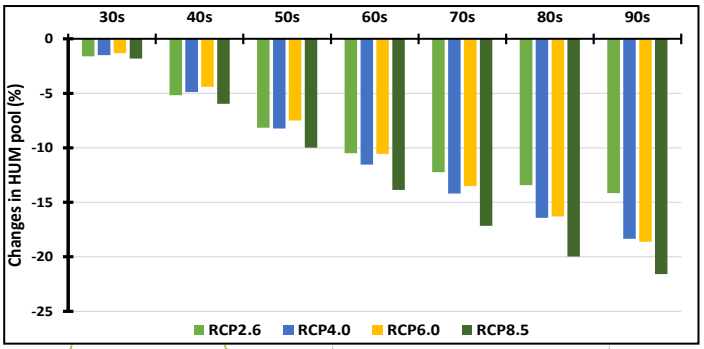
Long term nutrient management effect on soil potassium (K) fractions (mg kg^{-1})

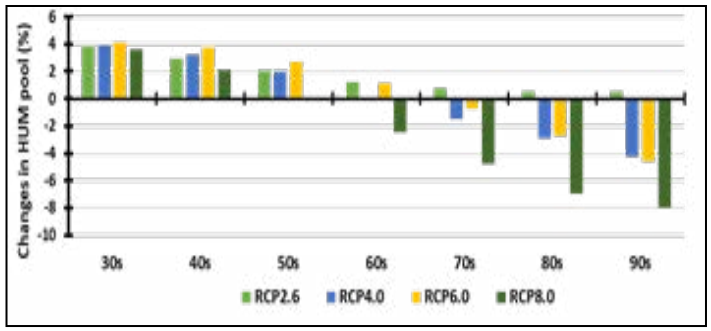
Soil organic carbon (SOC) sequestration potential under the changing climatic scenarios

The RothC model was used to simulate SOC dynamics in sorghum-wheat cropping systems under different management practices at LTFE-Akola centers. The model accounted for soil, climate, and management practices (100% NPK and 100% NPK+FYM), and used data from the LTFE experiment. The RothC model was parameterized and validated to predict SOC stock. Results showed that the application of 100% NPK resulted in a 20% reduction in SOC stock. Conversely, a 9% decrease in SOC stock was reported in the 100% NPK+FYM treatment under different climatic scenarios. Higher SOC stock in 100% NPK+FYM was due to increase in HUM pool. This indicated that management practices with FYM have potential to offset the effect of climate change. However, climate change has been found to decrease the rate of SOC sequestration, with higher decreases reported under RCP 8.5, followed by RCP 6.0, RCP 4.5, and RCP 2.6.





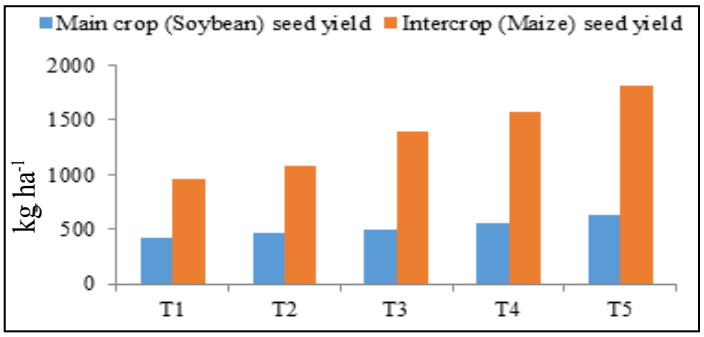




Decadal changes of SOC stock over the base year (2020) at LTFE-Akola center

Evaluation of natural farming practices on soil health and crop productivity

Field experiments were conducted to evaluate the effect of natural farming practices on soil health and crop performance. The seed yield of soybean significantly differed across the nutrient management systems. The highest yield was recorded in T_5 treatment followed by T_4 and T_3 as compared to T_1 (control) treatment. Maize was grown as an intercrop in natural farming experiment. The highest seed yield of maize was recorded under integrated crop management with need-based pesticide treatment (T_5) as compared to other treatments.



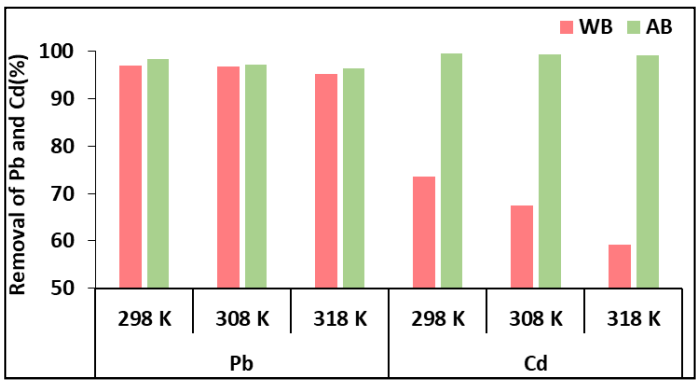
Seed yield of soybean and maize as affected by different nutrient management parctices

#Treatment: T1-Control, T2-Complete NF, T3- AI-NPOF package, T4 Integrated Crop Management + NF based pest control methods (ICMNF), T5 Integrated Crop Management + chemical pesticides (ICMP).

Pest control under organic farming
(sting bug and *Beauveria bassiana*)

Effect of temperature to remove Pb and Cd from wastewaters using different adsorbents

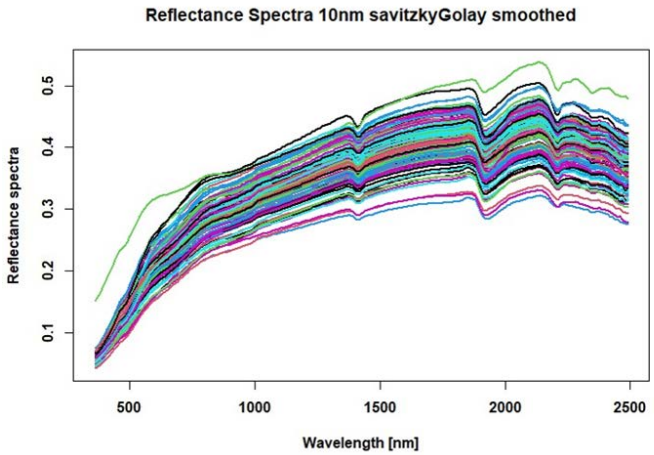
Removal of Pb and Cd from wastewater are significantly affected by temperature. Two adsorbents: wheat straw biochar (WB) and activated bentonite (AB) were used for adsorption study with Pb(II) and Cd(II) concentration at 50 mg/L and 5 mg/L, respectively under the experimental temperatures between 298K and 318K maintaining solution pH at 5.0. Adsorption efficiencies decreased with increasing the solution temperature from 298 to 318 K which indicates that metal ion adsorption onto adsorbents is physisorption in nature. WB and AB both showed better adsorption percentage (95 to 97%) for Pb(II) with decreasing temperature. Whereas, AB showed better Cd(II) adsorption (99%) in comparison to the WB (73%). Weak electrostatic interactions between the metal ions and the adsorbent at elevated temperatures could be the cause of the decrease in adsorption.



Removal of Pb and Cd at different temperature

Estimating soil pollutants in Jajmau industrial area using multi-spectral imagery

The Jajmau industrial area of Kanpur has more than 400 tanning industries, located on the left bank of the Ganga River. Twelve Landsat-8 cloud free images covering the study area between 1 January 2021 to 31 December 2022 were retrieved from US Geological Survey website. Satellite imagery Landsat 8 was found to be characterized by strong absorption of heavy metals between 400 and 2500 nm. The spectral reflectance showed increasing trend between 600 and 880 nm and a decreasing trend between 1200 and 1400 nm Consequently, spectral indices like differential vegetation index (DVI), enhanced vegetation index (EVI), clay mineral ratio (CMR), normalized differential vegetation index (NDVI), improved normalized water index (MNDWI), brightness, greenness and wetness indices were derived from the spectral values of the B2-B7 bands of the Landsat 8 images. The results showed that the Cr and Pb concentrations are significantly correlated with the reflectance values of B2, B3, B4, B5, B6 and B7 bands as well as EVI and MNDWI factors. The Cd concentration display less significant correlations with spectral factors such as DVI, EVI, CMR and brightness because of less amount of Cd in soils of the Jajmau. Therefore, six bands and eight indices can be employed for estimating the Cd, Cr, Fe and Pb contents of soils.

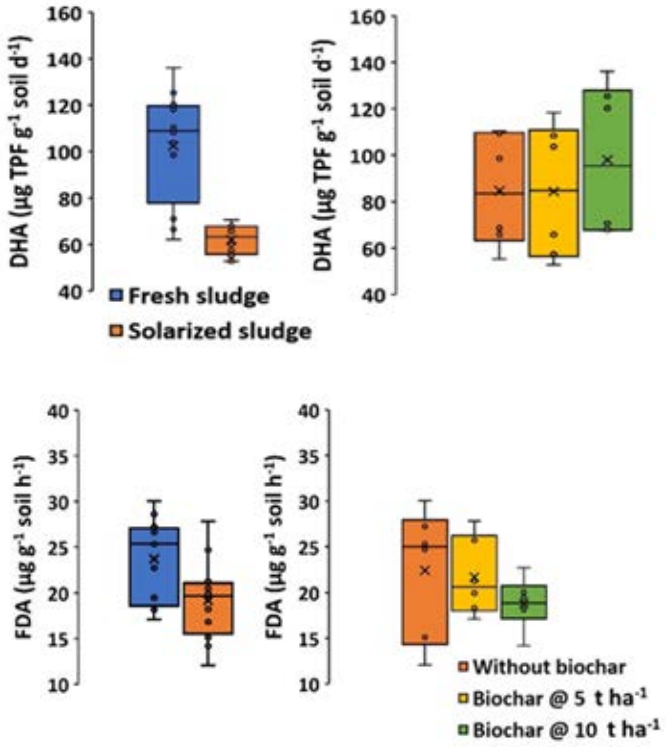


Reflectance spectraa of soil heavy metals of Jajmau industrial area, Kanpur

Municipal sludge a good soil amendment for spinach growth

Municipal sludge production is huge due to rapid urbanization; hence, proper management and utilization of municipal sludge is necessary for environmental sustainability. Total ten treatments comprising of graded doses of dry (DS) and fresh sludge (FS) (equivalent of

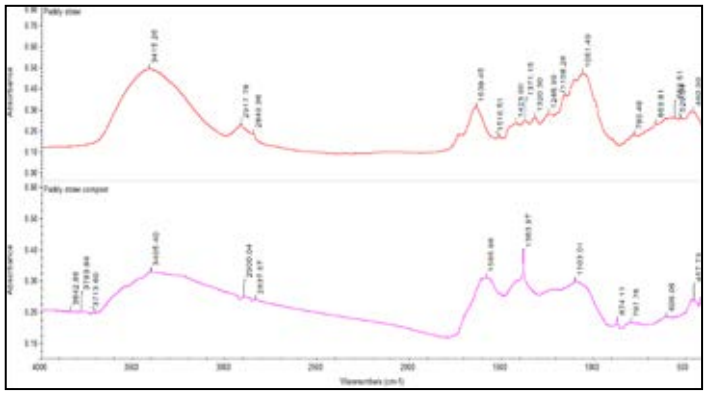
0, 20 and 40 t ha^{-1}), biochar (equivalent of 0, 5 and 10 t ha^{-1}) and lime (0.8 t ha^{-1}) were assessed against spinach growth. With higher doses of biochar, seed germination (%), leaves, root dry weight and chlorophyll contents significantly improved; whereas, NO_3^- -N, Fe, Mn, Zn, Cu and Pb content decreased in the leachate. Interestingly, decreased activities of dehydrogenase (DHA) and hydrolysis of fluorescein diacetate (FDA) were recorded under DS than the FS. Metal uptake by spinach were below permissible limits and calculation of Hazard Quotient (HQ) also indicate safe utilization of municipal sludge (40 t ha^{-1} with 10 t ha^{-1} biochar) for spinach production without hampering the environmental sustainability and human food-chain.



Effects of municipal sludge and biochar on soil enzymatic activities

Compost quality evaluation through FTIR spectroscopy

FTIR spectroscopy was used for process monitoring and quality control of paddy straw compost. After 110 days of co-composting paddy straw with cow dung, vermiworms, and biochar, the appearance of a strong absorption band at 1384 cm^{-1} is indicative of the nitrate band detected exclusively at the later composting phase when the material is well composted. The emergence of the absorption band at 1585 cm^{-1} is a band of protein origin indicated by nitrogen-rich composts. The aliphatic methylene bands at 2900 and 2837 cm^{-1} reached a constant band height when the organic matter stabilized.

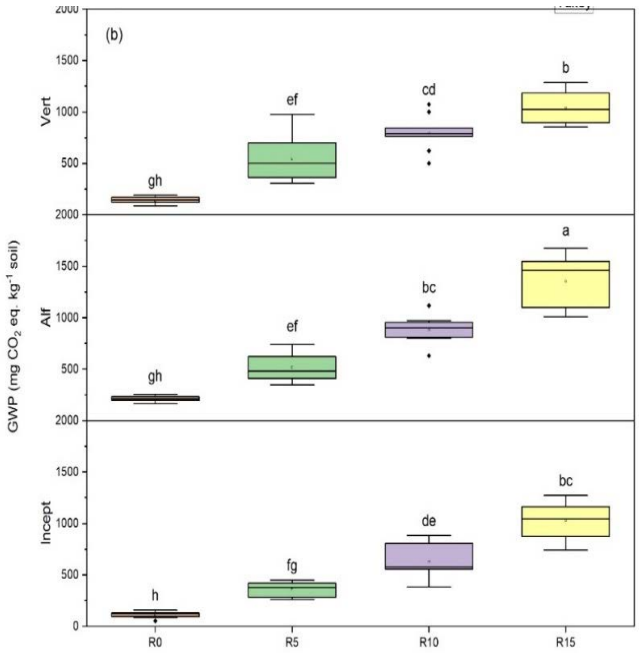


FTIR spectra of compost

Greenhouse gas emissions under crop residue and nutrient application rates in different soils

The response of three predominant soil types of India (Inceptisol, Alfisol, and Vertisol) to soil GHG emissions (CO_2, N_2O, and CH_4) and global warming potential under four wheat residue return rates (R0: no residue; R5: @5 Mg ha^{-1}; R10: @10 Mg ha^{-1}; R15: @15 Mg ha^{-1}) and two placements (surface, Rsur and incorporated, Rinc) under three nutrient supplement levels (NSL) (NS0: no nutrient, NS1: nutrients (N and P) added to balance the stoichiometry of C:N:P to achieve 30% humification in RR @ 5t ha^{-1}: NS2: 3 x NS1). The results demonstrated a significant ($p<0.01$) interaction effect of RR rate x soil type x NSL on N_2O emission and global warming potential (GWP). However, only the RR rate x Soil type interaction was significant ($p<0.01$) on CO_2 and CH_4 emissions. N_2O emission was the highest in Vertisol-R15-N2 (128.41 µg N kg^{-1} soil) and the lowest in Inceptisol-R10-N0 (-20.82 µg N kg^{-1} soil). Among the soil types, the mean lowest N_2O emission was from Inceptisol (-2.33 µg N kg^{-1} soil) and the highest was from Vertisol (17.60 µg N kg^{-1} soil), comparable to Alfisol (15.53 µg N kg^{-1} soil). The response of residue return rates on N_2O emission was R15≈R0 > R5≈R10. N2> N1>N0 (N2= 7.6 times N1 and N1= 2.59 times N0). Residue placement was significant $p<0.001$ (Rinc, 10.75 µg N kg^{-1} soil > Rsur, 4.18 µg N kg^{-1} soil). The global warming potential of Alfisol-R15-N2 was the highest (1489.75 mg CO_2 eq.

kg^{-1} soil), and Inceptisol-R0-N1 (96.70 mg CO_2 eq. kg^{-1} soil) was the lowest. The residue placement did not significantly affect the emission of CO_2, CH_4, and GWP. The results showed that the global warming of Inceptisol was the lowest. A linear response was observed between GWP and residue return rate.



Global warming potential of different soils under different crop residue and nutrient application rates

Fly ash as a potential phosphorus source for crop production

Fly ash is acknowledged as a valuable soil enhancer and a provider of specific nutrients crucial for plant growth, notably phosphorus and micronutrients. A study was conducted during the rabi season (2023-24) with wheat crop in Vertisol, aiming to assess fly ash's potential as a phosphorus fertilizer for sustainable crop yield. The weathered fly ash, sourced from the Super Thermal Power Station in Gadarwara (Madhya Pradesh), which was used for this study contained a notable total phosphorus content (0.15%). Results from the field trial on wheat cultivation in a Vertisol revealed that applying fly ash alongside the recommended fertilizer dosage led to a significant increase in wheat grain yield by 13.96% compared to using only the recommended fertilizer dosage. Moreover, the findings demonstrated that applying fly ash alongside a reduced phosphorus dose (-50% P) still resulted in a notable increase in wheat grain yield compared to the recommended fertilizer dosage, indicating fly ash's efficacy as a phosphorus supplement for crop production. However, the results need to be confirmed in long-term trials.

Characterization of Municipal Sludge Biochar

Municipal sludge (MS) was collected from the dump yard of the Sewage Treatment Plant (STP), Sehore. After that, dry sludge was processed, and municipal sludge biochar (MSB) was prepared in a batch type tubular stainless steel Pyrolyzer (pyrolysis reactor) at ICAR-CIAE, Bhopal**.** The pH of the municipal sludge (MS) and municipal sludge biochar (MSB) was 6.54 and 6.84, respectively. Whereas, the EC of the MS and MSB was 3.77 and 1.59 dS m^{-1} respectively. Also, we found that the fecal coliform is nil and 4.7×10^3 (unit: MPN 100 ml^{-1}) as per the method of APHA 23rd Edition in MSB and MS, respectively.

Municipal Sludge Biochar

Polythene mulch affects agronomic parameters of crop

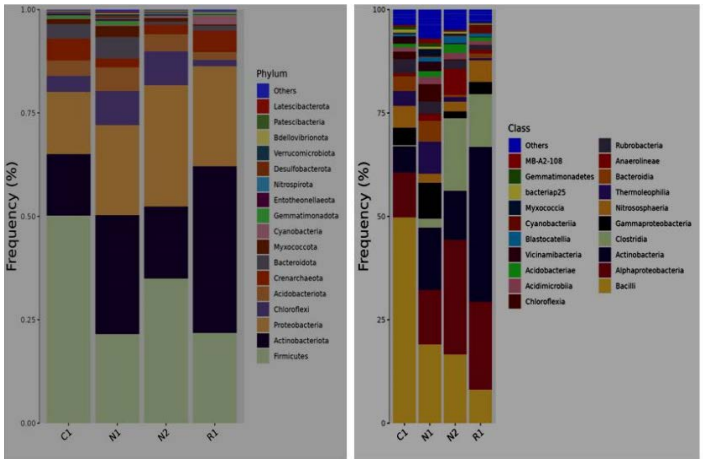
The maize crop yield was higher under mulching condition in comparison to control. Much higher weed density in control plots as compared to polymulched plots was observed. Weed density also varied between the seasons. A protocol has been formulated to measure the weed density.

POLY- MULCH

CONTROL

Soil microbial diversity under polymulching in Farmers field

Four soil samples (two from Narmadapuram district, one from Raisen district and one control sample without poly mulching) was studied for bacterial diversity. No change in simpson diversity index was observed while Shannon index was found slightly higher for the soils under poly mulching in Narmadapuram district. Although no drastic change in diversity index was recorded, proportion of different microbial taxa varied with treatmnt. Proportion of proteobacteria and actinobacteria was found to increase under polymulched soil whereas Firmicutes dominated in control soil.



Microbial diversity in four soil samples under polymulching in Farmers field

Fertilizer prescription equations under integrated plant nutrient supply system

Different cooperating centers have generated technologies for integrated supply of plant nutrients accounting contribution from soil, fertilizers, organic manures, and biofertilizers. The combined use of chemical fertilizers along with organics will help in sustaining the soil productivity and maintaining soil health by way of improvement of the soil's physical, chemical, and biological properties.

Differential partitioning of seed inhabiting methylotrophs in endospheres of wheat plant

Methylotroph bacteria are found on leaves (phyllosphere) which play key role in protecting plant from abiotic stress. Methylotrophs in seed, root, stem and leaf were quantified both by culturing and real time PCR targeting methanol dehydrogenase gene (MXF). In general, the abundance of endophytic methylotrophs varied in the order of leaf > stem > root > seed. The major endophytes of wheat plant were *Methylobacterium* sp., *Methylorubrum* sp., *Pantoea* sp., *Microbacterium* sp., *Curtobacterium* sp., *Pseudomonas* sp., *Rhizobium* sp., and *Burkholderia* sp. Results highlighted that methylotrophs from seed are preferentially transmitted to shoot but not to root, and this phenomenon is regulated by an alkaloid identified as peganine.

Impact of silicon on rice productivity in Vertisols of Central India

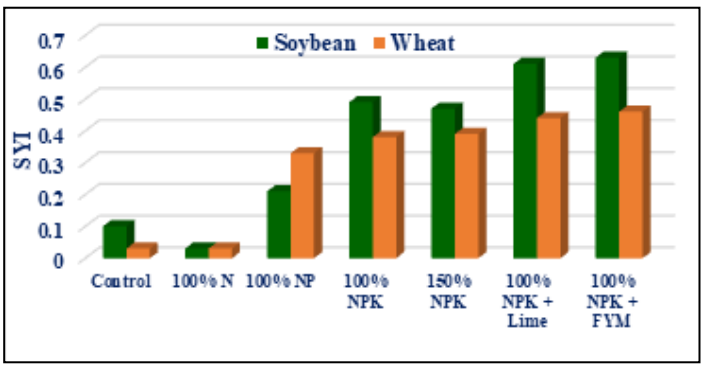
Silicate solubilizing bacteria for enhancing nutrient use efficiency of rice-wheat cropping systems in Vertisols of Central India showed that in rice crop, the treatment combining P+ Si priming + Si foliar yielded highest, while the control had the lowest yield among all treatments. This study suggests that the combine application of Si and P fertilizers significantly benefits the rice crop in Central Indian Vertisols. However, using Si alone, whether seed priming or foliar application, showed a less positive response compared to the recommended dose of fertilizers.

Treatment wise comparison of rice (PB 1) at harvest

Nutrient balance and yield sustainability in Alfisols under LTFE

Data on inputs (nutrient applied) and output (nutrient uptake) indicated that there was negative balance of N and K under the nutrient management practices for soybean-wheat cropping system. A positive balance of P in most of the treatments except control and 100% N were recorded for these Alfisols. Soybean being a leguminous crop has N fixing ability and thus nitrogen management in soil is possible for this crop but such phenomenon does not occur for P and K. Therefore, much attention is required for K management in acid soils to maintain its status and to minimize K mining. There was a mining of K even with balanced application (100% NPK) indicating rethinking on the existing fertilizer K recommendation. INM (100% NPK+FYM) attained maximum Sustainable Yield Index (SYI) values (0.63 and 0.46 for soybean and wheat, respectively). Similarly, higher SYI was obtained with NPK+lime (0.61 & 0.44 for soybean & wheat, respectively) as compared to 100% NPK (0.49 & 0.38) suggested the need of liming in Alfisols of Ranchi (Jharkhand) after 52 year of continuous application of fertilizers and manures.

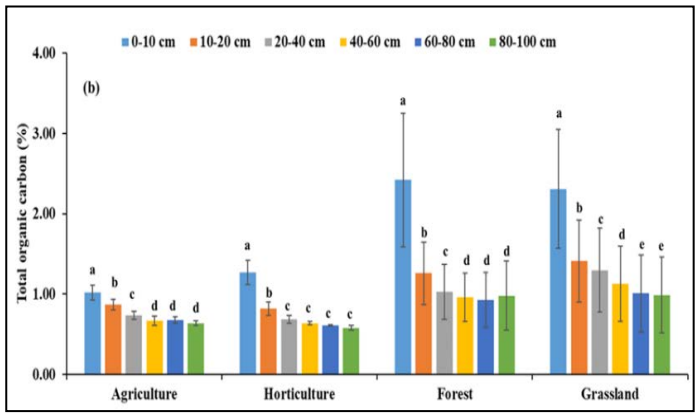
Treatment	Nutrient balance (kg ha^{-1})		
	N	P	K
Control	-61.1	-3.6	-22.8
100% N	104.3	-2.7	-17.2
100% NP	-4.6	14.3	-52.0
100% NPK	-78.0	9.4	-21.9
150% NPK	-22.7	20.6	-2.3
100% NPK + Lime	-128.8	4.8	-44.7
100% NPK + FYM	-148.6	1.8	-62.0



Impact of LTFE treatments on SYI in Alfisols of Ranchi

Effect of land use and soil depth on distribution of phyto-available nutrients and SOC pools in Vertisols of central India

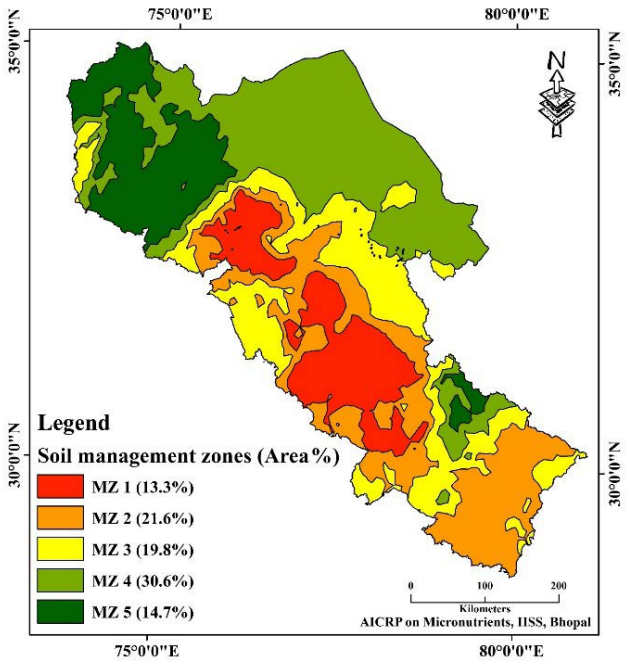
A total of 150 composite soil samples (from 25 plots including nine from agricultural land, nine from horticultural land, three from forest land and four from grassland) were collected from 6 soil depths viz., 0-10, 10-20, 20-40, 40-60, 60-80, and 80-100 cm under agriculture, horticulture, forest and grassland land uses present in central India and analysed. The values of SOC (0.19 to 1.00%), TOC (0.58 to 2.42%), very labile C (0.14 to 0.83%), labile C (0.05 to 0.25%), less labile C (0.05 to 0.26%) and non-labile C (0.23 to 1.42%) in various soil depths under different land uses also varied significantly. Forest and grassland land had higher levels of SOC, TOC, very labile and non-labile C content in all the soil depths in comparison to SOC, TOC, very labile and non-labile C content in different soil depths under agriculture and horticulture land use. The levels of SOC, TOC, very labile and non-labile C content under all the land uses decreased with increasing soil depths. SOC was positively and significantly correlated with AN, AK, AS and estimated SOC pools in surface soil layers. Principal component analysis (PCA) of soil parameters in different soil depths resulted in 5 principal components (PCs) with >1 eigenvalue and accounting for >75% variability. This information could be used for managing SOC status and phyto-available nutrients in Vertisols under different land uses.



Distribution of total organic carbon in different land uses.

Spatial variability of soil nutrients and delineation of soil management zones in an ecologically fragile North-Western Indian Himalayan region

Delineation of soil nutrients management zones (MZs), to understand the spatial distribution pattern of soil nutrients and their associated soil properties, in North-Western Indian Himalayan (NWIH) region was carried out using 18930 representative surface (0-15 cm depth) soil samples. The values of studied soil parameters varied widely with coefficient of variation ranging from 11.8 to 156%. Five soil MZs were identified by employing the techniques of principal component analysis and fuzzy c-means clustering. Principal components with eigen value > 1 were considered for further analysis. The soil parameters of identified MZs differed significantly. Thus, the study highlighted the usefulness of MZ delineation technique for site-specific soil nutrient management in different cultivated areas for sustainable crop production.



Soil nutrient management zones of the study area

EXTENSION ACTIVITIES

Frontline Demonstrations

Under the STC/TSP project 'Enhancement of soil health and livelihood of tribals in Central India', frontline demonstrations (FLDs) on nutrient management intervention integrating liquid bio-fertilizers (Rhizobium, PSB, KSB, ZSB, *Azotobacter* & *Acetobacter*) and bio- formulations (*Trichoderma* and *Pseudomonas*) were carried out in 200 tribal farm fields of Betul District in Madhya Pradesh in an area of 160 hectares for the third Kharif season in 2023.

Paddy crop under INM

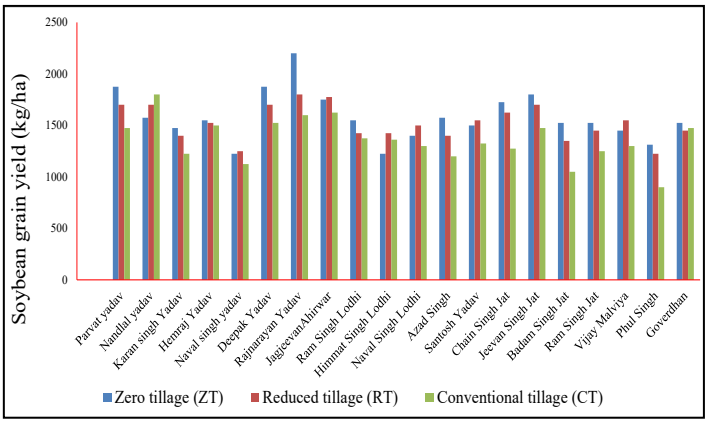
Under Farmer FIRST Program, 60 FLDs were carried out in an area of 24.28 hectares in six villages of Bhopal district in Madhya Pradesh for *kharif* crops viz., soybean (JS-2069) and rice (PB-1637) and *rabi* crops viz., wheat (HI-1544) and chickpea (RVG-202) during the 2023-24 crop season.

Soybean crop under Zero tillage system

Under the horticulture module, 53 FLDs on package of practice recommendations for improved vegetable production were carried out in an area of 5.62 ha for brinjal (40) and okra (13) crops.

Performance of Okra crop under recommended package of practices

Under CRP on CA project 25 frontline demonstrations on zero tillage, reduced tillage and conventional tillage were conducted for soybean (kharif) and wheat crop (rabi). Data revealed that zero tillage recorded higher grain yield of soybean compared to reduced tillage and conventional tillage.



Soybean yield in farmers' field

Sowing of wheat crop under zero tillage

Wheat crop under zero tillage

Under SCSP programme 17 demonstrations on balanced use of fertilisers and integrated nutrient management were conduted during the *kharif* season from July 2023 to November 2023. Twelve demonstrations on soybeans and five on maize was also conducted under SCSP at farmers' fields in Raipur, Kanera, Khichital, and Karond Khurd village.

Under the Agri Drone Project, Dr. Jitendra Kumar conducted a field-day demonstration of pesticide application through drones on 18th August, 2023 in the Parwalia Sadak village.

Drs. Sanjay Srivastava, R. Elanchezhian, NK Sinha, JK Thakur and Mr. Sanjay Kumar Parihar demonstrated institute technologies in 10th Bhopal Vigyan mela at BHEL, Bhopal during15-18 September, 2023.

Dr. Sanjay Srivastava and Mr. Sanjay Kumar Parihar demonstrated institute technologies in G20 meet at Varanasi during 17-19 April, 2023.

Drs. Sanjay Srivastava, N. K. Sinha, J. K. Thakur and Mr. Sanjay Kumar Parihar demonstrated IISS technologies on ICAR Foundation & Technology Day held at NASC, New Delhi during July 16-18. 2023.

Dr. S. K. Behera, Dr. Tapan Adhikari, Dr Sanjay Srivastava, Dr. N. K. Sinha, Dr. J. K. Thakur and Dr. KC Shinogi demonstrated institute technologies during XVI Agricultural Science Congress organized by the National Academy of Agricultural Sciences (NAAS), New Delhi and hosted by ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) during 10-13 October, 2023 at Kochi, India.

Input distribution and awareness program

Agricultural input distribution and awareness to approximately 50 farmers of village Sahapur, Kuthar, Kachibadkhedi, Sagoni was done on July 3 and 12, 2023 under SCSP project by Drs. Abhijit Sarkar, D. K. Yadav, Madhumonti Saha.

Training-cum agricultural input distribution programme to 50 tribal farmers was organized by Indian Institute of Soil Science, Bhopal at KVK Barwani on November 21, 2023 under TSP project (Participant scientists: Drs. R.K. Singh, Jitendra Kumar, Asit Mandal, Dhiraj Kumar and S.K. Badodiya, In charge, KVK, Barwani).

Under Farmer FIRST Programme, seeds of vegetable crops (okra and brinjal), seedlings of fruit plants (mango, guava and lime) and fertilizers were distributed to farmers.

Under SAP project, worm mother culture was multiplied and approximately 80 kg mother culture was distributed to the farmers of Khamkheda, Rasuliya Pathar, Ratibad, Beenapure and Khajuri villages.

Under CRP on CA project different inputs like seeds (wheat and chickpea) and fertilizers were distributed to 40 farmers of four villages.

Under SCSP project, fertilizers and seeds of soybean and maize in July and chickpea and wheat in October were distributed to the farmers of different villages of Bhopal district.

Workshop organized

Workshop organized on "AGROTAIN Incorporated Urea Produces with N-TEGRATIONTM Technology for Improving Nitrogen Use Efficiency in Major Cropping Systems of India" during August 26-27, 2023 at ICAR-IIISS, Bhopal. Organizing secretary : Drs. Pramod Jha, B.P. Meena, R. Elanchezhian.

Training organized

Drs. S.R. Mohanty, Asit Mandal, J.K. Thakur, B.P. Meena, N.K. Sinha, AK Tripathi organized 3 days farmers training on "Natural Farming and Soil Health" Sponsored by ATMA, Kaimur, Bihar during 02-04 August, 2023.

Drs. Sangeeta Lenka, Khushboo Rani, Alka Rani and Asit Mandal co-ordinated an Educational Trip for 80 students of Class IX of Sagar Public School on 16 October, 2023 at ICAR-IISS, Bhopal.

Drs. Sangeeta Lenka, Khushboo Rani, Jyoti Kumar Thakur, Jitendra Kumar and Rahul Mishra Co-ordinated free visit of the students & escorts participating in Regional Science Congress 2023-24 at ICAR-IISS, Bhopal on 29 November, 2023.

Dr. Jitendra Kumar conducted one-day awareness campaign on "Integrated nutrient management for sustainable soil health" under SCSP project on 07 December, 2023 under World Soil Day celebration week.

ICAR-IISS organized a 7 days Training Programme on "Application of Geo-Spatial Tools in Soil Science" under NAHEP-CAAST in association with CSKHPKV, Palampur (HP) at ICAR-IISS, Bhopal during 5-11 December, 2023. (Course Director: Dr N K Sinha and Dr N K Lenka; course coordinators: Drs Jitendra Kumar, Dhiraj Kumar, Alka Rani, Rahul Mishra)

Kisan Diwas (Farmer's Day) was organized on the occasion of National Farmers Day at Rasuliya Pathar, Bhopal (M.P) on 23 December, 2023. The program was coordinated by Drs. B.P. Meena, J.K. Thakur, D.K. Yadav, Abhijit Sarkar, Asit Mandal, Asha Sahu.

Swachhta Awareness Campaign

Twelve training programs (380 participants) and 42 swachhata awareness campaigns (1511 participants) were organised in Khamkheda, Rasuliya Pathar, Ratibad, Beenapur and Khajuri villages during July to December, 2023.





EVENTS

Independence Day

ICAR-IISS celebrated 77th Independence Day on 15 August, 2023.

87th Annual Convention of Indian Society of Soil Science at ICAR-IISS, Bhopal

The 87th Annual Convention of Indian Society of Soil Science (ISSS) was organized by Bhopal Chapter of the ISSS at ICAR-Indian Institute of Soil Science, Bhopal during 3-6 October, 2023. Shri Kamal Patel ji, Hon'ble Minister, Farmers Welfare and Agriculture Development Department, Government of Madhya Pradesh along with Dr. Himanshu Pathak, Secretary (DARE) and Director General (ICAR), Dr. Suresh Kumar Chaudhari, Deputy Director General (Natural Resource Management), inaugurated the convention. Dr. S.P. Datta (Director, ICAR-IISS), Dr. D.R. Biswas (President, ISSS), Dr. K.K. Bandyopadhyay (Secretary, ISSS) and Dr. A.K. Biswas (Organizing Secretary) inaugurated the Convention. More than 400 delegates attended the event.

Hindi Pakhwada

The Institute celebrated Hindi Pakhwada during 14-28 September, 2023, where staff members participated in the Hindi competitions, viz. debate, typing, translation, dictation, quiz etc.

Vigilance Awareness Week 2023

ICAR- Indian Institute of Soil Science, Bhopal celebrated Vigilance Awareness Week during 30 October to 5 November, 2023 with the Theme "Say No to Corruption: Commit to the Nation". During this period quiz, essay, debate competitions were organised at the institute and winners honoured with prizes. The closing ceremony of vigilance awareness week was presided by Dr. S.P. Datta, Director of the institute. Shri P.K. Manjhi, DIG, CBI, Bhopal as Chief guest and Dr. Dhirendra Shukla, OSD, M.P. Higher Education as special guest graced the event.

Agriculture Education Day

Agriculture Education Day was celebrated at ICAR-Indian Institute of Soil Science, Bhopal in collaboration with Bhopal Chapter of National Academy of Agricultural Sciences on 04 December, 2023. The theme was "Soil and Water- A source of life" where about 50 school students participated. A Quiz Contest on Soil Health Awareness was also conducted for students of Govt. H.S.S. Sardar Patel (CMRISE), Holy Cross Co-Ed School and Brigadier Trivedi Memo. Hr. Sec. School, Bhopal on this occasion.

World Soil Day

On the occasion of World Soil Day, a Soil Health Awareness Programme was organized at ICAR-Indian Institute of Soil Science, Bhopal during 4-6 December, 2023. This years' theme of WSD was "Soil and Water, a source of life". The programmes included quiz competition on "Soil Health" for school children; March Past by ICAR-IISS staff to spread awareness among the public on the importance of soil and water in human life, ecosystem and protection of these precious resources; World Soil Day lecture by Dr. A.K. Singh, Former Vice Chancellor RVSKV, Gwalior; and a village level mass awareness program on "Soil Health".

ICAR-Central Zone Sports Meet

* Dr. Sangeeta Lenka secured first position in shotput and discuss throw.
* Dr. Alka Rani secured third position in 100 m race.
* Mr. Sant Kumar Rai secured second position in cycle race.
* Dr. Asha Sahu and Mr. Pramod Kumar Raut secured second position in carrom.
* ICAR-IISS, Bhopal secured runner-up position in the event of football.

* Drs. Sangeeta Lenka, Asha Sahu, Sudeshna Bhattacharjya and Mrs. Babita Tiwari secured runner-up position in the 4×100 m relay race.

AWARDS & HONORS

Dr. Dhiraj Kumar received Dhiru Morarji Memorial Award in the Discipline of Agricultural Sciences from FAI, New Delhi (First Prize) for the article entitled "Impact of Fertilizer Consumption on Soil Health and Environmental Quality in India" on 6 December, 2023 in New Delhi.

Dr. Bharat Prakash Meena awarded with ISA-Associateship Fellow Award - 2021 by the Indian Society of Agronomy, New Delhi during XXII Biennial National Symposium on "Climate Smart Agronomy for Resilient Production Systems and Livelihood Security" at ICAR-Central Coastal Agricultural Research Institute, Goa held during 22–24 November, 2023.

Dr. R.H. Wanjari received Best Oral Presentation (2nd) Award at National Seminar on "Abiotic Stress Management for Sustainable Millet based Production Systems" at ICAR-NIASM Baramati (Pune) during 22-23 August, 2023.

Drs. S.R. Mohanty, B. Kollah, A. Sahu, S. Bhattacharjya, J.K. Thakur, A. Mandal, M.H. Devi, A.K. Tripathi and A. B. Singh received the ISSS- Dr. J.S.P. Yadav Memorial Award for excellence in Soil science at the 87th Annual Convention of the ISSS on 3 October, 2023.

Drs. Abhijit Sarkar, Sangeeta Lenka, D.K. Yadav, Madhumonti Saha, Ajay, B.L. Lakaria, Asit Mandal, M. Vassanda Coumar, J.K. Saha, J.K. Thakur received Best Poster Presentation Award: 2023 in the 87th Annual Convention of Indian Society of Soil Science held during 3-6 October, 2023 at the ICAR-Indian Institute of Soil Science, Bhopal.

Dr Khushboo Rani received best poster presentation award at the 87th annual convention of Indian Society

of Soil Science held during 03-06 October, 2023 at ICAR-Indian Institute of Soil Science, Bhopal

Dr. Abinash Das received the commendation certificate for best Ph.D. thesis presentation at the 87th annual convention of Indian Society of Soil Science held during 3-6 October, 2023 at ICAR-Indian Institute of Soil Science, Bhopal

Dr. Asha Sahu delivered invited talk on "National policy for management of crop residues" and "Adverse consequences of on-farm burning of crop residues" In the 3 days training program on "Swachchta Action Plan" during 18- 20 July, 2023 organized by SIAET, Bhopal.

Dr. Asha Sahu acted as invited speaker (online) on "International Conference on Agriculture and Plant Science'' during 6-7 September, 2023 at Singapore.

Dr. Pramod Jha delivered lead lecture on "Carbon Sequestration in Agricultural Soils" in 1st International Conference on Decarbonizing Agriculture during 25-27 November, 2023 at Mangalore, Karnataka.

Dr. Sangeeta Lenka was invited as a guest speaker in the Regional Advisory Group meeting on "Climate Change and its Impact on Agri-Allied Sector and strategies to address" organized by NABARD on 9 October, 2023.

Dr. Sudeshna Bhattacharjya was invited as External Examiner for six-month dissertation viva-voce of M.Sc. Agronomy IVth semester examination by Barkatullah University, Bhopal.

Dr Sanjay Srivastava attended Webex meeting on "Soil testing and soil fertility mapping using remote sensing/ drone technology on 25 October, 2023.

Dr Sanjay Srivastava delivered lecture on Soil Test Kit (Mridaparikshak) during Asian knowledge hub: webinar on soil testing kits on 7 November, 2023 organized by Asian Soil Partnership coordinator, FAO.

Dr. Sangeeta Lenka was the external examiner of five M.Sc. students for Soil Science and Agricultural Chemistry from OUAT, Bhubaneswar, from 7-8 November, 2023.

Dr. Alka Rani received the best poster presentation award in the '5th International Conference on Sustainable Natural Resources Management Under Global Climate Change' organized by Soil Conservation Society of India at NASC complex, New Delhi during 7-10 November, 2023.

Dr. Narayan Lal honored with Young Scientist Award on 30 October, 2023 by Royal Science Forum, Salem, India.

Dr. Asha Sahu delivered talk on "Soil Health" to Akashvani Bhopal on the occasion of World Soil Day 2023. (https://m.facebook.com/story.php?story_fbid=750494327095564&id=100064050098786&mibextid=Nif5oz)

Dr. Asha Sahu delivered talk on "Importance of World Soil Day" to DD Madhya Pradesh on the occasion of World Soil Day, 5 December, 2023. (https://youtu.be/uC4QrA7r6JI?si=xj_YH9f17EgU_fVH)

Dr. Asha Sahu made a coverage on "World Soil Day, 5 December, 2023" to DD News Madhya Pradesh. (https://www.youtube.com/live/wVdYbvQXIEk?si=XIY4E85xSLHKMid

Dr. RH Wanjari received Best Oral Presentation 2nd position Award at ICAR-NIASM Baramati (Pune) during 22-23 August, 2023.

Dr. Sudeshna Bhattacharjya has been recognized as Academic Editor of PLOS ONE.

Dr. Narayan Lal recognized as Editorial Board member of Asian Journal of Agricultural and Horticultural Research.

Dr. Narayan Lal recognized as Editor of Journal of Agriculture and Education Research.

Dr. R.S. Chaudhary acted as Member, Evaluation Committee of Swachhta Sarthi Fellowship Cohort assigned by the office of the Principal Scientific Adviser (PSA), GoI, 2023.

Dr. R.S. Chaudhary recognized as Member, Editorial Board, Indian Journal of Agricultural Physics, ISAP, New Delhi.

Dr. R.S. Chaudhary recognized as Member, Editorial Board, Indian Journal of Soil Conservation, Dehradun.

STAFF NEWS

Retirement

Dr. A B Singh, July 2023

Mr. O P Shukla, December 2023

Promotion

Dr. Tapan Adhikari joined as Head, Division of Environmental Soil Science w.e.f. 13 July, 2023.

Dr. Narendra Kumar Lenka joined as Head, Division of Soil Physics w.e.f 13 July, 2023.

Dr. Santosh Ranjan Mohanty joined as Head, Division of Soil Biology w.e.f 13 July, 2023.

Dr. Sanjib Kumar Behera joined as Head, Division of Soil Chemistry and Fertility w.e.f 13 July, 2023.

Transfer

Dr. Brij Lal Lakaria transferred on promotion as Head, ICAR-IISWC RC, Chandigarh

Dr. A.K. Viswakarma transferred on promotion as Project Coordinator, AICRP (Sesamum and Niger), Jabalpur

Dr. J. Somasundaram transferred on promotion as Head, ICAR-IISWC RC, Udhagamandalam

INTERNATIONAL COLLABORATION

Dr. S.R. Mohanty visited University of Strasbourg, France during Sep 10-19, 2023. He delivered a talk to the group on “Methanotrophs driven biogeochemical processes in soil ecosystem” on 15.9.2023

SCIENTISTS' PARTICIPATION IN TRAINING/SEMINAR/WORKSHOP/MEETING

Name	Program Attended/Participated	Venue/Organizer	Date/Duration
Dr. Sanjay Srivastava	Chintan Shivir on Agriculture	INM Division, DA&FW, New Delhi at NASC, New Delhi	7-8 July, 2023
All Scientists	ICAR Foundation Day Programme (Virtual)	ICAR, New Delhi	16-18 July, 2023
Dr. Tapan Adhikari	Presentation of NITI Aayog Report on Multidimensional Poverty	Organized by MP State Policy and Planning Commission at KTICC, Bhopal	8 August, 2023
Dr. Tapan Adhikari	Review and Monitoring of Foreign Aided Projects	NRM Division, ICAR, New Delhi at ICAR- CSSRI, Karnal	12 August, 2023
All Scientists	Wellness through Reiki presented by Reiki Master, Ms. Ritu Nanda	ICAR-IISS, Bhopal	10 August, 2023
All Scientists	NAAS special lecture on, "Minerals and Biochar for Climate Change Mitigation, Food security and Environmental Protection" by Dr. Binoy Sarkar, Research Fellow, University of South Australia	ICAR-IISS, Bhopal & NAAS Regional Chapter Bhopal (Online)	14 August, 2023
All Scientists	Institute programme during visit of Dr Himanshu Pathak, Hon'ble Secretary DARE & DG ICAR	ICAR-IISS, Bhopal	19 August, 2023
Dr. Khushboo Rani & Dr. Immanuel C. Haokip	Third Edition of Virtual International Conference "Plant security and food safety: Microbiology, Soil Science, Food Quality and Agricultural Genetics".	Nicolaus Copernicus University in Toruń, Poland	26-27 September, 2023
Dr. Immanuel C. Haokip	Global Symposium on Soils and Water by FAO	Virtual mode	2-5 October, 2023
All Scientists	Participated in 87th Annual Convention of the Indian Society of Soil Science	Jointly by Indian Society of Soil Science &ICAR-Indian Institute of Soil Science at Bhopal	3-6 October, 2023
All Scientists	Special symposium on "Natural Resources Management for Sustainable Millets (Shree Anna) Production in India"	Jointly by Indian Society of Soil Science & ICAR-Indian Institute of Soil Science at Bhopal	4 October, 2023
Jitendra Kumar	10-day training on "Remote Sensing & GIS in Predictive Soil Mapping"	IIRS, Dehradun	9-20 October, 2023
Drs. SK Behera, Sanjay Srivastava, NK Sinha, J.K. Thakur, Shinogi KC, Dhiraj Kumar and Rahul Mishra	XVI Agricultural Science Congress	NAAS at ICAR-CMFRI, Kochi, Kerala	10-13 October, 2023
Dr. Asha Sahu	International Conference on Biochemical and Biotechnological Approaches for Crop Improvement (IBBAC 2023)	NASC Complex, New Delhi	30 October - 1 November, 2023
Dr. Alka Rani	5th International Conference on 'Sustainable Natural Resources Management Under Global Climate Change'	Soil Conservation Society of India, NASC complex, New Delhi	7-10 November, 2023
Dr. R.H. Wanjari and Dr. Dhiraj Kumar	Virtual workshop of AICRP LTFE regarding data updates / data entry on Information System on Long Term Fertilizer Experiments (ISLTFE)	ICAR-IISS, Bhopal	8 November, 2023

Name	Program Attended/Participated	Venue/Organizer	Date/Duration
Dr. Shinogi KC	National Workshop of Farmer FIRST Programme (FFP)	ICAR at CSKHPKV, Palampur, (H.P)	28-30 November, 2023
Dr. Sudeshana Bhattacharjya	International Conference on Feeding the Future through Sustainable Eco-friendly Innovations in Rangeland, Forages and Animal Sciences	Range Management Society of India, ICAR-Indian Grassland and Fodder Research Institute, Jhansi & University of Agricultural Sciences, Bangalore	02-04 December, 2023
Dr R Elanchezhian	National Conference of Plant Physiology	ICAR - IARI and ISPP at ICAR - IARI, New Delhi	9-11 December, 2023
Dr Khushboo Rani	12th Advanced Course on Conservation Agriculture for Asia and North Africa	CIMMYT, Borlaug Institute for South Asia and ICAR-CSSRI, Karnal	9-24 December, 2023
Dr. Tapan Adhikari	105th Meeting of the Board of Governors of IIFM, Bhopal	Indira Paryavaran Bhawan, MOEF &CC, New Delhi	15 December, 2023
Drs. S.K. Behera, B.P. Meena, Abhijit Sarkar, Madhumonti Saha and Rahul Mishra	International Conference on "One health – one world)"	RVSKVV, Gwalior	28-29 December, 2023

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